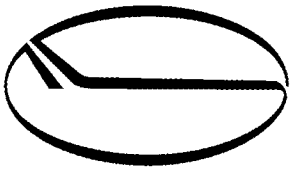


July 25, 2007

BY ELECTRONIC SUBMITTAL
Clerk of the Board
California Air Resources Board
1001 I. Street
Sacramento, California 95814
http://www.arb.ca.gov/lispub/comm/bclist.php

Re: Comments on Proposed Regulation for In-Use Off-Road Diesel Vehicles

Dear Board Members and Staff:

Please find attached the comments of the Air Transport Association of America, Inc. (ATA)[1] on the California Air Resources Board's (ARB's) Proposed Regulation For In-Use Off-Road Diesel Vehicles (ORD Rule or Rule).

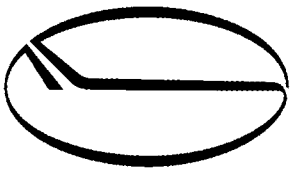
ATA is the principal trade and service organization of the U.S. scheduled airline industry, and ATA's airline members and their affiliates transport more than 90 percent of all U.S. airline passenger and cargo traffic. In this capacity, ATA regularly comments on federal and state regulatory developments that may affect the airline industry.

Please contact me at 202-626-4216 if you would like additional data or analysis concerning any of the points raised in these comments.

Sincerely,

Timothy Pohle
Assistant General Counsel – Environmental Affairs
Air Transport Association of America, Inc.

[1] The members of the Association are: ABX Air, Inc., Alaska Airlines, Inc., Aloha Airlines, American Airlines, Inc., ASTAR Air Cargo, Inc., Atlas Air, Inc., Continental Airlines, Inc., Delta Air Lines, Inc., Evergreen International Airlines, Inc., FedEx Corporation, Hawaiian Airlines, JetBlue Airways Corp., Midwest Airlines, Inc., Northwest Airlines, Inc., Southwest Airlines Co., United Airlines, Inc., UPS Airlines, US Airways, Inc.; associate members are: Air Canada, Air Jamaica Ltd., Mexicana.



Comments of
The Air Transport Association of America, Inc.

on the

California Air Resources Board's
Adoption of a Proposed
Regulation for In-Use Off-Road Vehicles

Submitted July 25, 2007

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INTRODUCTION AND SUMMARY

The Air Transport Association of America, Inc. (ATA) is the premier trade organization of the principal U.S. airlines.[1] ATA welcomes this opportunity to comment on the California Air Resources Board's (ARB) proposed In-Use Off-Road Diesel Vehicle Regulation (ORD Rule or Rule), which specifically targets airport ground support equipment (GSE) owned and operated by airlines. These comments supplement ATA's initial comments, submitted May 23, 2007, which are hereby incorporated by reference.[2]

ATA supports the ultimate emissions reduction goals for off-road diesel vehicles set forth in the proposed Rule. ATA recognizes aggressive reductions in diesel particulate matter (PM) and oxides of nitrogen (NOx) emissions are needed from off-road diesel vehicles by 2014 and 2020 to meet federal air quality standards and the objectives set forth in ARB's Diesel Risk Reduction Plan. Nevertheless, for the reasons set forth in these Comments, ATA cannot support the Rule.

In addition to ARB's fundamental lack of authority to impose mandates on GSE of the nature contemplated in the proposed Rule, the specifics of the proposal represent an inefficient means of seeking to achieve the emission reductions sought. The adoption of key changes to the regulation, most importantly the "Fixed Target Compliance Option" described in detail below, would not cure the legal problems inherent in ARB's attempt to regulate GSE, but would result

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[1] ATA's airline members and their affiliates transport more than 90 percent of all U.S. airline passenger and cargo traffic. The members of the Association are: ABX Air, Alaska Airlines, Aloha Airlines, American Airlines, ASTAR Air Cargo, Atlas Air, Continental Airlines, Delta Air Lines, Evergreen International Airlines, Federal Express Corporation, Hawaiian Airlines, JetBlue Airways, Midwest Airlines, Northwest Airlines, Southwest Airlines, United Airlines, UPS Airlines, and US Airways; associate members are: Air Canada, Air Jamaica, and Mexicana de Aviación.

[2] *See* Letter from T. Pohle, ATA, to ARB (May 23, 2007), available at: http://www.arb.ca.gov/lists/ordiesl07/868-2007-05-23_ata_initial_comments_on_proposed_ord_rule.pdf

in a Rule that would be significantly less objectionable as a practical matter, and would achieve virtually the same ultimate emission reduction goals more efficiently and cost-effectively.

In particular, as currently structured, the proposed Rule is unnecessarily complex, uncertain, and burdensome. The Rule is particularly problematic as applied to diesel GSE, due to its highly specialized nature and critical role in the safe and efficient functioning of the National Airspace System. The Rule will require our members to spend over $100 million and replace or retrofit virtually every diesel unit of GSE in California. Given the magnitude of this task, any regulation must, at a minimum, allow fleet operators to plan effectively and achieve a level of certainty that this effort will result in compliance. Anything less is wholly unacceptable to our members.

Moreover, the basic mechanism of the proposed Rule -- regulating end-use consumers of diesel vehicles -- is fundamentally flawed. In ATA's view, this approach has been dictated largely by ARB's decision, just a few years ago, not to require original equipment manufacturers (OEMs) to include additional PM emission controls in new Tier 3 engines, apparently based on the OEM's arguments regarding technical feasibility and cost-effectiveness. ARB now effectively seeks to require end-use consumers of vehicles, who lack the technical expertise and resources of OEMs, to install retrofit modifications to engines that ARB decided not to require of OEMs. This approach is legally and technically unsound. In addition, as explained in detail below, the proposed Rule's approach for achieving these emission reductions from ultimate purchasers, including the imposition of unworkable retrofit requirements and other inflexible mandates on GSE, would be arbitrary and capricious and contrary to law, and preempted under the federal Clean Air Act (CAA), Federal Aviation Act (Aviation Act), and Airline Deregulation Act (ADA).

However, ATA believes the same ultimate emission reductions proposed by ARB could be achieved under an approach that establishes clear, unchanging fleet average emissions requirements for 2014 and 2020, and that allows fleets the flexibility to determine how to achieve those emission reduction goals in the most cost-efficient and least burdensome manner. To this end, ATA has proposed a "Fixed Target Compliance Option," including proposed regulatory language (Exhibit A, attached hereto). In addition, ATA proposes changes to ensure appropriate credit for electrification of GSE (both for electric purchased in the past and going forward), which will further alleviate unnecessary burdens imposed by the Rule, without compromising its ultimate objectives and by encouraging where feasible the adoption of what is the most environmentally sound technology in the long-run.

Notwithstanding ATA's fundamental position that ARB lacks the authority to regulate GSE in the manner contemplated in the proposed ORD Rule, ATA has been working with ARB staff for over a year to help ARB develop a more practical regulation designed to achieve ARB's emission reduction goals using a more straightforward, common-sense approach, that avoids the needless uncertainty and burdens of the current proposed ORD Rule. While the changes set forth herein would not address ARB's lack of authority to regulate GSE in this manner, they would result in a significantly less objectionable Rule.[3]

Although we disagree regarding ARB's authority to regulate GSE, ATA very much appreciates the dedication, hard work, and willingness to listen demonstrated by ARB staff throughout the rulemaking process. ATA believes that staff deserves to be recognized for this effort, which has resulted in many practical improvements to the proposed Rule. We understand

[3] ATA and its members expressly reserve the right to bring suit to challenge the ORD Rule, on preemption or any other grounds, regardless of whether or not ARB elects to make the changes to the Rule described in these comments.

that staff intends to release additional proposed changes to the Rule in advance of the Board's July 26 hearing, which ATA hopes will help further address some of the problematic aspects of the Rule. ATA looks forward to having the opportunity to review and evaluate any such proposed changes, and reserves the right to supplement these comments to address them.

BACKGROUND

I. The Diesel Airport Ground Support Equipment (GSE) Targeted by the ORD Rule is Integral to Aviation

As the Federal Aviation Administration (FAA) has confirmed, "reliable GSE equipment is . . . essential to safe and efficient use of navigable airspace."[4] Diesel GSE in particular perform a myriad of complex and time-sensitive functions essential to the safe and efficient use of the National Airspace System. These functions include aircraft maintenance, fueling, deicing, starting aircraft engines, moving aircraft to and from the gate, and loading, unloading, and sorting cargo and baggage. The ability of GSE to perform all of these activities quickly, reliably, and in close coordination with each other and with the various types of aircraft in operation at various airports each day, directly affect the ability to move aircraft efficiently from the gate, through the runway queue, and into the National Airspace System safely and on schedule.

Among other things, even one piece of unreliable or underperforming GSE may mean that an aircraft is not ready to enter or leave the gate at the appointed moment, or cannot be moved across busy taxiways and runways to receive maintenance or to enter the runway queue in

[4] See Exhibit B, Letter from Paul Dykeman, Deputy Director, Office of Environment and Energy, FAA, to Donald Zinger, Assistant Director for Transportation and Air Quality, U.S. EPA, Attachment at 6 (August 24, 2000); *see also id.* ("GSE equipment is necessary to landings and takeoff of aircraft. Aircraft are dependent upon GSE for maintenance, fueling, housing, and in some cases, for movement on the ground as well as a myriad of other activities that are critical to the safety of aircraft and flight preparation."). FAA exercises primary and exclusive jurisdiction over aviation-related operations and its interpretations in such matters supercede state law. *Arapahoe County Pub. Airport Auth. v. FAA*, 242 F.3d 1213, 1220-1221 (10th Cir. 2001).

a prompt and coordinated manner. Failure of a diesel aircraft pushback, for example, can leave a fully loaded passenger plane stranded between the gate and the runway -- creating a potential hazard to passengers, other aircraft, and ground personnel, and upsetting the carefully choreographed interplay of aircraft and GSE. This intricate network of operations is carefully designed and closely regulated at the federal level to achieve safe and efficient closely-timed take-offs, landings, service of aircraft, and loading and unloading of passengers and cargo.

Even a short interruption or delay in a single flight caused by underperforming GSE will affect the timing and routing of other aircraft on the ground, resulting in, for example, delays in aircraft reaching the runway queue on time and consequent compression of the time between take-offs. Unlike many other off-road equipment applications to be addressed by the proposed Rule, GSE functionality cannot be compromised to achieve other regulatory goals. A GSE vehicle that underperforms in the midst of a busy airport operation cannot simply be pulled aside and replaced by a virtually identical unit with minimal safety and economic impacts, as may typically be the case in many construction applications or other activities governed by the Rule. In some cases, an airline or airport may have only one of a particular type of specialized GSE vehicle. In any event, even if a backup unit exists, it is not acceptable to disrupt airport operations to allow an underperforming unit to be removed from the tarmac, while another unit is pulled from service elsewhere and driven across a busy airfield to take its place.

There are approximately different 200-300 makes and models of GSE in operation at airports in California today, performing very specialized functions. While extraordinarily diverse, the total number of GSE in California is relatively small, accounting for approximately 1% of the equipment subject to the proposed Rule. Within this 1%, there are very small sub-niches of GSE that perform extraordinarily specialized functions at airports, and for certain GSE

types there may exist fewer than a handful of units even at a major airport (if not in the entire State). Thus, GSE represents a very small market for engine and vehicle manufacturers. However, given its critical role in the National Airspace System, GSE has disproportionate significance to the State and national economies.

Even apart from compliance with any emission regulation, managing an effective GSE fleet raises a host of unique engineering, planning, and operational challenges. In the context of complying with air emission rules, however structured, the addition of retrofits or use of any new engine technologies in GSE requires additional engineering, design, and development by airlines, who are often forced to seek to work together with OEMs. Integration of such technologies into GSE in a way that does not impede safe and efficient air transportation also requires substantial real-world testing and personnel training to ensure that modified or redesigned units are reliable, can perform the necessary functions safely and effectively in an airport setting, and can be successfully integrated into the overall aircraft service scheme. These additional steps are unique for GSE, and involve significant additional lead-time (typically at least 2-3 years), cost, uncertainty, and potential for operational disruptions. The end result of such efforts may be to demonstrate that a particular technology is simply not appropriate or feasible for a particular type of GSE.

II. Summary of Proposed ORD Rule

As proposed in April 2007, and with suggested modifications proposed by ARB staff on May 23, 2007, the ORD Rule would establish a highly complex framework for regulating both diesel PM and NOx emissions from in-use off-road vehicles that contain diesel engines with a maximum power of 25 horsepower (HP) or greater, including GSE. *Proposed Regulation for In-*

Use Off-Road Diesel Vehicles, 13 CCR § 2449(b) (ORD Rule or Rule).[5] Under the Rule, fleets would be required to comply by March 1 of each year with either progressively more stringent fleet average requirements, or draconian BACT turnover and retrofit mandates, for both NOx and PM emissions. These requirements would commence in 2010 (for "large" fleets) or 2013 (for "medium" fleets)[6] and continue through 2020. *Id.* at § 2449(d)(1)(A)-(2)(B). As discussed below, the fleet average targets to be achieved by each fleet must be recalculated each year using a complex formula, and both the fleet average targets and calculated emissions vary each year based on the fleet's HP composition on the March 1 compliance date. Under the BACT path, the fleet horsepower required to be replaced or retrofit is determined based on a percentage of the fleet's HP as of the previous March 1. *Id.* at § 2449(d)(1)-(2).

Notwithstanding that the fleet's emissions or targets cannot be known with certainty until the March 1 compliance date, under the Rule at some undefined point prior to March 1, the Rule requires that "[e]ach year, each fleet must determine if it will be able to meet the fleet average requirements [for each pollutant] for the next March 1 compliance date, and if not," the fleet must meet the severe BACT turnover and/or retrofit requirements by that date. *See id.* at § 2449(d)(2).

A. Fleet Average Requirements

As noted above, the NOx and PM requirements for each fleet must be determined each year depending on the fleet's HP distribution. The NOx or PM fleet average emissions

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[5] The proposed regulatory language, with the May 23 revisions, is available at: www.arb.ca.gov/msprog/ordiesel/documents/RevisedProposedRegLanguage.pdf.

[6] The Rule includes separate provisions for "small" fleets, defined as those with 1,500 or lower total HP, owned by a small business or municipality. *See* Sec. § 2449(c)(20)(C). Since the GSE fleets of most or all airlines will not qualify as "small" under this definition, these comments are focused on the Rule's requirements for large and medium fleets.

requirement (Target Rate) is calculated by taking the sum of the maximum HP for each covered vehicle times its target emissions number (Target), which may vary by more than 300% for a given model year based on which of eight HP categories the vehicle falls under, and dividing by the total maximum horsepower for the fleet. The NOx Targets for the eight vehicle HP categories change and become more stringent every year, resulting in 88 different vehicle target combinations for NOx (each of which is weighted by the rated HP of each unit) over the course of the Rule. The PM Targets change every two years, resulting in an additional 48 possible PM target combinations for a given vehicle over the course of the Rule. *Id.* at § 2449(d)(1)(A).

The fleet's calculated fleet average emissions (Index) is computed by multiplying each vehicle's maximum HP times its assigned "emissions factor," adding the resulting figures for each vehicle, and dividing by the fleet's total maximum HP. *Id.* As noted above, each vehicle has two emissions factors -- one for NOx and one for PM, based on each vehicle's model year and HP category. *See* Proposed ORD Rule, Attachment A. The Rule provides approximately 200 model year / horsepower combinations that are assigned NOx and PM emissions factors. *See id.* Fleet owners may elect each year to factor in annual hours of operation for each vehicle (if all are equipped with hours-of-use meters) in the calculation of that year's NOx and PM Indices. *Id.* at § 2449(d)(1)(D).

To determine compliance, fleet owners or operators must calculate the fleet average emissions Index each year and measure it against the Target Rate, both of which are based on the fleet as it will exist on the next March 1 compliance date. If the Index exceeded the Target Rate on March 1, then the fleet will be deemed to have violated the Rule.

Given that a fleet's Target Rate and Index Rate can only be determined based on the fleet as it exists on the March 1 compliance date, compliance with the fleet average requirement must

be achieved through planning that depends on a prediction of the future composition of the fleet. The Rule provides no fixed targets to be achieved and no meaningful lead-time to achieve them. Instead, compliance can only be measured on March 1, essentially looking *backward* at the emission reductions and fleet changes over the past year. *Id.* at § 2449(d)(1)(A)(2) ("For each compliance date, a large or medium fleet must demonstrate that its Diesel PM Index *was* less than or equal to the calculated Diesel Target Rate.") (emphasis added); *id.* at § 2449(g)(2)(A) (fleet must certify to ARB that it "was" in compliance as of March 1). Fleet operators who fail to achieve compliance are subject to civil and criminal penalties. *See id.* at § 2449(k).

B. BACT Requirements

Fleet operators that predict that they may be unable to meet the fleet average requirement for either NOx or PM by the March 1 deadline must instead comply, by that same deadline, with inflexible and severe Best Available Control Technology (BACT) requirements for that pollutant. The percentage BACT requirements are calculated based on the horsepower of the fleet's engines as of March 1 of the prior year. *Id.* at § 2449(d)(2). Fleets that believe they will not meet the NOx fleet average requirements must "turnover" 8% of the total HP of the fleet that existed on March 1 the previous year. The requirement rises to 10% after 2015. *Id.* at § 2449(d)(2)(A)(1). Even if a fleet seeks to achieve compliance under the NOx BACT path, it must also meet the NOx fleet average target by March 1, 2020, or it must continue 10% annual turnovers until achieving the fleet average. *Id.* at § 2449(d)(10).

For purposes of compliance with the NOx BACT provisions, "turnover" means retiring a vehicle, designating it as low-use, "re-powering" it by replacing the engine with a Tier 2 or higher engine, or applying a Verified Diesel Emission Control System (VDECS) for achieving a certain level of NOx reductions (none of which have been verified by ARB to date). *Id.* at § 2449(d)(2)(A). Vehicles are exempt from the NOx turnover requirement until they are 10

years old, as are certain specialty vehicles, vehicles retrofit within the last six years, and vehicles with Tier 4 interim or final engines. *Id.* at § 2449(d)(2)(A)(4).

Similarly, fleets that predict they will fail to meet the PM fleet average requirements must instead retrofit 20% of their total horsepower with the highest level VDECS during the previous year. *Id.* at § 2449(d)(2)(B)(1). However, as part of ARB staff's recommended changes issued May 23, 2007, certain replacements of existing equipment with interim or final Tier 4 vehicles may also be counted toward satisfaction of the 20% PM BACT retrofit requirement. *Id.* Engines in vehicles less than five years old are exempt, as are engines for which there is no Level 2 or 3 VDECS available, engines for which the only VDECS available has been determined by ARB to impair the safe operation of the vehicle, engines equipped with diesel particulate filters when new (likely Tier 4), and engines already retrofitted with Level 2 or 3 VDECS that was the highest level VDECS at the time of installation. *Id.* at § 2449(d)(2)(B)(4). Thus, as time passes, previously exempt units would become subject to the BACT retrofit requirements (*e.g.*, as units reach five years old, or ARB issues a "verification" for a new diesel PM VDECS).

Determining at what point to decide whether to opt for the BACT approach each year is, at best, a highly uncertain and speculative exercise, because of the constantly shifting NOx and PM Target Rates, among other factors.

C. 2021 Retrofit Mandate

Even after a fleet meets the final PM and NOx Target Rates by 2020, the ORD Rule then mandates that it retrofit by March 1, 2021, *all* remaining vehicles not exempt under the PM BACT provisions with the highest level VDECS then available. *Id.* at § 2449(d)(2)(B). In other words, regardless of whether a fleet previously achieved compliance under the fleet average emissions approach, and regardless of the fleet's actual average emissions level by 2021, in the

end the ORD Rule effectively requires fleet owners to comply with *both* the fleet average and BACT requirements.

D. Additional Requirements

The ORD Rule imposes a number of other requirements, including idling limits for all fleets of not more than five minutes. *Id.* at § 2449(d)(3). The Rule would require labels marked with an ARB-issued equipment identification number to be affixed on each vehicle in "clear view" following certain specifications. *Id.* at § 2449(f). The Rule also imposes a number of reporting requirements with which regulated fleet owners must comply on an annual basis, including certifications of compliance. *Id.* at § 2449(g). Fleet owners must also maintain detailed records and provide them to ARB within five business days upon request. *Id.* at § 2449(h).

ANALYSIS

I. The Board Should Defer Action on the Proposed Rule to Allow a Meaningful Opportunity for the Submission and Review of Public Comments

California law requires that public comments be considered by the Board *before* it takes action on a regulation. Cal. Gov't Code § 11346.8 (requiring an agency to "consider all relevant matter presented to it before adopting, amending, or repealing any regulation"); Cal. Gov't Code § 11346.4 (requiring that public be afforded at least 45 days to prepare and submit written comments). Given the public comment deadline of July 25, just one day before the hearing at which the Board is currently scheduled to vote on whether the Rule should be adopted, it would be impossible for the Board to perform any meaningful review of the written comments before acting. Although the Board is authorized by California law to delegate various functions to the Executive Officer, the Board cannot legally direct the adoption of the rule, make any statutorily required findings (or findings in support of a request for EPA authorization under CAA 209(e)),

or reach any other conclusions concerning the proposed rule until after ARB has reviewed and considered the written comments. *See* Cal. Gov't Code §§ 11346.4, 11346.8; *see also Building Code Action v. Energy Resources Conservation and Development Commission*, 162 Cal. Rptr. 734, 743 (Cal. Ct. App. 1980) (invalidating regulation due, in part, to the agency's failure to consider matters presented in comments).

In addition, given our understanding that ARB intends to issue a revised proposed Rule at or just before the July 26 hearing at which the Board is scheduled to vote, ARB should allow 45 days from the release of any such revised proposal for stakeholders to evaluate the revised proposed Rule as a whole and prepare and submit written comments. Cal. Gov't Code § 11346.4 (requiring that public be afforded at least 45 days to prepare and submit written comments); *Tidewater Marine W. v. Bradshaw*, 927 P.2d 296, 303 (Cal. 1996) ("The Legislature wisely perceived that the party subject to regulation is often in the best position, and has the greatest incentive, to inform the agency about possible unintended consequences of a proposed regulation.").

Accordingly, the Board should not vote on the Rule at the July 26 Board meeting, but should defer action, at least until the next scheduled Board meeting. The Board should also extend the comment period to allow the regulated community a full and fair opportunity to evaluate the proposed Rule as revised, and to provide factual, technical, and legal comment, and to allow the Board adequate time to review and consider the comments before acting.

II. The Rule is Needlessly Complex and Unpredictable

A. The Requirements Change Unpredictably Each Year, Impeding Compliance Planning

As ARB recognizes, the proposed Rule is extremely complex. *See, e.g., Initial Statement of Reasons for Proposed Regulation of In-Use Off-Road Diesel Vehicles* ("ISOR") (April 2007)

at 25. While complexity creates many difficulties and compliance burdens, the more significant problem with the Rule is its uncertainty and constantly shifting emission requirements. As noted above, the fleet average emission Targets (and to a lesser degree the BACT turnover and retrofit targets) not only change every year (for NOx) or every two years (for PM), but vary each year for each fleet based on that fleet's unique horsepower composition on the compliance date. Similarly, the calculation of the fleet's average emissions, called its "Index" (which must be at or below the Target), also varies for both PM and NOx based on the horsepower category of each vehicle in the fleet on the compliance date.

As a practical matter, the proposed Rule simply does not allow GSE operators to know with reasonable certainty the Rule's requirements in advance of the compliance date. As of March 1 of every year addressed by the Rule, each fleet must re-calculate its unique fleet average emissions target, and the fleet's emissions index, based on a complex formula that assigns ever-shifting emission targets and emission factors to each vehicle based on its horsepower category. As of that same date, the fleet must demonstrate that its emissions Index "was" less than or equal to the Target Rate. *See* Proposed ORD Rule §§ 2449(d)(1)(A)(1), 2449(d)(1)(A)(2). However, changes in the composition of the fleet can, over time, significantly change its fleet average emissions and compliance target. For GSE, such changes may be dictated by factors such as: (1) equipment failure; (2) expanded service; (3) new routes; (4) changes in aircraft ground service needs or procedures; (5) changes in the types or numbers of aircraft serviced; (6) introduction of new aircraft with different ground support needs; (7) airport infrastructure changes, requirements or restrictions; (8) airport procedures and safety regulations; or (9) replacements with new or improved equipment. The impact of such changes to the fleet's

NOx and PM Target and Index cannot be accurately predicted, and inadequate allowance is made for changes that may occur beyond the operator's control.

B. Fleet Changes and Other Factors Beyond the Fleet Owner's Control Contribute to the Creation of an Unpredictable Moving Target

Manufacturers, and not fleet operators, determine the horsepower of new equipment. Users of GSE in particular, due to the small size of the GSE market, have little control over the horsepower ratings of the engines in new GSE equipment made available for purchase. For example, as ARB staff is aware, due to a phenomenon known as "horsepower creep," new Tier 3 or 4 equipment may only be available in higher-than-expected horsepower ranges. As manufacturers develop and introduce new engines, the horsepower of the updated version of an engine model often changes. OEMs often change horsepower ratings for their own business purposes, or to facilitate their own broader compliance issues with respect to fleet fuel economy or other regulatory requirements. Such changes may unexpectedly and significantly change a fleet's horsepower composition, and thus its calculated fleet average emissions and targets under the Rule.

For example, when a fleet needs to order and obtain new Tier 3 or 4 replacements for older GSE models that a manufacturer previously offered at a particular power rating (*e.g.*, 90 HP), it may learn that the manufacturer has, for its own reasons, decided that the equipment will be made available only at a higher rating (*e.g.*, 120 HP). This seemingly minor change, outside the operator's control, would place the new units in an entirely new HP category and could dramatically change the NOx and PM Targets (and Index) for those units under the ORD Rule. In the above example, the PM Targets for the new units for 2012 and 2013 would change from 0.46 to 0.26 g/bhp-hr, a 43% drop. *Id.* at § 2449(d)(1)(A)(2), Table 2. Because the calculations are HP weighted, the more stringent target for the new unit would also receive 33% more weight

in the calculation of the overall fleet Target Rate. The HP change would also change the HP-weighted emissions factor assigned to the unit for purposes of calculating the fleet's PM Index.

End users have little or no control over this phenomenon, nor any significant ability to predict horsepower changes in future new vehicles available from OEMs.[7] The lack of control is particularly pronounced for a small market such as GSE. OEMs simply do not design engines with GSE in mind -- but instead assign for use in GSE engines designed to accommodate the needs of much larger markets.[8]

C. Integration of New Engines and Emission Technologies Into GSE Fleets Requires at Least 2-3 Years, and Any Regulation Must Provide Clear Targets Fixed Years in Advance

The ever-changing targets of the Rule simply fail to accommodate the need for careful advance planning to maintain the safe and efficient operation of the National Airspace System. Even without emission regulations, as ATA has explained in detail in previous comments to ARB, the process of acquiring and integrating new technologies into the GSE fleet typically takes more than 2-3 years. *See, e.g.*, Exhibit C, ATA Comments on Proposed LSI Rule (June 17, 2005) (incorporated herein by reference). Obtaining and integrating new units into airport operations requires a multi-year process consisting of: identifying GSE needs, obtaining approval for the necessary capital, placing orders and negotiating with OEMs to obtain equipment with the required capabilities, training personnel on safe operation, testing the

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[7] The fact that OEMs have direct control over vehicle emission characteristics, particularly for smaller markets where end-users have little influence as consumers, further illustrates why emission reductions should be achieved primarily through regulation of OEMs and not end users -- wisdom that is reflected throughout the applicable federal and California statutory schemes. *See* Part VI, below.

[8] As one recent example, for the past 12 years the Cummins 5.7 Liter turbo diesel was delivered in a 165 horsepower package, well suited for various GSE applications, including cargo loaders. Recently, however, the engine was changed to a 6.2 Liter engine with a significantly higher horsepower rating (which was more than needed for those GSE applications).

equipment to ensure seamless functionality under airport conditions, installing new facility infrastructure and obtaining approvals from airport authorities.

Given the small market that GSE represents for original equipment manufacturers, the airlines often experience delay in obtaining new GSE units that incorporate the latest engines -- with a number of carriers now reporting delays in obtaining units that incorporate Tier 3 engines, which have been nominally available since model year 2006 (for certain horsepower ranges). Similar delays are expected for GSE that incorporate Tier 4 engines, after those engines are nominally available for off-road purposes. While, for certain types of delay, the proposed ORD Rule allows for compliance extensions (sometimes requiring a formal request and demonstration to the Executive Officer), the potential for delay nonetheless further complicates planning (particularly for delays that do not qualify for or receive compliance extensions under proposed Sections 2449(e)(6) or (e)(9), or under the "Hours in Fleet Average" compliance option of proposed Section 2449(d)(1)(D)).

The unpredictable effect on a fleet's PM and NOx Target and Index of adding new equipment, or making other changes intended to improve future fleet average emissions, make compliance planning under the proposed Rule virtually impossible. Moreover, the Rule does not adequately account for the real possibility that new equipment (Tier 3 and 4) will fail to operate properly or as intended, necessitating increased use of existing equipment or other changes, and potentially denying or limiting the expected emissions benefit from the new equipment. The unpredictable and moving Targets and Indices of the ORD Rule do not accommodate the careful advance planning necessary to meet aircraft support needs (and are inconsistent with the safe and efficient operation of the National Airspace System as discussed below).

In this regard, the Rule fails to respect the legitimate expectations of responsible operators, such as the airlines, who are committed to be certain, through prospective planning, that they will be in compliance with all applicable regulatory requirements. The ORD Rule's provisions make it impossible to know with any certainty the regulatory Target, or a particular fleet's calculated emissions Index, until the day compliance is required -- at which time it is too late to make meaningful changes to the fleet. The proposed Rule precludes the very sort of responsible and careful compliance planning that ARB should encourage.

There is no reason why ARB (apparently for the first time in its history) should adopt a major regulation whose primary emission requirements shift constantly for each fleet, and embrace arbitrary requirements that can be determined with certainty for planning purposes only by reference to facts as they exist in the future. ATA expects the ORD Rule to require the airlines to spend at least $100 million, and to retrofit or replace virtually every unit of diesel GSE in California over a ten-year period. Given the magnitude of this task, the Rule must, at the least, allow fleet operators to plan effectively and achieve some level of assurance that this effort will result in compliance. Anything less is unacceptable to our members, and should be unacceptable to ARB.

III. The Rule Requires Extensive Double Conversions of the Same Equipment

The requirements of the rule as currently proposed, with annual fleet average standards for both NOx and diesel PM, lead to situations in which compliance with the rule will require "double control" of the same equipment, including purchases of new units to meet early year requirements that must later be retrofit to meet later requirements, or retrofit of existing units that must later be scrapped once new Tier 4 vehicles are available.

Given the structure of the Rule, fleet managers will have little alternative but to engage in large-scale purchases of Tier 3 engines to achieve compliance with early year targets. However,

these newly-acquired vehicles will not satisfy the Rule's stringent final 2020 fleet average targets, and many or all must be scraped or retrofit within a few years in order to maintain compliance with the Rule's requirements. In part, this is because the Rule imposes inflexible, inconsistent, and stringent annual requirements for the control of two different pollutants at the same time. Control of NOx and diesel PM are generally accomplished through different and not always complimentary means. For example, while VDECS retrofits theoretically could reduce PM emissions sufficiently to satisfy in large measure the early-year fleet average requirements for PM (setting aside for the sake of argument the problematic aspects of such retrofits for GSE, discussed in Part VI, below), the early NOx fleet average standards can currently be met *only* by replacing vehicles or vehicle engines.

Most or all of the new Tier 3 engines acquired for purposes of compliance with the early-year targets of the ORD Rule will either need to be scrapped in favor of Tier 4 or will require retrofit with Level 3 VDECS, either within a few years of acquisition (to comply with PM fleet average requirements), or to comply with the 2021 retrofit mandate. As discussed below in Part VI.A., given the highly diverse GSE fleet, any attempt to install VDECS would require a significant design/engineering effort, even after which the feasibility and operational reliability of the retrofit is not assured. In addition, such Tier 3 engines will also quickly become a liability with respect to compliance with the Rule's later-year fleet average emission standards. A regulatory structure that provides enough flexibility to allow significant investments in Tier 4 engines would avoid most or all of the double control issues presented by the current proposed Rule, and speed the introduction of vehicles that contain such new engines.

IV. The Rule Should be Restructured to Impose Clear, Prospective, and Fixed Fleet Average Emission Targets

Many of the practical flaws with the ORD Rule can be addressed, without compromising ARB's air quality objectives, simply by providing fleet operators with certainty regarding the level of emission reductions they must achieve. However, ARB failed to include among the regulatory alternatives considered any option for providing fixed (or more predictable) PM and NOx fleet average targets. ISOR at 59-61; *Technical Support Document for Proposed Regulation for In-Use Off-Road Diesel Vehicles* ("TSE") (April 2007) at 153-158. As ARB has done with numerous previous regulations, there is no reason why ARB cannot identify an appropriate fleet average emissions approach that provides clear, prospective, and fixed requirements for each fleet.

ARB can readily devise any number of alternatives that achieve the same goals without the vagaries and extreme uncertainty of the current proposal. As one straightforward example, ATA suggests that ARB rework the Rule to allow fleets to achieve the same emission reductions by 2014 and 2020 as under the proposed Rule, providing the certainty and regulatory predictability needed for meaningful compliance planning by operators. Under this approach the Rule would impose two fleet average targets, that each fleet could calculate years in advance -- one reflecting California's need to have emission reductions in place by 2014 to achieve the 2015 SIP target, and one reflecting ARB's final 2020 emission reduction goals. Each fleet would be required to develop ORD compliance plans for each target, which would describe the changes planned to their existing ORD fleet over the ensuing 4-5 year period. Proposed regulatory language to implement this approach is provided as Exhibit A hereto.

Under this approach, each fleet would identify its current emissions baseline and calculate a "fixed" 2014 fleet average emissions target based on its 2010 horsepower mix. The

fleet would then be required to implement the combination of controls necessary to achieve compliance with the fixed target by 2014. Thus, the airlines would have four years to achieve a known level of emission reductions (with an opportunity to "cure" any minor unanticipated shortfalls within a few months).

Each fleet would prepare a new ORD plan in 2015, to achieve the same final fleet averages reflected in the current ORD Rule proposal by 2020. Fleets would be allowed to modify their ORD plans to incorporate any improved technologies that may develop during the implementation of the Rule, or to accommodate fleet changes.

This approach will allow ARB and local air districts to have in place by 2014 the emission reductions needed to meet the state's 2015 SIP deadline, and allow ARB to satisfy its 2020 Diesel Risk Reduction Plan goal, while providing operators with critical flexibility and planning certainty. It will also:

- Substantially reduce the number of double conversions of the same equipment (*see* Part III, above). Because Tier 4 vehicles or interim Tier 4 vehicles with the lowest PM emission rates will not be available until 2011-2013, allowing operators flexibility in achieving the 2014 SIP reductions will allow them to invest more heavily in the best and cleanest new equipment, Tier 4, instead of mandating unworkable retrofits of older equipment and purchases of inferior engines that will need to be replaced with Tier 4 to achieve the Rule's final emission targets;
- Allow operators to avoid the infeasible BACT compliance path and the uncertainties and operational problems, and additional GHG emissions (*see* TSD, Appx. I), associated with retrofits;
- Allow meaningful planning and reduce operational problems associated with executing unnecessarily frequent, and repeated, GSE fleet turnovers to meet annual requirements.

There is no reason why ARB, in crafting what appears to be the most burdensome and costly off-road in-use regulation ever proposed or adopted in the United States, cannot (at a minimum) make clear a reasonable period of time in advance the precise requirements that fleet operators must meet. The Executive Officer has determined that the proposed Rule "may have a

significant statewide adverse economic impact," and asks the public for submission of alternative approaches, including "consolidation or simplification of compliance and reporting requirements." *Notice of Public Hearing to Consider the Adoption of a Proposed Regulation for In-Use Off-Road Diesel Vehicles* (posted at www.arb.ca.gov/msprog/ordiesel/ordiesel.htm, April 5, 2007). However, ARB staff has not identified or evaluated in the rulemaking record any approach that provides fixed fleet average targets for NOx and PM. As it has done in many previous regulations, we are confident that ARB staff can develop a proposal that sets forth clear prospective requirements for the regulated community to achieve. ATA stands ready to work with ARB staff, and to identify and develop any additional alternative approaches that will achieve these goals.

V. The Rule Should Provide Adequate Credit for Environmentally Superior Compliance Options

A. The Rule Should Encourage Electrification by Ensuring Appropriate Credit for Existing and New Electric

1. Electric Equipment Should be Credited Based on a Comparable Horsepower Figure

While the proposed Rule allows credit for electric vehicles based on the horsepower (HP) of any diesel vehicle that it replaced, it provides inadequate credit for new electric equipment that is added and does not "replace" an identifiable existing diesel unit. For such "new" electric, the Rule requires using the HP of the electric motor used -- a figure which is essentially meaningless, usually not readily available to the end-user, and not comparable to the HP ratings given to internal combustion engines. The Rule should provide credit for all electric GSE based on the average HP for all diesel GSE in a given category (which is consistent with the approach taken by ARB in its recently-adopted large spark-ignition regulation), or using other reasonable

default values that assign an HP figure to electric that is similar to the HP rating of a comparable diesel vehicle.

2. Full Credit Should be Provided for Early Electrification

Where feasible, ATA strongly supports electrification as a means of reducing air emissions from diesel vehicles. While not all GSE functions are amenable to electrification, ATA's members have been at the forefront in terms of moving the technology forward and have made substantial early voluntary investments in electric-powered GSE in appropriate applications in California and elsewhere. Every effort should be made to ensure that the Rule provides appropriate credit to fleet operators who install, or have already installed, electric equipment -- which emits zero diesel PM and NOx (and can be recharged from renewable, GHG efficient, sources). Every appropriate electric unit should be counted and credited under the Rule.

However, as currently proposed, the ORD Rule provides that electric GSE vehicles purchased prior to January 1, 2007, are limited to 20% credit toward the fleet average requirements. *See* Proposed ORD Rule, § 2449.1(d)(1)(C)(2)(a). Limiting credit for early GSE purchases to only 20% is not warranted, particularly where a given airline can demonstrate that more than 20% of its electric GSE purchased prior to 2007 replaced or performs work that would otherwise be performed by diesel equipment, or otherwise should be credited toward compliance with the ORD Rule. Early purchases of electric non-GSE equipment are not subject to a 20% limit, and no such inflexible cap should apply to GSE. While, as ARB staff has confirmed to ATA, under the proposed Rule early purchases of GSE may also be fully credited toward compliance with ARB's large-spark ignition (LSI) regulation (*see* proposed Section 2449.1(d)(1)(C)(2)(a)(i-ii), (b)(iii)), fleets that have achieved compliance with the LSI rule without that additional credit should not be limited to only 20% credit toward the ORD Rule for

early electric purchases that otherwise deserve full credit toward ORD Rule compliance. Similarly, the fact that electric GSE purchases were made before the ORD regulation was proposed provides no reason to deny such early investments in electric the additional double-credit incentive provided toward the early fleet average emission targets (2010-2016) for electric purchased on or after January 1, 2007. *See* Proposed ORD Rule, § 2449.1(d)(1)(C)(2)(1)(b).

Providing less credit for early electrification penalizes those airlines that took the most extensive voluntary action to achieve emission reductions, and would set a negative policy precedent that would discourage others from voluntarily investing in new emission reduction technology before being forced to do so through regulation. Arbitrarily limiting the credit available for early voluntary emission reductions effectively rewards operators for delaying such investments until regulation is contemplated.

In this regard, the May 23 comments submitted by the South Coast Air Quality Management District (SCAQMD) are counterproductive and illogical. The SCAQMD singles out GSE and asks ARB to discourage its electrification by disallowing any credit for electric GSE.[9] There is no basis for engaging in disfavored treatment of GSE or for discouraging electrification. Where feasible, electrification is widely recognized as an environmentally superior compliance option that should be encouraged through incentives and additional credit, due to its *zero* vehicle emissions of PM, NOx, and other pollutants, and the potential to reduce greenhouse gas emissions inventories. Among other things, the benefits of electric are reflected in ARB's Zero Emission Vehicle Program, which provides that zero and near-zero emission vehicles are a key element of California's plan for attaining health-based air quality standards.

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[9] Letter from B. Wallerstein, SCAQMD, to C. Witherspoon, ARB, dated May 23, 2007, Attachment 1 at 3. Available at: www.arb.ca.gov/lists/ordiesl07/922-ordiesl07-ws-12.pdf.

SCAQMD's comments are inexplicable, but appear based in part on a misunderstanding of the now-terminated South Coast Ground Service Equipment Memorandum of Understanding (MOU), which was entered voluntarily by ATA member airlines who came forward to achieve early air emission reductions at a time prior to any comprehensive regulatory regime in California targeting emissions from GSE (or from other types of existing off-road engines). Pursuant to its terms, the MOU was terminated in light of ARB's statewide regulatory effort to impose a comprehensive set of requirements on GSE statewide, which were not consistent with the MOU requirements. Past participation in the MOU does not today yield its signatories any credit toward compliance with the generally applicable regulations now being adopted and implemented by ARB to displace it (moreover, a number of non-ATA operators of GSE did not come forward to participate in the MOU in the first instance).

SCAQMD also recites a speculative notion of "avoid[ing] any possible overlaps with existing and future regulations."[10] Not surprisingly, given ARB's conclusion that the proposed ORD Rule already "represents the economic limit of what industry could bear," (ISOR at 3), ARB has indicated no plans for future regulation that "overlaps" with the ORD Rule, and none is warranted. In any event, there is no reason to discourage desirable compliance activities under the current proposed Rule based on sheer speculation about future rules (and, as always, any terms needed to harmonize any future rules would more appropriately be handled as part of the future proposal once its terms are known, and not by distorting the current proposal based on speculation).

SCAQMD also incorrectly asserts that "[c]redits for GSE electrified prior to or after 2007 are already taken into account in the previous MOU with the airlines and/or included in the

[10] *Id.*

CARB's large spark-ignited [sic] (LSI) regulation." Letter from B. Wallerstein, SCAQMD, to C. Witherspoon, ARB, dated May 23, 2007, Attachment 1 at 3. As noted above, the MOU signatories derive no credit toward regulatory compliance by virtue of their voluntary participation in the MOU. Moreover, as noted above, the current ORD Rule proposal would provide credit for only a small portion of electric GSE purchased prior to 2007, and provides credit for electric GSE purchased thereafter only if it is not already included in the owner's LSI fleet. SCAQMD's comments are baseless and should be rejected.

B. Emission Reductions From Clean LSI Replacements Should be Credited

As part of its May 23 recommended modifications, ARB staff proposed that the Rule allow credit for replacements of existing diesel vehicles with clean large spark-ignition (LSI) vehicles. ATA welcomes this development, and urges the Board to accept staff's recommendation to revise the Rule to afford credit for replacement LSI vehicles. There is no reason to deny credit for clean LSI replacements, which will reduce diesel PM to *zero* and provide NOx emissions roughly 3 or 4 times lower than any diesel option available during the early years of the Rule (particularly before the introduction of Tier 4 off-road engines), and at a lower cost. Allowing credit for reductions accomplished through LSI replacements will improve compliance flexibility and reduce the regulatory burden, without compromising emission reduction goals. Given ARB staff's determination that the proposed Rule "represents the economic limit of what industry could bear" (ISOR at 3), it is particularly important to allow sensible options that achieve the same emission reductions with increased flexibility and lower cost. Where an operator can achieve the required emission reductions by replacing an existing diesel vehicle with a cleaner LSI vehicle, those reductions should be credited.

ATA supports staff's recommendation and urges the Board to revise the Rule to allow credit for LSI replacements.

C. The PM BACT Mandate Should Provide Credit For Replacements with New Tier 4 Engines, and Should Not Mandate that Older Vehicles be Retrofit

As initially proposed on April 5, the Rule would have disallowed credit toward the annual 20% PM BACT retrofit requirement for operators who prefer to buy replacement vehicles that already incorporate emission controls, rather than trying to install and integrate retrofit controls on existing vehicles. However, as part of its revised proposal of May 23, ARB staff recommended to the Board that the ORD Rule be revised to allow credit toward the PM BACT requirement for purchases of Tier 4 vehicles that replace existing vehicles.

ATA supports staff's recommendation to allow PM BACT credit for Tier 4 replacements. It would make no sense to mandate that end-users must try to integrate emission controls into old vehicles, while denying them credit for purchasing Tier 4 vehicles that already incorporate such controls. In addition to being arbitrary and capricious, this provision of the April proposal would be contrary to the federal Clean Air Act (CAA) (*see* Parts IV and X, below). Moreover, ATA believes ARB should go a step farther and allow PM BACT credit for other changes that generate comparable omission reductions (*see* Part VII, below).

VI. The Rule's Heavy Reliance on VDECS Retrofits is Arbitrary and Capricious and Contrary to Law

The Rule as proposed is premised on the notion that compliance will be achieved through heavy reliance on VDECS retrofits. Compliance with the fleet average emission requirements, the BACT compliance path, and the 2021 retrofit mandate all either directly or effectively require the end-use consumers of existing diesel vehicles to modify those vehicles by installing retrofit VDECS emission controls. ARB recognizes this fact throughout the rulemaking record. For example, although the fleet average emission requirements on their face do not mandate the use of VDECS for compliance, ARB established the fleet average emission targets based on the expectation of heavy reliance on VDECS retrofits. *See, e.g.*, ISOR at 4. In addition, ARB

concedes that some fleets simply "cannot realistically meet the fleet average targets, especially in the early years of compliance," and are therefore forced to comply under the BACT path. ISOR at 61.

Moreover, ARB's evaluation of the cost of the proposed Rule is premised on the notion that compliance with be achieved in large part through VDECS retrofits. Indeed, ARB estimates that over half of the costs of compliance with the Rule will be for VDECS. ISOR at 39. Even if a fleet somehow manages to comply with the fleet average emission targets from 2010 through 2020 without heavy reliance on VDECS (for example, by purchasing new Tier 3 vehicles to comply with the early targets, and replacing with Tier 4 vehicles, once available, to meet the final targets), the Rule requires that all fleets -- regardless of fleet average emissions -- install VDECS retrofits on virtually all remaining vehicles (except Tier 4) by 2021.

As discussed below, the Rule's provisions and heavy reliance on VDECS retrofits are legally and technically problematic, particularly for GSE, and render the proposed Rule arbitrary and capricious and contrary to law in numerous respects.

A. VDECS Are Untested and Problematic for GSE, and ARB Failed to Adequately Consider Technical Feasibility, Lead-Time, and Cost

1. ARB Verification Says Nothing About Whether The Retrofit Can Be Readily Installed In A Particular Vehicle

The proposed Rule presumes that any Level 2 or 3 VDECS that has been verified by ARB for a particular engine is "available" and can be installed on a vehicle by the end-user. *See*, *e.g.*, Proposed ORD Rule, § 2449(c)(22). However, ARB verification of a diesel particulate filter (DPF) or other retrofit device means only that the device itself can eliminate the specified emissions and can continue to do so during its warranty period -- it does not confirm that the device can readily be installed on a given vehicle. Nor does ARB verification address the considerations, requisite for promulgation of the ORD Rule, of technical feasibility, extent of

vehicle redesign, necessary lead-time, cost, or other issues involved in seeking to integrate the retrofit into a particular piece of equipment. *See* 13 CCR Chapter 14 (Verification Procedure, Warranty and In-Use Compliance Requirements for In-Use Strategies to Control Emissions From Diesel Engines); *see also* TSD at 100 ("Verification is an approval from ARB which assures end users that a verified retrofit device achieves its advertised emission reductions and is durable.").

A device qualifies for ARB verification after the retrofit maker demonstrates 200 hours of "compatible" operation with "one vehicle or piece of equipment belonging to the initial emission control group for which it seeks verification." 13 CCR § 2705(a), (b) (Field Demonstration Requirements). Even for the one vehicle type tested, verification does not address the extent of technical or redesign work necessary to install the retrofit. To be found "compatible" with the particular vehicle type tested, the retrofit must not cause engine malfunction or damage, cause backpressure outside the manufacturer specifications, or hinder or detract from the vehicle or equipment's ability to perform its normal functions. *Id.* § 2705(a). None of these issues were examined for GSE.

While ARB examined the technical feasibility of retrofits for various construction equipment, ARB did not do so for GSE. *See* ISOR at 50-51 (noting that the retrofit devices have been demonstrated in numerous construction situations). In discussing the technical feasibility of DPF retrofits, ARB staff cites U.S. and particularly European experience in installing DPF retrofits on construction and mining equipment. *Id.* None of the examples cited by ARB involved GSE. Indeed, to ATA's knowledge, no Level 2 or 3 VDECS has been successfully

installed or tested on the various types of highly-specialized GSE -- in the U.S., Europe, or elsewhere.[11]

ARB's failure to adequately examine and consider the technical feasibility (including lead-time) and cost of retrofitting GSE with VDECS, renders the proposed Rule arbitrary and capricious and well as contrary to state law. *See*, *e.g.*, Cal Health & Safety Code § 43013(a) (emission standards must be cost-effective and technologically feasible, as well as necessary to carry out the purposes of the statute).

2. Integration of VDECS Into GSE Would be Problematic

VDECS retrofits are not an "off-the-shelf" solution, particularly for GSE. As discussed above, GSE is a small specialized market, consisting of approximately 200-300 makes and models of highly diverse and specialized equipment. For each make and model, installation of VDECS would require each end-user to determine how to install and integrate the retrofit unit into the vehicle. This involves identification and resolution of technical and mechanical issues, not only with respect to the exhaust pressure and regeneration features of the retrofit unit, but the overall vehicle design, including space, operator visibility, and functionality issues presented whenever a significant mechanical addition to a highly-specialized vehicle is contemplated.

The configuration of some GSE simply will not physically accommodate any of the VDECS retrofits approved by ARB, or will not do so without compromising the functionality of the equipment. For example, the current design of certain aircraft tractors does not allow for

[11] As part of ATA's effort to determine and evaluate the potential for VDECS for GSE, in the hopes of identifying any potentially viable means of compliance with the ORD Rule as proposed, ATA representatives met with representatives of HUSS Umwelttechnik, the maker of the HUSS FS-MK diesel particulate filter – identified as potentially the least problematic of the three Level 3 VDECS that have been approved by ARB. Discussions with HUSS confirmed ATA's understanding that, despite the otherwise extensive European use of DPFs, no comparable DPFs have been installed or used on GSE in Europe. These conversations also confirmed that seeking to integrate VDECS into GSE would pose problematic issues of technical feasibility, lead-time, operability, and cost, as discussed above.

positioning of a retrofit outside the body and there is limited space inside the chassis. Similarly, there are space limitations and heat concerns with placing a retrofit inside a cargo tractor that operates in close quarters with fully-fueled passenger aircraft.

3. ARB Failed to Consider the Technical Feasibility, Lead-Time, and Costs of Seeking to Integrate Retrofit Technologies Into GSE

In crafting the Rule, ARB failed to consider or take into account the technical feasibility of integrating untested VDECS technologies into highly specialized and diverse GSE, nor the limited expertise of the end-user consumers of the equipment to perform the vehicle engineering and redesign that would be necessary. Even for those types of GSE units where installing VDECS might ultimately be determined to be technically possible, ARB failed to consider or account for the necessary lead-time, cost, extent of likely operational and reliability problems, functionality issues (such as visibility impairment for vehicles with little or no space for VDECS installation within the chassis) and added uncertainty associated with the process. ARB should have considered these factors in deciding whether such heavy reliance on retrofits was the most appropriate regulatory option for GSE. *See, e.g.*, TSD at 99-127, 153-186; Cal. Gov't Code 11346.5(a)(9) (requiring the agency to consider the costs of the rule); Cal. Health & Saf. Code 43013(a),(b) (requiring motor vehicle emission standards to be technically feasible and cost-effective). ARB's failure to appropriately consider these factors renders the proposed Rule arbitrary and capricious and contrary to law.

The fact that emission control technologies exist, and may have been tested on other types of vehicles, does not resolve the issue of the technical feasibility of installing VDECS retrofits on GSE. Indeed, "[w]hen a technology is already in use in other industries, the court often expects more solid evidence that the technology can be transferred to the industry in question, or at least that relevant dissimilarities have been considered." *Natural Resources*

Defense Council v. EPA, 655 F.2d 318, 331 (D.C. Cir. 1981); *see also id.* at 332 (lead time includes that "necessary to permit the development *and application* of the requisite technology"). ARB has failed to consider these issues, and the rulemaking record includes no evidence concerning what it would take to incorporate VDECS into GSE.

ARB's unspoken and unsupported assumption of technical feasibility is also at odds with the conclusions EPA reached in its June 29, 2004 rulemaking regarding the "Control of Emissions of Air Pollution from Nonroad Diesel Engines and Fuel." 69 Fed. Reg. 38958. At that time, EPA recognized that the integration of existing emissions reduction technologies into nonroad engines would be "challenging and will require additional time to develop," even for original equipment manufacturers (OEMs) with the organic engineering capability and resources that operators lack. *Id.* at 38993. Further, EPA explained that its conclusion that such technologies could be integrated in the future given additional lead-time and the benefit of technology reviews was based on: (1) the premise that this would be accomplished by OEMs for *new* engines; (2) the conclusion that new engines in the 25-75 hp category would enjoy the benefits of the "strong trend toward the introduction of more advanced electronic fuel system technology in the future;" and (3) that this trend would foster falling costs for such systems. *Id.*

Particularly with respect to the retrofit of engines prior to model year 2001, EPA was careful to note that electronic fuel system technology was not employed prior to 2001 and, therefore, similar assumptions did not hold for engines in that category for those model years. *Id.* As such, ARB's unspoken assumption that retrofit of GSE in model years prior to 2001 will be technically feasible is arbitrary, unsupported by the record, and cannot be reconciled with EPA's regulatory conclusions in that regard.

B. ARB Cannot Retroactively Reverse Its Decision to Forego a Tier 3 PM Standard by Requiring End Users to Retrofit

Just a few years ago, ARB elected to forego imposing on original equipment manufacturers (OEMs) essentially the very diesel PM requirements it seeks to impose here, apparently based on technical feasibility concerns. ARB cannot, consistent with the law and sound regulatory policy, now seek to impose that burden on the end-use consumers of diesel vehicles -- who lack the engineering expertise of OEMs. However, the proposed ORD Rule would effectively do just that, rendering it contrary to the statutory scheme reflected in the federal Clean Air Act and California's state-law analogue, as well as arbitrary and capricious.

1. The Fleet Average and BACT Requirements Impose Double Conversions, Including Purchase and Later Retrofit of New Tier 3 GSE

To meet the aggressive early-year fleet average PM targets of the proposed ORD Rule, fleet operators will be required to implement a combination of new Tier 3 equipment and untested Level 3 VDECS retrofits of older equipment. As the fleet nears the final 2020 fleet average targets, Tier 3 and retrofit Tier 0-2 equipment will no longer satisfy the fleet average targets. Lower Tier units retrofit in early years will need to be scrapped and replaced with new Tier 4 equipment (once available), and Tier 3 units will need to be retrofit. The 2021 retrofit mandate, and the ever-present possibility that fleet changes or other conditions will require that compliance be sought during certain years using the BACT compliance path, make retrofit of relatively new Tier 3 equipment (purchased to comply with the early-year requirements) a virtual certainty.

In addition, PM retrofits do nothing to control NOx emissions. *See* generally ISOR at 1, 21. Thus, if not already necessitated by the need to comply with PM fleet average and retrofit provisions, the Rule's increasingly stringent fleet average NOx targets guarantee that Tier 3 and

retrofitted equipment, purchased and implemented to comply with the Rule's PM requirements before the availability of Tier 4, must be scrapped just a few years later and replaced with Tier 4.

2. ARB Decided Just a Few Years Ago Not to Require OEMs to Implement PM Aftertreatment Controls on Tier 3, and Cannot Now Require End-Users to Seek to Make Those Changes Through Retrofit

ARB approved the identification of diesel PM as a toxic air contaminant in August 1998. In 1999, ARB announced Tier 1, 2, and 3 new engine emission standards, with Tier 3 standards applicable to model years after 2006-2008 (depending on horsepower category). 13 CCR § 2423(b)(1). However, the Tier 3 standards adopted at that time included no improvement over Tier 2 standards with respect to diesel PM. *Id.* In other words, ARB elected not to adopt a Tier 3 PM standard -- allowing the same Tier 2 PM standard to continue in place over the four or five additional model years otherwise subject to more stringent Tier 3 standards for other pollutants.

However, in announcing Tier 1-3 emission standards in 1999, ARB stated that it was committed to conducting a technical feasibility review in 2001, and confirmed that in 2001 "*ARB will propose a Tier 3 PM standard.*" Exhibit D, *Amendments to Off-Road Compression-Ignition Engine Regulations: 2000 and Later Emission Standards; Staff Report: Initial Statement of Reasons* (Dec. 10, 1999), at 15, 20 (emphasis added).

However, ARB did not complete a technical feasibility review in 2001, and never proposed a Tier 3 PM standard. Instead, ARB waited until November 29, 2001 to issue an "information request" letter to diesel OEMs, seeking "information on the development of emission control technologies capable of meeting Tier 2 and 3 off-road compression ignition emission standards and beyond." Exhibit E, Letter from M. Carter, ARB to All Off-Road Compression Ignition Engine Manufacturers and Other Interested Parties (Nov. 29, 2001). According to ARB, "[t]he purpose of this request was to learn how far the technologies had

progressed and to understand [the original equipment manufacturing] industry's concerns regarding implementation, timing, and durability." Exhibit F, *Amendments to the California Off-Road Emissions Regulation for Compression-Ignition Engines and Equipment; Staff Report: Initial Statement of Reasons* (Oct. 22, 2004), at 20.

Among other things, ARB requested "all information related to the development of NOx and PM aftertreatment technologies for the off-road sector . . . ," which ARB explained "will provide significant direction regarding off-road regulatory development in the future." Exhibit E at 1. In particular, ARB emphasized the need for more stringent new engine emission standards for off-road engines, beyond then-current Tier 2 and 3 standards, to meet federal ambient air quality standards. *Id.*

ARB requested that each OEM list the emission control technologies it used in, or intended to incorporate into, its off-road product lines to meet Tier 3 standards. Among other things, OEMs were to provide "a detailed description of all the technologies . . . regarding functionality, operating conditions (e.g., exhaust temperature range), applicability, physical dimensions, and ease of integration into existing design packages." Exhibit E at 1. Further, OEMs were to "describe all powertrain and chassis design changes that were/are needed to accommodate each emissions control technology" and "[p]rovide a corresponding list of accessory components, substances, or procedures that are needed for these technologies to function properly (e.g., NOx sensor, urea, or periodic off-board regeneration)." *Id.*

OEMs were given until January 21, 2002 to respond. In response to recent telephone inquiries on behalf of ATA, ARB staff indicated that OEMs provided no written materials in response. Instead, ARB apparently has in its files detailed records of a number of phone calls

with OEM representatives. However, ARB staff declined to release these records, stating that they are labeled "confidential."

Whatever the OEMs may have argued or represented to ARB concerning the cost or technical feasibility of integrating diesel particular filters into new Tier 3 engines that apparently persuaded ARB to forego imposing any Tier 3 PM requirement on OEMs, ARB provided no formal explanation for its decision. Instead, ARB elected to leave in place the obsolete Tier 2 PM standard until the introduction of Tier 4 standards years later.

Having made a regulatory decision not to impose any Tier 3 PM standards for new off-road engines, apparently based on OEM arguments that it was too costly or technically difficult to integrate effective aftertreatment technologies into new Tier 3 engines and vehicles, ARB now proposes that end-user ultimate purchasers be forced to somehow bear that burden and retrofit existing vehicles, including those with Tier 3 engines that they will be forced to purchase to comply with the early-year requirements of the Rule. In proposing the ORD Rule, ARB continues to fail to explain why it elected not to impose more stringent PM standards on new Tier 3 engines. Nor does ARB adequately explain why, just a few years later, ARB believes it appropriate or technically feasible to impose essentially the same requirements on operators of the equipment -- who have little or no expertise integrating emission controls into vehicles. Tellingly, in proposing the ORD Rule for GSE, ARB examined none of the technical feasibility, design, and integration issues that ARB sought detailed information from OEMs about.

ARB should not, and legally cannot, retroactively change its Tier 3 standards by seeking to impose those requirements after-the-fact through end-user mandates that require retrofit and early replacement. ARB has failed even to consider the technical feasibility issues related to retrofitting GSE, which ARB had previously identified with respect to OEMs. Those issues are

present to a far greater extent for end-users, and ARB cannot now simply pretend they do not exist.

3. For CAA Purposes, Requiring End-Users to Determine How to Integrate VDECS Into Existing Vehicles is No Different Than Requiring Them to Invent New Emission Control Technology

As discussed above, VDECS retrofits are not an "off-the-shelf" solution, but will require each end-user to determine how to install and integrate the retrofit unit into each make and model of GSE. For CAA purposes, identifying and resolving the technical and mechanical issues necessary to integrate existing emission control technology into a particular engine and vehicle is no different from the development of the emission control technology itself. In other words, a mandate to integrate existing emission control technology into a vehicle is no different from a mandate to develop a new emission control technology, an irrational and arbitrary requirement to impose on ultimate purchasers.

Courts have appropriately recognized that integrating the emission controls is part and parcel of a "technology forcing" requirement, subject to technical feasibility, lead-time, and other CAA limitations. As reflected throughout the statutory scheme, Congress intended such requirements would be imposed on OEMs, not end users. *See*, *e.g.*, *Natural Resources Defense Council v. EPA*, 655 F.2d 318, 329, 332 (D.C. Cir. 1981) (reasoning that adequate lead time includes the time "necessary to permit the development *and application* of the requisite technology") (emphasis added); *American Motors Corp. v. Blum,* 603 F.2d 978 (D.C. Cir. 1979) (reviewing legislative history of provisions granting additional lead time to smaller manufacturers to allow them time to integrate emissions control technology developed by others into their vehicles).

4. The Federal Clean Air Act Contemplates That OEMs, Not End-Use Consumers, Will Incorporate Required Emission Control Technologies Into Engines and Vehicles

The primary means for reducing mobile source air emissions under the CAA and the complementary California statutory scheme is through emission standards for new engines, and a fundamental premise of those statutes is that new emission control technologies should be developed, and implemented into engines and vehicles, by OEMs. The OEMs are best suited for this task, as they have the technical expertise to develop the necessary technologies, and to identify and resolve implementation and operational issues inevitably presented by the incorporation of emission controls. New engine emission standards appropriately place the burden on OEMs to perform the highly technical tasks of designing and developing emission control technologies and integrating them into increasingly complex engines and vehicle systems.

As recognized throughout the CAA (and as a matter of common sense) manufacturers have unique expertise and resources necessary to comply with "technology forcing" regulations for new engines, and are in a position to achieve the integration of emission controls in the most cost-effective manner. Placing directly on OEMs the regulatory burden to engineer solutions to emission control problems also provides the appropriate incentives for the OEMs to apply their expertise and resources to achieve the goal established by EPA or California (where authorized by EPA). By contrast, end-use consumers lack any direct control over OEMs, and end-users of specialized, diverse equipment representing a small OEM market, such as GSE, lack significant market leverage over OEMs. Thus, the CAA statutory scheme (including the criteria for EPA authorization of a California standard) is written and premised upon the fundamental principle that requirements to develop and incorporate emission controls into vehicles are to be placed on OEMs, and not end-users.

Even so, while recognizing the OEMs' unique expertise, and allowing EPA to establish "technology forcing" standards, the CAA statutory scheme strikes a careful balance to preserve the economic viability of OEMs and limit the cost impacts for end-users who purchase the equipment. *See, e.g., Motor and Equip. Mfrs. Ass'n v. EPA*, 627 F.2d 1095, 1118 (D.C. Cir. 1979) ("Congress wanted to avoid undue economic disruption in the automotive manufacturing industry and also sought to avoid doubling or tripling the cost of motor vehicles to purchasers. It therefore requires that emission regulations be technologically feasible within economic parameters."). The CAA requires that any new engine emission standards must be technically feasible for OEMs to achieve, and must provide OEMs with adequate lead-time to develop and integrate the technologies into new engines and vehicles, taking cost into account. Emission standards are to apply for the useful life of the equipment, as established by EPA regulation, and provide adequate "stability" such that the standards do not change for each model year -- allowing OEMs the cost-efficiencies of implementing the same emission control levels for multiple model years of equipment before being required to redesign to accommodate the next level of controls.

While a panel of the D.C. Circuit previously stated that California has at least some authority to adopt standards for non-new off-road engines, California may only do so if the standards are authorized by EPA under CAA 209(e). *See* 42 U.S.C. § 7543(e)(2). EPA has made clear that authorization may only be granted to a California off-road standard if it is consistent with the requirements of CAA 202(a), which include technical feasibility, lead-time, useful life, and stability. As discussed in Part X, below, the ORD Rule is expressly preempted under CAA 209 and cannot qualify for EPA authorization.

In addition, however, the ORD Rule's heavy reliance on forcing end-users to integrate emission control retrofits into existing vehicles conflicts with the fundamental purposes and objectives of the federal Clean Air Act and is preempted under the doctrine of conflict preemption. *See, e.g.*, *Crosby v. NFTC*, 530 U.S. 363, 373 (2000) (a state law is invalid where it "stands as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress."). Forcing ultimate purchasers to perform this work is not only unreasonable and arbitrary, but would defeat a primary purpose of the CAA's mobile source emissions scheme, which (within the limits of technical feasibility, lead-time, cost, stability, and useful life requirements) places on OEMs the burdens of developing and integrating emission control technologies, through the use of OEMs' superior expertise, manufacturing infrastructure, and market-efficiencies.

C. The 2021 Retrofit Mandate is Unjustified and Would Undermine the Flexibility ARB Claims Will Result From the Fleet Average Approach

As noted above, regardless of compliance with fleet average emission requirements by 2020, the Rule ultimately requires that virtually each remaining unit must be retrofit by 2021 regardless of fleet average emission levels. *See* Proposed ORD Rule, § 2449(d)(10) ("Compliance After the Final Compliance Date"). Early in the planning process, ARB staff concurred with public comments from industry that a fleet average approach would be the most cost-effective way to achieve ARB's air quality goals. In justifying the current proposed rule, ARB staff has continued to tout the flexibility and cost-effectiveness of the fleet average compliance option. However, in February 2007, ARB staff added the 2021 retrofit requirement

without explanation, effectively removing much or all of the flexibility otherwise provided by a fleet average approach.[12]

As discussed below, this reversal is problematic for at least three reasons. First, ARB staff has failed to explain or justify the 2021 retrofit mandate in the context of a stringent fleet average approach. Second, ARB staff continues to tout the rule as flexible and cost-effective because of the fleet average approach and has failed to come to terms with the effects of the 2021 retrofit mandate in evaluating the alternatives and costs of the Rule. Third, the agency's less-than-forthright reversal is contrary to its obligation to pursue an open rulemaking process designed to increase public participation and improve the quality of regulations.

1. The 2021 Retrofit Mandate Has Not Been Adequately Explained or Justified

The proposed 2021 retrofit requirement is unnecessary to achieve ARB's stated goals, and has not been adequately explained or justified by ARB. The fleet average emission targets, without more, will fully achieve ARB's stringent emission reductions goal by 2020. *See, e.g.*, ISOR at 33 ("The regulation would achieve the 2020 goal of reducing PM 85 percent from 2000 baseline levels set forth in the 2000 Diesel Risk Reduction Plan"). If ARB staff decided it must go beyond that goal, it has not provided any reasoned explanation why, nor what level of additional emission reductions in 2021 are warranted, and its own reasoning shows that a fleet average approach is an equally effective and less burdensome alternative. *See* Cal. Gov't. Code § 11346.5(a)(13) (requiring the Board to determine that "no reasonable alternative considered by the agency or that has otherwise been identified and brought to the attention of the agency would

[12] *See* www.arb.ca.gov/msprog/ordiesel/documents/Reg_Lang_Strikeouts_Feb_Wkshps.pdf.

be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.").

Indeed, ARB staff has acknowledged many times that a fleet average approach is the preferred regulatory option, and that retrofit mandates are not cost effective. *See, e.g.*, ISOR at 25 (concluding that "requiring that all vehicles be retrofit by a certain date . . . would result in higher compliance costs for no commensurate emission benefit"); *id* at 60 (rejecting alternatives to a fleet average approach). Moreover, as discussed below, because the 2021 retrofit mandate represents a change in ARB's position since it endorsed the fleet average approach earlier in the rulemaking process, additional justification is necessary. *Cf. Motor Vehicle Mfrs Ass'n. v. State Farm Mut. Auto. Ins.*, 463 U.S. 29, 42 (1983) ("an agency changing its course ... is obligated to supply a reasoned analysis").

2. ARB Staff Did Not Fully Come to Terms with the Counter-Productive Aspects of the 2021 Retrofit Requirement in Evaluating the Reasonable Alternatives and Costs

ARB staff did not appear to recognize that the 2021 retrofit requirement undermines much of the flexibility (and thus cost-effectiveness) provided by the fleet average approach when conducting its analysis of reasonable alternatives. *See* Cal. Gov't Code § 11346.2(b)(3)(A) (requiring the agency to describe the reasonable alternatives considered and the reasons for rejecting the alternatives). ARB staff asserts that it chose the best alternative to achieve its stated goals to reduce emissions, "minimize the cost for fleets and, in particular minimize the need for fleets to control equipment twice," and "achieve cost-effective emission reductions on a dollars per ton basis." *See* ISOR at 59-61.

ARB staff misleadingly presents the ORD Rule as the best alternative, ostensibly because "each fleet can choose its own best, most cost-effective path toward compliance." ISOR at 4, 60. ARB staff expressly rejected one alternative because it "lacks the flexibility of a fleet average"

and another because it "[w]ould eliminate [the] fleet's ability to choose a cost-effective path to compliance." *Id.* at 60. Yet ARB staff ultimately selected an inflexible alternative, the 2021 retrofit mandate, without acknowledging that it suffers from these same flaws.

To the extent that ARB staff has sought to justify this rule as flexible and cost-effective due to the fleet average approach -- and selected it as the "best alternative" based on this rationale -- its conclusion is undermined by the inexplicable 2021 retrofit mandate. By asserting that the Rule provides the benefits of a flexible fleet average approach, ARB staff has ignored the fact that the 2021 retrofit mandate severely impairs or removes any such flexibility and has failed to properly evaluate the reasonable alternatives.

Similarly, ARB staff did not appropriately evaluate the costs associated with the 2021 retrofit mandate. *See* Cal. Gov't Code 11346.5(a)(9) (requiring the agency to consider the costs of the rule); Cal. Health & Saf. Code 43013(a),(b) (requiring motor vehicle emission standards to be "cost-effective.").[13] ARB staff has provided an estimate of the costs associated with the 2021 retrofit mandate in 2021. *See,* ISOR at 40 (providing a chart that includes retrofit costs in 2021). However, ARB staff does not appear to have considered the implications of the 2021 retrofit mandate in limiting flexibility in prior years. Rather than choosing the most cost-effective approach to meet the fleet average targets, a fleet owner will need to choose an approach that minimizes the impact of the 2021 mandate -- *i.e.*, one that emphasizes retrofits for every unit regardless of fleet average emissions. This substantially reduces or removes the flexibility

[13] The proposed Rule addresses both NOx and Diesel PM. Therefore, ARB must adopt the Rule pursuant to the requirements of both Section 39667 and 43013 of the Health and Safety Code. *See* ISOR at 31; Technical Support Document at 7. Section 43013 requires that the ORD Rule be cost-effective. *See* Cal. Health Saf. Code 43013(a),(b).

otherwise afforded by the fleet average approach and leads to greater costs throughout the compliance period.

3. The Retrofit Mandate is an Arbitrary Reversal of ARB's Determination to Adopt a Fleet Average Approach

The 2021 retrofit mandate is also flawed because it represents an apparently arbitrary reversal of ARB's position during the rulemaking process. In response to stakeholder comments, ARB staff previously endorsed a flexible fleet average approach for the ORD Rule. *See, e.g.*, ISOR at 55, 59 (noting that staff incorporated the fleet average approach at the request of stakeholders). However, ARB staff effectively abandoned this flexible position by adding the mandate that virtually each unit must be retrofit by 2021 regardless of fleet average emissions.[14]

This unexplained reversal is inconsistent with the California Administrative Procedure Act (CAPA), which is designed to foster an open and participatory rulemaking process. For example, CAPA requires California agencies to involve interested parties before a formal proposed regulation is released for public comment whenever it is "complex" and thus cannot be easily reviewed within the comment period. Cal. Gov't Code § 11346.45. This provision is designed to "improve the quality of regulations." *Id.* Contrary to ARB's obligation to engage in open and participatory rulemaking, ARB staff first told the regulated community that it agreed with and would adopt a fleet average approach, but then later added the 2021 retrofit mandate, essentially resulting right back where ARB staff started before it received any industry input -- a de facto BACT approach -- without explanation.

[14] *See, e.g.*, 2/20/07, 2/23/07, 2/26/07, and 3/1/07: Off-Road Diesel Vehicle Rule Public Workshop Presentations, *available at* www.arb.ca.gov/msprog/ordiesel/presentations.htm.

VII. The Rule Requires Numerous Additional Modifications and Clarifications

In addition to the above, the proposed Rule includes a number of other provisions that are arbitrary and capricious and unsupported by the rulemaking record, that require modification or clarification. These changes are necessary to help rationalize the PM BACT provisions and the "hours in fleet" activity-weighted compliance option, and to clarify and expand necessary compliance exemptions. The changes are listed below, and are discussed in further detail along with proposed regulatory language, as appropriate, in Appendix A to these comments.

- Changes to Section 2449(d)(2)(B) (PM BACT Path):
    - Modify the retrofit requirement to allow credit for replacements with new equipment (including electric), as well as other comparable actions such as retiring, selling, or designating as low-use, and clarify that replacements counted toward the NOx Turnover requirement may also be counted toward the PM BACT requirement;
    - Reduce the percentage retrofit requirement from 20 percent to 10 percent;
    - Clarify that units exempt from the PM BACT path should not be included in calculating the percentage of the fleet that must be converted; and
    - Clarify regulatory language to make clear that a fleet owner need not already be in the process of retrofitting every other unit before it can use the existing BACT exemptions.
- Change to Section 2449(d)(1)(D) (Hours in Fleet Average Option):
    - The 1.18 factor applied in calculating fleet average emissions under the activity-weighted compliance option (recommended by ARB staff as part of its May 23 revisions) is baseless and should not be adopted.
- Changes to Section 2449(e) (Special Provisions/Compliance Extensions):
    - Modify the compliance extension for Tier 4 availability delays to allow a compliance extension if GSE incorporating VDECS or Tier 4 engines experience significant reliability or performance problems;
    - Modify the time afforded to address VDECS failures from 90 days to 180 days.

VIII. The Rule Is Preempted by the Federal Aviation Act

The Federal Aviation Act of 1958 ("Aviation Act") establishes "a *uniform and exclusive* system of federal regulation" of aircraft operations that preempts state and local regulation.[15] This pervasive federal regulatory scheme extends not only to aircraft in flight, but also to aircraft-related operations on the ground.[16] GSE, like aircraft, do not "wander about . . . like vagrant clouds. They move only by federal permission, subject to federal inspection, in the hands of federally certified personnel and under an intricate system of federal commands."[17]

Any state regulation impacting ground operations that interferes with the "movements and operations of aircraft" intrudes upon the intensive and exclusive federal authority over aviation and is preempted by the Aviation Act.[18] Diesel-powered GSE are part of an intricate, time-sensitive ground support network that is a seamless extension of aircraft operations and critical to keeping flights running safely and efficiently. They operate in an extremely constrained safety and security environment on tightly orchestrated schedules where reliability and performance are critical to the safety and efficiency of the National Airspace System. By imposing ever-shifting annual conversion requirements on GSE that will frustrate fleet planning and prevent the certainty and predictability required to day-to-day aircraft ground service, and by

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[15] *Burbank v. Lockheed Air Terminal, Inc.*, 411 U.S. 624, 639 (1973) (emphasis added)("City of Burbank") ("[f]ederal control [over aviation] is intensive and exclusive.") (quoting *Northwest Airlines, Inc. v. Minnesota*, 322 U.S. 292, 303 (1944)); *see also American Airlines v. Department of Transp.*, 202 F.3d 788, 801 (5th Cir. 2000; 49 U.S.C. §§ 40101, 40103, 44701.

[16] *See, e.g.*, 49 U.S.C. § 40103(b)(2)(B)-(C); *City of Houston v. FAA*, 679 F.2d 1184, 1195 (5th Cir. 1982).

[17] *See City of Burbank*, 411 U.S. at 633-34 (quoting *Northwest Airlines, Inc. v. Minnesota*, 322 U.S. 292, 303 (1944) (Jackson, J., concurring)).

[18] *Burbank-Glendale-Pasadena Airport Authority v. Los Angeles*, 979 F.2d 1338, 1341 (9th Cir. 1992) (holding that a regulation of runways and taxiways was preempted).

requiring implementation of untested retrofit technologies and vehicle replacements that will limit the functionality and availability of GSE (and hence the aircraft they support), the proposed Rule would adversely affect the movement and operation of aircraft and is therefore preempted by the Aviation Act.

The Federal Aviation Administration ("FAA") has recognized the integral role played by GSE in support of aircraft operations, and as such concluded that state regulations that impose mandates "directly, or indirectly" affecting the ability of GSE to support the movement and operation of aircraft are preempted under the Aviation Act.[19] This interpretation of the scope of preemption is entitled to deference, as the FAA is the expert federal agency vested with exclusive and primary authority over aviation.[20] The FAA's position stems from a recognition that "[t]he availability of reliable GSE equipment is . . . essential to safe and efficient use of navigable airspace."[21]

Diesel-powered GSE perform a myriad of complex and time-sensitive functions essential to the safe and efficient use of the National Airspace System. These functions include aircraft maintenance, fueling, deicing, starting aircraft engines, moving aircraft to and from the gate, and loading, unloading, and sorting cargo and baggage. An airline cannot transport passengers and cargo without diesel-powered GSE performing these roles safely and efficiently, and any state

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[19] Exhibit B, Letter from Paul Dykeman, Deputy Director, Office of Environment and Energy, FAA, to Donald Zinger, Assistant Director for Transportation and Air Quality, U.S. EPA, at page 8 (August 24, 2000) ("Dykeman letter").

[20] *Arapahoe County Pub. Airport Auth. v. FAA*, 242 F.3d 1213, 1220-1221 (10th Cir. 2001) ("[I]n the arena of aviation regulation 'federal concerns are preeminent,' and the Department of Transportation, through the FAA, is statutorily mandated to represent those concerns.") (Citations omitted.).

[21] See Exhibit B, Dykeman letter, Attachment at 6 (August 24, 2000); *see also id.* ("GSE equipment is necessary to landings and takeoff of aircraft. Aircraft are dependent upon GSE for maintenance, fueling, housing, and in some cases, for movement on the ground as well as a myriad of other activities that are *critical* to the safety of aircraft and flight preparation.")

regulation that potentially compromises GSE availability, operability or reliability for these critical functions will adversely impact the movement and operation of aircraft and is thus preempted under the Aviation Act.

A. The Rule's Uncertain and Constantly-Shifting Compliance Targets Will Impair GSE Fleet Planning and Prevent Certainty Regarding Future Ground Support Capabilities, Impacting the Movement and Operation of Aircraft

As discussed above, the proposed Rule does not allow GSE operators to know its requirements in advance with reasonable certainty, making fleet planning virtually impossible. Unlike other industry sectors impacted by the Rule, if fleet changes have unexpected impacts on the emission requirements under the Rule, a GSE fleet cannot temporarily idle or transfer a piece of equipment, or readily buy or lease additional equipment identical to existing lower-emission units, in order to maintain compliance with the Rule. Unlike a construction fleet, for example, a GSE fleet cannot simply remove a unit that has higher-than-anticipated rated emissions, postpone work until the fleet can be adjusted, or take an additional day to complete a job. The continuous and delicately-orchestrated nature of airport operations, and the specialized nature of GSE, demand a high level of planning certainty which the Rule fails to accommodate.

Even if otherwise allowable, a state regulation touching upon airport operations must, at a minimum, provide reasonable certainty regarding what is required so that airlines and airport operators can plan accordingly and have in place the necessary capabilities well in advance. The ORD Rule's uncertain and ever-shifting horsepower-weighted fleet average emissions targets, calculated fleet emissions indexes, and percentage BACT requirements fail to provide the level of certainty needed to ensure safe and efficient aircraft operations on a continuous basis. The uncertainty of the Rule's requirements will inevitably impact the movement and operation of aircraft by impeding fleet planning, even with the types of changes suggested by ATA in these

comments. Accordingly, the Rule is preempted by the Federal Aviation Act, and should be revised to exempt GSE.

B. The Rule Mandates Rapid and Untested Technological Changes to GSE That Will Compromise Their Ability to Support the Movement and Operation of Aircraft

In addition to the uncertainty of its requirements, the ORD Rule will compromise the ability to safely and reliably service aircraft by requiring fleet owners to convert significant portions of existing fleets of diesel-powered GSE each year with unproven or experimental new or retrofitted equipment. As discussed above, the Rule's stringent Target Rates decrease for NOx every year and for PM every two years while the alternative BACT approach requires massive annual turnovers and/or retrofits. The Rule further requires that by 2021, virtually all vehicles must install VDECS, regardless of whether the fleet meets or exceeds the fleet average or BACT requirements. To comply with the Rule, fleet owners would have to repeatedly experiment with active GSE fleets by rapidly integrating new equipment and untested retrofits, causing unpredictable reliability, performance, and fleet compatibility problems.

The Rule's fleet average emissions requirements and percentage BACT mandates would also require significant design and structural changes to large portions of the existing GSE fleet each year. GSE often have unique design constraints because they operate in confined spaces dictated by the shape of aircraft and the convergence of multiple vehicles servicing aircraft at the same time. Changes to the exterior of existing GSE to accommodate retrofits may alter the design to such an extent as to render them unable to fulfill their intended use reliably and effectively. Even for GSE that have space for a retrofit, and even if the installation may ultimately provide technically feasible for that particular type of GSE, the additional equipment may interfere with operator visibility or cause other operability problems. By mandating retrofits

and rapid equipment turnover of GSE (without adequate time for testing), the proposed Rule will have significant impacts on the movement and operation of aircraft.

C. The Rule's Performance Requirements Will Impose Constraints on Aircraft Ground Support Operations That Interfere With the Movement and Operations of Aircraft

Compliance with the Rule would require changes in the supporting airport and maintenance infrastructure and aircraft ground support operations to accommodate modified GSE. These changes present problematic implementation issues because of the constantly shifting annual PM and NOx Target Rates, and as such would be by necessity rushed and difficult to coordinate. Fleet operators as a result may be forced to rapidly change locations and usage patterns of GSE at California airports. For example, certain GSE functions may hypothetically be replaceable by fixed systems, but these fixed systems cannot provide the requisite flexibility that airlines need to adjust to changes in flight arrival times and gates or unforeseen maintenance issues. In such situations, mobile GSE are critical. These changes in equipment, airport infrastructure, GSE fleet management, and GSE usage will have a clear effect on the movement and operation of aircraft.

The Rule's annual compliance targets also fail to provide flexibility to account for the engineering and technological development necessary to implement retrofit technologies compatible with each unique make and model of GSE. The addition of VDECS or use of any new engine technologies in individual GSE requires significant engineering, design and development by airlines, often necessitating working together with GSE original equipment manufacturers. While the Rule would provide ARB staff limited ability to grant a compliance extension for delays in the availability of certain vehicles, the Rule does not account for market delays in the availability of Tier 4 in GSE in the first instance, nor of VDECS retrofits.

Airlines that cannot find technological solutions for retrofitting their GSE fleet, which is highly likely given that the initial 2010 compliance deadline is less than three years away, would be forced to purchase and rapidly integrate new GSE or retire or relegate to "low-use" a higher percentage of critical GSE in order to meet fleet average emissions targets. The relegation to "low use" of, for example, all but one aircraft pushback tractor would have a ripple effect on the movement and operation of aircraft, disrupting the National Airspace System.

IX. The Rule Is Preempted by the Airline Deregulation Act ("ADA")

The ADA provides that a state "may not enact or enforce a law, regulation, or other provision having the force and effect of law related to a price, route, or service of [an] air carrier. . . ."[22] This language "express[es] a broad preemptive purpose," and ADA preemption applies even if a state law is not expressly designed to affect airline prices, routes, and service, and even if the impact is only indirect. *See Morales v. Transworld Airlines*, 504 U.S. 374, 383 (1992) (holding that ADA preempted state law requirements that expressly referred to airlines and established "binding requirements" upon them). Thus, any state law "having a connection with, or reference to, airline 'rates routes, or services'" is preempted. *See id.* at 384. ADA preemption extends to regulation of GSE and airport support vehicles because such equipment is "integral" to carriers' services.[23]

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[22] 49 U.S.C. § 41713(b)(1). This statutory provision was previously codified at 49 U.S.C. § 1305(a)(1). *See* 49 U.S.C. App. § 1305(a)(1). In 1994, Congress reenacted this provision at 49 U.S.C. § 41713(b)(1) as part of its reenactment of Title 49, and changed the operative language from "rates, routes or services" to "price, route, or service," but no substantive change was intended. *See American Airlines v. Wolens*, 513 U.S. 219, 223 n.1 (1995).

[23] *See, e.g.*, *Federal Express Corp. v. California Pub. Util. Comm'n*, 936 F.2d 1075, 1078 (9th Cir. 1991) (holding that California's generally applicable trucking regulation of air carrier's trucking operations was preempted because such trucking operations "are integral to . . . operation as an air carrier"); *Marlow v. AMR Serv.*, 870 F. Supp. 295, 298-99 (D. Haw. 1994) (finding ADA preemption because GSE (jet bridge) forms an "integral part" of air carrier services).

A. The Rule's Impact on GSE Operability, Reliability, and Availability Would Significantly and Directly Affect Airline Decisions on Routes and Service and Is Therefore Preempted by the ADA

The ORD Rule's uncertain and ever-shifting requirements, its intensive and technology-forcing mandates, and the attendant GSE operational and reliability problems that will inevitably occur through efforts to comply, will impact airline decisions concerning routes and services in a manner that is not "tenuous, remote or peripheral"[24] but significant and direct. The Rule would require fleet owners to make sweeping changes to GSE fleets each year, and deprive them of the ability to engage in meaningful fleet planning, impacting the availability, functionality, and reliability of key equipment in such a way as to alter an airline's ability to fly particular aircraft to and from California airports. Certain aircraft, such as the largest wide-body aircraft used in international and cross-country flights, require special types of GSE or have uniquely intense or demanding GSE requirements, and any impact on availability or a pattern of unreliability with such GSE would affect airlines' decisions to use California airports. Older aircraft may also be designed to function with existing GSE, so any changes to design or integration of new equipment, or uncertainty regarding the Rule's requirements, could force airlines to reroute those older planes to other airports outside the state.

The Rule would require changes to (1) airport infrastructure, (2) the composition of the GSE fleet, and (3) allocation of GSE among California airports, all of which would affect routes and the availability of air transportation service to communities by adversely impacting the capacity of airports throughout the state to support airline operations, including aircraft

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[24] *See Gary v. The Air Group, Inc.*, 397 F.3d 183, 186 (3rd Cir., 2005) (hereinafter "Gary") (citing *Morales v. Trans World Airlines, Inc.*, 504 U.S. 374, 390 (1992)). The Third Circuit held in *Gary* that a regulation would "relate to" airline services under the ADA if it either "expressly references" them or "has a forbidden significant effect on them." See *Gary* at 397 F.3d at 186.

maintenance routes and time-sensitive cargo service (*e.g.*, cargo flights of lifesaving medicines and biological material, documents, "just-in-time" inventory capability, critical equipment delivery, perishable goods shipments). As a result, airline decisions concerning whether to provide expanded service to California airports, or reduce such service in favor of competing airports in neighboring states, would be impacted by the Rule's effects on GSE capacity to handle flight traffic efficiently and ensure on-time delivery. Limiting the GSE capacity at California airports to handle increased volume of air traffic or certain types of aircraft will force airlines to route flights to other airports and limit or eliminate service to communities in contravention of the language and purpose of the ADA.

In the likely event that GSE capacity to accommodate routine or stand-by maintenance is reduced or affected by the Rule, the volume or type of flights routed through California airports will necessarily be affected. A range of diesel-powered GSE is critical to ensuring that aircraft are serviced properly and quickly so that they may return to operation safely and on time. The impacts of the proposed Rule on such equipment will affect the ability of California airports to continue to make available the existing level of maintenance support, and thus alter airline decisions concerning routes and services. All of these impacts flow directly from restrictions on GSE use and availability imposed by the ORD Rule, and as such subject the Rule to preemption under the ADA.

The high costs associated with the Rule could also directly and significantly impact decisions on airline routes and services. According to ARB staff, the ORD Rule "represents the economic limit of what industry could bear." *See* TSD at 4. The ARB fails to explain the analysis underlying this conclusion or to particularize its consideration to the airline industry, which is uniquely competitive and sensitive to economic burdens and has marginal cost

flexibility. As a result, should the costs of the Rule even slightly exceed what the airline industry can bear, airlines would be forced to cease to provide service to certain airports based on the financial viability of those routes.

Altering air service to airports or specific routes would be contrary to the rationale for the ADA, which is to allow airlines to operate from any commercial airport and to serve any domestic route without regulatory approval or interference from state or local government in order to best serve the needs of the traveling public.[25] While Congress enacted the ADA "to end federal economic regulation of commercial aviation and to promote competition within the airline industry," at the same time, it made clear that it "did not intend to leave a vacuum to be filled by the Balkanizing forces of state and local regulation."[26] The ORD Rule would, effectively, regulate changes to airline decisions about flying to and from California airports by imposing an invasive and costly state GSE regulation that will result in substantial GSE functionality and reliability issues, and increase the costs and burdens of supporting aircraft with diesel GSE. The ORD Rule is therefore is subject to ADA preemption.

B. The ORD Rule Would Materially Affect Airline Prices and Is Therefore Preempted by the ADA.

It is undisputed that the ORD Rule will be extremely costly to implement, and ARB Staff concedes that these costs can and must be passed along in the form of increased prices. ARB specifically lists airlines among the industries expected to pass the regulation's costs to their

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[25] *See* 49 U.S.C. §§ 41713(b), 47101(a)-(b); *cf. Seattle Cmty. Council Fed'n v. FAA*, 961 F.2d 829, 835 (9th Cir. 1992) (FAA does not control market demand).

[26] *See American Airlines, Inc., v. Dep't of Transp.*, 202 F.3d 788, 805 (5th Cir. 2000) (quoting *New England Legal Found. v. Massachusetts Port Authority*, 883 F.2d 157, 173 (1st Cir. 1989)).

customers. *See* ARB TSD at 5. The ORD Rule, therefore, is subject to ADA preemption because of its direct effect on airline prices.

In addition, the impacts of the ORD Rule on airline routes and services as described above have financial implications that would affect the cost of flying to certain airports and be reflected in airline prices. For example, "on-time" departures are critical to making connections and ensuring financial viability of routes and schedules. Unreliable GSE fleets that fail to efficiently service aircraft and return them to the National Airspace System in a timely manner can result in significant costs to the airlines due to lost or re-routed passenger traffic. This is particularly true for California airports that service a significant number of the highest priced transcontinental or cross-country flights and international connections.

For these reasons, the Rule's fundamental requirements (even if specific provisions are revised in accordance with the changes proposed herein by ATA) are preempted by the ADA, and the Rule should be revised to exempt GSE.

X. The Rule is Expressly Preempted by the Federal Clean Air Act and Does not Qualify for EPA Authorization

A. The Rule Constitutes an Emission Standard Under CAA 209

As indicated in the Initial Statement of Reasons, the Rule, including its fleet average emission standards and BACT requirements, constitute "emission standards." ISOR at 31; *Engine Manufacturers Association v. South Coast Air Quality Management District*, 541 U.S. 246 (2004); 40 C.F.R. Part 89, App. A. Accordingly, the Rule is expressly preempted by CAA 209(e) absent a grant of authorization from EPA.

B. Under CAA Section 209(e), California Cannot "Adopt" An Emission Standard Until After It Obtains EPA Authorization

Under Section 209(e), California cannot "adopt" the ORD Rule until *after* it obtains EPA authorization. *See* 42 U.S.C. § 7543(e) (if authorization criteria are satisfied EPA shall, "*after*

notice and opportunity for public hearing, *authorize California to adopt* and enforce standards and other requirements relating to the control of emissions.") (emphasis added). Although EPA has sought to "interpret" the statute to preempt only enforcement of an emission standard, but not its adoption,[27] any such position is contrary to the plain language of the statute and is invalid. *See, e.g., K Mart Corp. v. Cartier, Inc.*, 486 U.S. 281, 291 (1988) (where the statutory language is unambiguous "that is the end of the matter, for the court, as well as the agency, must give effect to the unambiguously expressed intent of Congress.") (citations omitted).

C. The Rule Does Not Qualify for EPA Authorization

1. The Rule is Inconsistent With the "Useful Life" Requirements of CAA 202(a)

Among other prerequisites to obtaining EPA authorization under CAA 209(e), a California non-road emission standard must be consistent with Section 202(a). *See, e.g.*, 70 Fed. Reg. 2151, 2152 (January 12, 2005) ("EPA will review nonroad authorization requests under the same 'consistency' criteria that are applied to motor vehicle waiver requests," including consistency with Section 202(a)); *see also* 59 Fed. Reg. 36969, 36983 (July 20, 1994) ("EPA shall not grant an authorization . . . if California's nonroad standards are not consistent with . . . section 209(a), section 209(e), and section 209(b), as EPA has interpreted that subsection in the context of motor vehicle waivers"); 42 U.S.C. § 7521(a)(3)(A), CAA § 202(a) (providing, among other things, that emission standards "shall be applicable to vehicles and engines for their useful life" and must be achievable through the application of technology that EPA determines will be available based on the standards for the relevant model year, giving consideration to cost, energy, and safety factors). In addition to issues with the technical feasibility and lead-time

[27] *See* 40 CFR §§ 85.1603(d), 85.1604(a); 59 Fed. Reg. at 36981-82.

requirements of Section 202(a) (discussed in Part VI, above), [28] the Rule is inconsistent with the useful life requirements of CAA 202(a)(3)(A).

Under CAA 202(a)(3)(A), emission standards "shall be applicable to vehicles and engines for their useful life." 42 U.S.C. § 7521(a)(3)(A). The useful life of vehicles is established by EPA regulation. 42 U.S.C. § 7521(d); 40 CFR 89.104(a). For engines rated at or above 25 HP and under 50 HP, the regulations establish a minimum useful life of seven years (or 5,000 hours of use). 40 CFR § 89.104(a)(2). Engines rated at or above 50 HP are afforded a minimum useful life of ten years (or 8,000 hours of use). 40 CFR § 89.104(a)(3).[29]

In the ISOR, ARB appears to recognize that any emission standard must preserve the useful life of the equipment, up to ten years for vehicles over 50 HP. For example, in explaining why the Rule's regulation of construction equipment is not preempted under CAA 209(e)(2) (prohibiting emission standards for "new" construction equipment under 175 hp), ARB explains that: "Because the proposed regulation addresses in-use rather than new off-road engines, it is permitted by the federal Clean Air Act. For example, turnover of a vehicle is not required until a vehicle is older than 10 years." ISOR at 31.

Nevertheless, a number of provisions of the Rule are inconsistent with the useful life requirements established under the CAA. Most directly, the PM BACT provisions require retrofit of vehicles only five years old, which fails to afford the vehicles their full useful life. In

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[28] EPA has determined that "[s]tate standards are inconsistent with section 202(a) if [i] there is inadequate lead time [ii] to permit the development of the necessary technology [iii] giving appropriate consideration to the cost of compliance within that time period." 68 Fed. Reg. 65702, 65703 (Nov. 21, 2003); see also 42 U.S.C. § 7521(a)(3)(A) (emission standards must be achievable through the application of technology that EPA determines will be available based on the standards for the relevant model year, giving consideration to cost, energy, and safety factors).

[29] All engines rated under 25 HP, and constant speed engines under 50 HP with rated speeds of 3,000 rpm or greater, are afforded a minimum useful life of five years (or 3,000 hours of use). 40 CFR § 89.104(a)(1).

other words, notwithstanding that engines were compliant with Tier 1, 2, or 3 new engine emission standards when purchased, the PM BACT provisions would effectively and retroactively change those emission standards by requiring installation of additional emission controls before the end of the unit's seven- or ten-year useful life. *See also* 59 Fed. Reg. 31306, 31331 (June 17, 1994) (state retrofit requirements imposed sufficiently close in time to the engine's original sale, for example before the engine is rebuilt, "are effectively regulations on the design of new engines" and relate back to the original engine manufacturer's design) (citing *Allway Taxi Inc. v. City of New York*, 340 F. Supp. 1120 (S.D.N.Y.), *aff'd* 468 F.2d 624 (2d Cir.1972)). Similarly, the Rule's fleet average emission requirements also demand conversions or retirement of equipment before the end of its seven- or ten-year useful life. Proposed ORD Rule, Attachment A.

2. The Clean Air Act Does Not Contemplate California's Imposition of "Technology Forcing" Requirements on Engine Users

While the CAA contemplates and generally allows "technology forcing" requirements for new engines (provided that technical feasibility and other CAA requirements are satisfied), this component of the legislation was premised on the assumption that such requirements would fall on engine and vehicle manufacturers who would bear the nonconformance penalties (NCPs) if they did not apply the technical resources available to them to meet the challenge.[30] Moreover, the technology-forcing provisions of the CAA were justified from a practical and policy perspective by: (1) Congress' desire to force *manufacturers* to commit resources to research, development and innovation; and (2) the associated asymmetry of information regarding technical capabilities that exists between manufacturers and regulators. In other words,

[30] *See NRDC v. Thomas*, 805 F.2d 410, 416 (D.C. Cir. 1986).

manufacturers generally have more information than regulators about their technical capabilities and may understate the existing technology or their capabilities to regulators as a means to avoid regulatory burdens and the cost of research, development, and implementation. To that end, the CAA contemplates that EPA may require manufacturers to innovate and integrate emission control technologies into vehicles, and impose NCPs to "force" them to do so.

The in-use requirements of the ORD Rule, however, have no regulatory consequence for manufacturers and "force" them to do nothing. Instead it would impose on end-use consumers what ARB concedes is a hugely burdensome regulation, including a requirement to install retrofits that have never been successfully integrated into GSE, and force end users to rely on retrofit manufacturers over whom they have no effective leverage or control. In particular, contrary to the CAA's concern that manufacturers might understate their ability to innovate in order to avoid regulatory burdens upon themselves, the retrofit manufacturers in this instance have the incentive to overstate their ability, as the default consequence will not be an NCP, but a regulation that requires end users to buy retrofits from retrofit manufacturers. However, retrofit manufacturers have little or no incentive to innovate and develop practical solutions tailored to the limited GSE market (and particularly for engines still in use after 2020), that might enable GSE users to obtain and more readily integrate retrofits.

As discussed in detail above, end-users lack the expertise and resources to develop their own technical solutions, and manufacturers are not mandated by the ORD Rule to develop the technologies, redesigns, or equipment needed to implement the boutique engine retrofits necessary for each make and model of GSE. ARB's approach cannot be reconciled with the Clean Air Act. The ORD Rule would place an unreasonable burden on end-use consumers to

develop and install retrofits on existing equipment -- a burden that the Clean Air Act contemplates can and should only be placed on original equipment manufacturers.

CONCLUSION

While ATA strongly supports ARB's ultimate air quality goals, ATA cannot support the mechanism for achieving those ends set forth in the proposed ORD Rule. For the reasons set forth above, at a minimum ARB should rework the regulation to provide fixed fleet average emission goals for 2014 and 2020 that will allow planning and avoid double conversions, and provide a number of other changes to enhance flexibility and reduce compliance burdens, as described in these comments.

Notwithstanding ATA's position that ARB lacks the authority to regulate GSE in the manner contemplated in the proposed ORD Rule, ATA stands ready to continue to work with ARB staff to help ARB develop a regulation designed to achieve ARB's emission reduction goals using a more straightforward, common-sense approach, that avoids the needless uncertainty and burdens of the current proposed ORD Rule.

Appendix A

Appendix A -- Additional Proposed Modifications to ORD Rule

I. MODIFICATIONS AND CLARIFICATIONS TO THE PM BACT PROVISIONS

A. PM BACT Credit Should Not be Limited to Retrofit or Tier 4 Replacements, But Should Cover Any Appropriate Replacements and Other Comparable Actions

As currently drafted, the proposed Rule requires a fleet owner to demonstrate that it has converted 20 percent of its fleet each year either through VDECS retrofits or certain replacements with interim or final Tier 4. While ATA supports ARB staff's recommendation that Tier 4 replacements be credited, for similar reasons ARB should allow credit for other appropriate replacements, retiring vehicles, electrification, and other comparable actions. As discussed in Parts VI and X of ATA's comments it would be arbitrary and contrary to law to mandate that operators retain older units and retrofit them, while disallowing credit for replacements with new units that incorporate the latest Tier engines (including Tier 3 replacements of Tier 0-1 engines, particularly in the years before Tier 4 is commercially available in new GSE), retiring an older vehicle, or purchasing new electric vehicles with zero PM and NOx emissions. Moreover, ARB should clarify that vehicles replaced to satisfy the NOx BACT turnover requirement also count toward the PM BACT retrofit requirement.

In addition, comparable emission reductions would be achieved by allowing credit toward the PM BACT percentage where a fleet owner can demonstrate that it has retired, sold, transferred out-of-state, or designated a unit as low-use equipment. ATA's proposed change is reflected in the proposed regulatory language, under I.C., below.

B. ARB Should Reduce the Percentage Retrofit Requirement from 20 Percent to 10 Percent

The retrofit requirement should be changed from 20 percent back to 10 percent, as ARB originally proposed in its July 17, 2006, draft of the regulation. As discussed in Part VI.A. of ATA's comments, retrofits are not an "off-the-shelf" solution, and a 20% annual retrofit requirement is unworkable -- particularly for GSE. GSE is highly diverse and specialized, consisting of approximately 200-300 makes and models of vehicles, each of which will require a separate engineering effort to attempt to integrate a retrofit. A requirement to retrofit 20% of the GSE fleet each year is untenable, and is unsupported by the rulemaking record.

C. ARB Should Clarify that Units Exempt from the PM BACT Requirements Are Not Included in Calculating The Percentage Retrofit Rate

The regulatory language discussing the calculation of the Retrofit Rate should be clarified. The Rule should make clear that units exempt from the retrofit requirement are not to be counted as part of the fleet's "total maximum horsepower" in calculating the percentage that must be retrofit.

To reflect the changes set forth under I.A., I.B., and I.C., above, ATA suggests the following revisions to Section 2449(d)(2)(B):

> **(B) PM ~~Retrofit~~ Conversion Requirements for Fleets Not Meeting Diesel PM Target Rate**
>
> 1. PM Retrofit Rate - If a fleet does not meet the Diesel PM Target Rate in 2449(d)(1), it must demonstrate that it retrofit, **replaced with a new unit, retired, sold, transferred out-of-state, or designated as low-use, a total of ~~20~~ 10** percent of its total maximum power (not including specialty vehicles retrofitted and exempted from turnover in section 2449(d)(2)(A)4.b. **and units exempt from the BACT requirement under section 2449(d)(2)(B)4. or any other provision of this regulation). Replacements counted toward satisfaction of the NOx Turnover requirement may also be counted toward satisfaction of the PM Retrofit Rate.** Any

carryover ~~retrofit~~ **conversion** credit previously accrued may be applied toward the **10** ~~20~~ percent ~~retrofit~~ **conversion** required . . . .

D. ARB Should Revise the Regulatory Language to Make Clear That a Fleet Owner Need Not Retrofit 100% of Its Other Units Before Being Eligible for the Exemptions

The exemption provision, Section 2449(d)(2)(B)(4), is poorly worded and should be revised to make more clear that an operator need not already be in the process of retrofitting 100% of its units before any of the regulatory exemptions apply. Accordingly, ATA proposes the following change to Section 2449(d)(2)(B)(4):

> 4. **Exemptions** - The following **vehicles are exempt** ~~exemptions~~ from the retrofit requirement ~~apply, provided that retrofits have been or are being applied to all other engines in the owner's fleet not subject to these exemptions~~. A fleet is exempt from the retrofit requirement in 2449(d)(2)(B)1. if all its vehicles' engines meet one of the criteria below: . . . .

II. THE 1.18 FACTOR APPLIED TO THE DIESEL PM AND NOx INDEX UNDER THE HOURS IN FLEET AVERAGE OPTION IS ARBITRARY AND SHOULD BE ELIMINATED

As part of its May 23 proposed revisions to the Rule, ARB staff recommended that a factor of 1.18 be used in calculating fleet average emissions indexes for both diesel PM and NOx under the "hours in fleet" activity-weighted fleet average emissions option. *See* Proposed Section 2449(d)(1)(D). In effect, this would arbitrarily add 18% to the calculated fleet average emissions of any fleet that elects to comply under the "hours in fleet" option. There is no basis for such a factor, and no explanation or support appears in the rulemaking record. An accurate calculation of a fleet's emissions weighted by use does not require the use of any such arbitrary factor, which can only reduce the accuracy of the emissions calculation. Accordingly, the Board should not adopt staff's suggestion of adding the 1.18 factor.

III. THE COMPLIANCE EXTENSION PROVISIONS SHOULD BE MODIFIED AND CLARIFIED

A. ARB Should Expand the Compliance Extension for Delays in Availability of Tier 4 to Allow an Extension if GSE Experience Reliability or Performance Problems Due to VDECS Retrofits or New Tier 4 Engines

The provision affording Compliance Flexibility for Delays in Availability of Tier 4 Vehicles (*see* Proposed Section 2449(e)(9)) should also allow the Executive Officer to provide a compliance extension in the event of GSE performance, reliability, or safety problems caused by retrofits or new Tier 4 equipment. Simply because a retrofit or engine is nominally "available" does not mean that it will function in GSE without causing performance, reliability, or safety problems. GSE performance, reliability, or safety issues will impair the ability to move aircraft safely and efficiently through the gate and into the runway queue on schedule -- causing delay or compressed take offs and landings. These effects ripple throughout the country, impairing the safe and efficient operation of both the airport in question and the National Airspace System. While the proposed Rule includes a provision that allows ARB to find that a particular VDECS is not the highest level "available" if it would impair the safe operation of the vehicle, that provision does not allow a compliance extension. *See* Proposed Section 2449(e)(8). Nor does the current proposed Rule address performance or reliability problems related to VDECS, safety issues at airports caused by use of VDECS that go beyond the safe operation of the vehicle itself, any issues that arise after installation, or any issues caused by Tier 4 engines.

ATA proposes to modify Section 2449(e)(9) to allow for a compliance extension in the event of GSE performance, reliability, or safety problems associated with VDECS retrofits or new Tier 4 vehicles. Specifically, ATA proposes the following revisions to Section 2449(e)(9):

> (9) **Compliance Flexibility for Delays in Availability of Tier 4 Vehicles <u>or Performance, Reliability, or Safety Problems associated with VDECS or New Tier 4 GSE Vehicles</u>**: If the Executive Officer finds that there is a delay in availability of

vehicles with engines meeting the Tier 4 interim or final emission standards so that vehicles with Tier 4 interim or final engines to meet a fleet's needs are not available or not available in sufficient numbers or in a sufficient range of makes, models, and sizes**, or that VDECS or new interim or final Tier 4 GSE Vehicles experience performance, reliability, or safety issues,** then the Executive Officer may grant an extension to the fleet from the requirements in 2449(d)(1) and 2449(d)(2). If such a delay **or performance, reliability, or safety issues** affects a group of fleets, the Executive Officer may issue an extension to all fleets with certain characteristics. Any such delay must be documented based on verifiable information from the fleet regarding its vehicle needs and/or verifiable information from the equipment manufacturer, engine manufacturer, distributor, and/or dealer regarding the unavailability of appropriate vehicles with Tier 4 interim or final engines. **Any such performance, reliability, or safety issues must be supported by documentation or other reliable information from the fleet operator or other appropriate source**.

B. ARB Should Modify the Time to Address VDECS Failures from 90 Days to 180 Days

The proposed Rule provides only 90 days to address failure or damage of a VDECS, which is likely to be insufficient. *See* Proposed Section 2449(e)(1). Even if GSE fleet owners were able to solve the technical feasibility and other issues associated with attempting to retrofit GSE in the first instance, 90 days is an inadequate amount of time to order, receive, and re-install a retrofit (particularly on highly-specialized GSE, where chassis space may be limited, and significant re-engineering performed to allow initial installation). At a minimum, the time to address VDECS failures should be increased to 180 days.

Exhibit A

[Section 2449(d)(1)](E) **Fixed Target Compliance Option --**

As an alternative to the compliance dates and NOx and diesel PM targets in section 2449(d)(1)(A), owners of large and medium fleets may opt instead to comply with this regulation by calculating fleet average NOx and Diesel PM Fixed Targets for two compliance dates, March 1, 2014 and March 1, 2020, and developing and making available to ARB compliance plans for achieving those Fixed Targets, as set forth in this Section 2449(d)(1)(E).

1. Calculating 2014 and 2020 Fixed Targets

The 2014 Fixed Fleet Average Emission Target Rates ("2014 Fixed Targets") and 2020 Fixed Fleet Average Emission Target Rates ("2020 Fixed Targets") for NOx and diesel PM shall be determined for each fleet using the NOx and diesel PM Target Rate formulas under Section 2449(d)(1)(A) (and the other provisions of this regulation relevant to the calculation of Target Rates under Section 2449(d)(1)(A), including Sections 2449(d)(1)(C) and 2449(e)). However, notwithstanding the foregoing:

a. the 2014 Fixed Targets shall be calculated using the NOx and diesel PM targets for the 2014 compliance date as set forth in Tables 1 and 2 under Section 2449(d)(1)(A), applied to each engine that was part of the fleet as of January 1, 2010; and

b. the 2020 Fixed Targets shall be calculated using the NOx and diesel PM targets for the 2020 compliance date as set forth in Tables 1 and 2 under Section 2449(d)(1)(A), applied to each engine that was part of the fleet as of January 1, 2016.

2. Development and Maintenance of 2014 and 2020 Compliance Plans

By April 1, 2010, each fleet owner shall calculate its 2014 Fixed Targets and develop a 2014 Compliance Plan, setting forth the fleet's 2014 Fixed Targets and the changes the fleet expects to make to achieve the 2014 Fixed Targets.

By April 1, 2015, each fleet owner shall calculate its 2020 Fixed Targets and develop a 2020 Compliance Plan, setting forth the fleet's 2020 Fixed Targets and the changes the fleet expects to make to achieve the 2020 Fixed Targets.

The fleet owner may include in the 2014 and 2020 Compliance Plans any combination of changes to the fleet to achieve the 2014 and 2020 Fixed Targets (e.g., purchases of electric, replacements with gasoline-powered vehicles, VDECS, purchases of higher Tier diesel vehicles or engines, etc). The 2014 and 2020 Compliance Plans shall be prepared using forms to be provided by ARB, or in a substantially similar format. Compliance Plans may be updated periodically at the fleet owner's option to eliminate obsolete provisions, reflect availability of new technologies or new company operating and capital plans, or other changes. A copy of the 2014 and

2020 Compliance Plans shall be maintained at a location within the State of California, and shall be made available or submitted to ARB upon request.

3. Achievement of 2014 and 2020 Fixed Targets

In lieu of the Annual Reporting and Compliance Certification provisions of Section 2449(g)(1)(D)(2), the fleet owner shall report to ARB: (a) by April 1, 2014, its NOx Index and diesel PM Index as of March 1, 2014; and (b) by April 1, 2020, its NOx Index and diesel PM Index as of March 1, 2020. The NOx and diesel PM Indexes shall be calculated as provided under Section 2449(d)(1)(A) or (D) (Hours in Fleet Average Option), and the other provisions of this regulation relevant to the calculation of NOx and diesel PM Indexes under Section 2449(d)(1)(A) or (D) (including Sections 2449(d)(1)(C) and 2449(e)). Achievement of the 2014 and 2020 Fixed Targets shall constitute compliance with this regulation, notwithstanding whether the measures actually implemented differ from those identified in the 2014 and 2020 Compliance Plans.

If the fleet's NOx Index and/or diesel PM Index exceeds the 2014 Fixed Target for that pollutant by 10% or less, the fleet shall have until August 1, 2014 to address the shortfall and demonstrate achievement of the 2014 Fixed Target for that pollutant. Similarly, if the fleet's NOx Index and/or diesel PM Index exceeds the 2020 Fixed Target for that pollutant by 10% or less, the fleet shall have until August 1, 2020 to address the shortfall and demonstrate achievement of the 2020 Fixed Target for that pollutant.

Exhibit B

ATTACHMENT A

U.S. Department of Transportation
Federal Aviation Administration

800 Independence Ave., S.W.
Washington, D.C. 20591

Donald Zinger
Assistant Director for
Transportation and Air Quality
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

AUG 24 2000

Dear Mr. Zinger:

This letter clarifies the Federal Aviation Administration's (FAA) views concerning the rule adopted by the Texas Natural Resources Conservation Commission (TNRCC) on April 19, 2000, on emissions from airport ground service equipment. Enclosed please find an analysis of preemption issues related to that rule. The analysis concludes that any authority the State of Texas has to regulate airport ground service equipment is exceeded when that authority is exercised in a manner that would necessarily regulate aircraft operations. The Clean Air Act and Federal Aviation Act preempt state regulations that impinge upon aircraft operations and management of the navigable airspace. Based upon the data available, the FAA is unable to conclude that the regulation has left fleet operators a choice between suggested, reasonably available alternative means to comply with the TNRCC regulation and the freedom to select measures that do not restrict aircraft operations in the future.

The FAA has confidence that the ongoing discussions with the U.S. EPA with stakeholder groups to develop voluntary measures to reduce emissions from the aviation sector will be successful in providing reductions at airports throughout the country. In the meantime, FAA encourages U.S. EPA and TNRCC to continue to work cooperatively with appropriate airport officials and other affected parties to explore ways to reduce oxides of nitrogen and

other pollutants at airports that do not impinge upon aircraft operations. If you would like to discuss this matter further, please feel free to contact me at (202) 267-3577 or Daphne A. Fuller in the FAA Office of the Chief Counsel at (202) 267-3199.

Sincerely yours,

Paul Dykeman
Deputy Director
Office of Environment and Energy

Enclosure

cc: Ben Harrison, Office of U.S. EPA Regional Counsel

I. Factual Background

The TNRCC has adopted a rule that would require persons who own or operate ground service equipment (GSE) in the Dallas Ft. Worth (D/FW) ozone nonattainment area at airports having 100 or more air carrier operations per year, averaged over a three year period to "demonstrate a reduction of oxides of nitrogen (Nox) emissions" equal to or greater than the amount specified in the regulation. This includes the four largest commercial airports in the D/FW ozone nonattainment area, Dallas Ft. Worth, Meachem, Alliance, and Love Field airports. GSE is defined to include equipment that is used to service aircraft during passenger and/or cargo loading and unloading, maintenance, and other ground-based operations (excluding equipment used to service general aviation aircraft and military aircraft and equipment that is used during freezing weather such as ground heaters and deicing vehicles). Owners and operators of ground service equipment are required to:

(1) have a 100% electrified fleet by May 1, 2005 or three years after the airport becomes subject to the rule, whichever is later. If a GSE unit is not available for purchase or conversion to electric power then the lowest emitting equipment available may be used instead, subject to the approval of the executor director of TNRCC and U.S. EPA; or
(2) have a plan that provides for emission reduction measures to achieve the phased compliance required by (a), (b), or (d)(generally 20% by 2003, 50% by 2004, and 90% by 2005). The plan may include measures, which are applied to the GSE fleet itself, and measures which have been achieved elsewhere within the nonattaiment area as long as those measures would be creditable in accordance with the Commission's emission banking program.

By letter dated June 23, 2000, to the Chairman of the Texas Natural Resource Commission, the U.S. EPA Regional Administrator for Region 6 clarified earlier U.S. EPA comments concerning the proposed rule. The letter stated that, based upon U.S. EPA's analysis "the Texas regulation is not preempted by the Clean Air Act."

II. Discussion

A. Federal Preemption

Article VI of the United States Constitution provides that the laws of the United States "shall be the supreme law of the Land; . . . any Thing in the Constitution or Laws of any state to the Contrary notwithstanding." Cipollone v. Liggett Group, Inc., 505 U.S. 504, 516 (1992), quoting Art. VI, cl. 2. Since M'Culloch v. Maryland, 17 U.S. (4 Wheat.) 316, 427 (1819), it has been settled that state law that conflicts with Federal law is "without effect." Maryland v. Louisiana, 451 U.S. 725, 746 (1981). Consideration of issues arising under the Supremacy Clause start with the assumption that the historic police powers of the States are not to be superceded by Federal law unless that is the "clear and manifest purpose of Congress." Cipollone, 505 U.S. at 516, quoting Rice v. Santa Fe Elevator Corporation, 331 U.S. 218, 230, (1947). Accordingly, the purpose of Congress is the ultimate touchstone of preemption analysis. Cipollone, 505 U.S. at 516. Preemption is predicated on Congressional intent.

Federal law may supercede state law in several different ways. California Federal Saving and Loan Association v. Guerra, 479 U.S. 272, 280-281(1987). First, when acting within constitutional limits, Congress is empowered to preempt state law by so stating in express terms. Jones v. Rath Packing Company, 430 U.S. 519, 525 (1977). Second, Congressional intent to preempt state law in a particular area may be inferred from a " 'scheme of federal regulation . . . so pervasive as to make reasonable the inference that Congress left no room for the States to supplement it,' because the 'Act of Congress may touch a field in which the federal interest is so dominant that the federal system will be assumed to preclude enforcement of state laws on the same subject,' or because 'the object sought to be obtained by the federal law and the character of obligations imposed by it may reveal the same purpose.' " Pacific Gas and Electric v. State Energy Resources Conservation & Development Commission, 461 U.S. 190, 203-204 (1983), quoting Fidelity Federal Savings & Loan Association v. De la Cuesta, 458 U.S. 141, 153 (1982), Rice v. Santa Fe Elevator Corporation, 331 U.S. 218, 230 (1947). Third, in those areas where Congress has not completely displaced state regulation, Federal law may nonetheless preempt state law to the extent that it actually conflicts with Federal law. Such conflict occurs either because "compliance with both

federal law and state regulations is a physical impossibility," Florida Lime & Avocado Growers, Inc. v. Paul, 373 U.S. 132, 142-143 (1963), or because the state law stands "as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress." Hines v. Davidowitz, 312 U.S. 52, 67 (1941).

B. State Regulation Of Aircraft Operations and Use of the Navigable Airspace Is Preempted Under the Clean Air Act, the Federal Aviation Act and Airport Noise and Capacity Act

The authority of the State to regulate aircraft to reduce air pollution is sharply circumscribed under the Clean Air Act, as amended, 42 U.S.C. § 7401, et seq. Section 233 of the Clean Air Act expressly preempts state regulation of aircraft engine emissions. Section 233 provides that "no state or political subdivision thereof may adopt or attempt to enforce any standard respecting emission of any air pollution from any aircraft or engine thereof unless such standard is identical to a standard applicable to such aircraft under this part." 42 U.S.C. § 7573.[1]

Section 233 preempts any action by the State to enforce any standard for aircraft emissions unless the standard is identical to a standard applicable under the Clean Air Act. In other words, the State may only adopt a regulation addressing a particular aircraft emission if it is identical to a Federal standard. If there is no Federal standard, then State action is preempted and the State has no authority to apply a standard. In addition to the explicit prohibition under Section 233, the comprehensive scheme established by Sections 231 and 232 of the Clean Air Act for regulation of aircraft engine emissions by the U.S. Environmental Protection Agency ("EPA") and the U.S. Department of Transportation ("DOT") demonstrates Federal preemption of the field.[2] Under Section 231, the EPA, in consultation with the Secretary of Transportation (to assure safety), establishes national standards for aircraft engine pollutants. EPA must consult with DOT to assure that the standard takes effect after time allowing for the development and application of requisite technology. If DOT finds

[1] This section has been interpreted in California v. Dept of the Navy, 624 F. 2d 885 (9th Cir. 1980). In that case, the court ruled that the State could regulate U.S. Navy jet engine test cells. These test cells were not considered to fall within the preemption of Section 233 because the test cells were separate and apart from the aircraft engines themselves and could be regulated without necessarily affecting the operation of the aircraft.

[2] See, Washington v. General Motors Corp., 406 U.S. 109, 114 (1972)(Congress has "preempted the field so far as emissions from airplanes are concerned.")

that a proposed standard would create a hazard to aircraft safety, then the DOT may request review by the President who determines whether to disapprove the standard. The EPA has established standards for fuel venting and exhaust emissions for in-use gas turbine airplane engines manufactured after 1984. See 40 CFR Part 87. Under Section 232, the FAA is then responsible for enforcing those standards through the certification process. See 14 CFR Part 34. Based upon this comprehensive scheme there is clearly no room for States to establish or impose any aircraft emission standard not identical to those established by the EPA. When the scheme of regulation of aircraft engine emissions under the Clean Air Act is read together and harmonized with the other aviation statutes discussed below, it is clear that standards under Section 233 refer broadly not just to quantitative emission levels, but to emission reduction targets that necessarily have the direct or indirect effect of restricting aircraft operations.

The Federal Aviation Act, as recodified at 49 U.S.C. § 40103, the regulations implementing it in 14 C.F.R., the Airport Noise and Capacity Act (ANCA), as recodified at 49 U.S.C. § 47521, and the regulations implementing it in 14 C.F.R., preempt the States from regulating in the area of aircraft operations and airspace management. In a long series of cases,[3] the courts have ruled that neither the States nor their political subdivisions can regulate the manner in which aircraft are operated or the airspace in which the aircraft are operated. This Federal scheme of regulation is deemed to be pervasive, intensive, and exclusive and is vested solely in the FAA. The court in City of Burbank v. Lockheed Air Terminal[4], expressed concern about the need for uniformity of safe, efficient use of the navigable airspace. It reasoned that to permit curfews and other local regulation of flight operations would increase difficulties of scheduling flights to avoid congestion and concomitant decrease in safety would be compounded.

Congress recently reiterated in ANCA the federal policy against "uncoordinated and inconsistent restrictions on aviation that could impede the national air transportation system." 49 USC 47521(2). Where, as here,

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[3] Allegheny Airlines v. Village of Cedarhurst, 238 F.2d 812 (2d Cir. 1956); American Airlines, Inc. v. Town of Hempstead, 398 F.2d 369 (2d Cir. 1968), cert. denied, 393 U.S. 1017, 21 L.Ed.2d 561, 89 S.Ct. 620 (1969); American Airlines v. City of Audubon Park, 297 F.Supp. 207, aff'd, 407 F.2d 1306 (6th Cir. 1969), cert. denied, 396 U.S. 845, 24 L.Ed.2d 95, 90 S.Ct. 78 (1969); City of Burbank v. Lockheed Air Terminal, 411 U.S. 624 (1973).

[4] 411 U.S. 624 (1973).

Congress has articulated a policy, the most relevant preemption standard appears to be that stated in Rice v. Santa Fe Elevator Corp., 331 U.S. 218, 236 (1947): "The test [of applicability of state laws] is whether the matter on which the State asserts the right to act is in any way regulated by the Federal Act. If it is, the federal scheme prevails though it is a more modest, less pervasive regulatory plan than that of the State." See also, American Airlines v. Hempstead, 272 F. Supp 226, 230, aff'd, 398 F.2d 368, cited in City of Burbank v. Lockheed Air Terminal, 411 U.S. at 628 ("The aircraft and its noise are indivisible; the noise of the aircraft extends outward with the same inseparability as its wings and tail assembly; to exclude the aircraft noise from the Town is to exclude the aircraft...")

Finally, the Airline Deregulation Act of 1978 (ADA), 49 U.S.C. § 41713, prohibits state regulation of aircraft operations. Congress enacted the ADA to "... ensure that the States would not undo federal deregulation with regulation of their own." Morales v. Trans World Airlines, Inc., 504 U.S. 374, 378 (1992). (States' enforcement of attorney general guidelines on air travel industry advertising and marketing practices held to be preempted for having a connection with or reference to airline rates, routes, or services). Section 105 prohibits any State or political subdivision from enacting or enforcing "... any law, rule, regulation, standard, or other provision having the force and effect of law relating to price, routes, or services of any air carrier ...." 49 U.S.C. § 41713(b)(1). The Supreme Court has defined the "relating to" language broadly to mean "having a connection with or reference to airline rates, routes, or services." American Airlines v. Wolens, 513 U.S. 219, 223 (1995), citing Morales, 504 U.S. 374.

D. The TNRCC Regulation

Using its delegated authority under the Clean Air Act and its residual authority, the State of Texas may regulate sources of air pollution to achieve and maintain state and national air pollution standards. We do not here reach the issue of whether the Texas regulation is preempted under Section 209 of the Clean Air Act. We assume here, arguendo, without conceding, that the State of Texas may regulate airport ground service equipment in some manner. However, as discussed above, the State may not impose measures that necessarily regulate aircraft or aircraft operations and interfere with safety and efficiency in management of the navigable airspace. The central issue here is whether the TNRCC regulation has left owners and operators of GSE equipment the discretion to choose among suggested

procedures and the freedom to choose measures that do not necessarily regulate aircraft operations. See, Air Transport Association v. Crotti, 389 F. Supp. 58 (ND Cal. 1975)(Court upheld state airport noise statute that imposed noise abatement duties on airport proprietors where airport proprietors were left to choose among suggested procedures and were free to choose noise control measures that did not directly regulate aircraft operations). See also, California v. Navy, 431 F. Supp at 1286.

Based upon review of the preamble to the Texas regulations, FAA lacks sufficient data to make an informed judgment that compliance with the Texas regulation is possible without affecting growth in aircraft operations. GSE equipment is necessary to landings and takeoff of aircraft. Aircraft are dependent upon GSE for maintenance, fueling, housing, and in some cases, for movement on the ground as well as a myriad of other activities that are critical to the safety of aircraft and flight preparation. The availability of reliable GSE equipment is accordingly essential to safe and efficient use of the navigable airspace.

There is no clear evidence that the emission reduction requirements can be met without reducing total GSE equipment and, in turn, aircraft flights. Electrification will be difficult to implement without affecting operations given the recharging time, battery life, and the need for space for recharging equipment at the airport. Both the phased-in percentage emission reduction alternative and the electrification alternative potentially reduce the availability of GSE during peak periods of airport operation. Limitations on total numbers of GSE available at any given time would create difficulties in scheduling flights and increase congestion and delays.

It is equally unresolved whether the requirement for 100% electrification is feasible given the cost and availability of such equipment or reasonably attainable within the next five years given the infrastructure and electric grid requirements considering cost. TNRCC does not appear to have considered whether "opportunity charging" is practicable. There is little or no evidence that a reliable source of power exists that is adequate to provide power for all necessary GSE equipment and sufficient back-up systems in the event of power outages or disruptions. Although the regulation provides for substitution, the regulation does not articulate the standards that TNRCC and U.S. EPA will use to determine when electric GSE is not available such that the lowest emitting available technology may be substituted.

Based upon information available to date, the emission trading program does not obviate any necessity for fleet operators to limit growth to achieve compliance in the future. There has been no analysis to demonstrate that credits are reasonably expected to be available elsewhere in the nonattainment area. Nor is it clear that the Commission trading program leaves GSE owners and operators the freedom to purchase credits from other nonattainment areas in Texas, such as the Houston area, which has more emissions available for credit. Although we agree with the U.S. EPA letter that the TNRCC regulations may allow owners and operators of GSE to include measures in their plans besides the two enumerated, there is no analysis showing that other viable measures are available to fleet operators.

A case that involves similar facts is San Diego Unified Port District v. Gianturco.[5] In Gianturco, the State sought to require the Port District, as owner of Lindbergh Field, to extend the hours of an existing curfew. The State made extension of the curfew a condition of the variance needed for the permit to continue to operate the airport, which was not in compliance with California noise standards. The Ninth Circuit Court of Appeals held that the State's curfew was federally-preempted because it impinged on airspace management by directing when planes may fly in the San Diego area. The court explained that "Local governments may adopt local noise abatement plans that do not impinge upon aircraft operations." 651 F.2d at 1314. The court reasoned that the State could not use variances, licenses and permits to achieve indirectly what the Supreme Court had precluded in Burbank. Similarly, assuming arguendo that the State of Texas may adopt plans to regulate ground service equipment, such plans may not indirectly impinge upon aircraft operations. The State of Texas may not accomplish indirectly that which it is precluded from imposing directly.

The TNRCC regulations may also be determined to be preempted under § 105 of the Airline Deregulation Act of 1978 (ADA), 49 U.S.C. § 41713. To the extent that the TNRCC regulation would effectively require fleet operators to limit operations at airports in Texas, the TNRCC regulations very likely "relate" to air carrier routes in violation of § 41713(b)(1). Whether a fleet operator may take advantage of the flexibility inherent in the Federal deregulatory environment and increase service would appear to depend upon whether the TNRCC regulation indirectly restricts future growth in flights. The statute's proprietary exception, 49 U.S.C. §

[5] 457 F. Supp. 283 (SD Cal. 1978), aff'd. 651 F. 2d 1306, 1313-14 (9th Cir. 1981), cert. den. 455 US 1000 (1982).

41713(b)(3), does not apply here since the State of Texas is not an airport proprietor.

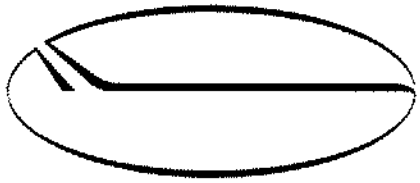
In support of the conclusion that state regulation of GSE equipment is not federally preempted, in its letter dated June 23, 2000, U.S. EPA posits that the prohibition on state emissions standards under section 233 has been interpreted similarly to the prohibition in section 209. As authority for this proposition, EPA cites State of California v. Navy, supra. However, that case is factually distinguishable. It involved state authority to regulate aircraft engine test cells. The court in that case concluded that state regulation of aircraft engine test cells was not preempted, but did not otherwise define the scope of state authority to regulate aircraft operations. Nor did the court uphold state authority to indirectly regulate aircraft operations through operational restrictions on ground service equipment. Indeed, the reasoning in the case, particularly the opinion of the U.S. District Court, which was cited favorably by the Ninth Circuit Court of Appeals, strongly supports the conclusion that state regulations are federally-preempted to the extent that they necessarily impinge upon aircraft operations. A broad reading of state authority to regulate aircraft operations directly, or indirectly through ground service equipment limitations, would be inconsistent with federal preemption of airspace management and aircraft operations. Compare, Motor Equipment Manufacturers Association v. EPA, 627 F.2d 1095 (DC Cir. 1979), cert. den., 446 U.S. 952 (1980); Engine Manufacturers Association v. US EPA, 88 F.3d 1075, 1094 (DC Cir. 1996)(Section 209 of the Clean Air Act only preempts state regulation to establish quantitative limits on emissions. States have authority to impose restrictions on use of motor vehicles and non-road engines and vehicles, such as limitations on downtown usage).

To interpret the term standards in Section 233 of the Clean Air Act so narrowly as to authorize states to regulate aircraft operations would set a precedent that could lead to a proliferation of restrictions at other airports to control local air pollution. Such a result would be contrary to the concepts of Federal preemption and the comprehensive and pervasive scheme of Federal oversight of the nation's air transportation system enacted by Congress.

This analysis is limited to clarifying the scope of state authority based upon Section 233 of the Clean Air Act, when read together with federal aviation laws. FAA otherwise expresses no opinion concerning the remainder of the

analysis in the U.S EPA letter dated June 23, 2000. The FAA reserves the right to revise this analysis should the FAA receive additional, relevant information not heretofore available regarding the TNRCC regulation and alternatives for compliance available under that regulation.

Exhibit C



Air Transport Association

June 17, 2005

By Electronic Mail & Facsimile

Clerk of the Board
California Air Resources Board
1001 I Street, 23rd Floor
Sacramento, California 95814
Fax: 916-322-3928
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Re: Notice of Public Hearing to Consider Adoption of Emission Standards and Test Procedures for New 2007 and Later Off-Road Large Spark-Ignition ("LSI") Engines and Fleet Requirements for Users of Off-Road LSI Engines

To the Clerk of the Board:

I am writing on behalf of the Air Transport Association of America, Inc. ("ATA")[1] to provide comments on the California Air Resources Board's ("ARB's") proposed "Emission Standards and Test Procedures for New 2007 and Later Off-Road Large Spark-Ignition (LSI) Engines and Fleet Requirements for Users of Off-Road LSI Engines" ("LSI Rule").[2] ATA regularly comments on federal and state regulatory developments that may affect the airlines. In that capacity, we submit these comments on the proposed rule.

SUMMARY OF COMMENTS

The LSI Rule's proposed regulation of airport ground support equipment ("GSE") is preempted by federal law, including the Federal Aviation Act, Airline Deregulation Act, and Clean Air Act. Among other things, these laws reflect Congress' judgment that GSE – which is critical to the safe and efficient functioning of the National Airspace System – can only be regulated in a consistent and uniform manner at the federal level. The LSI Rule, in the form

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[1] ATA is the principal trade and service organization of the U.S. scheduled airline industry. The members of the Association are: ABX Air, Inc. Alaska Airlines, Aloha Airlines, America West Airlines, American Airlines, Astar Air Cargo , ATA Airlines , Atlas Air, Continental Airlines, Delta Air Lines, Evergreen International Airlines, Federal Express Corp., Hawaiian Airlines, JetBlue Airways, Midwest Airlines, Northwest Airlines, Polar Air Cargo, Southwest Airlines, United Airlines, UPS, and US Airways; associate members are: Aerovias de México, Air Canada, Air Jamaica, and Mexicana de Aviación.

[2] *See* Notice of Public Hearing, Initial Statement of Reasons for Proposed Rulemaking ("Initial Statement of Reasons" or "ISOR"), and related materials at www.arb.ca.gov/regact/lore2005/lore2005.htm (posted May 6, 2005).

proposed on May 6, 2005 (the "May 6 proposal"), would impose profound and ill-considered mandates on GSE, requiring replacement of virtually all LSI GSE with unproven equipment within an unreasonably short time, resulting in prohibited impacts on aircraft operations and airline prices, routes, and services.

In recent discussions with ATA, ARB staff has acknowledged that the 7 to 8 year fleet turnover assumption on which the proposal is based is inaccurate as applied to GSE, and has agreed to revise the assumption and propose revised terms for GSE at the June 23, 2005 hearing. ATA is working with ARB staff to analyze potential approaches. It is unclear as of this filing whether the parties can identify a mutually acceptable approach, or whether any revisions that ARB may propose will fully address the infirmities of the rule as applied to GSE. Absent exclusion of all GSE from the scope of this and other off-road rules,[3] ATA and its members reserve the right to take appropriate action to have the rules declared invalid as preempted by federal law notwithstanding any changes in the rule ARB may propose.

Separate and apart from its invalidity under federal law, the proposed LSI Rule suffers from a number of fundamental flaws as applied to GSE, including:

- Incompatibility with ARB's Voluntary Agreement with the Carriers

The rule is wholly inconsistent with the letter and spirit of the South Coast Ground Service Equipment Memorandum of Understanding, dated November 27, 2002 ("MOU" or "South Coast MOU"). The MOU was negotiated and executed by ARB and ATA member airlines ("Participating Airlines") that operate at the five major commercial airports in the South Coast Air Quality Management District ("South Coast"). The MOU provides that, by December 31, 2010, the Participating Airlines will reduce NOx and hydrocarbons (HC) to 2.65 g/bhp-hr, and electrify specific percentages of GSE, among their aggregate fleet in the South Coast, including both LSI and diesel. The MOU is the most stringent off-road fleet conversion undertaking in the nation, and would require conversion of virtually all of the carriers' LSI-powered GSE. In reliance on the understandings reached with ARB under that agreement, the carriers have already made significant investments toward compliance, including purchases of electric equipment and supporting infrastructure, and purchases of currently best-available LSI engines with emission rates of 3.0 g/bhp-hr.

The LSI Rule would impose a different and inconsistent set of fleet average emission requirements, focused only on the LSI portion of the GSE fleet in isolation. The May 6 proposal would require the carriers almost immediately to re-convert their LSI GSE fleets to meet the 2013 target of 1.7 g/bhp-hr. The proposed exemption for GSE subject to an MOU does nothing to address this issue, because the exemption would expire in 2012. In addition, fleet average emissions under the LSI Rule are calculated without regard to actual equipment

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[3] The "Airborne Toxic Control Measure (ATCM) For Diesel Particulate Matter From Portable Engines Rated At 50 Horsepower and Greater," eff. March 11, 2005 ("PE ATCM"), and the off-road diesel ATCM, expected to be proposed later this year (http://www.arb.ca.gov/msprog/ordiesel/ordiesel.htm).

usage, whereas fleet average emissions under the MOU take usage into account -- subjecting the carriers to fundamentally different fleet management requirements. These inconsistencies are exacerbated by ARB's adopted and planned off-road diesel ATCMs, which would impose yet another set of requirements on diesel GSE, on different schedules, with no consideration of a complementary and cohesive fleet management strategy necessary to ensure the efficient operation of GSE.

The only way to structure the LSI Rule (and ARB's other off-road rules) that could be at least somewhat equitable to the carriers and consistent with the MOU would be to exempt all GSE subject to the MOU for its useful life, with provision for carriers to elect to include their South Coast fleets in their statewide averages. Even if ARB were to take these measures, the carriers would still be faced with the significant costs and inefficiencies of administering inconsistent compliance schemes -- *i.e.*, an aggregate MOU target for all GSE in the South Coast, and LSI- and diesel-specific regulatory targets in the rest of the state, all with different effective dates.

The carriers entered into the MOU based upon ARB's assurances that the Board would not also seek to regulate GSE, and the MOU provides that the airlines may terminate the agreement should ARB do so. The carriers' current predicament illustrates why that protection was vital. Both the PE ATCM and the LSI Rule have triggered the termination provision, and the airlines are now free to terminate the MOU. As ATA has advised ARB staff, the carriers are likely to find it necessary to exercise their right to terminate the MOU.

- Inaccurate Turnover Assumption

ARB's Initial Statement of Reasons and economic impact assessments rely on the inaccurate assumption that all *non-forklift* LSI equipment has a 7-8 year turnover cycle. However, as the parties discussed in the South Coast MOU negotiations, and as discussed in further detail below, the actual median useful life of LSI-powered GSE is significantly longer. ATA has recently provided ARB staff with updated calculations, based on a methodology agreed to with ARB in the MOU negotiations, showing that the carriers' current statewide LSI GSE fleet has a median useful life of approximately 19 years.

This inaccurate turnover assumption exacerbates the impact that the May 6 proposal would have on the carriers, and would render that proposed rule arbitrary and capricious as applied to GSE. The assumption leads to proposed fleet averages that would require the carriers to completely turn over their LSI fleets within only a few years, at a fraction (about 1/5) of their useful life. The May 6 proposal would impose three increasingly stringent fleet average emission standards over only a four-year period (3.0 g/bhp-hr by 2009, 2.3 by 2011 and 1.7 by 2013). To meet these requirements, the carriers would have to implement fleet conversions to meet the 2009 interim target, just one or two years before newer and much cleaner LSI engines are expected to reach the market. The May 6 proposal would then almost immediately require a second conversion using the newer equipment in order to achieve the 2011 and 2013 targets.

In recent discussions with ATA, ARB staff agreed to revise the May 6 proposal to reflect the longer median useful life of GSE, with provision for ATA to comment on the revisions. It is ATA's understanding that, at or after the June 23, 2005 Board hearing, ARB staff will propose less stringent fleet average emission targets for 2011 and 2013, but may maintain the 3.0 g/bhp-hr target for 2009.

However, as discussed below, given the actual useful life of GSE, the LSI Rule must not be structured in a way that will force rapid fleet turnovers using unproven equipment, and force the airlines to scrap good and serviceable GSE at a time when quarterly operating losses for the industry exceed one billion dollars. Merely adjusting the emission targets without adjusting the 2009, 2011, and 2013 compliance dates would not adequately take account of the actual useful life of GSE. Accordingly, if ARB does not exempt GSE from the rule, it should take account of GSE's actual useful life through an appropriate combination of adjustments to both the compliance deadlines and the fleet average emission targets for GSE.

In the ISOR, ARB used a turnover assumption of 7 to 8 years to establish the final effective date of 2013 in the May 6 proposal. As discussed below, applying the same methodology using GSE's 19-year median useful life produces a final effective date of 2024. If ARB is unwilling to accept this result of its methodology, ARB should work with ATA and the carriers to arrive at appropriate adjustments to both the compliance deadlines and emission level targets that accommodate the carriers' need to manage their GSE fleets in a way that ensures the reliability of their time-critical operations.

- Failure to Recognize the Time, Cost, Uncertainty, and Operational Disruptions Associated with GSE Fleet Conversions

The LSI Rule's assumption that virtually the entire LSI GSE fleet can be converted and reconverted within the rapid timeframes contemplated by the rule, even with less stringent fleet average emission targets, is inconsistent with the efficient operation of the National Airspace System, and unsupported by practical experience. In particular, the LSI Rule incorrectly assumes that new lower-emission LSI engines can be purchased from engine manufacturers and made functional in useable GSE within 2-3 years (or less) of the date that the engine ostensibly is expected to become available. *See, e.g.*, ISOR at 23 (assuming that 1.0 g/bhp-hr equipment could be purchased and placed in use by 2009, and 0.4 g/bhp-hr equipment by 2012).

In fact, as discussed in further detail below, GSE represents a small market of highly diverse and specialized types of equipment that must be integrated into a complementary scheme of interdependent aircraft support functions. Each piece of GSE is a necessary component of an overall operational strategy for efficiently supporting aircraft moving through the National Airspace System. The development of new, re-powered, or retrofitted GSE that can safely and effectively service aircraft within that unique scheme and maintain the unimpeded flow of air commerce requires significant additional design and development by airlines and GSE manufacturers, real-world testing, and personnel training. These additional

steps are necessary to integrate new engine or electric technology into GSE that meets operational requirements (or to demonstrate that the technology is not feasible for a particular type of GSE), and to integrate the GSE into the fleet. This effort requires a much longer period of time than provided by the LSI Rule's fleet average emission requirements, with greater cost, uncertainty, and operational disruptions.

These considerations were not taken into account by ARB staff in developing the LSI Rule, and further demonstrate the incompatibility of state-mandated regulations that force restructuring of existing functioning ground support fleets in contravention of the federal aviation laws. ARB should reevaluate its approach of seeking to impose rapid, profound, and ill-considered GSE mandates on the aviation industry using a rule designed primarily to address non-GSE forklifts. If ARB does not remove GSE from the scope of the rule, it should work with ATA to arrive at appropriate adjustments to the compliance deadlines and fleet average emission targets to allow adequate time for the required GSE fleet conversions, and to prevent the need for "double conversions." The rule should also include "safety valve" provisions that delay the deadlines in the event that viable, proven equipment or verified retrofits cannot be developed and are not available to meet the requirements.

Should ARB choose to proceed with applying the rule to GSE in spite of federal preemption, inconsistency with the MOU, and the other fundamental flaws set forth above, at a minimum ARB should change the content of the proposed rule in a number of additional respects. As discussed more fully below, it is quite possible that, because of the limited market for GSE, compliant retrofits and/or GSE with compliant engines, field-tested to the degree that carriers can rely upon it for their time-sensitive operations, will not be available at whatever effective dates may be established. ARB should therefore revise and broaden the "Limited Hours of Use" and "Specialty Equipment" exemptions to recognize the needs of GSE fleet management.

DISCUSSION

I. The LSI Rule is Preempted by Federal Law

Federal aviation law provides for uniform and exclusive federal authority over the National Airspace System, and preempts any state rule that affects either: (a) the movement and operation of aircraft; or (b) airline prices, routes, or services. This preemption extends to state regulation of airport infrastructure, facilities, and ground operations that support aircraft. As a consequence, as discussed further below, federal aviation law preempts the LSI Rule to the extent it applies to GSE. In addition, the federal Clean Air Act ("CAA") independently preempts enforcement of the LSI Rule unless and until ARB requests and receives authorization from the United States Environmental Protection Agency ("EPA") under Section 209(e) of the CAA.

A. The Federal Aviation Act and Associated Regulations Establish an Exclusive Federal System of Aviation Regulation, and Preempt ARB's Regulation of GSE

The Federal Aviation Act of 1958 ("Aviation Act") establishes "a *uniform and exclusive* system of federal regulation" of aircraft operations that preempts state and local regulation.[4] This pervasive federal regulatory scheme extends not only to aircraft in flight, but also to aircraft-related operations on the ground.[5] Through its extensive regulation of GSE, and requirement that airlines restructure and replace virtually their entire existing LSI GSE fleets with unproven equipment within an unreasonable and unworkable timeframe, the May 6 proposal would significantly affect the movement and operation of aircraft on the ground and in the air, and is therefore preempted by the Federal Aviation Act.

As the FAA has recognized, "[t]he availability of reliable GSE equipment is . . . essential to safe and efficient use of navigable airspace."[6] LSI GSE performs a myriad of complex and time-sensitive functions essential to the unimpeded flow of aircraft and to the safe and efficient use of the National Airspace System. These functions include aircraft maintenance, fueling, deicing, starting aircraft engines, moving aircraft to and from the gate, and loading, unloading, and sorting cargo and baggage. All of these activities affect the airlines' ability to move aircraft efficiently from the gate, proceed through the runway queue on time, and move into the National Airspace System on schedule. Like aircraft, GSE "do not wander about . . . like vagrant clouds. They move only by federal permission, subject to federal inspection, in the hands of federally certified personnel and under an intricate system of federal commands." *See City of Burbank v. Lockheed Air Terminal, Inc.*, 411 U.S. 624, 633-34 (1973) (quoting *Northwest Airlines, Inc. v. Minnesota*, 322 U.S. 292, 303 (1944) (Jackson, J., concurring)). Because GSE comprise such an important part of the airline industry's ground operations and flight preparation processes, their ability to function quickly, reliably, and with minimal interruption is necessary to maintaining a consistent national air travel network.

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[4] *Burbank v. Lockheed Air Terminal, Inc.*, 411 U.S. 624, 639 (1973) (emphasis added); *see also American Airlines v. Department of Transp.*, 202 F.3d 788, 801 (5th Cir. 2000) ("[f]ederal control [over aviation] is intensive and exclusive.") (quoting *Northwest Airlines, Inc. v. Minnesota*, 322 U.S. 292, 303 (1944)); 49 U.S.C. §§ 40101, 40103, 44701.

[5] *See, e.g.*, 49 U.S.C. § 40103(b)(2)(B)-(C); *City of Houston v. FAA*, 679 F.2d 1184, 1195 (5th Cir. 1982).

[6] Letter from Paul Dykeman, Deputy Director, Office of Environment and Energy, FAA, to Donald Zinger, Assistant Director for Transportation and Air Quality, U.S. EPA, Attachment at 6 (August 24, 2000) (Attachment A hereto); *see also id.* ("GSE equipment is necessary to landings and takeoff of aircraft. Aircraft are dependent upon GSE for maintenance, fueling, housing, and in some cases, for movement on the ground as well as a myriad of other activities that are critical to the safety of aircraft and flight preparation.")

Compliance with the LSI Rule (and ARB's off-road diesel ATCMs)[7] will adversely affect these ground operations, and the rule impermissibly encroaches on the primary jurisdiction that FAA maintains over aircraft operations. The LSI Rule would require carriers to develop new or repowered GSE, replace existing GSE or retrofit them with control devices, switch to alternative fuels, and/or implement electrification. To comply with the rule, each carrier would be required to turn over virtually its entire existing fleet of LSI GSE with unproven or experimental new or retrofitted equipment, under an initial 2009 compliance deadline less than four years away.

As discussed in further detail in Section IV, below, the industry's experience demonstrates that any effort to replace GSE with new technology is a difficult proposition, that often brings unanticipated reliability, performance, and fleet compatibility problems. For example, although the industry has already made substantial voluntary electrification efforts in the South Coast, including development and significant purchases of certain types of electric replacement units, in many applications no electric battery has yet been developed that can perform an entire duty cycle as required for operations. Thus, many of those electric units are still considered experimental, and must be supplemented on a regular basis with existing LSI equipment to avoid operational disruptions.

Even if ARB is correct in assuming that lower-emission off-road LSI GSE engines will be developed in the timeframes contemplated, ARB has ignored the difficult question of whether the market will support development and manufacture of GSE that integrate such engines and that meet the exacting specifications and performance requirements needed for airport operations. There is no basis in the rulemaking record to conclude that this can occur on the schedule assumed by ARB, or without substantial under-performance and reliability problems. Moreover, the Federal Aviation Act preempts the LSI Rule's attempt to pre-condition the purchase and use of GSE upon compliance with state certification requirements and other mandates that relate to the types of large spark-ignition GSE engines and other technologies used in aircraft-related ground operations.[8] Indeed, EPA has rejected SIP measures on similar grounds.[9]

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[7] To a certain extent, it is impossible to sever the impacts of the LSI Rule from the overall effects of the LSI Rule, the PE ATCM, and ARB's planned off-road diesel ATCM expected later this year. Compliance with the three rules would require GSE fleet operators to adopt comprehensive new fleet management strategies affecting both LSI and diesel GSE. If all three rules are adopted, the impacts on aviation described above will be even more problematic and have an adverse material impact on the free flow of air commerce.

[8] *See, e.g., Burbank-Glendale-Pasadena Airport Authority v. City of Los Angeles*, 979 F.2d 1338, 1341 (9th Cir. 1992) (zoning ordinance that required consideration of environmental impacts before runway construction amounted to an "interference with the movements and operations of aircraft" preempted by the Federal Aviation Act).

[9] *See, e.g.*, 66 Fed. Reg. at 57,189 (rejecting suggested SIP measure because states and localities have "no authority to control airline operations").

In addition to equipment changes, compliance with the LSI Rule would also require changes in the supporting airport and maintenance infrastructure and aircraft ground support operations to accommodate modified GSE. It would likely impose changes in the locations and usage patterns of GSE at California airports, in part to reduce the number of pieces of higher-emitting GSE equipment, limiting the numbers of GSE used at a given airport and their operations. These changes in equipment, airport infrastructure, GSE fleet management, and GSE usage will in turn affect the movement and operation of aircraft.

The exclusive federal nature of aviation regulation does not allow individual states to interfere with airline operations by mandating that airlines restructure their operational model and replace virtually all of their LSI GSE fleet with unproven equipment at that state's airports. Rather, it is incumbent upon states, when adopting regulatory requirements, to ensure that existing, highly specialized and integrated operations essential to the efficient movement of aircraft are not disrupted or forced into wholesale changes that have yet to be validated by significant field experience.

The LSI Rule's impermissible intrusion into operations will be further exacerbated by the fact that, having invested substantial resources and capital in a GSE fleet management strategy agreed to by ARB in the MOU, the LSI Rule (and ARB's other off-road rules) will force the airlines to abandon that strategy in mid-course and start anew with a second burdensome and problematic retooling of its GSE fleet that will have to be accomplished within time frames that are not practically feasible.

B. The Airline Deregulation Act Preempts ARB's Regulation of GSE

The Airline Deregulation Act ("ADA") provides that a state "may not enact or enforce a law, regulation, or other provision having the force and effect of law related to a price, route, or service of [an] air carrier . . . ."[10] As the Supreme Court has explained, this language "express[es] a broad preemptive purpose," and ADA preemption applies even if a state law is not expressly designed to affect airline prices, routes, and services, and even if the impact is only indirect.[11] Federal courts have held that ADA preemption extends to regulation of GSE and airport support vehicles because such equipment is "integral" to carriers' services.[12]

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[10] 49 U.S.C. § 41713(b)(1). This statutory provision was previously codified at 49 U.S.C. § 1305(a)(1). *See* 49 U.S.C. App. § 1305(a)(1). In 1994, Congress reenacted this provision at 49 U.S.C. § 41713(b)(1) as part of its reenactment of Title 49, and changed the operative language from "rates, routes or services" to "price, route, or service," but no substantive change was intended. *See American Airlines v. Wolens*, 513 U.S. 219, 223 n.1 (1995).

[11] *Morales v. Transworld Airlines*, 504 U.S. 374, 386 (1992) (holding that ADA preempted state law requirements that expressly referred to airlines and established "binding requirements" upon them).

[12] *See, e.g., Federal Express Corp. v. California Pub. Util. Comm'n*, 936 F.2d 1075, 1078 (9th Cir. 1991) (holding that California's generally applicable trucking regulation of air carrier's trucking operations was

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The LSI Rule (in conjunction with ARB's off-road diesel rules) would impermissibly restrict and limit the critical carrier services and operations performed by GSE, and compliance with the proposed rule would require changes in the airlines' decisions concerning their prices, routes, or services. As noted above, the LSI Rule would require changes in the types of GSE equipment used, electrification, use of alternative fuels, and/or retrofits, many of which will directly alter or limit the functionality and reliability of the equipment. The LSI Rule will also affect airport infrastructure planning, the composition of the GSE fleet, and allocation of GSE among California airports, all of which affect the ability to service aircraft at various California airports and to provide scheduled passenger and cargo service to meet the demands of the market without regulatory limitation or interference from the State.

Because GSE is an integral part of air transportation, ARB's regulation of GSE and the forced restructuring of the carriers' existing fleets through the LSI Rule and ARB's other off-road rules will affect airline decisions regarding prices, routes, and services. Among other things, this includes airline decisions concerning: the volume, frequency, and scheduling of transportation service that would otherwise be offered in order to meet the demands of the market; prices and the selection of markets where air transportation is offered; and the types of service offered (*e.g.*, passenger, cargo, mixed). Indeed, given the significant estimated costs to the airlines of compliance with the LSI Rule (approximately $85-115 million), the rule may ultimately have a direct and substantial effect on prices for air transportation service to and from California destinations. The added GSE costs at California airports due to ARB's regulations will also affect decisions concerning routes and service, for example, providing incentives for flights to be routed through non-California airports where servicing aircraft with unregulated GSE is less costly or more effective, or through certain California airports at the expense of others where the additional cost of GSE conversion renders the efforts to provide service operationally problematic or financially prohibitive. For these reasons, ARB's regulation of GSE would disrupt or displace the primary role of market demand in determining the transportation services that airlines offer, and subject transportation decisions to state regulation. As the federal judiciary has repeatedly recognized, this is precisely what Congress intended to prevent with the ADA.

For the reasons previously explained, ARB's regulation of GSE would also subject airlines who executed the MOU to unequal, arbitrary and undue burdens by requiring them to convert their fleets a second time within an unworkable time frame, notwithstanding the prior agreement by ARB that they would not be so burdened. This concern places particularly problematic burdens on air commerce in light of the difficult conditions currently faced by the industry. Regulatory mandates to restructure ground support fleets within unworkable timeframes become all the more problematic in an economic environment in which significant

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preempted because such trucking operations "are integral to . . . operations as an air carrier"); *Harlow v. ARINC Servs.*, 870 F. Supp. 295, 298-99 (D. Haw. 1994) (finding ADA preemption because GSE (jet bridge) forms an "integral part" of air carrier services).

costs of compliance are imposed arbitrarily on carriers operating at a loss or on historically narrow profit margins. To the extent that the additional costs of operation imposed by the LSI Rule force another air carrier into bankruptcy, there can be no doubt that would affect airline prices, routes, and services.

C. The Clean Air Act Independently Preempts the LSI Rule

Absent EPA authorization, Section 209(e) of the Clean Air Act ("CAA") preempts states from establishing or enforcing "standards and other requirements relating to the control of emissions from" off-road engines, which includes LSI engines in GSE.[13] CAA preemption extends to emission standards for both new and existing ("in use") off-road engines, including the types of fleet requirements, emission restrictions, and retrofit and engine conversion requirements proposed in the LSI Rule.[14] Accordingly, as ARB must recognize, the LSI Rule establishes emission standards within the meaning of CAA Section 209(e), and is preempted and unenforceable unless and until ARB requests and EPA grants authorization for the rule.[15]

However, the LSI Rule does not qualify for EPA authorization. Among other things, EPA is prohibited from granting authorization unless a California rule is "consistent with" Section 209, which in turn requires that the rule be consistent with the requirements of Section

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[13] 42 U.S.C. § 7543(e).

[14] *See, e.g., Engine Mfrs. Ass'n v. South Coast Air Quality Management District*, 541 U.S. 246 (2004) (holding that California fleet rules requiring purchase of certain levels of low and zero-emission on-road vehicles constituted "standards" under Section 209(a)); *Engine Mfrs. Ass'n v. United States Envtl. Protection Agency*, 88 F.3d 1075, 1087-93 (D.C. Cir. 1996) (preemption not limited to new vehicle standards); *American Auto. Mfrs. Ass'n v. Cahill*, 152 F.3d 196, 200 (2nd Cir. 1998) (state on-road rules constitute emission standards if they are "regulatory measures intended to lower the level of [vehicle] emissions); *see also* 40 C.F.R. § 85.1603(e)(2); 40 C.F.R. Part 89, App. A ("EPA believes that states are precluded from requiring retrofitting of used nonroad engines" absent EPA authorization); EPA, "Summary and Analysis of Comments: Control of Emissions from Unregulated Nonroad Engines," at III-61 (Sept. 2002) ("EPA agrees [with ATA] that certain regulations of vehicles in use, for example, retrofit requirements, would generally be considered emission standards . . . and thus covered by the preemption of Section 209(e)") (excerpts provided as Attachment B hereto).

[15] As both the Federal Aviation Administration ("FAA") and EPA have concluded, federal aviation law preempts emissions regulations independent of CAA preemption. FAA, which has exclusive jurisdiction in this area, has explained that "[t]he Federal regulatory regime for aviation is grounded in a number of statutory and regulatory provisions that generally preempt states from regulating the area of commercial aviation," and has concluded that a state measure is subject to federal aviation preemption, regardless of whether it may be otherwise permissible under the CAA. *See* Letter from Carl Burleson, FAA to Gerald Fontenot, EPA, Region IV, at 2 (Apr. 24, 2001) (Attachment C hereto). EPA has rejected commercial aviation-related measures from State Implementation Plans ("SIPs") based solely on preemption under federal aviation laws, and has concluded that states have "no authority to control airline operations." *See* 66 Fed. Reg. 57,160, 57,189 (2001). EPA has expressly admonished states and localities that they "should keep the [federal aviation law preemption] arguments of ATA in mind if they attempt" to enact aviation-related emissions measures. *See* EPA, "Summary and Analysis of Comments: Control of Emissions from Unregulated Nonroad Engines, at III-60 through III-62 (Sept. 2002) (excerpts provided as Attachment B hereto).

202(a). 42 U.S.C. § 7543(e)(2)(A)(iii).[16] Section 202(a) requires that an emission standard must: be technically feasible; provide adequate lead time to permit the development of necessary technology; and give appropriate consideration to the cost of compliance within that time period. 42 U.S.C. § 7521(a); *see also, e.g.*, 68 Fed. Reg. 65702, 65703 (Nov. 21, 2003).

Among other authorization criteria not satisfied by the LSI Rule, as discussed throughout these comments the LSI Rule does not satisfy the Section 202(a) requirements as applied to GSE. For example, compliance with the rapid, multiple GSE fleet conversions required by the LSI Rule is not technically feasible, and the rule fails to provide adequate lead time to permit the development and incorporation into GSE fleets of the lower-emission engines and other technology required to meet the emission targets. (*See* Section IV, below). The rule also fails to give appropriate consideration to the cost of compliance, particularly in light of the actual useful life of GSE, its highly specialized nature and limited market, and the unique requirements of the aviation industry. (*See* Sections III and IV, below).

Accordingly, the LSI Rule does not qualify for authorization, and its adoption and enforcement is, and will continue to be, preempted by the federal Clean Air Act. In addition, ARB failed to take into account the CAA Section 202(a) and 209(e) requirements in formulating the LSI Rule, and failed to address these requirements in the ISOR. Thus, the rulemaking is also arbitrary and capricious, and contrary to California law.[17]

II. The LSI Rule Is Incompatible with ARB's Voluntary Agreement with the Carriers

As noted above, the South Coast MOU is the most stringent and aggressive off-road fleet conversion obligation in the nation. Under this voluntary agreement, by the end of 2010 the Participating Airlines must achieve fleet average emissions of 2.65 g/bhp-hr of HC + NO_X for South Coast GSE, including both LSI and diesel equipment. In addition to extensive electrification, achievement of this emission target will require carriers to convert virtually all of their LSI fleets by 2010. In total, if the MOU remains in effect, it will require conversion of approximately 85-90% of the Participating Airlines' South Coast GSE fleets (both gas and diesel) by 2010, and cost the airlines over $100 million. The Participating Airlines have already expended a substantial portion of this amount to implement the emission reductions under the MOU, including purchase of new 3.0 g/bhp-hr LSI engines.

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[16] *See also, e.g.*, 68 Fed. Reg. 65702, 65703 (Nov. 21, 2003) ("because California's nonroad standards and enforcement procedures must be consistent with section 209(b)(1)(C), EPA will review nonroad authorization requests under the same 'consistency' criteria that are applied to motor vehicle waiver requests," including consistency with Section 202(a)).

[17] Moreover, due to the existing federal regulation addressing LSI engine emissions, ARB is required by California law to make additional findings in the ISOR, including that the LSI Rule is "authorized by law" and/or the cost of differing state regulations is justified. *See* Cal. Gov't Code § 11346.2(B)(5). No such findings are included in the ISOR.

When the Participating Airlines agreed to make these substantial early investments in lower-emitting GSE in the South Coast, they acted with the understanding that these investments would not be made irrelevant or duplicative by subsequent ARB regulation of GSE, particularly action that would require re-conversion of the same equipment. This understanding was reflected in the MOU's termination provision, which allows the Participating Airlines to terminate the MOU if ARB adopts any regulation that affects GSE. *See* South Coast MOU, Section V.H.3. ARB triggered this termination provision by adopting the PE ATCM earlier this year, and the LSI Rule would provide an additional and separate basis for termination of the MOU. Even if GSE subject to the MOU were fully exempted from the LSI Rule and ARB's off-road diesel ATCMs, ATA expects that its members will find it necessary to terminate the MOU based on ARB's regulation of non-MOU GSE, because of the cost and inefficiency of maintaining separate and inconsistent compliance schemes.

The requirements of the LSI Rule in particular are incompatible with the emission reduction scheme agreed to under the MOU, and it would not make sense for the airlines to seek to satisfy both. The May 6 proposal would impose three increasingly stringent fleet average emission standards over only a four-year period, with the final 2013 target of 1.7 g/bhp-hr becoming effective just two years after the MOU targets are reached. In addition, the LSI Rule would impose a GSE fleet management scheme fundamentally different from that agreed to by ARB under the MOU. For example, under the LSI Rule fleet average emissions are generally calculated without regard to actual equipment usage -- weighting each piece of equipment equally regardless of whether it is operated for thousands of hours per year, or just a few hundred (or under some circumstances even less). In addition to providing an inaccurate estimate of actual emissions, this methodology would require a fundamentally different fleet management strategy from the MOU, under which usage is taken into account in calculating fleet average emissions.

Under the proposed LSI Rule, GSE subject to the South Coast MOU would lose its exemption from the LSI Rule on January 1, 2012 -- only one year after the MOU's final compliance date of December 31, 2010. To then meet the May 6 proposal's 2013 fleet average emission requirement of 1.7 g/bhp-hr, the LSI Rule would require the airlines to implement significant additional conversions to their South Coast MOU GSE fleets by, first, purchasing 0.6 g/bhp-hr engines, which are not expected to become available for any application until the 2010 model year, and second, seeking to design and develop new or repowered GSE using those new engines. In other words, carriers who only recently achieved early reductions by converting virtually all of their South Coast LSI fleets, including substantial investments in development of GSE powered by the lowest emitting LSI engines available (primarily 3.0 g/bhp-hr), to meet the 2010 target of the MOU, would almost immediately be required to "double convert" a significant amount of LSI equipment with 0.6 g/bhp-hr engines to meet the 2013 target of the LSI Rule. The revised fleet averages for GSE that ARB is currently evaluating must eliminate the necessity for carriers to implement such double controls.

The proposed MOU exemption, extending one year past the expiration date of the MOU, does not alleviate any of the inequities that the Participating Airlines now face. Due to the

emission reductions achieved under the MOU, the South Coast GSE fleets of some or all of the Participating Airlines are likely to have lower average emissions than GSE in other parts of California through at least 2010. Accordingly, the exemption of GSE subject to an MOU could be read as requiring the exclusion of lower-emitting South Coast equipment from fleet operators' average emission calculations -- driving up the average emissions levels and requiring operators to make deeper reductions outside the South Coast than would otherwise be required.

For these reasons, and consistent with the understanding underlying the MOU, the LSI Rule should be structured to exempt all GSE subject to the MOU as of its expiration on December 31, 2010 for the useful life of that equipment. Moreover, carriers must have the option to include their South Coast fleets in their statewide fleet average calculations. The carriers should not be punished under later-adopted statewide rules for voluntarily entering into an agreement that achieved lower average emissions in the South Coast. Accordingly, in addition to extending the term of the exemption, as discussed herein, the MOU GSE exemption provision should be revised to provide that GSE subject to an MOU "shall be exempt from the requirements of this article except that each individual participating airline may elect in any given year to include such ground support equipment in its Fleet for purposes of determining compliance with the Fleet Average Emission Level requirements of this Article . . ." *See* Proposed 13 CCR Section 2775(b)(2). To provide otherwise would risk further punishing Participating Airlines for achieving substantial early voluntary emission reductions in the South Coast.

III. The LSI Rule is Premised on a Dramatic Underestimate of the Useful Life of GSE, Rendering the Rule Arbitrary and Capricious as Applied to GSE

As noted above, and as ARB staff acknowledged in recent discussions with ATA, the LSI Rule is premised on the critical incorrect assumption that all non-forklift LSI equipment has a 7-8 year turnover cycle. *See* ISOR at 22-24 (Fleet Average Compliance Scenarios). Based on data provided to ARB staff, the parties agreed in the South Coast MOU negotiations that the median useful life of GSE is considerably longer. The parties arrived at a methodology for calculating median useful life, taking the average age of the GSE fleet and applying the ratio of average age to median useful life derived from ARB's OFFROAD model, which we have calculated to be 1:1.75, to arrive at median useful life. ATA has updated these calculations using 2003 and 2004 inventories of the average age of GSE, and using the agreed methodology the median useful life of California LSI GSE is determined to be approximately 19 years.[18]

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[18] As discussed in further detail in the attached Memorandum from Ashworth Leininger Group ("ALG") dated June 3, 2005 (Attachment D hereto), ATA has data concerning the average age of GSE in California based on 2003 and 2004 GSE inventories, but does not have direct data concerning median useful life. The calculation of median useful life was performed by examining the relationship between age and median life for a static equipment population as set forth ARB's OFFROAD Model. These calculations show that the ratio of median useful life to average age in the OFFROAD Model is approximately 1.75 to 1. Thus, to calculate the estimated median useful life for GSE in California, ALG multiplied the average age of GSE (11.3 years) times the ratio 1.75 from ARB's OFFROAD Model. The resulting estimated median useful life for California GSE is calculated to be

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The May 6 proposal's reliance on an incorrect turnover assumption results in an unrealistically short compliance schedule, which would impose three increasingly stringent fleet average emission standards over four years. As ARB staff implicitly recognized by acknowledging to ATA that the turnover assumption in the ISOR is inaccurate for GSE, the proposed compliance schedule is inconsistent with the actual rate of GSE turnover. As explained above, the proposed compliance schedule would require "double conversions" of GSE, since compliance with the interim 2009 and 2011 standards[19] would require substantial investments in existing technology (primarily 3.0 g/bhp-hr LSI engines), while compliance with the 2013 standard would require re-conversion using 0.6 g/bhp-hr engines that ARB assumes will become available by Model Year 2010.

In addition, the flawed turnover assumptions led ARB to dramatically underestimate the cost of the May 6 proposal with respect to GSE. Based on ARB's 7-8 year turnover assumption, the fleet average compliance scenarios set forth in the Initial Statement of Reasons incorrectly conclude that ordinary GSE turnover would allow low cost compliance by operators through scheduled replacement of obsolete GSE with newer, lower-emitting equipment. *See* Initial Statement of Reasons at 22-24. Instead, given GSE's actual useful life of about 19 years, the May 6 proposal would require much more aggressive and expensive early replacement of serviceable GSE equipment. Moreover, the assumptions and scenarios ignore the carriers' operational need to retain older equipment, rather than simply replace it, as backup for the unproven new technology that they would be forced to develop to meet the proposed fleet averages. In addition, ARB has failed to account for the substantial costs associated with developing and using new GSE technology, as discussed below in Section IV.

For these reasons, ARB's cost effectiveness calculations fall far short of the actual costs of the LSI Rule with respect to GSE. The actual costs per ton of reduced emissions are vastly greater than stated in the Initial Statement of Reasons, and ARB's erroneous calculations render the proposed rule arbitrary and capricious as applied to GSE.[20]

These considerations further illustrate that the LSI Rule is fundamentally flawed with respect to regulation of GSE, and demonstrate that ARB should remove GSE from the scope of

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19.7 years, which has been rounded down to 19 years as a conservative estimate for discussion purposes in these comments. ATA and ARB staff discussed and mutually accepted this methodology in correspondence and supporting materials exchanged during the negotiations for the South Coast MOU. *See* Letter from M. Carlock and G. Honcoop, ARB to S. Belcher, ATA and E. Ashworth, ALG, dated August 13, 1999 (accepting methodology for estimating useful life); *see also* Memorandum from T. Paxman to S. Belcher dated July 14, 1999 (explaining methodology).

[19] Or compliance with the 2010 MOU standard for South Coast GSE, if the MOU remains in effect.

[20] ARB should reevaluate its assessments of the costs and compliance burdens associated with the May 6 proposal, and any revised proposal, in light of the actual median useful life of GSE.

the LSI Rule, as well as other rules, for separate consideration in light of the unique and highly specialized nature of GSE. If ARB is unwilling to remove GSE, in the alternative, it should at a minimum work with ATA to formulate extended deadlines and fleet average emission limits for GSE that recognize GSE's actual useful life and minimize "double conversions." Applying the same methodology that ARB used in the ISOR, and using the correct median useful life for GSE of 19 years, the final effective date would be 2024. Delayed compliance deadlines would allow meaningful strides toward compliance to be achieved through fleet turnover, and minimize the need for "double conversions" of GSE fleets (as well as allow the time necessary for development and integration of new technology into GSE fleets, as discussed below in Section IV).[21]

During recent discussions with ATA, ARB staff has indicated that it intends to propose revised fleet average emission targets for GSE as a means of accounting for GSE's actual useful life. However, in addition to revised fleet average emission targets, deferral of effective dates is necessary and appropriate to account for the 19-year useful life of GSE, and to allow adequate time for the fleet conversions required under the proposed rule while accommodating GSE fleet management needs. As noted in the ISOR, as of 2004, GSE accounted for only about 7% of the baseline HC+NOx emissions addressed in the May 6 proposal, and that figure includes significant GSE emission reductions in the South Coast already achieved by the Participating Airlines under the MOU. *See* ISOR at 8. Seeking extremely marginal additional emission reductions from GSE by imposing unrealistically short compliance deadlines based on inaccurate useful life assumptions is an unnecessary and ill-advised approach, especially given the unique importance of GSE to the National Airspace System. Accordingly, ARB should reconsider not only the fleet average emission targets, but also the compliance deadlines for GSE.

IV. The LSI Rule Fails to Recognize the Substantial Effort and Uncertainties Associated With Integration of New Technologies Into GSE Fleets, Rendering the Fleet Compliance Schedule, Cost Estimates, and Other Aspects of the Rulemaking Arbitrary and Capricious

ATA members have substantial real-world experience in GSE fleet conversion to achieve air emission reductions and other objectives, having undertaken certain voluntary GSE and on-road equipment conversions at many major airports and cities in the United States. Industry experience demonstrates that the LSI Rule's assumptions concerning the costs, delays, and operational difficulties associated with conversion or replacement of LSI GSE equipment are wholly unrealistic. The rapid integration of new technologies and accelerated multiple fleet

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[21] If ARB intends to propose retaining the final 2013 effective date and adjusting stringency levels to address the median useful life of GSE, another means of partially addressing the "double conversion" issue would be to provide additional flexibility for compliance with the proposed interim 2009 and 2011 fleet average emission targets. For example, the rule could exempt GSE from the interim requirements, or allow GSE operators to satisfy the interim 2009 and 2011 targets by submitting a satisfactory fleet management plan demonstrating how the 2013 fleet average emission target will be satisfied (such as through commitments to purchase and integrate cleaner LSI engines after they become available).

turnovers contemplated by the May 6 proposal are not feasible for GSE, and the rulemaking record provides no evidence to the contrary. The proposed rule fails to take account of the costs and operational problems that would result from the attempt, and would risk compromising the safety and efficiency of airline operations in California. As illustrated by the real-world examples provided on pages 20-23 below, integration of new technology into the GSE fleet requires successful completion of a series of challenging and time-consuming steps, with no up-front guarantee that the new technology will be feasible when applied to GSE in "real world" operational scenarios.[22] Any revised proposal must take account of these considerations regarding GSE fleet management.

First, the new or re-powered GSE or retrofit must be designed, developed, and manufactured, including the integration of any new technology or engine into the GSE equipment. Because the GSE market is small and highly specialized, contrary to the assumptions underlying the LSI Rule, the airlines cannot simply purchase a new LSI engine "off-the-shelf" from the original engine manufacturer ("OEM"), install it into a piece of GSE, and expect the equipment to perform the specialized functions required of it in the context of an airport operating environment. In addition, there are currently no available verified retrofits for GSE to meet the emission targets, and as ARB recognized in the context of agricultural equipment, it is significantly less feasible to retrofit older equipment such as GSE. ISOR at 24 ("as the equipment gets older, several factors conspire to decrease the feasibility of retrofits"). There are over 20 different categories of GSE, each of which must meet different performance requirements through various duty cycles.[23] Any new engine block, electric power system, or other technology must be carefully integrated into the equipment to operate properly relative to the GSE's unique vehicle and operational functions, controls (electronic, hydraulic and mechanical), braking systems, and other aspects of real world performance at the airport. This represents a substantial design task in which in-house airline engineering staff must be proactive partners with both OEMs and GSE manufacturing companies. ATA members have invested significantly in such programs in the past, and have engaged outside design and engineering expertise to work with manufacturers. In the industry's experience, it typically takes several years to design, develop, and manufacture prototype re-powered, electric, or new GSE equipment. Even with such an effort, there is no guarantee of success, and several years of development may result in a determination that the proposed new technology is not feasible for use with a particular piece of GSE.

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[22] In addition to rendering the May 6 proposal arbitrary and capricious, these considerations further demonstrate that the LSI Rule is preempted by the federal aviation laws, as discussed above in Section I. While airlines may voluntarily conclude that it is appropriate to undertake certain GSE fleet conversions even if the changes may affect aircraft operations, prices, routes, or services, the federal aviation laws prohibit states from imposing mandatory GSE requirements that have such effects.

[23] Even within a single category, some GSE may be designed and modified over the years to have unique vehicle and operational characteristics needed to service a particular type of aircraft within the conditions and infrastructure of a particular airport, or to perform in other respects unique to a particular air carrier's operations.

Second, even if a prototype can be produced that meets the required specifications, it typically takes one to five additional years of actual operating data in the field to determine whether a new technology will meet long term GSE requirements for aircraft support. Simply securing a prototype for use is insufficient to conclude that the new vehicle can be effectively integrated into the existing GSE fleet. Each piece of GSE must operate as one component in a carefully integrated and complementary ground support system, and must work together seamlessly to support the efficient movement of aircraft through the National Airspace System and maintain the unimpeded flow of air commerce. Actual in-service data are also necessary to confirm that the unit itself is safe and reliable, can perform the necessary tasks in the field safely and efficiently, can operate continuously throughout the required duty cycle, and that its components will adequately hold up throughout its useful life. Such experience is necessary to identify and correct the inevitable "bugs" in any new equipment technology. This is particularly important if a substantial portion of an existing fleet is to be converted within a compressed schedule as contemplated under the May 6 proposal (and, according to ARB staff, the impending revised proposal). When a performance, safety, reliability, or fleet compatibility problem is found, equipment may need to be modified or even substantially redesigned. The airlines must meet strict passenger and employee safety requirements,[24] tight schedules, and on-time reliability performance requirements that cannot be compromised, and which are not typically faced by operators of the non-GSE forklifts that the LSI Rule was primarily designed to regulate.

Finally, before new GSE technology can be fully integrated into the existing fleet, operations and maintenance staff must complete mandatory airport safety and operations training requirements. Such safety and training for new equipment typically requires 8-12 months to design, review, coordinate and complete. Until training is completed and the equipment's functionality and reliability is established, the carrier must retain and continue to use the old equipment to supplement and backup the newer equipment. In some instances the old equipment may continue to be in use for one or more hours daily.[25] In addition, contrary to the assumptions underlying the LSI Rule (*see, e.g.*, Initial Statement of Reasons at 36-37), new GSE technology typically will result in increased operating costs due to additional maintenance and unanticipated compatibility and functionality problems associated with the adoption of the new technology.

Overall, industry experience demonstrates that it takes more than the two or three years contemplated by the May 6 proposal, and often substantially longer, to bring a new technology

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[24] If airline safety officials determine that a new or redesigned piece of GSE fails to satisfy vigorous safety requirements, the GSE must be removed from airport operation. *See, e.g.*, 14 C.F.R. § 139.329 (requiring airport operators to establish and implement procedures for safe and orderly operation of GSE). ARB lacks the authority to require operation of a piece of GSE that is determined not to be safe for airport operations.

[25] Equipment operated one hour per day would not qualify for the low-use exemption under the proposed rule, which is limited to equipment used less than 251 hours per year. *See* proposed 13 CCR Section 2775.1(e).

into GSE use, at a substantial cost to the airline (or other GSE fleet operator) for the necessary development, testing, and training. As with any new technology, unanticipated performance and reliability issues often arise, and there is no guarantee that the technology will be feasible over the useful life of the unit. The compressed and inflexible fleet average emissions compliance schedule of the May 6 proposal fails to take these issues into account. ARB's assumption that the necessary LSI GSE equipment and fleet conversions can be accomplished within the timeframes provided is unsupported by the rulemaking record and is contrary to industry experience, which demonstrates that compliance with the deadlines as contemplated in the proposed rule is not feasible.

In contrast to the proposed LSI Rule, current federal and California regulations concerning LSI engines[26] accomplish emission reductions only by setting engine emission requirements for *new* engines. This distinguishes those rules as they allow airlines flexibility in assessing the feasibility of incorporating such new equipment and deciding when a particular new engine has proven sufficiently reliable to be integrated without disruption. Such prospective regulation of new engines also provides adequate time to pursue the development of GSE that incorporate such new engines in ways that are less disruptive to airport operations. The May 6 proposal, on the other hand, provides very little integration flexibility, and would require airlines to purchase and seek to implement new engines and other technology into their GSE fleets almost immediately as it becomes available.

A technology-forcing regulation such as the LSI Rule is not a workable option for GSE, in the same way that technology forcing is not appropriate generally in aviation contexts.[27] The consequences of a tractor towing an aircraft with hundreds of passengers on board failing to perform reliably as specified in the context of a busy, tightly-orchestrated and highly congested airport are significantly more severe than the consequences of an unreliable or underperforming forklift motor in a warehouse setting. Indeed, ARB implicitly recognized this fact in negotiating and committing to the South Coast MOU -- an effort that allowed ARB and the airlines to work together to develop a workable emission-reduction strategy appropriate for GSE. Whatever the reasons behind ARB staff's decision to abandon that approach and to seek to impose mandates on GSE, that decision should be reconsidered. Simply put, to require airlines to restructure virtually their entire existing LSI GSE fleets to unproven equipment within the timeframes of the LSI Rule is to ask the airlines to take unacceptable reliability and, potentially, safety risks.

None of these GSE conversion issues were adequately considered in the development of the May 6 proposal. As ARB assesses a revised proposal that addresses the median useful life of GSE, it should also reevaluate the rule in light of a more realistic assessment of the difficulties

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[26] *See* 67 F.R. 68241 (November 8, 2002); 13 C.C.R. §§ 2430-39.

[27] *See, e.g.*, 42 U.S.C. § 7571 (requiring that federal aircraft emission standards must be technically feasible, take effect only after such time as is necessary to develop and apply the requisite technology, and do not adversely affect safety).

posed by GSE conversion (including a reassessment of the costs and benefits of the regulation of GSE). These considerations further demonstrate the unsuitability of seeking to impose inflexible GSE mandates using a rule primarily developed to regulate non-GSE forklifts. Furthermore, they confirm that the LSI Rule is preempted by federal aviation laws intended to ensure the free flow of air commerce and the safe and efficient operation of the National Airspace System. As such, the LSI Rule can and should exempt GSE.

In the alternative, as discussed above, at a minimum ARB should not only adjust fleet average emission targets for GSE (as suggested by ARB staff during recent discussions with ATA) but also work with ATA to develop adjusted compliance deadlines for GSE that allow adequate time for development and integration of new technology into GSE fleets. As ARB recognized with respect to agricultural fleets that are likely to encounter feasibility problems in seeking to retrofit older equipment, it is appropriate to adjust both the emission targets and compliance deadlines to account for such issues. *See* ISOR at 24-25 ("staff believes it is appropriate to give the agriculture-related industries a relaxed standard and additional time").

In addition, the rule should include "safety valve" provisions that delay the compliance deadlines if proven lower-emission GSE incorporating new LSI engines, verified retrofits, or other technologies does not become commercially available within the timeframes contemplated by the LSI Rule. During the development process for the LSI Rule, ARB staff made clear that ARB would revisit the fleet average emission requirements if new technology does not result in lower-emitting LSI engines as expected.[28] Because the fleet average emission requirements of proposed Section 2775.1 are premised on the availability of verified retrofits, and the development and integration of new engines and other technologies into GSE, this concept should be made an express part of the LSI Rule through a safety-valve provision. As recognized by ARB, forklifts comprise a much greater share of the off-road LSI engine market than GSE. *See, e.g.*, Initial Statement of Reasons at 18. For this reason, and due to the greater specialization required of GSE equipment, engine manufacturers will likely develop lower-emission LSI engines for the forklift market well before they seek to develop such engines for GSE, and the limited GSE market may not be sufficient to support the incorporation of such engines and other technologies by GSE manufacturers.[29]

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[28] The anticipated engine technology is set forth in Part 1 of the Proposed Regulation Order, which would require that new LSI Engines over 1 liter meet a 3.0 g/bhp-hr standard by Model Year 2004, 2.0 g/bhp-hr by Model Year 2007, and 0.6 g/bhp-hr by Model Year 2010. See proposed 13 CCR Section 2433(b)(1).

[29] The proposed LSI Rule provides for a blanket one-year compliance extension of all of the fleet average emission requirements if there are no verified retrofit systems available by 2007, with an additional one-year extension if no verified retrofits are available by 2008. *See* proposed 13 CCR Section 2775.2(g)(1). However, as discussed above, vendors may decide to obtain verification first for the much larger forklift market, and only later seek to obtain verification for non-forklift LSI equipment such as GSE. Accordingly, the situation could easily arise that there are verified retrofits available for forklifts, but not non-forklift LSI engines. Thus, in the alternative to the general "safety valve" provision described above, at a minimum Section 2775.2(g)(1) should be clarified to provide that if there are no verifiable retrofits available for non-forklifts, the compliance extensions will still be triggered for Non-Forklift Fleets, even if verified forklift retrofits are available.

Industry Examples

Set forth below are a few examples of past industry efforts to incorporate new technology and develop lower-emission GSE to replace existing LSI and diesel equipment. As demonstrated by these examples, and by other voluntary GSE initiatives undertaken by the airlines (such as efforts undertaken pursuant to the South Coast MOU), ATA and its members actively support the continuing development of new lower-emission GSE technology. However, these examples serve to illustrate how the development of a piece of lower-emission GSE is a considerable undertaking with no guarantee of success, which requires substantially more time and effort than contemplated by the LSI Rule, and (if pursued as contemplated under the LSI Rule) carries real potential for operational disruptions.

- *Electrification of Cargo Loaders and Other GSE*

ATA members have been actively involved in developing electric powered cargo loaders. Cargo loaders are used to load and unload containerized cargo into and out of aircraft, to transport cargo through the airport, and in some instances to help sort incoming cargo for re-loading during the same duty cycle. The most common type of cargo loader has a lift capacity of about 15,000 pounds and is used to load containers into the lower lobe (deck) of both passenger and cargo aircraft. A second type of cargo loader is the main deck loader, with a 30,000-pound lift capacity, which is used to load 8 to 30 containers on the top side of cargo aircraft (where passengers would be seated on a passenger aircraft). Many loaders used by cargo carriers must be capable of continuous heavy operation for an extended duty cycle, in order to rapidly unload, transport, sort, and re-load cargo, and may travel a total of four to five miles per day. Cargo loaders are most often powered by diesel engines (although many others use LSI engines), but this example is provided to illustrate the technology implementation process, which is the same regardless of whether the original engine is diesel or LSI.

Over the past ten years, at least two of our members independently attempted to develop electric lower lobe and main deck loaders. Collectively the two programs cost these airlines over $10,000,000, and were undertaken in conjunction with two separate GSE manufacturers. In one example, the GSE manufacturer took one year to develop an initial prototype. The prototype unit was evaluated by the airline, and the airline provided the GSE manufacturer with design and engineering feedback to address operational and equipment issues. Over the next two years, the GSE manufacturer redesigned the prototype and provided the airline with 25 modified units. However, the design modifications were still not sufficient to satisfy the reliability and serviceability requirements for the equipment. Despite spending over $5,000,000, and devoting full-time operations and engineering staff (including personnel hired from the GSE manufacturer to work full-time for the airline), the program was terminated because the electric cargo loader still failed to meet minimum performance requirements. All 25 units were scrapped. The second effort, initiated by a different airline with a different GSE manufacturer, had a similar experience. The second GSE manufacturer produced 32 electric cargo loaders, of which 26 were ultimately converted to diesel fuel, and six are in limited use.

During these efforts a number of insurmountable technical problems arose. For example, meeting the high power demand for cargo loaders required installation of large battery packs that weighed over 2½ tons. Even with these large battery packs, the maximum useful life of the battery at full load was less than three hours. However, the cargo loaders were required for use over an entire eight-hour shift, without any opportunity to recharge within a shift. In addition, the speed of the rear loading platform was inadequate to meet performance requirements. The electric units also experienced a high rate of component and electric motor failure, as well as recurrent failures of the lifting mechanism.

Individual airlines have achieved some limited success in converting or designing certain other types of new electric GSE with less-demanding functions, such as certain types of baggage loaders and tractors, push-back aircraft tractors, and other specific types of GSE. These programs required the airlines to work with multiple GSE equipment suppliers (one carrier has evaluated eight separate electric-powered baggage tractors), individual component manufacturers (e.g., transmission, hydraulic, electrical), and in-house design teams to properly define operating specifications unique to the airline's fleet and operations, to design or re-design existing internal GSE systems, to build and test prototypes, and to perform in-field testing to identify and correct deficiencies. Such projects have typically required at least three to five years to complete for a given type of equipment (e.g., belt loaders, baggage and cargo tractors, etc.), with no up-front guarantee of success. Additionally, airlines have had to develop opportunity and equalization charging systems and refine existing battery technology to support electrification and to allow these electric GSE to operate safety over the course of a day.

Should a piece of GSE fail or underperform within the airport, aircraft may be damaged, schedules delayed, or airline workers or passengers injured. As illustrated by the airlines' attempt to electrify large cargo loaders, it is incorrect to assume that electrification is a viable option for all types of LSI GSE as a means of complying with the fleet average targets. Based on the airlines' extensive experience in the development of electric GSE, it is clear that there is no guarantee that electrification of a category of equipment will work in all applications. Even where electrification has worked, it has required a substantial design effort of three to five years or more for each type of equipment, the development of supporting technology, and the development and installation of supporting airport infrastructure. Each step of the process may reveal technical or airport operations problems, any of which could prove insurmountable. Even if the project can be completed, it may result in equipment that underperforms in actual use, or require airport infrastructure changes that cause unacceptable interference with operations.

- *Re-powering GSE with Off-The-Shelf LSI Engines*

At least three airlines attempted to re-power uncontrolled LSI GSE with electronically fuel injected Ford 2.5 or 4.2 liter off-road spark ignition engines. Both engines are able to provide over 90% reduction in NOx+HC emissions; the 4.2 liter V-6 has been certified by Ford Power Products to meet current LSI emission limits. Airlines worked cooperatively with both the engine manufacturer and GSE equipment manufacturers to re-power existing LSI GSE with

both of these engines. During a three- to four-year development process, a number of design issues were encountered and addressed to ensure reliable and safe operation of the re-powered equipment. For example:

- the standard electronic four-speed transmission that was offered with the engine was not suitable for GSE operations, where maximum speeds are limited to 15 miles per hour. Additionally, the reliability of the standard transmission had not been demonstrated in GSE service, which requires higher torque to move heavier loads. The new LSI engine had to be redesigned so that it could be matched with the standard C6 two-speed transmission used in GSE applications;

- the 4.2 liter engine was too large to fit within the engine bay of existing LSI-powered cargo tractors;

- both engines required extensive redesign and testing of the electronic control modules (ECMs) to ensure safe operation over the duty cycle of the engine. To optimize emission reductions, the new LSI engines rely heavily on the computer-controlled fuel management system, as well as on multiple sensors within the vehicle chassis, transfer case, and engine. The ECMs supplied with the engines did not work in the GSE duty cycle. It took several years for the OEM engineers and the airlines to diagnose and begin to redesign the control module, wiring harness, and associated equipment. For example, three separate oxygen sensor configurations were tested on the 4.2 liter engine before the proper design was determined;

- the electronic throttle assembly and pedal had to be redesigned to repair short circuiting and metal failure;

- problems with poor idling required the manufacturer to modify the induction system of the 4.2 liter engine; and

- problems with the electronic coil and wiring harness required redesign to ensure reliability in severe cold and hot/humid operating climates.

Based on these intensive design and testing programs, and the problems outlined above, at least one carrier determined that repowering their GSE with the 2.5 liter LSI engine was not workable. Even after the redesign process, the re-powered equipment could not operate seamlessly at low speed or idle, which posed significant safety problem for cargo handlers. Airline cargo handlers must manually connect the tractors to carts, which requires personnel to step between the tractor and the cart itself to attach the tow bar or connect carts to each other. This is perhaps the most dangerous task in managing cargo, and an unacceptable safety risk is posed should the engine jerk, hesitate or rapidly accelerate. Such unpredictable engine performance may result in a broken arm or leg, loss of a limb, or other serious injury. Despite the time, money, and effort exerted to optimize this re-power option, at least one carrier

determined that the continued safety risks posed by the re-powered units required the carrier to cancel the project.

This practical experience has led several airlines to conclude that re-powering LSI GSE is not technically practicable. This is especially true given the short time frames under which such re-powering would be required to satisfy the LSI Rule. A number of airlines have concluded that they would not attempt to re-power existing equipment to comply with fleet average emission requirements, but would seek to develop and purchase new equipment. It should be noted, however, that similar systems integration problems can be expected with the design and development of any new GSE using new engine technology. As with electrification, there have also been some successful re-powering efforts, but, again, such programs typically require a number of years, often cause unanticipated performance problems and other issues in the field, and carry no up-front guarantee of success. To say the least, commercial availability of a low emission engine provides no guarantee that it can be successfully integrated into GSE of a given category.

- *Application of On-Road Hybrid Technology*

Even for simpler on-road equipment (which does not share many of the particular challenges of GSE, such as highly specialized performance requirements), industry experience demonstrates that implementation of new lower-emission technologies takes longer than the 2-3 years assumed in the LSI Rule. For example, one of our members has invested heavily to develop a hybrid cargo delivery vehicle -- an on-road medium duty delivery truck that can run on both electric and an LSI or diesel engine, with 90% reductions in NOx+HC and PM emissions. Through a competitive design and construction process, the airline solicited 20 proposals, and selected two vendors to provide prototypes. After five years of continuous development work, there are now 18 pre-production hybrid trucks in revenue service, which are still going through demonstration and real-world testing.

V. Regardless of Whether the MOU Remains in Effect, The LSI Rule Is Flawed in Other Respects and Should be Modified

A. The LSI Rule's Definitions of GSE Should Be Clarified to Give Credit For Existing Electrification and Establish Incentives for Additional Electrification

In recent discussions, ARB has clarified that it intended to allow electric equipment used in lieu of LSI equipment to be included in calculating fleet average emission levels. The definitions of "airport ground service equipment" and "sweeper/scrubber" in the May 6 proposal do not expressly provide for inclusion of electric units that perform work that would otherwise be performed by LSI equipment. ATA supports ARB's intention to clarify the proposal to make clear that GSE will be treated the same as other LSI equipment for this purpose. To this end, ATA proposes modifying the definitions under proposed Section 2775 to read as follows:

> "Airport Ground Support Equipment" means any large spark-ignition engine-powered, or functionally equivalent electric or other zero-emission powered, equipment contained in the 24 categories of equipment included in section B.3 of Appendix 2 of the South Coast Ground Support Equipment Memorandum of Understanding, dated November 27, 2002.
>
> "Sweeper/scrubber" means a large spark-ignition engine-powered, or functionally equivalent electric or other zero-emission powered, piece of industrial floor cleaning equipment designed to brush and vacuum up small debris and litter and then scrub and squeegee the floor.

Moreover, since ARB favors electrification as a control strategy, it should establish regulatory incentives for operators to make early electrification conversions. ARB took this approach under the Portable Engine Airborne Toxic Control Measure adopted earlier this year, providing double credit toward fleet averages for Tier IV diesel equipment purchased in early years of the rule. In similar fashion, if effective dates earlier than 2024 are proposed, electric equipment replacing LSI equipment more than two years before the first interim effective date should be counted twice when counting fleet average emission levels for purposes of determining compliance with the LSI Rule's interim fleet average emission requirements. The real benefit to ARB and the airlines is that such credit will allow maximum penetration of both electric and 0.6 g/bhp-hr technology in the GSE fleet in California and reduce total compliance costs.

B. The LSI Rule's Definition of "Off-Road" Should be Modified to Give Credit for Off-Road Use of Equipment Designed for On-Road Use

ARB has also clarified in recent discussions that it intends to count low-emitting on-road equivalent ("ORE") LSI equipment used in airport operations toward fleet averages. ATA supports this revision to the proposal, and would be pleased to work with ARB staff to arrive at emission factors implementing this clarification.[30] Specifically, ATA proposes adding the following definition under proposed Section 2775:

> "Off road" equipment includes any equipment that lacks a license plate issued by the California Department of Motor Vehicles, specifically including unlicensed equipment designed or manufactured for on-road use.

C. The "Limited Hours of Use" Exemption Should be Modified to Apply to Equipment Operated Less Than 500 Hours Per Year, and to Clarify That Equipment Already Certified to a 3.0 g/bhp-hr Standard Need Not be Arbitrarily Retired or Replaced

As currently proposed, the "limited hours of use" exemption would exempt LSI equipment used less than 251 hours per year, subject to certain additional requirements. However, as explained above, carriers often have to retain older equipment to supplement electric GSE developed under the MOU, which cannot complete certain duty cycles. This retained equipment is often operated more than one hour per day, and would exceed the 251 hour limit. Given the specialized nature of GSE, and the relatively low number of units involved, the "limited hours of use" exemption should be modified to apply to equipment operated less than 500 hours per year. This would allow the airlines to continue to operate existing electric equipment, and consider expanding electrification, with limited use backup equipment that is used more than one hour per day.

In addition, as currently drafted the exemption also requires the operator to either: (i) retrofit or repower the equipment to a Level 2 or Level 3 verification level; or (ii) "retire the equipment or replace the equipment with a new or used piece of equipment" certified to a 3.0 g/bhp-hr standard. *See* Proposed 13 CCR Section 2775.1(e)(1)(D)(ii). However, prong (ii) of this test does not recognize the possibility that the existing equipment might already be capable of being certified to a 3.0 g/bhp-hr standard. For such equipment, there is no reason to require

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[30] There are special considerations in devising emission factors for ORE used in airport operations. On-road equipment emissions are generally determined based upon the estimated average speed at which the equipment is operated. For GSE, the maximum speed within an airport is limited to 15 miles per hour. As part of the GSE MOU negotiations, the ARB allowed the airlines to use an average speed of 13 miles per hour, which was then applied to the appropriate g/mile certified emission rate for the class of on-road equipment. These data, combined with the horsepower and odometer readings for the on-road equivalent, allowed the airlines to express emissions of on-road vehicles in g/bhp-hr.

that the operator "retire the equipment or replace the equipment," since the existing equipment already meets the 3.0 g/bhp-hr standard. Accordingly, proposed Section 2775.1(e)(1)(D)(ii) should be amended to read as follows:

> (ii) ~~retire the equipment or replace the equipment with a new or used piece of~~ the equipment is certified to a 3.0 g/bhp-hr hydrocarbon plus oxides of nitrogen emission standard.

D. The Proposed "Specialty Equipment Exemption" is Unworkable

The LSI Rule would exempt certain "Specialty Equipment" from fleet average emission requirements, provided the equipment is metered and recorded as being used less than 251 hours per year, with the approval of the Executive Officer. *See* proposed 13 CCR 2775.1(f). The proposed rule would apply this exemption only if the replacement cost of the equipment is 50% higher than a "typical" piece of equipment from that "category," or the retrofit cost is 100% higher than the "typical" retrofit cost. *See* proposed 13 CCR 2775.1(f)(1)(A). However, the proposed rule does not define what constitutes a typical piece of equipment from the same category.

While potentially useful in concept, we believe that any average cost scheme likely will be unworkable -- neither ARB nor the fleet operators will have sufficient data to determine or agree upon typical replacement costs for a given category, or support a finding that a given replacement or retrofit exceeds the 50% or 100% thresholds. However, we agree with ARB's recognition during rulemaking workshops that GSE is inherently specialty equipment, and that there is a real need to provide an exemption for such equipment. The specialty equipment provision should expressly recognize this fact and exempt all specialty GSE (*i.e.*, all GSE equipment that is not also available "off the shelf" for non-GSE applications) from the rule. In the alternative, working with ATA and its members, ARB should develop a practical, workable test or expressly list those categories of GSE deemed to constitute specialty equipment.

CONCLUSION

As with the Portable Engine Diesel ATCM, and the off-road diesel engine ATCM that ARB expects to propose later this year, the LSI Rule impermissibly regulates GSE and is preempted under federal law. Unless all GSE is exempted from the LSI Rule and the ATCMs, ATA and its members may be compelled to pursue legal recourse to have the rules declared invalid as preempted by federal law.

The LSI Rule (and the diesel ATCMs) are also inconsistent with the letter and spirit of the agreement between the Participating Airlines and ARB, embodied in the South Coast MOU. ARB, EPA, and the carriers spent several years and substantial resources negotiating the MOU, the implementation of which will require the Participating Airlines to spend over $100 million in a very difficult economic environment for the industry. ATA expects that the Participating Carriers will find it necessary to terminate the MOU to avoid the cost and inefficiency stemming from inconsistent compliance obligations.

Regardless of whether the MOU is terminated, the proposed LSI Rule is fundamentally flawed and based on incorrect assumptions concerning the useful life of GSE and the time, effort, and operational difficulties associated with the integration of lower-emission technology into GSE. These considerations further demonstrate why ARB should not seek to regulate GSE -- particularly not through the LSI Rule, which was primarily designed to regulate non-GSE forklifts and fails to recognize or afford weight to the unique nature of GSE and its vital role in the National Airspace System. In the alternative, in recognition of these considerations the fleet average emission targets should be revised, compliance deadlines should be substantially delayed as applied to GSE, and numerous other terms of the LSI Rule should be amended, as discussed herein.

Please call me at (202) 626-4151 if you have questions about these comments.

Sincerely,

Betty Leach Hawkins

Betty L. Hawkins
Assistant General Counsel

Attachments

Exhibit D

State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS

PUBLIC HEARING TO CONSIDER AMENDMENTS TO OFF-ROAD COMPRESSION-IGNITION ENGINE REGULATIONS: 2000 AND LATER EMISSION STANDARDS, COMPLIANCE REQUIREMENTS AND TEST PROCEDURES

Date of Release: December 10, 1999
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Agenda Item No.: 2000- -

This report has been reviewed by the staff of the California Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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EXECUTIVE SUMMARY

In November 1994, the Air Resources Board (ARB) approved a State Implementation Plan (SIP) for ozone. The SIP contains measures M9 and M10, which call for new state and national emission standards for new off-road diesel engines beginning in 2005. In August 1996, ARB, the United States Environmental Protection Agency (U.S. EPA), and the manufacturers of off-road diesel engines signed a Statement of Principles (SOP) which established a progressive set of emission standards and called for harmonization of ARB and U.S. EPA off-road diesel engine regulations (62 Federal Register 200, January 2, 1997). In October 1998, U.S. EPA adopted the SOP emission standards, along with changes to the existing federal averaging, banking, and trading program (ABT), for off-road diesel engines sold in the other 49 states. This report presents the staff's proposal to amend the existing California exhaust emission standards for off-road diesel engines to harmonize with the recently adopted federal requirements, as per the SOP.

The heart of the proposal is a set of emission standards for new off-road diesel-cycle engines, which would be implemented beginning in 2000. The standards would limit emissions of oxides of nitrogen (NOx), non-methane hydrocarbons (NMHC) and particulate matter (PM). Rather than a single standard for all engine sizes, the proposal consists of different standards partitioned by the power produced by the engine. All standards are identical to those adopted by the U.S. EPA.

In addition to the emissions standards, this proposal mirrors adopted federal requirements for durability, maintenance intervals, recordkeeping, warranty periods, certification test fuel, and engine useful life periods. As a package, these requirements would help assure the air quality benefits of the proposed standards are achieved, and help ensure that the engines remain cleaner longer. Harmonization of certification and compliance procedures will facilitate the implementation of future controls, by minimizing administrative issues and ensuring a focus on the technical issues of emissions reductions.

As noted above, SIP measure M9 calls for new emission standards beginning in 2005. This proposal does not reach the 2.5 grams per brake-horsepower-hour (3.4 grams per kilowatt-hour) NOx level called for in the SIP, but the proposed emissions standards are implemented earlier, allowing greater fleet turnover by the SIP deadlines. The proposal achieves virtually the same emissions benefit as the SIP measure would in 2010, and provides benefits beyond the SIP measure in earlier years. However, the updated emissions inventory (also scheduled to be presented to the Board in January 2000) indicates that further emissions reductions from these sources will be necessary.

The staff estimates that in 2010, the statewide benefits of the proposal would be approximately 91 tons per day of NOx and 19 tons per day of NMHC, based on the proposed off-road emissions inventory. The estimated California cost-effectiveness associated with adoption of the staff's proposal would be approximately $ 0.32 per pound of NOx plus NMHC reduced. This cost-effectiveness is at the low end (i.e., not as expensive) of the range of cost-effectiveness for other adopted motor vehicle control measure costs. The staff recommends that the Board adopt the staff proposal.

I. INTRODUCTION

Despite significant improvements in California's air quality over the last forty years, more must be done to improve air quality and protect the health of those living in California. California currently has six major areas that are not in attainment with the one-hour federal ambient ozone standard. These areas are: the South Coast Air Basin, the Sacramento Metropolitan area, the San Diego Air Basin, the San Joaquin Valley Air Basin, the Southeast Desert Air Basin, and Ventura County.

Mobile source controls are vital to attainment of air quality standards, as mobile sources account for about 60 percent of ozone precursors, statewide. The California Clean Air Act (CCAA), as codified in the Health and Safety Code Sections 43013 and 43018, granted ARB the authority to control off-road mobile sources. California's plan for attaining the federal ozone ambient air quality standard, the 1994 Ozone State Implementation Plan (SIP), calls for more stringent exhaust emission standards for new off-road diesel engines.

The term "diesel" can be ambiguous, as it can refer to any engine that uses the diesel (compression-ignition) combustion cycle, or it can refer to a subset of those engines that are fueled by diesel oil. Typically, compression-ignition engines do burn diesel oil, but other fuels are sometimes used. To prevent confusion, the staff will refer to compression-ignition engines throughout this report.

Compression-ignition engines are in widespread use in off-road applications. Examples include tractors, excavators, backhoes, portable generators, irrigation pumps, welders, air compressors, scrubber/sweepers, airport service vehicles, and a wide array of other agricultural, construction and general industrial equipment. Although compression-ignition engines are also used extensively to propel locomotives and commercial marine vessels, engines in those applications are not included in this proposal. Those sources are or will be regulated in separate rulemakings by the U.S. EPA.

In summer 1996, the ARB, the U.S. EPA, and off-road compression-ignition engine manufacturers agreed that the U.S. EPA should adopt nationwide emission standards for those engines. The agreement was codified as a Statement of Principles (SOP) and signed by representatives of ARB, U.S. EPA, and various engine manufacturers (62 Federal Register 200, January 2, 1997). The text of the SOP and the signatories thereto, are included in Appendix C. Harmonization of the emissions standards and other requirements across the nation will benefit the engine manufacturers by allowing them to spread the cost of engine development and certification over a larger fleet.

In October 1998, the U.S. EPA promulgated the SOP standards for nonroad[1] compression-ignition engines (63 Fed. Reg. 56,968 (Oct. 23, 1998)). With this report, ARB staff is proposing to adopt the Tier 2 and Tier 3 national standards, as per the SOP (California has had Tier 1 emission standards in effect since 1996 for engines not preempted from state control and U.S. EPA has had substantially similar Tier 1 requirements in place since the same time). In addition to the proposed emission standards, this proposal mirrors the adopted federal requirements for equipment manufacturer flexibilities, durability period, maintenance intervals, recordkeeping, warranty period, and engine useful life period. As a package, the requirements would protect the air quality benefits of the proposed emission standards and help ensure that the engines remain cleaner for a longer period.

This proposal is designed to harmonize as closely as possible with the federal program, while maintaining the emission reduction benefits of the California program. There are some areas where staff believes it is not necessary or practical to replicate the federal requirements – specifically, with regards to the enforcement provisions. Furthermore, staff believes that further emissions controls are both necessary and technologically feasible, even though it is not proposing emissions standards that are more stringent than the federal standards at this time.

Sections I and II of this report contain the introduction and background, respectively. Section III contains a discussion on the need for the proposed emission standards. Section IV is a summary of the proposed requirements, while Section V describes the areas where the proposal differs from the federal program. The technological feasibility of the proposed program is addressed in Section VI. Section VII discusses remaining issues that arose during development of the requirements, and how they are addressed in this proposal. Section VIII describes the regulatory alternatives that were considered, and Section IX discusses the economic impacts. The environmental impacts and cost-effectiveness of the proposal then follow in Section X., as well as the cost-effectiveness analysis pertaining to the proposed requirements. Finally, Section XI summarizes the staff's findings and recommendations, followed by a list of references in Section XII.

II. BACKGROUND

This Section provides an overview of the exhaust emissions from compression-ignition engines, the current regulations for off-road compression-ignition engines, and the SIP commitments for off-road compression-ignition engines.

[1] The federal statutes and regulations refer to these engines and vehicles as "nonroad" but in this staff report the term "off-road" is most often used. This is because "off-road" is the term used in California statutes and regulations, except when referring specifically to federal sources.

A. COMPRESSION-IGNITION ENGINE EMISSIONS

In compression-ignition engines, liquid fuel is injected in the form of a mist of fine droplets that mix in the combustion chamber with air that has been heated by compression. The power output is controlled by regulating the amount of fuel injected into the combustion chamber, unlike spark-ignition engines, which regulate the amount of fuel and air entering the engine. The heat of the compressed air evaporates the fuel, which mixes with oxygen in the air. At several sites where the fuel mixes with the oxygen, the fuel autoignites due to the prevailing high temperature and pressure.

The primary pollutants of concern from compression-ignition engines are oxides of nitrogen (NOx) and particulate matter (PM). The high temperatures and excess air cause the nitrogen in the air to combine with available oxygen to form NOx. Because of the presence of excess air (and thus oxygen), hydrocarbons (HC) evaporating in the combustion chamber tend to be mostly burned, and HC and carbon monoxide (CO) are not emitted at high levels. Evaporative emissions from diesel engines are insignificant due to the low evaporation rate of diesel fuel. However, PM emissions result from the fuel that has not completely combusted. Lubrication oil that enters the cylinder also contributes to PM emissions.

B. EMISSIONS INVENTORY

Since the adoption of the 1994 SIP, the emissions inventory for compression-ignition engines has been updated. The updated inventory will also be presented to the Board for adoption in January 2000. In general, the attrition rate for older engines and the uncontrolled emissions rates have been revised to reflect improved sources of that data. The emissions information in this report is based on the updated proposed emissions inventory, unless noted otherwise.

As shown in Figures 1 and 2 below, off-road engines in 1990 emitted roughly 21 percent of the mobile source HC+NOx emissions and 46 percent of the mobile source PM10 exhaust emissions. The percentages are expected to increase with time, reaching 33 percent and 59 percent, respectively, in 2010. This increase is due to growth of off-road engine usage and the increased control of other sources. Mobile sources account for 61 percent of total HC+NOx and 4 percent of total PM10 emissions (including natural sources) in 2010.

Figure 1

Statewide Mobile Source Emissions (Tons/Day: 1990)

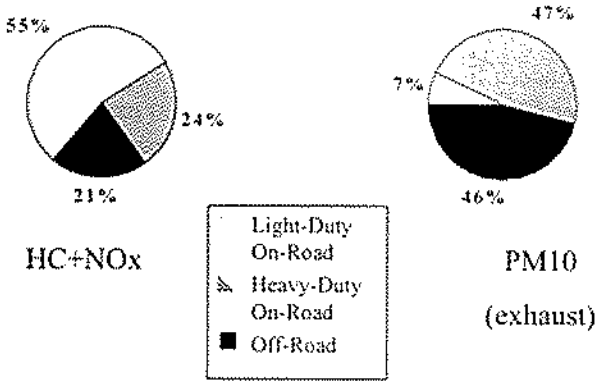
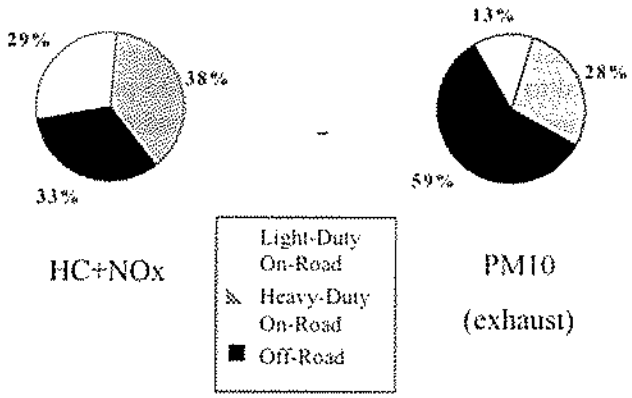


Figure 2

Statewide Mobile Source Emissions (Tons/Day: 2010)



C. CLEAN AIR ACT – PREEMPTION OF CONSTRUCTION AND FARM EQUIPMENT AND U.S. EPA AUTHORIZATION

The federal Clean Air Act Amendments of 1990 (CAA) preempt California's authority to control emissions from new farm and construction equipment under 175 horsepower (CAA Section 209(e)(1)(A)) and require California to receive authorization from U.S. EPA for controls over other off-road sources (CAA section 209 (e)(2)(A)). Because of the preemption, significant emissions from this engine category are beyond ARB's authority to regulate. Thus, since only the U.S. EPA has authority to establish emission standards for these preempt engines, the ARB staff has worked closely with U.S. EPA toward the development of a nationwide federal rule to cover all new engines in this category. This federal rule would then serve to regulate emissions from new farm and construction equipment in California in the absence of ARB's authority to do so. The federal rule and California's regulations, if adopted, will be harmonized as much as possible to minimize any confusion and expenses that could result from significantly different state and federal requirements for non-preempt engines in the near-term. Preemption, however, does not apply to existing farm and construction engines that are already in service. A list of those new engine applications considered to be subject to the federal preemption is included in Appendix B.

As with other off-road regulations, the ARB will request for these regulations U.S. EPA authorization under CAA section 209 (e) (2) (A), regarding adoption and enforcement of standards and other requirements relating to the control of emissions from the covered engines. Because the proposed regulations closely mirror the federal regulations for these engines but allow California to conduct its own enforcement programs, the California regulations will be, in the aggregate, at least as protective of public health and welfare as the applicable federal standards. In addition, the emission reductions from these proposed regulations are necessary to meet requirements under the State Implementation Plan.

D. EXISTING EMISSION STANDARDS

California is the only state that has the authority to establish off-road mobile source emission standards for new engines different from federal standards (CAA Section 209(e)(2)(A)), although Section 209(e)(2)(B) of the CAA does allow other states to adopt standards identical to California's (40 Code of Federal Regulations (CFR) 85.1601-1606). California standards must be, in the aggregate, at least as protective of public health and welfare are applicable federal standards. In 1992, the ARB approved regulations to control emissions from compression-ignition engines 175 horsepower and greater. The 175 horsepower boundary was chosen to avoid preemption issues in the implementation of the regulation, not for technical or cost-effectiveness reasons. Following the ARB's action, the U.S. EPA adopted a substantially similar program for engines 50 horsepower and greater.

Until the federal action in October 1998, which adopted the SOP emission standards, California's

emission standards for off-road compression-ignition engines 175 horsepower and greater and the federal emissions standards for those engines were aligned. However, the ARB also had adopted regulations for compression-ignition engines less than 25 horsepower, whereas the U.S. EPA had not. When the ARB last examined the small off-road engine regulations in March 1998, the emissions standards for the smaller compression-ignition engines were modified to reflect the SOP, and thus, they are already consistent with the October 1998 federal action.

Table 1, below, lists the current California emission standards for off-road compression-ignition engines. Table 2 lists the proposed future California standards that are the same as the recently-adopted U.S. EPA standards. All proposed future standards are noted in terms of grams per kilowatt-hour, rather than grams per brake horsepower-hour, to maintain consistency with the U.S. EPA[2].

Table 1
Current California Emission Standards
for Off-Road Compression-Ignition Engines
(grams per brake-horsepower hour)

Engine Power Category	Year	Emission Standard in g/bhp-hr				
		THC[a]	CO	NOx	PM	NMHC +NOx[b]
hp[c]<11	2000-2004		6.0		0.75	7.8
	2005		6.0		0.6	7.1
11≤hp[c]<25	2000-2004		4.9		0.6	5.6
	2005		4.9		0.6	5.6
175≤hp≤750	1996-2000	1.0	8.5	6.9	0.4	
	2001+	1.0	8.5	5.8	0.16	
hp>750	2000+	1.0	8.5	6.9	0.4	

Notes:

a. Total hydrocarbons.

b. NMHC + NOx = nonmethane hydrocarbons plus oxides of nitrogen.

c. The California standards for compression-ignition engines less than 25 horsepower already reflect the SOP standards. Previously, compression-ignition engines less than 25 horsepower had been regulated virtually identically to spark-ignition engines. In March of 1998, ARB took the first steps to align the smaller diesel engine requirements with the federal program. However, because the federal program had not yet been finalized, the regulations now require further modification.

[2] Kilowatts can be converted to horsepower by multiplying by 1.34. Thus, grams per kilowatt-hour can be divided by 1.34 to determine the equivalent grams per brake horsepower-hour.

Table 2
Proposed California Emission Standards
for Off-Road Compression-Ignition Engines[a]
(grams per kilowatt-hour)

Maximum Rated Power (kW)	Tier	Model Year	NOx	HC	NMHC+ NOx[e]	CO	PM
kW<8[b]	Tier 1	2000-2004	—	—	10.5	8.0	1.0
	Tier 2	2005 and later	—	—	7.5	8.0	0.80
8≤kW<19[b]	Tier 1	2000-2004	—	—	9.5	6.6	0.80
	Tier 2	2005 and later	—	—	7.5	6.6	0.80
19≤kW<37	Tier 1	2000-2003	—	—	9.5	5.5	0.80
	Tier 2	2004 and later	—	—	7.5	5.5	0.60
37≤kW<75	Tier 1	2000-2003	9.2	—	—	—	—
	Tier 2	2004-2007	—	—	7.5	5.0	0.40
	Tier 3	2008 and later	—	—	4.7	5.0	—
75≤kW<130	Tier 1	2000-2002	9.2	—	—	—	—
	Tier 2	2003-2006	—	—	6.6	5.0	0.30
	Tier 3	2007 and later	—	—	4.0	5.0	—
130≤kW<225	Tier 1[c]	1996-2002	9.2	1.3	—	11.4	0.54
	Tier 2[d]	2003-2005	—	—	6.6	3.5	0.20
	Tier 3	2006 and later	—	—	4.0	3.5	—
225≤kW<450	Tier 1[c]	1996-2000	9.2	1.3	—	11.4	0.54
	Tier 2[d]	2001-2005	—	—	6.4	3.5	0.20
	Tier 3	2006 and later	—	—	4.0	3.5	—
450≤kW≤560	Tier 1[c]	1996-2001	9.2	1.3	—	11.4	0.54
	Tier 2[d]	2002-2005	—	—	6.4	3.5	0.20
	Tier 3	2006 and later	—	—	4.0	3.5	—
kW>560	Tier 1[d]	2000-2005	9.2	1.3	—	11.4	0.54
	Tier 2	2006 and later	—	—	6.4	3.5	0.20

Notes:

a. The proposed California standards for engines less than 130 kilowatts (175 horsepower) apply only to non-preempted equipment.
b. The Tier 1 and Tier 2 emission standards for less than 25 horsepower compression-ignition engines were already adopted in the small off-road engine rulemaking.
c. The Tier 1 emission standards were already adopted for 1996 and later engines. This proposal will modify the existing standards for 2000 and later engines, replacing them with the noted Tier 2 and Tier 3 standards.
d. The Tier 1 emission standards were already adopted for 2000 and later engines.
e. NMHC + NOx = nonmethane hydrocarbons plus oxides of nitrogen

E. STATE IMPLEMENTATION PLAN (SIP)

In November 1994, the ARB approved the State Implementation Plan (SIP) for ozone, which outlines the measures to be taken to bring the state's air quality into attainment with the federal ambient air quality standards for ozone. During the SIP's development, it became clear that reducing emissions of NOx and reactive organic gases (ROG)[3] from off-road engines and equipment operating within the state is imperative for cleaning California's air. The SIP identified several categories of off-road equipment where significant emission reduction opportunities exist, including compression-ignition engines used in off-road equipment.

SIP measures M9 and M10 call for ARB and U.S. EPA to adopt a 2.5 g/bhp-hr (3.4 g/kW-hr) NOx emission standard for new off-road compression-ignition engines beginning in 2005. The current proposal has been developed in response to M9, as the recent U.S. EPA final rulemaking for nonroad compression-ignition engines was developed in response to SIP measure M10. How the specifics of the federal action and this proposal compare to M9 and M10, and the implications regarding the SIP and attaining ozone compliance are discussed in detail in Section X.

III. NEED FOR CONTROL

The emission standards that staff is proposing to the Board for adoption, represent a major step in reducing the human health and environmental impacts of ground-level ozone and PM. This section summarizes the air quality rationale for the proposed new standards.

A. OZONE

There is a large body of evidence showing that ozone (which is created by the photochemical reaction of NOx and HC) causes harmful respiratory effects including chest pain, coughing, and shortness of breath. Among those who may be affected severely are people with compromised respiratory systems and children. In addition, NOx itself can directly harm human health. Beyond their human health effects, other negative environmental effects are also associated with

[3] Reactive Organic Gas (ROG): A reactive chemical gas, composed of hydrocarbons, that may contribute to the formation of smog . Also sometimes referred to as Non-Methane Organic Compounds (NMOCs). The ARB is primarily concerned with reducing ROG because it includes only those hydrocarbons that have the potential for reacting to form ozone.

ozone and NOx. Ozone has been shown to injure plants and materials; NOx contributes to the secondary formation of PM (nitrates), acid deposition, and the overgrowth of algae in coastal estuaries.

As described above, the 1994 Ozone SIP is California's plan for reaching statewide attainment with the ozone ambient air quality standards. The SIP calls for new measures to cut ozone precursor emissions from mobile sources to half of what the emissions would be under existing regulations. The current proposal, developed in response to SIP measures M9 and M10, would reduce both HC and NOx emissions, as well as directly-emitted PM emissions. Details are noted in Section X.

B. DIESEL EXHAUST AND PARTICULATE MATTER

In August 1998, the Board approved the identification of particulate matter from diesel exhaust as a toxic air contaminant (TAC). Section 39655 of the California Health and Safety Code defines a TAC as "an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health." With the identification of diesel particulate as a TAC, the ARB is required by law to prepare a report, which assesses the need and appropriate degree of control of diesel particulate, in consultation with the local districts, affected industry, and the public. If reductions in exposure are needed, the ARB must design control measures that consider the issues and reduce emissions to the lowest level achievable through the application of best available control technology or a more effective control method. In the case of diesel particulate, there have been several regulations, including the emission standards for compression-ignition engines proposed in this document, that have resulted or will result in significant reductions in PM emissions from diesel engines.

Almost all of the particle mass in diesel exhaust is in the range of 10 microns or less in diameter (PM-10). PM-10, like ozone, has been linked to a range of serious respiratory health problems. These fine particles can be deposited deep in the lungs and result in health effects including premature death; increased hospital admissions and emergency room visits; increased respiratory symptoms and disease; decreased lung function, particularly in children and individuals with asthma; and alterations in lung tissue and in respiratory tract defense mechanisms. The proposal will require greater control of PM emissions from off-road compression-ignition engines than is currently required. Note that no PM emission standard is proposed at this time for Tier 3 engines. As part of a technology feasibility review in 2001, committed to as part of the SOP, the U.S. EPA and ARB will propose a Tier 3 PM standard. More stringent NMHC + NOx standards may also be considered at that time. More stringent standards will become more practicable, for instance, as the sulfur content of diesel fuel is reduced, since sulfur is one of the primary factors preventing aftertreatment devices such as catalysts and particulate traps from being applied to

these engines. The ARB will be involved in the feasibility review, which is described in further detail in Section IV. B.3. – Future Feasibility Review. The effects of fuel sulfur content are discussed in Section VI. B.6 – Aftertreatment.

In addition to the directly-emitted PM, secondary nitrate PM (consisting mostly of ammonium nitrate) accounts for a substantial fraction of the airborne particulate matter in some areas of California. For example, in the Los Angeles Basin, secondary nitrate PM levels represent about 25 percent of measured PM-10 (U.S. EPA 1997a). Fine secondary nitrate particles are produced in the atmosphere from the NOx emitted by compression-ignition engines and other sources. Because it is formed from a gaseous component that can spread more quickly than primary PM, secondary PM tends to be a regional, rather than a strictly local problem. Regional-scale NOx controls, like the proposed off-road compression-ignition engine emission standards, are very effective in reducing secondary PM over a significant area.

Although the proposal will reduce ozone precursor emissions as well as PM emissions, the proposal is not the last word regarding control of emissions from these engines. The use of compression-ignition equipment is widespread, covering virtually all populated areas in California. Combined with the serious health effects of the pollutants emitted from those engines, this ubiquity makes it clear that further control of emissions from compression-ignition engines will be required to safeguard the public health. The ARB staff has already begun evaluating additional controls as part of its response to the identification of diesel particulate as a toxic air contaminant, as mentioned above.

IV. SUMMARY OF PROPOSED REGULATIONS

The staff recommends that the Board amend sections 2111, 2112, 2137, 2139, 2140, 2141, 2400, 2401, 2403 (with referenced test procedures), 2420, 2421, and 2423-2427, Title 13, California Code of Regulations, as set forth in Attachments 1 and 2. The proposed regulatory language will essentially mirror the federal regulations adopted in 1998, except for some areas, which are discussed in detail in Section V. Although the California and federal programs for compression-ignition engines will be similar upon adoption of this proposal, ARB will retain its authority to further regulate off-road mobile sources in the future and its ability to enforce the regulations in California.

In August 1996, ARB signed the SOP that calls for harmonization of ARB and U.S. EPA regulations for off-road compression-ignition engines. This first step will result in lower-emission off-road vehicles and equipment being introduced nationwide. However, California's special air quality problems will continue to require ARB to seek additional

emission reductions in order to meet air quality goals. Future review of the feasibility of the proposed new emission standards will be needed. This review will likely result in a staff proposal for the adoption of appropriate Tier 3 standards for PM and Tier 4 standards for NOx and PM.

Today's proposal would require new off-road compression-ignition engines to meet stringent exhaust emission standards for NMHC + NOx, CO, and PM. Implementation of these standards would begin with the 2000 model year, but phased-in based on the engine power category. Staff proposes that the Board allow participation in the federal averaging, banking, and trading (ABT) program for compression-ignition engines and adopt new useful life extensions, maintenance intervals, emission warranty periods, rebuild provisions for compression-ignition engines, in-use compliance testing, and the Selective Enforcement Auditing program. Staff also proposes provisions for implementation flexibility for equipment and vehicle manufacturers and post-manufacture marinizers (i.e., those who produce marine engines by modifying engines purchased from other engine manufacturers). Staff further proposes optional reduced-emission standards and labeling requirements for compression-ignition engines ("Blue Sky Series"). The following sections discuss the major provisions of the staff proposal in further detail.

A. APPLICABILITY

At the core of this proposal are the emission standards that would apply to new off-road compression-ignition engines used in a variety of off-road vehicles and equipment. For this proposal, compression-ignition applies to those 2000 model year and later engines typically with operating characteristics significantly similar to the theoretical "diesel" combustion cycle, which includes any alternate-fueled compression-ignition engines. All the provisions in this proposal apply to off-road compression-ignition engines produced for sale in California, except for engines with a per cylinder displacement of less than 50 cubic centimeters, engines used to propel locomotives, underground mining equipment, marine vessels (propulsion engines rated at 37 kW and greater), aircraft, other preempt equipment, and off-road military tactical vehicles or equipment that have been exempted from regulations under the federal national security exemption.

Specific provisions of this proposal are:

- Emission standards for NMHC + NOx, CO, and PM would apply to new off-road compression-ignition engines beginning with the 2000 model year, being phased-in by power category.

- Emission standards aligned with the federal standards for small off-road compression-ignition engines less than 25 horsepower (19 kilowatts) have already been adopted. This proposal will not modify the existing standards. However, the small off-road engine regulations will be amended to exclude 2000 model year and later small off-road compression-ignition engines; procedural changes will be made to consolidate these

engines with all off-road compression-ignition engines subject to the provisions of this proposal.

- Amendment of closed crankcase requirements to begin with Tier 2 off-road compression-ignition engines, except turbocharged petroleum-fueled diesel cycle engines.

- Amendment to the smoke standards for new 2001 and later model-year heavy-duty off-road diesel cycle engines 175 to 750 horsepower (130 to 560 kilowatts) to align with federal smoke standards; adoption of smoke standards for all new off-road compression-ignition engines with the exception of single-cylinder, propulsion marine diesel, and constant-speed engines.

- New voluntary reduced-emission standards for compression-ignition engines ("Blue Sky Series") would be available beginning in 2000 through 2004. This proposal is the same as the federal program.

- New labeling requirements would apply to engines certified to optional standards and constant-speed engines; amendments to labeling requirements would apply to heavy-duty off-road diesel cycle engines and small off-road compression-ignition engines.

- Amendment to the test procedures to incorporate federal changes. Provisions requiring federal fuel to be used for off-road compression-ignition engine certification would apply beginning in 2000.

- New or revised useful life extensions, deterioration factors, maintenance intervals, emission warranties, in-use compliance testing/recall, and rebuild/replacement provisions would apply to new off-road compression-ignition engines.

- Incorporation of the federal Selective Enforcement Auditing program for new engine compliance, and incorporation of compression-ignition engines into the existing California in-use compliance and recall program beginning in 2000, in place of the existing new engine compliance and quality audit testing programs.

- Participation in the federal Averaging, Banking, and Trading (ABT) program (40 CFR 89.111) would be allowed for California-certified off-road compression-ignition engines upon adoption of this regulation.

- Implementation flexibilities for vehicle/equipment manufacturers and post-manufacture marinizers.

B. EMISSION STANDARDS

1. Proposed Mandatory Emission Standards

Staff proposes that the Board adopt NMHC + NOx, CO and PM emission standards for all off-road compression-ignition engines as outlined in Section IV. A. – Applicability. These standards would apply to model year 2000 and later, with the standards being phased-in by horsepower category. Current emission standards (Tier 1) for heavy-duty off-road diesel cycle engines 175 to 750 horsepower (130 to 560 kilowatts) would continue to apply until more stringent emission standards apply (Tier 2 and 3). Currently adopted emission standards for small off-road compression-ignition engines are the same as the recently promulgated federal regulations. Therefore, there will be no change to the current emission standards for this category. Tables 1 and 2 list the current California emission standards for off-road diesel engines and the proposed emission standards, respectively.

Staff proposes to amend the regulations to require closed crankcase requirements for Tier 2 and later off-road compression-ignition engines, except for petroleum-fueled engines using turbochargers, pumps, blowers, or superchargers for air induction. This provision will align closed crankcase control requirements with federal requirements.

Staff proposes to amend the smoke standards for new 2001 and later model-year heavy-duty off-road diesel cycle engines 175 to 750 horsepower (130 to 560 kilowatts) to align with federal smoke standards. With the adoption of this regulation smoke standards would apply to all new off-road compression-ignition engines subject to exhaust emission standards with the exception of single-cylinder engines, propulsion marine diesel engines, and constant-speed engines.

By 2020, the proposed standards reduce emissions for NOx and NMHC by more than 50 percent and PM by more than 40 percent, nationwide. Reductions in NOx will also reduce secondary nitrate PM. The resulting emission reductions will translate into needed improvements in air quality in California and assist in attaining applicable ambient air quality standards.

2. Proposed Voluntary Reduced-Emission Standards

To continue support of incentive programs that encourage the use of engines that go beyond mandatory emission standards, the staff proposes that the Board adopt the proposed voluntary reduced-emission standards through 2004, as shown in the following table.

Table 3 - Voluntary Emission Standards Through 2004
(grams per kilowatt-hour)

Maximum Rated Power (kW)	NMHC + NOx	PM
kW<8	4.5	0.5
8≤kW<19	4.5	0.5
19≤kW<37	4.5	0.36
37≤kW<75	4.7	0.24
75≤kW<130	4.0	0.17
130≤kW≤560	4.0	0.12
kW>560	3.8	0.12

Manufacturers may opt to certify engines to these voluntary standards earning the designation of a "Blue Sky Series" low-emitting engine. Tier 3 emission levels, where applicable, were chosen as the best level for defining Blue Sky Series engines. This represents a reduction of approximately 40 percent beyond the Tier 2 NMHC + NOx levels. For PM emissions and for engines with no Tier 3 standards, a calculated level corresponding to a 40 percent reduction beyond Tier 2 levels will be used to qualify as a Blue Sky Series engine. Engines certified to these voluntary standards would be eligible for marketable credit programs. The manufacturer must declare at the time of certification whether it is certifying an engine family to an optional reduced-emission standard (that could subsequently be used in a marketable credits program).

3. Future Feasibility Review

Staff also proposes that the Board allow for review of the new emission standards. Staff believes the proposed emission standards are technologically feasible, and achievable. However, as part of the SOP, U.S. EPA and ARB agreed to a future review of the proposed standards. U.S. EPA will conduct its review in 2001, and ARB staff will participate. ARB may elect to conduct its own review to reassess the appropriateness of the standards specific to California, and the technical and economic feasibility of the standards, based on information available in 2001.

With the recent identification of diesel PM as a TAC, the importance of further reducing the public's exposure to PM emissions has become more paramount. As previously indicated, staff expects that future review of the standards will likely result in a proposal for the adoption of appropriate Tier 3 standards for PM, Tier 4 standards for NOx and PM, and possibly standards for existing engines already in-use.

The Board's final review would take place after U.S. EPA completes its 2001 review, and would determine what changes, if any, would be required for California. If due to new information the proposed standards are determined not to be technologically feasible, staff would propose appropriate levels at a future date. The standards proposed herein, if adopted by the Board, would stay in effect until revised.

C. CERTIFICATION

1. Definition of Compression-Ignition

The requirements of this rulemaking will apply to all compression-ignition engines subject to California regulations as outlined in Section IV. A. – Applicability. Most current compression-ignition engines burn diesel fuel and operate over the conventional diesel cycle, which generally allows interchangeable use of the terms "compression-ignition," "diesel-cycle," and "diesel." Some of these engines, however, can be modified to operate on other fuels such as natural gas or liquefied petroleum gas. This definition will serve to include all fuel types that fall under the compression-ignition engine category and will be applicable beginning with the 2000 model year.

2. Labeling

The proposed language for new and replacement off-road compression-ignition engine labels will align California with the federal requirements, except that the label must state that the engine complies with both California and U.S. EPA regulations. Also, new labeling requirements would apply to engines certified to optional standards and constant-speed engines. It is proposed that engines certified to the optional emission standards be labeled as "Blue Sky Series" and constant-speed engines labeled as "constant-speed only."

3. NMHC Test Method

Beginning with the 2000 model year, staff proposes two options for NMHC measurement procedures: 1) use of a measurement procedure selected by the manufacturer with prior approval of the Executive Officer; or 2) subtraction of two percent from the measured THC value to obtain a NMHC value. The methodology must be specified at the time of certification and will remain

the same for the engine family throughout the engines' useful life. These proposed amendments would align the NMHC test methods with the federal test methods recently adopted.

4. Certification Test Fuel

The regulations for 1996 and later model year heavy-duty off-road diesel cycle engines included a provision to allow manufacturers the option of certifying on California diesel fuel. Since California diesel fuel is cleaner burning than federal fuel, this option has been beneficial to engine manufacturers. This option was provided to help manufacturers meet the emission standards for a newly regulated mobile source category. After adoption of this rulemaking, emission standards for California-certified off-road compression-ignition engines will be the same as federal standards. It is proposed that the test procedures be amended to require that all off-road compression-ignition engines be certified on federal fuel beginning in 2000.

5. Test Procedures

Current test procedures will continue to apply through 1999. Amendments to the test procedures are proposed for 2000 and later model year compression-ignition engines that are equivalent to the International Organization for Standards[4] (ISO) test cycles (Attachment 5). The proposed emission standards are based on the use of existing steady-state (modal) test procedures. New steady-state test cycles are specified for constant-speed engines, marine propulsion engines, and engines rated less than 19 kilowatts. The following describes the proposed selection of various test cycles.

Compliance with emission standards is determined by measuring emissions while operating engines over a prescribed test cycle. The current regulations specify a cycle that is nominally the same as the ISO 8178 C1 test cycle as the principle test cycle for measuring emissions from engines 175 horsepower (130 kilowatts) and greater. It is proposed that the C1 test cycle be retained for most engines and that additional cycles be defined for specific engine types. Engines that are limited by design to constant-speed operation would be subject to testing using a test cycle equivalent to the ISO 8178 D2 cycle. This cycle, which omits idle and intermediate-speed modes from the C1 cycle, is representative of engines such as generators, which are designed never to run at these omitted speeds. Because of the more limited range of engine operation in the D2 cycle, manufacturers must ensure that engines certified with data generated with the D2 cycle are used exclusively in constant-speed applications. Accordingly, these engines would include labeling information indicating this limited emission certification.

[4] ISO is an international organization of engineers and scientists who work to develop appropriate and consistent standards and procedures.

For variable-speed engines rated less than 19 kilowatts, it is proposed that the regulations continue to specify a test cycle that is equivalent to the ISO 8178 G2 cycle. The G2 cycle includes the same modes as the D2 cycle and adds a mode for operation at idle. The G2 and D2 cycles also have different weighting factors for the various modes. The G2 cycle was developed to represent the operation of small compression-ignition engines used primarily at rated speed, such as in lawn and garden applications, generators, pumps, welders, and air compressors. Staff proposes to specify a test cycle equivalent to the ISO 8178 E3 cycle for testing propulsion marine engines rated less than 37 kilowatts. The E3 cycle, which consists of engine operation at four different engine speeds and four different loads, was developed by ISO to represent the operation of propulsion marine engines. Auxiliary marine engines subject to this rule (i.e., engines installed on a marine vessel, but not used for propulsion) would be tested using either the G2, C1, or D2 test cycles, consistent with the constraints described above for the counterpart land-based off-road engines.

Finally, staff recommends that manufacturers generally be allowed to use the C1 test cycle to generate certification data for engines otherwise required to use the D2 or G2 test cycle. Staff also proposes to allow manufacturers to use the C1 test cycle to generate certification data for propulsion marine engines where such engines are included in a land-based engine family. In each of these cases in which the manufacturer elects to use the C1 cycle, ARB would retain its ability to test using the respective G2, D2, or E3 test cycle, but would also be able to test using the C1 test cycle.

D. DURABILITY AND WARRANTY PROVISIONS

To achieve the full benefit of the emissions standards, programs are necessary to encourage manufacturers to design and build engines with durable emission controls and encourage proper maintenance and repair of engines throughout their lifetime. The goal is for engines to maintain good emission performance throughout their life in-use.

Currently, there are few requirements in the regulations that address deterioration concerns for off-road compression-ignition engines. As tighter standards are put into place, staff believes that it becomes necessary to adopt measures to address concerns about possible in-use emission performance degradation. The adoption of durability demonstration requirements and the revision of warranty provisions that parallel the U.S. EPA's provisions would help ensure adequate durability and proper maintenance of the engine and emission controls.

1. Useful Life Extension/Warranty Provisions/Recall Testing Periods

In order to align this proposal with the federal provisions, staff proposes the Board adopt a useful life period of 8,000 hours or ten years of use for all engines rated at 37 kilowatts and greater; 5,000 hours or seven years of use for engines rated at 19 kilowatts and greater, but less than 37 kilowatts; and 3,000 hours or five years of use for constant-speed engines rated less than 37 kilowatts with rated speeds greater than or equal to 3,000 rpm. The useful life period for engines rated less than 19 kilowatts will remain unchanged at 3,000 hours or five years of use.

For warranty, the Board has already adopted periods of two years for engines rated less than 19 kilowatts; and 3,000 hours or five years of use for engines 130 kilowatts and greater. Proposed changes to these provisions, in order to align with federal requirements, include: 1) the addition of a 1,500 hour warranty period for engines rated less than 19 kilowatts; 2) 1,500 hours or two years of use for constant-speed engines rated less than 37 kilowatts with rated speeds greater than or equal to 3,000 rpm; and 3) for all other engines 3,000 hours or five years of use. Current requirements for warranty language that manufacturers are to provide for consumers is proposed to be amended to align with federal warranty language.

Federal provisions for recall testing periods were based on the ratio of useful life and liability periods established for engines rated at or above 37 kilowatts. The purpose of having liability periods that are shorter than the useful lives is to ensure that engines used in recall testing are not statistical outliers with poor emissions durability. However, if a recall were ordered, all engines in that family would be subject to the recall regardless of their age. The following recall testing periods are proposed for adoption in order to align with federal requirements: 1) 2,250 hours or four years for engines rated less than 19 kilowatts and constant-speed engines rated less than 37 kilowatts with rated speeds greater than or equal to 3,000 rpm; 2) 3,750 hours or five years for all other engines rated at 19 kilowatts and greater, but less than 37 kilowatts; and 3) 6,000 hours or seven years for all engines rated at 37 kilowatts and greater.

2. Selective Enforcement Audit and In-Use Compliance/Recall Programs

The U.S. EPA has a Selective Enforcement Audit program to ensure that actual production engines meet the emission standards. California has its own new engine compliance program which is similar, but allows the ARB to independently ensure that new engines intended for sale in California are meeting the emission standards. In order to align with federal requirements, staff proposes to adopt the federal Selective Enforcement Audit program for 2000 model year and later off-road compression-ignition engines. However, small off-road compression-ignition engines (less than 19 kilowatts or 25 horsepower) will continue to comply with Section 2407, Title 13, California Code of Regulations, through 1999. ARB reserves the right to order a Selective Enforcement Audit of a new engine being sold in California. However, in any case, ARB would

limit the number of Selective Enforcement Audit test orders to the annual limit in the regulations. The annual limit is determined to be the larger of either 1) Production factor, determined by dividing the projected off-road engine sales in the United States for that model year by 16,000 (if the projected sales are less than 8,000, this factor is one); or 2) Family factor, determined by dividing the manufacturer's total number of certified engine families by five. When the annual limit has been met, ARB may issue additional test orders to test those families for which evidence exists indicating noncompliance. In addition, manufacturers shall supply upon request emission test results from U.S. EPA-directed audits for engines certified in California.

The U.S. EPA has in-use testing and recall procedures in place to ensure that certified engines meet the emission standards over the useful life of the engine. California adopted its own in-use compliance and recall program for on-road vehicles and certain off-road vehicles under Articles 2.1 – 2.3, Chapter 2, Title 13, California Code of Regulations. Staff has proposed that the California In-Use Compliance/Recall Program be extended to all 2000 and later model year off-road compression-ignition engines certified for use in California.

3. Emission Defect Reporting Requirements

Staff is proposing that the emission defect reporting requirements for 2000 and later model year California off-road compression-ignition engines be the same as the federal requirements. The specific federal sections that describe the reporting requirements are outlined in the California Exhaust Emission Standards and Test Procedures for New 2000 and Later Off-Road Compression-Ignition Engines, Part I-B (Attachment 4).

4. Deterioration Factors

California regulations do not currently require off-road diesel engines 175 horsepower (130 kilowatts) or greater to accumulate operating time on durability data engines or to generate deterioration factors for engine certification. This is because the focus was on reductions in NOx emissions, requiring emission control technologies that were not expected to deteriorate. The degree of emissions control stability can be attributed to the fact that diesel engine manufacturers have met emission standards through internal improvements to the engine and fuel systems, rather than relying on aftertreatment and other devices that would be more susceptible to in-use degradation.

As NOx, NMHC, and PM standards are made more stringent and off-road compression-ignition engine manufacturers introduce new technologies solely for emission control purposes, such as aftertreatment, sophisticated fuel delivery controls, and exhaust gas recirculation (EGR), long-term emissions performance becomes a greater concern. In addition, emission deterioration characteristics are not well known for aftertreatment, EGR, and other more sophisticated emission control strategies.

Staff proposes that the Board adopt provisions for deterioration to align with federal requirements. As proposed, the application of deterioration factors (DFs) would apply to all engines covered by this rulemaking. The DF is a factor applied to the certification emission test data to represent emissions at the end of the useful life of the engine. Separate DFs apply to each measured pollutant, except that a combined NMHC + NOx DF applies to engines that do not use aftertreatment devices. Decreasing emissions of one pollutant over time would not be allowed to offset increasing emissions of the other pollutant in this combined DF.

It is not the intent to force a great deal of data gathering on engines using established technology for which the manufacturers have the experience to develop appropriate DFs. New DF testing may not be needed where sufficient data already exist. The main interest is that technologies with unproven durability in off-road applications, such as EGR, are demonstrated to meet emission requirements throughout their useful lives. However, because this rule proposes to create a program that will introduce new standards and new technologies over many years, the DF requirement is being proposed for all engines so that ARB can be sure that reasonable methods are being used to ascertain the capability of engines to meet standards throughout their useful lives.

Similar to the provisions for on-road engines, staff proposes to allow the off-road engine manufacturers the flexibility of using durability emission data from a similar engine that has either been certified to the same standard or for which all of the data applicable for certification has been submitted. In addition, staff proposes to extend this flexibility to allow deterioration data from on-road engines to be used for similar off-road engine families.

Furthermore, staff proposes that, for engines using established technology for which the manufacturers have the experience to determine appropriate deterioration factors, good engineering analysis be allowed in place of actual service accumulation. For instance, in the case where no durability data exist for a certain engine but both smaller and larger engines using similar technology have been shown not to deteriorate for NOx in use, it would be possible to build a case showing no NOx deterioration for that engine. It is proposed that engines be considered as using established technologies if they do not meet the Tier 3 emission standards, unless they use EGR or aftertreatment devices. In addition, staff proposes that manufacturers of engines that do meet the Tier 3 standards but have technologies similar to those employed in Tier 2 designs may also rely on engineering analysis in lieu of actual service accumulation, with prior Executive Officer approval. This proposal is essentially the same as that adopted by U.S. EPA.

5. Emissions Related Maintenance

Staff proposes changes to the minimum allowable maintenance intervals for engines 130 kilowatts and greater and the addition of minimum allowable maintenance intervals for all off-road compression-ignition engines. These provisions would align California regulations with federal requirements. The following amended minimum intervals being proposed for adjustment, cleaning, repair, or replacement of various components are as follows:

At 1,500 hours, and 1,500-hour intervals thereafter:

1. EGR related filters and coolers
2. Positive crankcase ventilation valve
3. Fuel injector tips (cleaning only)

At 3,000 hours, and 3,000-hour intervals thereafter for engines rated less than 130 kilowatts or 4,500-hour intervals thereafter for engines rated 130 kilowatts and greater:

1. Fuel injectors
2. Turbocharger
3. Electronic engine control unit and its associated sensors and actuators
4. PM trap or trap-oxidizer system
5. EGR system (including all related control valves and tubing)
6. Catalytic converter
7. Any other add-on emissions-related component

Add-on emission-related components are those whose sole or primary purpose is to reduce emissions or whose failure will significantly degrade emission control, yet not significantly affect the performance of the engine.

In addition, the following components are defined as critical emission-related components:

1. Catalytic converter
2. Electronic engine control unit and its associated sensors and actuators
3. EGR system (including all related filters, coolers, control valves and tubing)
4. Positive crankcase ventilation valve
5. PM trap or trap-oxidizer system
6. Any other add-on emissions-related component

If maintenance is scheduled on critical emission-related components in-use, it will be required that the manufacturer show the reasonable likelihood that the maintenance will, in fact, be performed in use. The regulations list options for this demonstration, including showing that

performance would degrade without maintenance, providing survey data showing that the maintenance is performed, using a visible signal system, offering free maintenance, and other methods approved by the Executive Officer. These special provisions do not apply to critical emission-related components for which no maintenance is specified over the useful life of the engine.

6. Rebuild Provisions

A remanufactured engine must be rebuilt equivalently from an emissions standpoint, to the original certified engine. As a means of preventing tampering, staff proposes that the Board adopt rebuild requirements for all off-road compression-ignition engines subject to the Tier 2 or subsequent standards and regulations. The proposed rebuild requirements would be the same as those adopted in the federal regulations.

Staff believes that the proposed rebuild requirements are commonly accepted practices and would not add a significant additional burden on rebuilders. The staff's proposal would require that rebuilders have a reasonable technical basis for knowing that the rebuilt engine is equivalent from an emissions standpoint to a certified configuration. That is:

- the model year(s) of the engine configuration must be identified;
- replacement parts used when rebuilding an engine, whether the part is new, used, or rebuilt, must perform the same function with respect to emissions control as the original part; and
- parameter adjustments or design changes must be made only in accordance with the original engine manufacturer's instructions, without affecting in-use emissions.

Secondly, staff proposes that when an engine is being rebuilt and remains installed or is reinstalled in the same vehicle, it must be rebuilt to a configuration of the same or later model year as the original engine. In addition, when an engine is being replaced, the replacement engine must be an engine of (or rebuilt to) a configuration of the same or later model year as the original engine. Lastly, when conducting an in-frame rebuild or the installation of a rebuilt engine, all emissions-related components must be checked and cleaned, repaired, or replaced where necessary, following manufacturer recommended practices.

At the time of rebuild, emissions-related codes or signals from any on-board monitoring systems may not be erased or reset without diagnosing and responding appropriately to the diagnostic codes. Furthermore, such signals may not be rendered inoperative during the rebuilding process. All codes must be responded to and the problems corrected before the rebuilt engine is returned to service.

Different parties may perform different tasks during the engine rebuilding process. For example, one party may rebuild engine components, while another is responsible for full engine assembly and installation. Staff therefore proposes that individual parties have full responsibility for only the activities they are conducting and have control over. Furthermore, the party responsible for supplying a rebuilt engine would not be allowed to supply a replacement engine that is not rebuilt to a certified configuration of the same or later model year as the trade-in engine.

7. Rebuild Record Keeping Requirements

Staff proposes that the Board adopt requirements consistent with the federal record keeping requirements. These requirements are consistent with customary business practices, and will assist in assessing compliance with the new rebuild provisions. The records would be kept by persons involved in the process of off-road engine rebuilding or remanufacturing. Records would include the following:

- Mileage and/or hours at the time of rebuild;
- A list of the work performed on the engine;
- Any repair of emission control systems, including a list of replacement parts used, engine parameter adjustments, and design element changes;
- Emissions-related codes and equipment monitoring signals that are responded to and reset; and
- Responses to such signals and codes, and work performed as described in the rebuild provisions above.

Staff proposes that records be kept for two years after the engine is rebuilt. The records may be kept in a format or system of the rebuilder's choice. Parties are not required to keep information that they do not have access to as part of normal business practices.

For rebuilders, if it is customary practice to keep records for engine families rather than specific engines, such record keeping practices would satisfy these requirements. Rebuilders can use records that they keep for the engine families being rebuilt, rather than for individual engines, provided each engine is rebuilt in the same way to those specifications. Records could include build lists, parts lists, engineering parameters, etc.

In addition, rebuilders are only required to keep information on individual emissions-related diagnostic codes if the codes are addressed through a set of procedures that are not considered to be uniform. For example, if an engine is equipped with a sensor that monitors the EGR flow rate,

the rebuilder may keep on record the specifications and procedures used to rebuild the EGR system in all instances. It is a general practice that engine remanufacturers keep these types of records in order to control the quality of their products.

E. AVERAGING, BANKING, AND TRADING PROGRAM

Federal regulations provide for an ABT program in the other 49 states. The federal ABT program was modified as part of the October 1998 federal rulemaking for compression-ignition engines to provide manufacturers additional flexibility in meeting lower federal NMHC + NOx, and PM standards. The federal ABT program applies to all off-road compression-ignition engines subject to the regulations, and contains a family emission limit (FEL) approach, discussed in the following section, for determining ABT credits generated for averaging, banking, and/or trading.

California does not currently allow participation in the federal ABT program. However, in order to more closely align with federal regulations, staff proposes the Board adopt regulations to allow California participation in the recently revised federal ABT program. Participation in ABT would apply to all off-road compression-ignition engines subject to California regulations as outlined in Section IV. A. – Applicability; manufacturers participating in the ABT program would be allowed to trade ABT credits throughout California and the other 49 states.

The ABT program is designed to provide engine manufacturers flexibility in meeting applicable emission standards. It would also encourage the early introduction of cleaner engines, thus securing earlier emissions benefits. Under the ABT program, manufacturers would average emissions across engine families to determine compliance with the applicable standard. If average engine family emissions are below the applicable standards, a manufacturer could generate ABT credits, and unused or excess ABT credits could be banked for future use. Excess ABT credits could also be traded or sold to other engine manufacturers participating in the ABT program. If average emissions are above the applicable standard, manufacturers could use their own, or purchase ABT credits to meet the applicable emission standards. Manufacturers choosing to certify engines to the Blue Sky Series standards, however, would not be allowed to include those engines in the ABT program.

1. General ABT Provisions for Compression-Ignition Engines

Staff is proposing that the Board adopt the federal ABT program provisions to allow California participation. Since the proposed ABT program for use in California is identical in nature to the federal program, staff is not providing an exhaustive explanation of the specific requirements for each power category of compression-ignition engines. The proposed ABT program provisions can be found in the "California Exhaust Emission Standards and Test Procedures for New 2000 and Later Off-Road Compression-Ignition Engines, Part I-B" which references the federal program.

2. Generating ABT Credits Using the Family Emission Limit (FEL)

The FEL is an emission limit that the engine manufacturer selects for each engine family in its fleet. Generally, the FEL is based on an emission level that the manufacturer is confident a particular engine family could test to and meet over the useful life of the engine. Staff proposes that ABT credits be calculated based on an FEL declared by the engine manufacturer for each engine family.

Separate FEL declarations would be required for each engine family. To be eligible to generate credits in the ABT program, FELs would be declared below the adopted emission standard. The FEL must be based on an emission level calculated for the useful life of the engine family. Engine manufacturers with FELs established below the adopted emission standards would have ABT credits available to average, bank, trade or combination thereof. Manufacturers declaring FELs above the applicable standard would use or obtain ABT credits to address the excess emissions. The proposed upper limits to the FEL values that may be declared are shown in the following table.

Table 4 – Upper Limit for Family Emission Limits (FEL)
(grams per kilowatt–hour)

Maximum Rated Power (kW)	Tier	Model Year	NOx	NMHC + NOx	PM FEL
kW<8	Tier 1	2000-2004	---	16.0	1.2
	Tier 2	2005 and later		10.5	1.0
8≤kW<19	Tier 1	2000-2004	---	16.0	1.2
	Tier 2	2005 and later	---	9.5	0.80
19≤kW<37	Tier 1	2000-2003	---	16.0	1.2
	Tier 2	2004 and later	---	9.5	0.80
37≤kW<75	Tier 1	2000-2003	14.6	---	---
	Tier 2	2004-2007	---	11.5	1.2
	Tier 3	2008 and later	---	7.5	
75≤kW<130	Tier 1	2000-2002	14.6	---	---
	Tier 2	2003-2006	---	11.5	1.2
	Tier 3	2007 and later	---	6.6	
130≤kW<225	Tier 1	1996-2002	14.6	---	---
	Tier 2	2003-2005	---	10.5	0.54
	Tier 3	2006 and later	---	6.6	
225≤kW<450	Tier 1	1996-2000	14.6	---	---
	Tier 2	2001-2005	---	10.5	0.54
	Tier 3	2006 and later	---	6.4	
450≤kW≤560	Tier 1	1996-2001	14.6	---	---
	Tier 2	2002-2005	---	10.5	0.54
	Tier 3	2006 and later	---	6.4	
kW>560	Tier 1	2000-2005	14.6	---	---
	Tier 2	2006 and later	---	10.5	0.54

F. FLEXIBILITY PROVISIONS

In implementing the new standards, staff's intention is to avoid unnecessary hardship for equipment manufacturers (sometimes referred to as original equipment manufacturers or OEMs), who install diesel engines in their products. Engine suppliers may not always provide adequate lead time for the equipment redesigns needed to accommodate engine design changes such as mounting locations and heat rejection loads. For some OEMs, even timely information on the new engine designs may not be sufficient because of the sheer volume of redesign work needed to change diverse product offerings with limited engineering staffs.

In response to these concerns, staff proposes that the Board adopt an OEM transition program, which would be the same as the federal program, to provide equipment manufacturers with some flexibility in transitioning to the new standards. It is recognized that new emission standards may create challenges for engine and equipment manufacturers beyond simply developing low-emission technologies. As specified and agreed to in the SOP, some form of implementation flexibility was needed in order to gain the desired air quality benefits as early as possible while still addressing manufacturers' concerns. The OEM transition program consists of four major elements, each directed at a specific need. Although they involve certain planning and recordkeeping responsibilities if taken advantage of, all of these elements are voluntary. The elements of the proposed program, which are identical to the federal program, are 1) a percent-of-production allowance, 2) a small-volume allowance, 3) continuance of the Tier 1 allowance to use up existing inventories of engines, and 4) availability of hardship relief. Each of these is discussed in detail below.

1. Percent-of-Production Allowance

Each equipment manufacturer would be able to install engines not certified to the proposed new emission standards in a limited percentage of equipment produced for the U.S. market. This percentage applies separately to each power category and is expressed as a cumulative percentage of 80 percent over the 7 years beginning when the Tier 2 standard first applies in the category (Tier 1 for power categories less than 37 kW). No exemptions are allowed after the seventh year. For example, an OEM may exempt 40 percent of its 2003 production of equipment that use engines rated between 130 and 225 kilowatts, 30 percent of its 2004 production, and 10 percent of its 2005 production. If the same OEM were to produce equipment using engines rated between 8 and 19 kilowatts, a separate cumulative percentage allowance of 80 percent would apply to these equipment during the seven years beginning in 2000. Staff proposes to allow equipment manufacturers to participate in this program, but must comply with the Enforcement and Recordkeeping Requirements outlined in Section F. 5. below.

It is recognized that the 80 percent exemption allowance, were it to be used to its maximum extent by all OEMs, would bring about the introduction of cleaner engines later than would have occurred if the new standards were to be fully implemented on their effective dates. Although there is no way of knowing at this time how many exempted engines will be produced, staff believes it will be substantially less than the allowance. Many engine designs being planned for the new standards will fit the equipment with little change. Also, the desire of engine manufacturers to avoid producing two engine designs that, from an applications perspective, are redundant, will prompt them to change over to the new designs as quickly as they can accommodate their customers' needs.

Equipment that uses engines built before the standard goes into effect needs not be included in the exemption count. Engines that produce emissions at higher levels than the standards, but for which the engine manufacturer uses ABT program credits to demonstrate compliance, count as complying engines. In power categories rated at 37 kilowatts and greater, the exempted engines must comply with Tier 1 standards. In power categories rated below 37 kilowatts, the exempted engines may be uncontrolled. This is consistent with U.S. EPA requirements.

In addition, ARB is requiring the engine manufacturers to have, available upon request, a list of equipment manufacturers that plan to and have received engines under this and the other flexibility provisions. The list should include the manufacturer name, engine models, and production volumes. When needed, this recordkeeping requirement will provide ARB with information to track these flexibility programs.

2. Small Volume Allowance

The percent-of-production approach described above may provide little benefit to small businesses[5] focused on a small number of equipment models. Therefore, staff proposes that equipment manufacturers be allowed to participate in a small volume allowance program, but must comply with the Enforcement and Recordkeeping Requirements outlined in Section F. 5. below. Equipment manufacturers would be allowed to exceed the percent-of-production allowances described above during the same years affected by the allowance program for general applications, provided they limit the number of nationally exempted engines used in each power category to 700 total over the 7 years, and to 200 in any one year. In addition, manufacturers making use of this provision must limit exempted engines to a single engine family (or to a single manufacturer for engines rated less than 37 kW) in each power category. These restrictions are considered necessary to maintain the intent of this provision--helping small businesses with limited product offerings--rather than giving bigger exemption allowances for larger OEMs who can effectively use the percent-of-production provisions. These provisions are the same as the federal program.

[5] Small business for manufacturing companies is defined by the Small Business Administration as those companies with 500 or fewer employees.

3. Existing Inventory Allowance and Replacement Engines

With regard to replacement engines, current California regulations require that by the year 2000, all replacement engines for pre-1996 equipment must comply with the 1996 emission regulations. However, in their final rule, the U.S. EPA requires that replacement engines only need to be identical in configuration in all material respects to the original engine being replaced. In order to harmonize with federal requirements, staff proposes to amend current California regulations to allow replacement engines for pre-1996 engines similar to the U.S. EPA's final rule (U.S. EPA 1998a). However, manufacturers are required to use complying engines whenever feasible. If newer, cleaner engines do not "fit" into older equipment, the engine manufacturer may offer noncomplying engines provided 1) the engine manufacturer has ascertained that no certified engine is available, 2) the replacement engine is properly labeled as such, and 3) the actual number of replacement engines produced for California is reported annually for 4 years, beginning with 2000.

4. Hardship Relief Provision

Staff is also proposing a safety-valve provision whereby an OEM that does not make its own engines could obtain limited additional relief by providing evidence that, despite its best efforts, it cannot meet the implementation dates, even with the OEM transition program provisions outlined above. Such a situation might occur if an engine supplier without a major business interest in the OEM were to change or drop an engine model very late in the implementation process.

Appeals for hardship relief must be made in writing to the Chief of the Mobile Source Operations Division, must be submitted before the earliest date of noncompliance, must include evidence that failure to comply was not the fault of the OEM (such as a supply contract broken by the engine supplier), and must include evidence that serious economic hardship to the company would result if relief is not granted. Staff intends to work with the applicant to ensure that all other remedies available under the flexibility provisions are exhausted before granting additional relief, and would limit the period of relief to no more than one year. Manufacturers should be able to complete their strategy on how they will meet a new emission standard within the first year of implementation. Therefore, applications for hardship relief would only be accepted during the first year after the effective date of an applicable new emission standard.

Staff would like to make clear that it expects this provision to be rarely used. Each granting of relief would be treated as a separate agreement with no prior guarantee of success, and with the inclusion of measures, agreed to in writing by the OEM, for recovering the lost environmental benefit.

5. Enforcement and Recordkeeping Requirements

Engine manufacturers would be allowed to continue to build and sell the engines needed to meet the market demand created by the OEM transition program, provided they receive written assurance from the engine purchasers that such engines are being procured for this purpose. Engine manufacturers who participate in this program would be required to annually provide copies of letters from OEMs requesting such engines.

OEMs choosing to take advantage of the allowances must: (1) keep records of the production of all pieces of equipment produced for sale (on a national basis) exempted under the allowance provisions for at least two full years after the final year in which allowances are available for each power category; (2) include in such records the serial and model numbers and dates of production of equipment and installed engines, rated power of each engine, and the calculations used to verify that the allowances have not been exceeded in each power category; and (3) make these records available to the Executive Officer upon request.

Secondary manufacturers who purchase new equipment, modify it such as by adding specialized attachments or relabel it (i.e., privately branded equipment), and resell it as new equipment would be subject to the regulations in the same way as independent dealers and distributors. The OEM flexibility provisions would only apply to the manufacturer who originally installs the engine into the equipment.

All companies/manufacturers that are under the control of a common entity, and that meet the definition of an off-road vehicle or off-road equipment manufacturer, must be considered together for the purposes of applying exemption allowances. This would provide certain benefits for the purpose of pooling exemptions but would also preclude the abuse of the small volume allowances that would exist if companies could treat each operating unit as a separate OEM.

Staff recognizes that the OEM transition program may involve a certain amount of complexity and administrative burden that was not present for OEMs under the Tier 1 rule, which limited the compliance options for OEMs. However, this program is entirely voluntary and manufacturers wishing to implement the new standards in the same manner as for the Tier 1 regulations are free to do so.

G. FLEXIBILITY FOR POST-MANUFACTURE MARINIZERS

Post-manufacture marinizers produce marine engines by modifying engines purchased from other manufacturers. They are therefore subject to both the engine manufacturer's concern about certifying engines to the standards and the OEM's concern about timely delivery of redesigned engines from their engine suppliers.

U.S. EPA recognized that the potential unavailability of certified base engines may make it difficult for post-manufacture marinizers to comply with the adopted emission control program, since they may not be able to obtain base engines in time to adjust their marinization process,

especially considering that most of the marine engines under the federal rule are subject to standards beginning in 1999 (U.S. EPA 1998a). Based on these concerns, U.S. EPA determined that the recently adopted emission standards would not be feasible for post-manufacture marinizers who produce marine engines less than 37 kW without some flexibility provisions beyond those available in the ABT program. As a result U.S. EPA adopted two additional flexibility provisions for post-manufacture marinizers. Staff is proposing that these two additional flexibilities also be adopted for California as outlined below.

First, the OEM flexibility provisions discussed above are proposed to be extended to post-manufacture marinizers. Second, provided they informed the Executive Officer in writing before the date Tier 1 standards would take effect, post-manufacture marinizers could elect to delay the effective dates applicable to marine engines less than 37 kW for one year, instead of using the OEM flexibility provisions. Post-manufacture marinizers would not be able to take advantage of both the delayed effective date provision and the OEM flexibility provisions.

Although it provides a substantial boost in certainty to post-manufacture marinizers, the optional 1-year delay provision would have a very small environmental impact. This is because: (1) the marine engines less than 37 kW produced by post-manufacture marinizers are a very small part of the total off-road diesel engine production; (2) these engines produce relatively low emissions due to their small size and low usage characteristics; and (3) the total number of engines potentially exempted under this flexibility provision would not be much greater than that possible under the exemption allowance provisions.

V. DIFFERENCES BETWEEN FEDERAL AND CALIFORNIA REGULATIONS

Staff has endeavored to harmonize as closely as possible with U.S. EPA's final rule for off-road compression-ignition engines. However, the proposed California off-road compression-ignition program differs from the federal program in some aspects. Aligning California's program completely with the federal program would require policy changes to several California programs. Those policy changes would relax current California standards to the extent that attaining ambient air quality standards and meeting California's SIP commitments would be jeopardized. Therefore, staff's proposal differs from the federal program in ways that staff believes are needed to protect the air quality benefits of ARB's mobile source program, as discussed below.

A. CURRENT CALIFORNIA PM TESTING

In 1992, the Board adopted emission standards and test procedures for new 1996 and later heavy-duty off-road diesel cycle engines. The test procedures that were adopted were based on the International Standards Organization (ISO) 8178 test procedure for steady state emission testing. U.S. EPA chose not to amend their test procedures for PM testing during their recent rulemaking, but ongoing efforts to examine the ISO test procedures will likely result in future amendments during their 2001 feasibility review. Although there are updated versions of the ISO test procedures for PM testing available, additional changes to the ISO test procedures are currently underway. Rather than adopt an ISO test procedure that may soon be outdated, ARB intends to work with U.S. EPA during the 2001 feasibility review that may incorporate the latest ISO test procedures at that time.

At the time the regulations were adopted, staff had incorporated the ISO test method for measuring emissions with some changes, which included the requirement of using a multiple filter method of measuring PM emissions instead of a single filter method. The multiple filter method requires one set of particulate filters[6] to be used for each mode of the certification test. U.S. EPA allows the use of one set of filters for an entire test. Staff had originally proposed the multiple filter method to minimize any problems or errors associated with the adjustment of the exhaust gas flow rate to match the modal weighting factors (i.e., the single filter method measures PM emissions by timing of the modes rather than mathematically after the test procedure has been completed).

In addition, since using the multiple filter method provides PM emissions data on a mode-by-mode level, the emissions data can be compared with other ISO test cycles. This benefits those manufacturers who wish to certify their engines for other applications in countries that also subscribe to the ISO test methods. Therefore, staff is proposing no change to the current requirement for PM emissions testing with regard to the multiple filter method.

B. IN-USE COMPLIANCE/RECALL PROGRAM

The U.S. EPA has recall procedures in place to ensure that certified engines meet the emission standards over the useful life of the engine. California adopted its own in-use compliance and recall program for on-road vehicles and certain off-road vehicles under Articles 2.1 –2.3, Chapter 2, Title 13, California Code of Regulations. Staff has proposed that the California In-Use Compliance/Recall Program be extended to all 2000 and later model year off-road compression-ignition engines certified for use in California.

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[6] The filters are used to gather particulate matter in the exhaust stream during emissions testing. The filters are weighed and the mass of the particulate emissions is measured and converted to grams per kilowatt-hour for compliance determination.

This California program for in-use compliance/recall should not cause manufacturers any significant burden. These program procedures would only be performed periodically when needed (i.e., when information might indicate a problem with meeting the emission standards). This proposal will allow the ARB to continue to ensure that engines are meeting the emission standards, regardless of any subsequent changes to the federal programs.

VI. TECHNOLOGICAL FEASIBILITY

A. EPA'S REVIEW

The technological feasibility of the proposed standards has already been thoroughly evaluated by the U.S. EPA as part of their Regulatory Impact Analysis (RIA). As noted in the preamble for the U.S. EPA regulations (U. S. EPA 1998a, pages 56985-56986):

> The emission standards finalized in this document apply to a broad range of diesel engines used in a wide variety of nonroad applications. Section 213 (a)(3) of the Clean Air Act calls for EPA to establish standards that provide for the "greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the engines or vehicles to which such standards apply, giving appropriate consideration to the cost of applying such technology within the period of time available to manufacturers and to noise, energy, and safety factors associated with the application of such technology" (63 Fed. Reg. 56968, 56984, October 23, 1998). EPA has concluded, as described in the Final RIA, that the new standards will have no significant negative effect on noise, energy, or safety.
>
> Because the emission standards for nonroad diesel engines are based largely on the standards for highway engines and rely on the evaluation of technologies for complying with the standards for highway engines, the discussion of technological feasibility in the highway engine rulemaking is central to supporting the feasibility of the new standards for nonroad engines. This analysis of diesel engine technologies is contained in Chapter 4 of the Final RIA for the highway rulemaking ["Final Regulatory Impact Analysis: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines," U.S. EPA, September 16, 1997 (Docket A-95-27)]. This analysis is considered and applied to nonroad engines in Chapter 3 of the Final RIA for this rulemaking.

And:

> Emission control technology for diesel engines is in a period of rapid development in response to the range of emission standards anticipated for the years ahead. This effort will need to continue to meet the requirements of this final rule. However, the emission targets are set in the framework of a long lead time with various flexibility provisions,

which provide manufacturers the time they will need to apply emission control technology developments to nonroad engines. Also, the experience gained in response to EPA's emission standards for highway engines will be invaluable in meeting the comparable requirements for nonroad engines. Because the technology development for highway engines will to a large extent constitute basic research of diesel engine combustion, this effort will also benefit manufacturers that produce no highway engines.

On the basis of information currently available, EPA believes that it is feasible for nonroad diesel engine manufacturers to meet the standards finalized in this document within the specified time frame, using combinations of the technological approaches discussed in the Final RIA. In addition, EPA believes that the flexibilities incorporated into this final rule will permit nonroad vehicle and equipment manufacturers to respond to engine changes in an orderly way. For both industries, EPA expects that meeting these requirements will pose a significant challenge. As described above, EPA plans to assess, as part of the 2001 feasibility review, the appropriateness of the Tier 3 standards, and the Tier 2 standards for engines rated under 37 kW.

The thoroughness of the U.S. EPA analysis and the staff's concurrence with that analysis render redundant any exhaustive discussion of technological feasibility in this report. This Section will therefore briefly discuss some of the likely control strategies. Much of the information contained herein is derived from the U.S. EPA's Regulatory Impact Analysis.

B. SUMMARY OF TECHNOLOGY

In general, manufacturers of off-road compression-ignition engines are expected to use emission controls similar to those already in use by the manufacturers of on-road compression-ignition engines, even though the effectiveness could vary because of the different operating environment experienced by off-road engines. Although on-road and off-road engines alike experience frequent load and speed changes, the operating speed of an off-road engine is less likely to change speeds often compared to an on-road engine. Another important consideration is that the same off-road engine may be used in a variety of applications; this can complicate the application of some strategies due to different packaging constraints. However, as noted in the U.S. EPA Regulatory Impact Analysis, "[n]onroad engine manufacturers are . . . currently in the process of introducing models that have been certified to the Tier 1 standards and are successfully demonstrating their ability to meet the first level of emission standards. Based on a review of current emissions research, EPA believes that emission control improvements from engine design changes have not yet leveled off and that further emission reductions are possible" (U.S. EPA 1998b, page 20).

1. Turbocharging and Aftercooling

Turbocharging is used for both on-road and off-road applications to generate increased power from a given displacement engine. A turbocharger uses the waste energy in the exhaust gas to drive a turbine, which then boosts the pressure of the incoming air charge. By forcing more air into the combustion chamber, more fuel can also be added, resulting in higher power while still inhibiting particulate formation.

Aftercooling was initially developed to improve the specific power output of an engine by increasing the density of air entering the combustion chamber, but it also reduces NOx emissions, since it works by reducing the temperature of the charge air after it has been heated during compression. There are two kinds of aftercooling strategies: air-to-water, which releases the absorbed heat to the engine coolant system; and air-to-air, which releases the heat to a separate heat exchanger. Air-to-air aftercoolers are more effective, but are less commonly used for off-road engines. This is in large measure due to concerns about the dust encountered during off-road use and space constraints. However, according to the U.S. EPA, "[g]round-level dust is becoming less of an issue because recent developments have improved dust resistance, primarily through greater fin spacing on the heat exchanger. Over time, equipment manufacturers are expected to modify their designs to make space for air-to-air aftercooling technology. While introducing air-to-air aftercooling requires a greater degree of engine and equipment modification, the benefits for improved fuel efficiency, greater engine durability, and better control of NOx emissions make a compelling case for their widespread use in the long term" (U.S. EPA 1998b, page 25).

2. Timing retard

Retarding the fuel injection timing is the strategy most likely to be used by manufacturers of smaller engines (i.e., those less than 37 kilowatts) to meet the new standards. Retarding the timing reduces NOx emissions by shortening the time available for combustion and lowering cylinder temperature and pressure. Conversely, timing retard increases HC, CO, PM, and fuel consumption, for the same reasons. In most cases, timing retard will be used in conjunction with other strategies to counteract those increases.

3. Combustion chamber design

While manufacturers already use combustion chamber design to reduce emissions, further improvements are likely for the off-road engines. Specifically, modifications to: (1) the shape of the chamber and the location of injection to induce swirl[7]; (2) crevice volumes; and (3) compression ratio; it has been thoroughly explored for on-road engines, and thus off-road engine design can benefit from that experience.

4. Advanced Fuel Injection Controls

Improved fuel injection is a major part of virtually any approach to reduce emissions from compression-ignition engines. High injection pressures offer better fuel atomization and mixing of the fuel and air, achieving more complete combustion. Timing retard can be used in conjunction with this strategy to inhibit NOx formation, resulting in overall reductions in NOx, HC, and PM simultaneously. Rate shaping is another technique that helps reduce NOx. In a rate shaping system, the fuel is injected in several different injection events. Especially with electronic controls, this results in more carefully-controlled combustion. Thus, rapid increases in temperature and pressure can be minimized, reducing NOx formation. Some manufacturers already use electronically-controlled fuel injection, and staff expects the number to increase.

5. Exhaust Gas Recirculation

Exhaust gas recirculation (EGR) reduces peak combustion chamber temperatures by feeding exhaust gas back into the cylinder. This slows reaction rates and absorbs some of the heat, resulting in lower NOx emissions. PM increases can be minimized by reducing the amount of EGR during high-load operation. Another concern is that soot from the exhaust is added to the intake air, which could increase engine wear, damage a turbocharger or reduce the efficiency of an aftercooler. Researchers are evaluating ways to reduce the soot fed back into the engine.

6. Aftertreatment

Aftertreatment strategies are not expected to be needed to achieve the emission standards being proposed. However, aftertreatment remains a likely option for the future. Further reductions in emissions from diesel exhaust sources will be needed, particularly since diesel PM was recently

[7] "Swirl" refers to the turbulence of the intake air entering the combustion chamber. A high degree of turbulence in the combustion chamber better mixes air and fuel. This reduces the amount of unburned and unevaporated fuel, and thus reduces HC, PM and smoke emissions.

identified as a TAC. When ARB conducts its feasibility review of the proposed standards in 2001, it is expected that Tier 3 PM and Tier 4 NOx and PM emission standards will be proposed, and aftertreatment devices will be seriously considered as feasible technology.

The primary use of diesel aftertreatment in today's off-road equipment is in underground mining applications, where oxidation catalysts and particulate traps are used to maintain acceptable conditions for workers in the enclosed spaces. Some of these retrofit devices may be feasible to reduce emissions from other categories of diesel engines that are already in service.

There are a number of aftertreatment technologies being researched for use on diesel-fueled vehicles and equipment where demonstrations have shown a potential to control greater than 75 percent of engine-out NOx emissions. Some of these include DeNOx or "Lean-NOx" catalysts, NOx Adsorbers or NOx "Traps," Selective Catalytic Reduction (SCR) Technology, and Non-Thermal Plasma. For advanced particulate emissions control, a NOx Oxidation Catalyst/Continuously Regenerating Diesel Particulate Filter has been applied commercially in Europe and may provide reductions in excess of 85 percent for PM, HC, and CO emissions. These technologies are strong candidates for both new engine and retrofit applications.

All catalyst-based technologies are sensitive, to some extent, to the sulfur content in fuels. Sulfur impacts the emissions reduction capability of the aftertreatment device by attaching to the chemical sites that are needed for the catalytic reaction that reduces the emissions. Therefore, it is desirable to use the lowest sulfur diesel fuel available. Currently, California limits the sulfur level of diesel fuel used in on-road and most off-road engines to 500 ppm (parts per million). Actual sulfur levels are about 120 ppm, well below the maximum limit. The U.S. EPA also limits sulfur levels of diesel fuel for on-road vehicles to 500 ppm; in-use levels average 350 ppm. The U.S. EPA does not currently regulate diesel fuel used in off-road vehicles and equipment; and sulfur levels average about 3,500 ppm. In order for manufacturers to take advantage of the emissions reduction potential of these advanced aftertreatment technologies, adoption of a nationwide sulfur limit of 30 ppm or less for all on- and off-road diesel fuel will be necessary. This is particularly true for PM reductions, as a high sulfur content directly leads to high levels of sulfate-based PM, rendering low PM levels infeasible with high-sulfur fuel.

VII. REMAINING ISSUES

Staff presented the concepts for the proposed regulations in a document made available October 8, 1999. Draft versions of the regulations and test procedures were made available to interested stakeholders for comment in October 1999. Following receipt of comments from interested stakeholders, the staff then modified portions of the regulations and this report accordingly to address those industry concerns which could be addressed without impeding the goals of the regulations.

VIII. REGULATORY ALTERNATIVES

The staff evaluated various alternatives to the current proposal, including some alternatives suggested by interested stakeholders. A brief description of the alternatives and the staff's reasoning for rejecting them follows.

A. DO NOT AMEND CURRENT CALIFORNIA REGULATIONS

One alternative to this proposal would be to continue the use of the off-road diesel engine emission standards that have already been set in place for 2001 and subsequent years. The existing California regulations for off-road diesel engines were adopted by the Board in 1992. With the passage of U.S. EPA's nonroad compression-ignition rule in 1998, current California regulations have become less stringent than the federal program. Pursuant to the federal Clean Air Act (CAA), in order for California to enforce its own emissions reduction program the Board must adopt regulations that are, in the aggregate, at least as protective of public health and welfare as applicable federal standards (CAA Section 209(e)(2)(A)). Furthermore, under the SOP, ARB committed to harmonize with U.S. EPA's emissions standards and other provisions, provided such action would not compromise California's obligations to comply with state and federal law including the SIP. Therefore, staff rejected this alternative.

B. REPEAL CALIFORNIA REGULATIONS ENTIRELY

In the early stages of developing this regulation, staff was asked to consider repealing the separate California regulatory program in its entirety, and allow all control of these sources to fall to the U.S. EPA. This would result in the least possible burden for engine manufacturers. However, the staff has serious reservations about abdicating its ability to independently enforce the regulations. There is also the possibility for modifications to the federal program that would place California in jeopardy of not complying with the national ambient air quality standards. Repeal would place implementation of measures M9 and M10 fully with U.S. EPA, where ARB would be just one of many interested parties involved in establishing the effectiveness and timing of the federal regulations. Furthermore, this alternative would hinder California's ability to pursue further control of these sources. Since California has long been recognized by the federal government as having special air quality problems, and needing special authority to address those problems, this alternative was rejected.

C. ADOPT MORE STRINGENT EMISSIONS STANDARDS

The staff recognizes that more stringent control of emissions from these sources will be necessary both to attain the federal ambient air quality standard for ozone and to reduce public exposure to diesel particulate, a toxic air contaminant. The details of the benefits of the proposal and the impact on the SIP are discussed in Section X. At this time, in compliance with the SOP, the staff is not recommending more stringent standards. Harmonization of the certification requirements with the federal program will reduce the administrative burden on industry, allowing a greater focus on the technical issues of emissions control. Future strategies that will be examined include the revision of diesel fuel standards to require lower sulfur levels, the wider application of aftertreatment technologies, and perhaps alternate fuels. The need for quick action on the provisions of the SOP did not provide enough time for the development of proposed requirements reflecting those technologies. Therefore, staff rejected this alternative at this time, but anticipates setting more stringent standards in 2001.

IX. ECONOMIC IMPACTS

The proposed regulatory amendments harmonize, with federal regulations, California emission standards, useful life, warranty, deterioration factors, maintenance intervals, rebuild/replacement provisions, test procedures and test fuel requirements, labeling requirements, and provide for participation in an ABT program. The California adoption of the standards would not impose additional costs above the costs to comply with the federal standards. The adoption is actually expected to benefit engine manufacturers, who may face production inefficiencies when they have to comply with different standards. The harmonization of the standards would reduce production inefficiencies, thereby lowering compliance costs. Therefore, staff believes that the proposed amendments would have no noticeable impact on business competitiveness, California employment, or on business creation, elimination, and expansion. This Section discusses, in greater detail, the potential cost and economic impacts of the proposed amendments based on U.S. EPA findings.

A. LEGAL REQUIREMENT

Sections 11346.3 and 11346.5 of the Government Code require State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination, or creation, and the ability of California business to compete.

State agencies are required to estimate the cost or savings to any state or local agency, and school districts. The estimate is to include any nondiscretionary cost or savings to local agencies and the cost or savings in federal funding to the state.

B. AFFECTED BUSINESSES

Any business that is involved in manufacturing and/or rebuilding of off-road CI engines and equipment manufacturers that utilize these engines in their equipment can potentially be affected by the federal standards and the proposed state standards. U. S. EPA had identified 30 major engine manufacturers and 581 original equipment manufacturers nationwide. Also affected are businesses that operate or service CI engines. An estimated 790,000 off-road CI engines will be utilized in equipment and vehicles operating in California in 2000.

C. ESTIMATED COSTS TO ENGINE MANUFACTURERS

The costs of the proposed requirements to engine manufacturers have been estimated and are based on U.S. EPA's analysis for the national emission standards. Engine manufacturers will likely use multiple technologies to meet the 2000 and later standards and the maintenance and durability requirements. To estimate the incremental impact of the federal standards on engine costs, U.S. EPA determined a plausible combination of technologies taking into account the observed value of performance improvements in the field. Some of the technologies expected to be used include modifications to basic engine design features, electronic controls, advanced fuel injection, and cooled exhaust gas recirculation. To take into account the non-emission benefits of those technologies in the way of engine performance, fuel consumption, and life of the engine, a discounting method based on equal weighting of emission and non-emission benefits was used. Assuming that engine manufacturers pass on the entire costs of the new standards to end users, the incremental increase in per-engine purchase price and overall life-cycle operating costs have been estimated. These cost estimates are presented in the following table.

Table 5
Projected Unit Costs – Engines

Cost Category	Year of Production	Power (kW)					
		0-37	37-75	75-130	130-450	450-560	560+
Tier 1							
Incremental purchase price	1	$34	—	—	—	—	—
Life-cycle Operating Costs (npv[8])	all	$44	—	—	—	—	—
Tier 2							
Incremental purchase price	1	$72	$124	$425	$464	$1355	$683
Life-cycle Operating Costs (npv)	all	$44	$59	-$147	-$262	-$1347	$0
Tier 3							
Incremental purchase price	1	—	$240	$511	$758	$1858	—
	6	—	$120	$297	$435	$535	—
Life-cycle Operating Costs (npv)	all	—	$97	-$652	-$826	-$1212	—

Source: U.S. EPA's Final Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines, August 1998. Costs are in 1995 dollars.

The estimated costs are separated into incremental purchase price and total life-cycle operating costs. The incremental purchase price for new engines and equipment includes 1) variable costs for hardware and assembly time, and 2) fixed costs for research and development, retooling, and certification. Total operating costs include any expected increases in maintenance or fuel consumption. Since U.S. EPA relied extensively on the contracted study of the cost of highway

[8] Net Present Value

engine technologies conducted by ICF, Incorporated[9] and Arcadis Geraghty & Miller[10], all costs are presented in 1995 dollars. Life-cycle costs have been discounted to the year of sale using a discount rate of 7 percent.

Overall, the incremental costs of the new federal standards are expected to decline over time. For example, the incremental purchase price of a new Tier 3 engine greater than 450 kilowatts in its first year of production is estimated to be $1858. The estimated incremental cost of a new engine purchased in its sixth year of production is $535, reflecting the benefits of a "learning-curve." Standards were called for in ARB's 1994 SIP, and further defined in the SOP in August 1996, giving manufacturers extensive lead time. This lead time allows substantial technology development before reaching production. U.S. EPA's analysis predicts that extended research will allow manufacturers to use simpler packages of emission control technologies, that innovations will lower the cost of production, and that manufacturers will have time to focus research efforts on eliminating problems such as increased fuel consumption or maintenance costs. As an example, manufacturers expect that upgrading from air-to-water aftercoolers to air-to-air aftercoolers at Tier 1 emission levels would provide a fuel economy improvement of 6 to 8 percent. That benefit would decrease as NOx emission levels declined. Therefore, U.S. EPA estimated the fuel economy improvement would be 3 percent for upgraded aftercooling systems and 6 percent for those engines that currently have no aftercooling. As such, there is an expected positive effect on operating costs over the lifetime of the engine/equipment. U.S. EPA's analysis shows that the operating costs are likely to offset much, if not all, of the increased engine and equipment costs for engines above 75 kilowatts due to expected improvements in fuel economy for engines meeting the new standards.

D. POTENTIAL COSTS TO EQUIPMENT MANUFACTURERS

In addition to the costs directly associated with the manufacture of complying engines, costs may also result from the need to redesign the off-road equipment in which these engines are used. The main concern for equipment manufacturers in accommodating complying engines has been the late delivery of such engines by engine manufacturers, which cuts into the lead time that equipment manufacturers need to properly redesign their equipment. The flexibility provisions that were adopted by the U.S. EPA and are proposed by staff attempt to avoid any business disruptions resulting from the changes associated with the new emission standards.

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[9] "Benefits of Reducing Mobile Source NOx Emissions," prepared by ICF Incorporated for Office of Mobile Sources, U.S. EPA, Draft Final, September 30, 1996.

[10] "Estimated Economic Impact of New Emission Standards for Heavy-Duty On-Highway Engines," Acurex Environmental Corporation Final Report (FR 97-103), March 31, 1997. The Acurex Environmental Corperation has since changed its name to Arcadis Geraghty & Miller.

With adequate lead time, an equipment manufacturer can invest enough engineering time to design around the new engine, usually with minimal increase in hardware costs. The main issue anticipated for equipment redesign is in changing the engine compartments to accommodate the physical changes to engines; i.e., making space for the larger engine system and to integrate the engine into the overall functioning of the equipment. The projected unit costs are shown in the following table.

Table 6a
Projected Unit Costs

Tier		Power (kW)					
		0-37	37-75	75-130	130-450	450-560	560+
Tier 1	Equipment	$24	—	—	—	—	—
	Total Engine & Equipment	$59	—	—	—	—	—
Tier 2	Equipment	$8	$125	$441	$340	$1315	$404
	Total Engine & Equipment	$80	$250	$867	$804	$2670	$1087
Tier 3 short-term	Equipment	—	$42	$147	$113	$439	—
	Total Engine & Equipment	—	$282	$658	$872	$2296	—
Tier 3 long-term	Equipment	—	$3	$4	$5	$7	—
	Total Engine & Equipment	—	$122	$301	$440	$543	—

Source: U.S. EPA's Final Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines, August 1998. Costs are in 1995 dollars.

E. POTENTIAL IMPACTS ON BUSINESS

The new federal standards are expected to impose additional costs on engine manufacturers, rebuilders, and equipment manufacturers that utilize these engines in their equipment. A detailed analysis of these costs is provided in the U.S. EPA regulatory impact analysis of the new federal standards. The incremental costs of the new standards can be viewed in the context of their fraction of the total purchase price of equipment. For example, U.S. EPA collected quoted list prices on different types of equipment with high sales volume to represent low and high end prices for several engine ratings. Using a range of these prices (discounted by 20 percent from list prices to obtain estimated actual sales prices), U.S. EPA determined a best estimate of actual prices for off-road compression-ignition equipment (see Table 6b). The table includes both portable and motive (self-propelled) equipment, as both types of equipment are powered by engines subject to this proposal. Comparing the estimated unit costs for engines and equipment with the current purchase prices show cost increases are almost all under 2 percent of purchase price, while most are well below 1 percent.

Table 6b
Federal Estimated Prices for New Nonroad Diesel Equipment

Power Range	Portable Equipment Estimated Sale Price	Motive Equipment Estimated Sale Price
0-37 kW (0-50 hp)	$1,600-12,000	$16,000-20,000
185-335 kW (250-450 hp)	$24,000-40,000	$130,000

Source: U.S. EPA's Final Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines, August 1998. Costs are in 1995 dollars.

The California adoption of the new federal standards is not going to alter the above costs because these costs already include the cost to California. The harmonization of the standards would actually benefit most engine manufacturers, which often face production inefficiencies when they have to comply with different standards.

F. POTENTIAL IMPACT ON BUSINESS COMPETITIVENESS

The proposed amendments would have no significant impact on the ability of California businesses to compete with businesses in other states. The amendments would harmonize the California standards with the federal standards for off-road compression-ignition engines. Thus, California operators of off-road compression-ignition equipment and vehicles would not be disadvantaged relative to operators from other states. The harmonization of the standards should actually benefit engine manufacturers and equipment manufacturers. This is because these manufacturers would not have to deal with different requirements that can result in production inefficiencies.

G. POTENTIAL IMPACT ON EMPLOYMENT

The proposed amendments are not expected to cause a noticeable change in California employment. The adoption of the federal standards in California is expected to benefit manufacturers, who might be faced with production inefficiencies if they had to comply with different California and federal standards. As mentioned above, the harmonization of the standards would reduce production inefficiencies, thereby lowering compliance costs. Since these costs are generally passed on to vehicle operators, they could benefit from lower compliance costs. This would, in turn, moderate any adverse impact the federal standards might have on employment.

H. POTENTIAL IMPACT ON BUSINESS CREATION, ELIMINATION OR EXPANSION

The proposed amendments would have no noticeable impact on the status of California businesses including small businesses. The proposed emission standards would be the same as the federal standards. Therefore, no additional costs for off-road compression-ignition equipment or vehicle operators in California are expected. The implementation flexibilities proposed would help alleviate the potential impact on businesses including small businesses.

I. POTENTIAL COSTS TO LOCAL AND STATE AGENCIES

As discussed in the Section on regulatory alternatives, ARB must either adopt the requirements in this proposal, or other requirements that would result in equivalent or greater air quality benefits in order to comply with the federal Clean Air Act. ARB staff believes the proposed standards are the only feasible and cost-effective means of achieving emission reductions of the same magnitude as the standards by 2010. ARB staff believes there would be no real incremental cost increase associated with adopting the federal standards as the California standards. Accordingly, the proposed requirements are not expected to result in an overall increase in costs for state and local

agencies. However, there may be a small increase in enforcement/certification resources to ensure the standards are being met over the useful life of these off-road compression-ignition engines.

X. ENVIRONMENTAL IMPACTS AND COST-EFFECTIVENESS

This Section presents the air quality benefits and the cost-effectiveness of the proposed standards. Staff's analysis is based on U.S. EPA's national analysis, adjusted to reflect California costs and emission reductions. Control of these sources was committed to in the 1994 Ozone State Implementation Plan as part of SIP measures M9 and M10; this Section also includes an analysis of how the proposed standards fulfill the SIP commitments for the South Coast Air Basin, the only area of the state that relied on measures M9 and M10 reductions for attainment. Because the proposed regulations would apply statewide, they would provide significant cost-effective emission reductions throughout California.

A. AIR QUALITY BENEFITS

1. Statewide Benefits

By 2010, it is estimated that the emission standards proposed and those adopted by the U.S. EPA would result in 75 tons per day of NOx reductions, almost 16 tons per day of NMHC reductions, and 2.7 tons per day of PM reductions in California, using the updated proposed emissions inventory. Table 7 shows the statewide emissions benefit of the staff's proposal and from equivalent federal control in 2010 as compared to the baseline emissions inventory; the baseline includes the effect of the Tier 1 ARB and U.S. EPA rules that were implemented beginning in 1996. Table 8 shows the emission reduction benefits in the South Coast Air Basin in 2010. The data in these tables reflect the latest information on engines in the category affected by the staff proposal and their emissions.

Table 7

2010 Statewide Benefit of the Proposal
Updated Proposed Inventory (in tons per day)
(Note that discrepancies may occur due to rounding of the numbers)

Measure	Pollutant	Emissions Inventory		Reductions
		Baseline	Controlled	
Staff Proposal (Non-Preempt Engines)	NMHC	15.9	13.1	2.8
	NOx	187.5	155.5	32.0
	PM	7.7	6.8	0.9
Federal Action (Preempt Engines)	NMHC	49.6	33.2	16.4
	NOx	307.2	247.8	59.4
	PM	29.6	22.0	7.6
TOTAL	**NMHC**	**65.5**	**46.3**	**19.2**
	NOx	**494.7**	**403.3**	**91.4**
	PM	**37.3**	**28.8**	**8.5**

Table 8

Emissions from Compression-Ignition Engines
In the South Coast Air Basin
Updated Proposed Inventory (in tons per day in 2010)

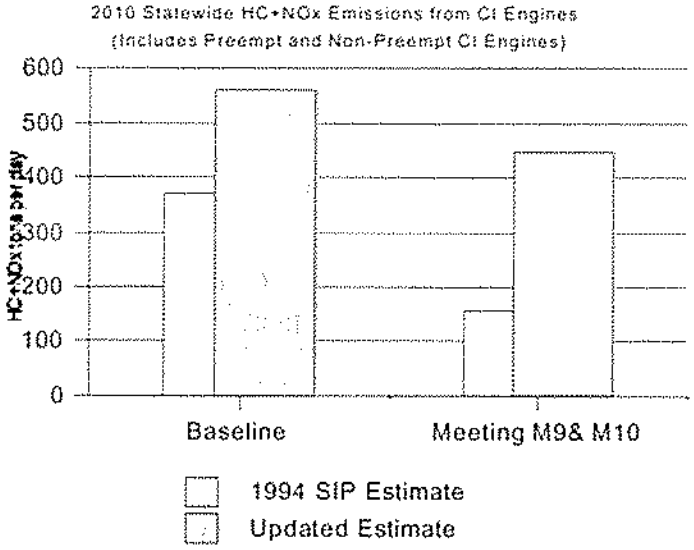
Category	Emissions Inventory				Reductions due to Staff Proposal	
	Baseline		Controlled			
	ROG	NOx	ROG	NOx	ROG	NOx
M9 (Non-Preempted)	4.5	49.7	3.8	41.1	0.7	8.6
M10 (Preempted)	14.4	89.0	9.3	70.3	5.1	18.7
Total	18.9	138.7	13.1	111.4	5.8	27.3

2. Inventory Updates

Substantial improvements have been made to the emissions inventory for off-road compression-ignition engines. Updated data on activity, growth, population, turnover (useful life), emission rates (including emissions deterioration), and which engine applications are exclusively under the jurisdiction of U.S. EPA, have been incorporated into the revised inventory.

The inventory revisions show that the projected hydrocarbon and NOx emissions in 2010 from both uncontrolled and controlled engines are much higher than anticipated in 1994. Much of these increases result from inclusion of a wider range of equipment types, and an increase in base population estimates. Figure 3 illustrates the impact of the revised estimates on compression-ignition engine emissions. The 1994 SIP estimate shows the baseline and controlled emissions assumed in the SIP. In the 1994 SIP, it was believed that more than half of the emissions from off-road diesel engines were in the South Coast Air Basin (SCAB). The current estimate shows that the SCAB portion of the off-road inventory is now only roughly one quarter of the statewide total. The reason for this change is that the statewide emission inventory for agricultural equipment has increased significantly. As a result, emissions from off-road compression-ignition engines are now much higher than previously assumed in the San Joaquin Valley and other farming regions.

Figure 3



The emissions reductions associated with measures M9 and M10 for the updated proposed inventory are less than estimated in SIP currency due to the differences in the turnover rate and deterioration rate. The 1994 SIP assumed a higher turnover rate than the updated proposed inventory. This meant that the SIP calculations assumed replacement of older, more-polluting engines with newer, cleaner engines would happen earlier, providing greater benefits in the 2010 timeframe. Additionally, the updated proposed inventory includes deterioration, which causes a further increase in emissions, while the SIP currency estimate assumed no deterioration.

3. Impacts on the 1994 Ozone State Implementation Plan

The 1994 Ozone SIP is California's master plan for achieving the federal ozone standard in all areas of the state by the federally required date. The 1994 Ozone SIP includes state measures to control motor vehicles and pesticides, local measures for stationary and area sources, and federal measures for sources under exclusive or practical federal control. The U.S. EPA approved the 1994 Ozone SIP in September 1996 (62 Federal Register 1150, January 8, 1997).

a. Review of SIP Measure M9 – SIP Measures M9 and M10 were developed in 1994 with the belief that manufacturers would be able to use proven on-road technologies – such as improved engine design, EGR, and aftertreatment – to reduce NOx emissions from off-road compression-ignition engines by approximately 60 percent while also reducing hydrocarbon emissions by 50 percent on a per engine basis. U.S. EPA's action and the staff's proposal have established that the technological underpinnings of measures M9 and M10 are sound, although the specifics of the staff's proposal have changed somewhat to address the significant changes to the emissions inventory.

b. Comparison of Staff Proposal to SIP Measure M9 – The NOx and reactive organic gas (ROG) emission reductions anticipated from SIP measures M9 and M10 in the South Coast Air Basin are listed in Table 9[11]. Also shown are the effects of the staff proposal in "1994 SIP currency"(using ARB's off-road mobile source emission inventory model that was used during the development of the 1994 SIP). While 1994 SIP currency must be used as the official guide to provide consistency with the legal obligations of the SIP, staff recognizes that the SIP currency does not reflect updated information and that further control of emissions from these engines may be necessary in the future. The staff proposal would provide more ROG reductions than the SIP measures M9 and M10, while falling short of the NOx reductions anticipated in the SIP. Taken as a whole, the combined ROG and NOx reductions from the proposal are essentially equal to the combined ROG and NOx reductions called for in the SIP.

Table 9

Emissions from Compression-Ignition Engines
Compared to the SIP Target
In "1994 SIP Currency"
(Tons per day in South Coast Air Basin in 2010)

Category	1994 SIP Emission Reductions		Emission Reductions from Staff Proposal		Change in Emission Reductions	
	ROG	NOx	ROG	NOx	ROG	NOx
M9 (ARB)	2.7	33.5	5.4	29.4	+ 2.7	- 4.1
M10 (Federal)	5.3	44.2	9.7	41.7	+ 4.4	- 2.5
Total	**8.0**	**77.7**	**15.1**	**71.1**	**+ 7.1**	**- 6.6**

c. Benefits of Staff's Proposal in 2005 – Although other nonattainment areas did not rely on emissions reductions from Measures M9 and M10 in the SIP, the earlier implementation of the staff proposal will provide some emissions benefits for those areas by 2005. Table 10 describes the emissions reductions expected in these areas from the proposed regulations using 1994 SIP currency.

[11] For purposes of this analysis, ROG and NMHC emissions are considered to be equivalent.

Table 10

Expected Emission Reductions for SIP Measures M9 and M10 and the Staff Proposal
(1994 SIP Currency in tons per day)

SIP Area	Year	1994 SIP Emission Reductions		Emission Reductions from Staff Proposal	
		ROG	NOx	ROG	NOx
Ventura	2005	0	0	0.1	0.4
Sacramento	2005	0	0	0.2	0.9
South Coast	2005	1	9	6	18
South Coast	2010	8	78	15	71

d. Summary of 1994 SIP Analysis – Using 1994 SIP currency, the staff's proposal meets the 1994 SIP commitment to achieve 86 tons per day of ROG and NOx reductions from off-road compression-ignition engines. Additionally, the staff's proposal provides some emissions benefits in SIP areas with 2005 attainment dates (Sacramento and Ventura Air Basins). This measure will also provide emission reductions in the San Joaquin Valley Air Basin in 2005 – the San Joaquin Valley will not meet their attainment date of 1999 and must submit a new plan demonstrating attainment by 2005.

It should be noted that because the updated inventory is higher than previously estimated, the remaining emissions from off-road compression-ignition engines are higher than envisioned in the 1994 SIP. As air quality plans are updated in the future, the larger contribution of emissions from off-road compression-ignited engines will be closely scrutinized.

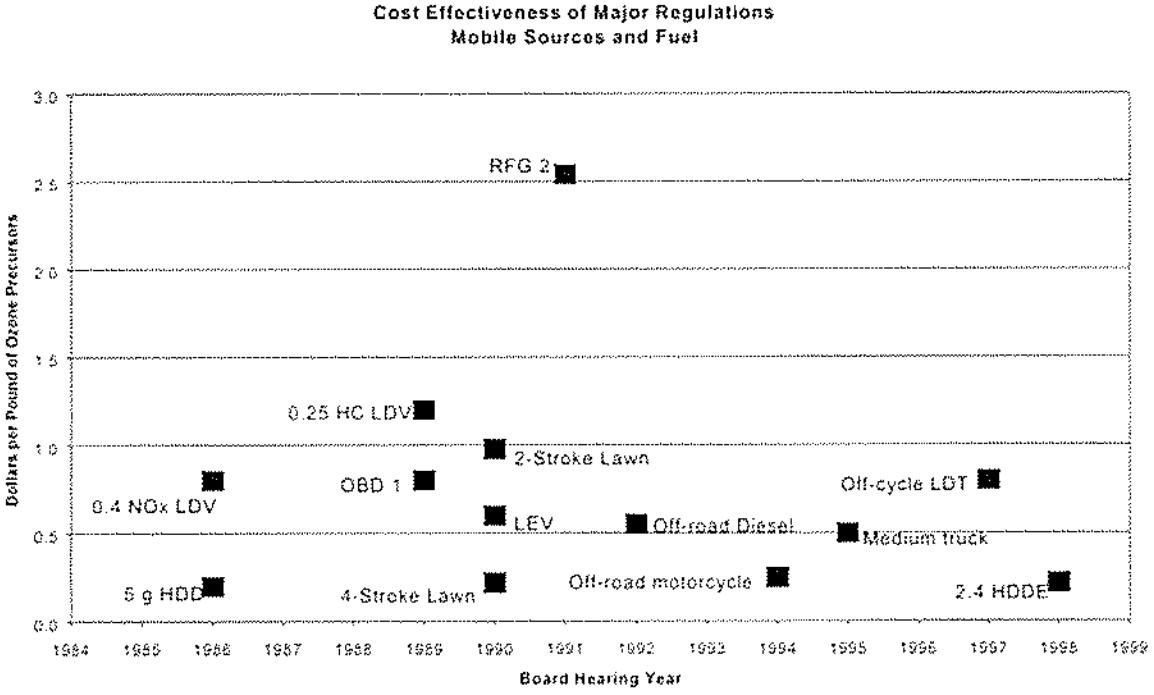
e. Future Planning Efforts – ARB is scheduled to revise its statewide control strategy for ozone in 2000. In future years, ARB will also develop plans for meeting fine particulate matter ambient air quality standards and to meet regional haze requirements. Due to increases in both the on- and off-road emission inventories, staff will be evaluating all feasible cost effective emission reductions, including re-examining the regulations currently in place for a broad range of mobile sources and consumer products under the jurisdiction of the ARB. Due to the large upward revision of the off-road compression-ignition engine emission inventory, particularly in areas outside of the South Coast Air Basin, ARB will be closely examining the progress made toward reducing emissions from these engines and evaluating the feasibility of further reductions.

B. COST-EFFECTIVENESS

The cost of complying with the proposed emission standards and regulations in California is not expected to be different from complying with the federal regulations. Therefore, no additional cost is anticipated from the adoption of the proposed off-road compression-ignition regulations for California. For informational purposes, the estimated fleet-wide cost-effectiveness of the federal requirements is given in Appendix A. The estimated cost of complying with the standards will vary depending on the power category and model year under consideration. Operating costs are actually expected to lower overall costs in the way of reduced fuel consumption.

The cost-effectiveness for aligning with the federal requirements in California is expected to be similar to the national cost-effectiveness. The highest federal fleet-wide cost-effectiveness of the NMHC + NOx standards is expected to be $650 dollars per ton reduced. In dollars per pound, the cost-effectiveness of this measure would be about $0.32 per pound of ozone precursors reduced. As shown in Figure 4, this compares favorably with the cost-effectiveness of California mobile source and motor vehicle fuels regulations adopted over the past decade. Those adopted measures had cost-effectiveness values from $0.17 to $2.55 per pound of ozone precursors reduced. The highest cost-effectiveness of the PM standard is expected to be $1.16 per pound of PM reduced.

Figure 4



XI. SUMMARY AND STAFF RECOMMENDATION

The staff estimates that in 2010, the statewide benefits of the proposal would be 89 tons per day of NOx and 32 tons per day of NMHC. The estimated California cost-effectiveness with adoption of the staff's proposal would be approximately $ 0.32 per pound of NMHC + NOx reduced. This cost-effectiveness is well within the range of other motor vehicle control measure costs.

Furthermore, harmonization of certification and compliance procedures with the U.S. EPA will facilitate the implementation of Tier 4 and later controls, by minimizing administrative issues and allowing a greater focus on the technical issues of emissions control. Future strategies that will be examined include the revision of diesel fuel standards to require lower sulfur levels, and the wider application of aftertreatment technologies to new and in-use engines.

No alternative considered by the agency would be more effective in carrying out the purpose for which the regulation is proposed or would be as effective or less burdensome to affected private persons than the proposed regulation. Therefore, the staff recommends that the Board adopt the staff proposal.

XII. REFERENCES

ARB, 1995. Public Hearing to Consider Amendments to Regulations Regarding California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel-engines and Vehicles, to Specify Mandatory Standards for 1998 and Subsequent Heavy-Duty Engines and Optional Standards for 1995 and Subsequent Heavy-Duty Engines, May 12, 1995 (Staff Report).

ARB, 1994. The California State Implementation Plan for Ozone, Volume II, November 15, 1994.

ARB, 1991. Public Hearing to Consider The Adoption of Regulations Regarding the California Exhaust Emission Standards and Test Procedures for New 1996 and Later Heavy-Duty Off-Road Diesel Cycle Engines and Equipment Engines, November 12, 1991 (Staff Report).

U.S. EPA, 1998a. Control of Emissions of Air Pollution From Nonroad Diesel Engines; Final Rule, 63 Federal Register 56967-57023, October 23, 1998.

U.S. EPA, 1998b. Final Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines, August 1998, (Docket A-96-40).

U.S. EPA, 1997a. Control of Emissions of Air Pollution From Highway Heavy-Duty Engines; Final Rule, 62 Federal Register 54693-54730, October 21, 1997.

U.S. EPA, 1997b. Final Regulatory Impact Analysis: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines, September 16, 1997 (Docket A-95-27).

APPENDIX A: FEDERAL COST-EFFECTIVENESS OF THE OFF-ROAD COMPRESSION-IGNITION EMISSION STANDARDS

The following tables show the federal cost-effectiveness of the emission standards for compression-ignition engines. The estimated cost of complying with the standards varies depending on the model year under consideration. The Model Year Grouping refers to the different model years during which the costs are expected to change with respect to the implementation of the new emission standards.

Table 1
Discounted Fleet-wide Cost-effectiveness of the NMHC + NOx Standards
(Excluding operating costs)

Level of Standard	Model Year Grouping	Discounted Cost-effectiveness ($/ton)
Tier 2	1 to 2	$600
	3 to 5	$540
Tier 3	1 to 2	$650
	3 to 5	$550
	6 to 10	$410
	11+	$300

Table 2
Discounted Fleet-wide Cost-effectiveness of the NMHC + NOx Standards
(Including operating costs)

Level of Standard	Model Year Grouping	Discounted Cost-effectiveness ($/ton)
Tier 2	1 to 2	$540
	3 to 5	$480
Tier 3	1 to 2	$220
	3 to 5	$130
	6 to 10	$0
	11+	$0

Table 3
Discounted Fleet-wide Cost-effectiveness of the PM Standards

Level of Standard	Model Year Grouping	Discounted Cost-effectiveness ($/ton)
Tier 1 and Tier 2 combined	1 to 2	$2,320
	3 to 5	$2,100
	6 to 10	$1,680
	11+	$700

APPENDIX B: LIST OF PREEMPTED OFF-ROAD APPLICATIONS

(a) Equipment types with engines less than 25 horsepower are presumed not to be construction or farm equipment, with the exception of the following equipment types, which have been determined to be construction or farm equipment:

Aerial devices: vehicle mounted
Asphalt recycler/reclaimer, sealer
Augers: earth
Back-hoe
Backpack Compressors
Baler
Boring machines: portable line
Breakers: pavement and/or rock
Brush cutters/Clearing saws 40 cc and above (blade capable only)
Burners: bituminous equipment
Cable layers
Chainsaws 45 cc and above
Chippers
Cleaners: high pressure, steam, sewer, barn
Compactor: roller/plate
Compressors
Concrete buggy, corer, screed, mixer, finishing equipment
Continuous Digger
Conveyors: portable
Crawler excavators
Crushers: stone
Cultivators: powered
Cutting machine
Debarker
Detassler
Drills
Dumper: small on-site
Dusters
Elevating work platforms
Farm loaders: front end
Feed conveyors
Fertilizer spreader
Forage box/Haulage and loading machine
Forklifts: diesel and/or rough terrain
Harvesters, crop
Jackhammer
Light towers
Mixers: mortar, plaster, grout
Mowing equipment: agricultural

Mud jack
Pavers: asphalt, curb and gutter
Pipe layer
Plows: vibratory
Post hole diggers
Power pack: hydraulic
Pruner: orchard
Pumps 40 cc and above
Rollers: trench
Sawmill: portable
Saws: concrete, masonry, cutoff
Screeners
Shredder/grinder
Signal boards: highway
Silo unloaders
Skidders
Skid-steer loaders
Specialized fruit/nut harvester
Sprayers: bituminous, concrete curing, crop, field
Stump cutters, grinders
Stumpbeater
Surfacing equipment
Swathers
Tampers and rammers
Tractor: compact utility
Trenchers
Troweling machines: concrete
Vibrators: concrete, finisher, roller
Welders
Well driller: portable
Wheel loaders

(b) Equipment types with engines 25 horsepower or greater are presumed to be construction or farm equipment, with the exception of the equipment types listed below, which have been determined not to be construction or farm equipment.

Aircraft Ground Power
Baggage Handling
Forklifts that are neither rough terrain nor powered by diesel engines
Generator Sets
Mining Equipment not otherwise primarily used in the construction industry
Off-Highway Recreational Vehicles
Other Industrial Equipment

Refrigeration Units less than 50 horsepower
Scrubbers/Sweepers
Tow/Push
Turf Care Equipment

APPENDIX C: NONROAD COMPRESSION-IGNITION ENGINE STATEMENT OF PRINCIPLES

9/13/96

NONROAD COMPRESSION-IGNITION ENGINE STATEMENT OF PRINCIPLES

Members of the nonroad compression-ignition (CI) engine and equipment industry, the U.S. Environmental Protection Agency (EPA) and the California Air Resources Board (ARB) (collectively, the Signatories) recognize the importance of preserving the environment while maintaining a strong industry. This Statement of Principles (SOP) increases certainty and stability for the nonroad CI engine and equipment industry which is vital for their business planning. It also ensures cleaner air in a manner which is both realistic for industry and responds to environmental needs.

With this SOP the nonroad CI engine and equipment industry has stepped forward to become a leader in environmental protection, and industry and government will work as partners to bring about cleaner air.

EPA and ARB have recently established programs to control emissions from nonroad engines. EPA and ARB recognize these engines are sources of ozone-forming oxides of nitrogen (NOx) and hydrocarbons (HC), as well as of particulate matter (PM) and other pollutants, all of which raise concerns for public health and the environment. The current Tier 1 regulations for large CI nonroad engines are primarily focused on achieving significant NOx reductions as early as possible and are being phased in by horsepower level beginning in 1996. At the time of finalizing the Tier 1 regulations, EPA and ARB recognized that more stringent standards for these engines, and further evaluation of the test procedure by which compliance with the standards is measured, would likely be needed in the future to help meet air quality goals. These agencies also recognized the need to control emissions from spark-ignited (SI) and other CI nonroad engines as well.

Although recent progress in improving the nation's air quality has been encouraging, EPA and ARB believe there is strong evidence that currently adopted measures are insufficient to offset such factors as the growth in vehicle and equipment sales and usage. The states and others have strongly urged EPA to undertake new programs to achieve further cost-effective emission reductions in a time frame consistent with the Clean Air Act attainment goals. In response, among other initiatives, EPA and ARB have initiated a program to further reduce emissions from heavy-duty on-highway vehicles and nonroad engines.

The industries that produce these engines have also stepped forward, expressing a desire to develop and use cost-effective emission control technologies to help meet the nation's air quality goals. EPA and ARB have consulted with these

industries to help craft proposals that provide the needed air quality benefit. The effectiveness of this approach is evidenced by the issuance of a joint Statement of Principles (SOP) on July 11, 1995, outlining a proposal for stringent new nationwide standards for on-highway heavy-duty engines. EPA followed up that SOP with an Advanced Notice of Proposed Rulemaking (ANPRM) and a Notice of Proposed Rulemaking (NPRM). The 1995 SOP expressed an intent by the Signatories to pursue a similar SOP for heavy-duty nonroad engines.

After considerable discussion between EPA, ARB, and the nonroad engine and equipment industries, this SOP has been completed. The Signatories expect major reductions in emissions from the standards set forth in this SOP. For nonroad CI engines rated at 50 hp (37 kW) and higher, the Tier 2 and Tier 3 standards together will achieve about a 75 percent reduction in NOx from uncontrolled levels. The Tier 2 standards for PM represent about a 40 percent reduction from current levels. For nonroad CI engines rated at less than 50 hp, the Tier 2 standards are expected to result in NOx and PM reductions similar to those from the Tier 2 standards for engines rated at 50 hp and higher.

The Signatories agree that EPA should issue an ANPRM in 1996 and an NPRM in 1997 consistent with the points outlined in this document. A final rule would follow by February 1998. However, this SOP does not change the importance of EPA demonstrating the need for the standards described below and EPA's obligation to meet the criteria of the Clean Air Act in finalizing any rule, including complying with all applicable rulemaking procedures.

1. Scope

This SOP concerns CI nonroad engines as defined in 40 CFR 89.2, and the nonroad equipment powered by these engines, with the exception of engines used in aircraft, underground mining equipment, locomotives, and marine vessels. However, propulsion and auxiliary marine CI engines rated at less than 50 hp (37 kW) are included.[1] EPA is addressing marine CI engines rated at 50 hp and higher separately from this SOP.

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1. Currently, EPA is required under a court order to take final action on proposed regulations for CI marine engines by December 18, 1996. EPA will seek appropriate changes to this order regarding final action on CI marine engines less than 50 hp (37 kW) to conform to this SOP.

Although EPA and ARB have made significant progress in SOP discussions with the manufacturers of nonroad SI engines rated at above 25 hp (19 kW) (as well as the manufacturers of equipment using these engines), these discussions have not yet reached a stage that would allow inclusion of these engines in this SOP. EPA and ARB will pursue the development of an SOP for nonroad SI engines above 25 hp by the end of 1996. Such an SOP would assist the nonroad engine and equipment manufacturers in their product planning. The Signatories recognize the possible competitive effects of regulating CI and SI engines separately, and EPA and ARB will take those effects into account in the development of an SI engine SOP.

2. National Standards for CI Nonroad Engines

This SOP seeks to establish a nationwide program that, in real-world operating experience, achieves the emission control levels indicated below. Recognizing that real-world control is closely linked to the test procedure by which conformance with standards is measured, the following discussion of standards should be read in the context of the test procedure discussion that follows it. The Signatories' goal is a combination of emission standards and test procedures that achieves real-world emission reductions corresponding to these standards, provided that such standards are technologically feasible and cost effective, taking into consideration both engine and equipment manufacturer costs.

a. NMHC, NOx, CO and PM Standards

EPA will propose combined standards for nonmethane hydrocarbons (NMHC) and NOx, and separate standards for carbon monoxide (CO) and PM. These standards would apply to any affected engine that is newly manufactured on or after January 1 of the year indicated in the following table, except as provided in Section 5, Implementation Flexibility, below. While this SOP does not specify PM standards in Tier 3, the Signatories acknowledge that there is, in general, an inverse relationship in controlling certain pollutants (e.g., NOx and PM). The Signatories recognize that the manufacturer signatories have agreed to the Tier 3 NMHC+NOx standards set forth below on the condition that there would be no further reduction in PM or CO from Tier 2 levels. If such reductions should be proposed, EPA will take the reductions into account in its review of the feasibility of the proposed Tier 3 NMHC+NOx standards (see Section 4, Feasibility Review, below). The Signatories recognize the role that direct injection engine technology plays in the less than 50 hp nonroad engine market and expect the standards set forth in this SOP to allow for the continued existence of that technology. As part of the feasibility review (see Section 4 below), EPA will assess the progress in meeting Tier 2 standards for those engines using direct injection technology.

b. Smoke

The Signatories support the completion and worldwide adoption of the new smoke test being developed by the International Standards Organization (ISO 8178-9). EPA intends to propose to replace its current smoke test with the ISO test procedure for the sake of harmonization and improved control of smoke, provided that it provides for a level of smoke control at least as adequate as the current test. EPA will also propose to extend the smoke standards that were adopted in the Tier 1 rule to the under 50 hp engine category, and will evaluate the appropriateness of any changes to the smoke standards for all engine size categories in formulating the proposal.

c. Crankcase Emissions

For several years, emission regulations for on-highway engines have required that crankcase emissions be eliminated, except in the case of turbocharged diesel engines, which present special difficulties in designing for closed crankcase. EPA will propose to extend this requirement to covered nonroad engines (including the provision for excepting turbocharged diesel engines).

NMHC+NOx / CO / PM in g/hp-hr (g/kW-hr)										
hp (kW)	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Tier 1						Tier 2*			
<11 (8)		7.8 (10.5) 6.0 (8.0) 0.74 (1.0)					5.6 (7.5) 6.0 (8.0) 0.60 (0.80)			
≥11 (8) <25 (19)		7.0 (9.5) 4.9 (6.6) 0.60 (0.80)					5.6 (7.5) 4.9 (6.6) 0.60 (0.80)			
≥25 (19) <50 (37)	7.0 (9.5) 4.1 (5.5) 0.60 (0.80)					5.6 (7.5) 4.1 (5.5) 0.44 (0.60)				
			Tier 2					Tier 3*		
≥50 (37) <100 (75)						5.6 (7.5) 3.7 (5.0) 0.30 (0.40)				3.5 (4.7) 3.7 (5.0) **
≥100 (75) <175 (130)					4.9 (6.6) 3.7 (5.0) 0.22 (0.30)				3.0 (4.0) 3.7 (5.0) **	
≥175 (130) <300 (225)					4.9 (6.6) 2.6 (3.5) 0.15 (0.20)			3.0 (4.0) 2.6 (3.5) **		
≥300 (225) <600 (450)			4.8 (6.4) 2.6 (3.5) 0.15 (0.20)					3.0 (4.0) 2.6 (3.5) **		
≥600 (450) <750 (560)				4.8 (6.4) 2.6 (3.5) 0.15 (0.20)				3.0 (4.0) 2.6 (3.5) **		
≥750 (560)								4.8 (6.4) 2.6 (3.5) 0.15 (0.20)		

* These standards are subject to a feasibility review as discussed in Section 4.
** See above discussion on PM standards.

3. Test Procedures

In adopting a steady-state test cycle for its Tier 1 final rule, EPA stated that further study will be required to better characterize the nature and level of transient operation experienced by nonroad engines in actual use. The Signatories recognize that additional data would be beneficial in assessing the adequacy of the steady-state test in achieving control of regulated emissions, especially PM, in use. Other test parameters, such as the composition of the test fuel, may also impact the program's success in controlling in-use emissions.

The Signatories further recognize: (1) the crucial role that the test procedure plays in ensuring real emissions control in use, (2) the critical importance of in-use emission reductions in improving air quality and in determining state implementation plan credits under the Clean Air Act, (3) the effect that changes to test procedures could have on industry's ability to design, test and produce engines that comply with the applicable standards in the time periods contemplated by the SOP, (4) the need for a well-planned and well-coordinated test program to settle the issue of test procedure adequacy, (5) the value of proceeding in concert with international standard setting organizations in adopting a harmonized test procedure, and (6) the potential for this to be a lengthy process.

In order to achieve major NOx reductions as early as possible, EPA will propose that the current steady-state test be retained in the adoption of this SOP's standards. In addition, the Signatories will initiate a comprehensive test program, coordinated by EPA and cooperatively executed, to evaluate the adequacy of the current test procedure for achieving in-use emissions control. The test program will be initiated within six months of signing this SOP and will be completed by December 1998. The Signatories will also engage interested parties in the European Union (EU) in this comprehensive test program with the goal of gaining their participation as partners, if possible. Should the results of the testing program indicate that the test procedure does not achieve adequate control of emissions in use, EPA will initiate action to revise the test procedure if another test procedure is expected to provide significantly better control.

It is recognized that the standards in the SOP are based on the current steady-state test procedure. Further, all Signatories recognize that any test cycle changes or additions would likely complicate and delay industry's ability to research, design, test, and produce engines that comply with the standards contained in the SOP. As a result, any proposal to revise the current test procedure would propose that the revision not be implemented before Tier 3. Any changes in the test procedure will be taken into consideration as part of the Tier 3 feasibility review outlined below.

Engines rated at under 50 hp are not subject to the current Tier 1 standards and test procedure. The Signatories recognize that the manufacturer signatories' agreement to the standards for these engines set forth in Section 2 of this SOP is based on the assumption that the following test cycles are adopted:

Land-based CI engines	
Variable- and constant-speed <25 hp (19 kW)	ISO 8178 G2
Variable-speed 25-50 hp (19-37 kW)	ISO 8178 C1
Constant-speed 25-50 hp (19-37 kW)	ISO 8178 D2
Auxiliary marine CI engines	
Variable- and constant-speed <25 hp (19 kW)	ISO 8178 G2
Variable-speed 25-50 hp (19-37) kW	ISO 8178 C1
Constant-speed 25-50 hp (19-37) kW	ISO 8178 D2
Propulsion marine CI engines <50 hp (37 kW)	ISO 8178 E3

In addition, the Signatories recognize that the manufacturer signatories' agreement to the application of the standards set forth in Section 2 of this SOP to land-based constant-speed engines rated at over 50 hp is based on the assumption that the ISO 8178 D2 test cycle is adopted for these engines as an optional alternative to the current steady-state test. EPA will assess the adequacy of the above cycles for the indicated engines and propose appropriate cycles in the NPRM. If EPA should propose different cycles, then EPA will reassess the feasibility of the standards in light of the proposed cycles.

4. Feasibility Review

In order to assess the progress of the industry in meeting the Tier 3 standards and effect dates for over 50 hp engines and Tier 2 standards and effect dates for under 50 hp engines (hereafter collectively, the "Later Standards"), and to ensure the lowest appropriate standard levels at the earliest appropriate time, EPA shall conduct a review of any rule adopting the Later Standards set forth in this SOP. This review will conclude in 2001 and will commence with a notice providing opportunity for public comment on whether or not the standards are technologically feasible and otherwise appropriate under the Clean Air Act. After the public comment period, EPA will take final action on the review under Section 307 of the Clean Air Act. Should the Agency conclude as a result of this review that these standards are not technologically feasible, or are otherwise not appropriate under the Clean Air Act, it shall revise the rule as appropriate. In any such revision, the NMHC+NOx standards are not expected to be raised more than 1.0 g/hp-hr (1.3 g/kW-hr), assuming no change in the PM and CO standards.

In reviewing the rulemaking as set forth above, EPA shall review the need for and feasibility and cost of the Later Standards, including, but not limited to: (1) the need to provide engine and equipment manufacturers an adequate period in which to recoup the capital investment required to achieve the previous standards; (2) the need to provide engine and equipment manufacturers no less than four full years of leadtime[1/] between the time the feasibility review is finalized and the Later Standards become effective (while maintaining the engine category phase-in set forth in Section 2 above); (3) the need to assess the suitability, effectiveness and cost of transferring on-highway engine technology to nonroad engines and equipment; and (4) the need to assess the costs associated with redesigning equipment to accommodate the Later Standards.

The Signatories acknowledge that the standards set forth in this SOP will require a substantial investment for nonroad engine and equipment manufacturers, and their customers, and that the affected nonroad industry ordinarily requires a substantial period of stability in which to recoup such an investment. The period of stability between the previous and Later Standards ordinarily would be too short a time in which to reasonably recoup the investment needed to comply with the previous standards before imposing additional costs to comply with the Later Standards. Thus, the Signatories agree that the Later Standards in this SOP are based on the premise that no significant equipment redesign beyond that required to accommodate engines meeting the previous standards will be required to accommodate engines meeting the Later Standards.

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2. In the case of engines rated at less than 50 hp, no less than two full years of leadtime.

As part of the review discussed in this Section, EPA will solicit information as to whether equipment redesign will be required as a result of changes to engines that will be required to meet the Later Standards. Should such equipment redesign be required, EPA will assess its significance, taking into account the cost and technical difficulty of such redesign, the need for a period of stability to reasonably recoup the investment in equipment redesign to meet the previous standards, the number of equipment models affected, and other relevant factors. If significant equipment redesign is required to accommodate engines meeting the Later Standards, EPA will propose appropriate measures to address the burden of such redesign. Such measures would include flexibilities similar to those set forth in Section 5 below, a minimum two-year[3/] adjustment of the time between the previous standards and Later Standards for all engine families in each affected power category, an adjustment to the Later Standards to address the need for the redesign, or some combination thereof. EPA also may propose additional measures as appropriate under the Clean Air Act. EPA and ARB acknowledge that this SOP will require the industry to make a commitment to meet the Later Standards that will require a substantial period of stability.

EPA's review and assessment of the feasibility and cost of the Later Standards will include a review of the costs associated with the Later Standards on a marginal cost basis, taking into consideration total equipment production and operating costs, not just engine costs. If this assessment shows that the nonroad equipment industry will experience significant adverse impacts from changes in standards that are too frequent, rapid, or costly, EPA further commits to propose relaxing the standards and/or delaying the effective date of the standards, consistent with relevant provisions of the Clean Air Act.

The Signatories shall meet periodically to provide updates on their efforts and progress in complying with this SOP.

5. Implementation Flexibility

The Signatories recognize that new emission standards may create challenges for engine and equipment manufacturers beyond simply developing low-emission technologies. The nonroad industry is characterized by a diversity in engine models and equipment applications, many of which have small markets, making it difficult to rapidly and frequently implement design changes across wide product lines. Even small changes in engine designs can create major difficulties for equipment makers with low volume models, diverse product lines, or inadequate leadtime to respond to the changes. If engine makers were to discontinue engine models made in small

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3. Minimum three years and one year for engines in the 175-300 hp and 300-600 hp categories, respectively.

volumes, this could cause market disruptions, especially for small manufacturers of equipment who buy these engines, and their customers.

Problems of this sort could be dealt with by phasing new standards in very gradually. However, in order to gain the desired air quality benefits as early as possible, this SOP instead aims to resolve the problem by broadening the flexibility granted to equipment manufacturers by providing them implementation options. Thus, EPA will propose programs whereby, on an annual basis, an equipment manufacturer would be allowed to install engines not meeting the otherwise applicable Tier 2 or 3 standards for engines 50 hp or higher in some of its equipment (Tier 1 standards for engines less than 50 hp). The following subsection describes two such programs that will be proposed, based on a percent-of-sales approach. The Signatories agree to work together in developing alternative flexibility proposals, with the understanding that these alternatives will not involve a projected loss in overall emission benefits over that entailed in the below-described program. One alternative approach under consideration would exempt equipment on an application-specific basis; EPA will, at a minimum, seek comment on such an approach in the NPRM.

a. Equipment Manufacturer Phase-in

Engines 50 hp or higher. For engines rated at 50 hp or higher, EPA will propose to allow each equipment manufacturer to install engines certified to the Tier 1 standards in a maximum of 15 percent of the equipment produced for sale in the United States during the first year that a new Tier 2 standard applies, and in a maximum of 5 percent during each of the six years thereafter. This allowance would continue for a total of seven years after Tier 2 standards become effective for each engine category. At the end of this allowance period, equipment manufacturers would be required to install Tier 3 engines (or Tier 2 engines in any engine categories without Tier 3 standards) in all new equipment using engines in the category. However, if the effective dates of Tier 3 standards in any engine category are delayed beyond those set forth in Section 2, the allowance period for that engine category would be extended by the same period of time. For manufacturers electing to take advantage of the special flexibility provision for farm and logging equipment described below, the above-described flexibility provision would apply to just the non-farm/logging equipment the manufacturer sells.

To avoid disadvantaging smaller companies with limited product offerings, manufacturers would be allowed to exceed the above percent of production allowances during the same years affected by the above allowance program, provided they limit the installation of Tier 1 engines to a single equipment model with an annual production level (for U.S. sales) of 100 pieces or less.

In addition to the above general flexibility allowances, EPA will propose that manufacturers of farming or logging equipment will be allowed to install Tier 1 engines in a maximum of 30 percent of this equipment (produced for sale in the United States) during the first year that a new Tier 2 standard applies, and in a maximum of 15 percent for each of the seven years thereafter. This allowance would continue for a total of eight years after Tier 2 standards become effective for each engine category. At the end of this allowance period, equipment manufacturers would be required to install Tier 3 engines (or Tier 2 engines in any engine categories without Tier 3 standards) in all new farm or logging equipment using engines in the category. However, if the effective dates of Tier 3 standards in any engine category are delayed beyond those set forth in Section 2, the allowance period for that engine category would be extended by the same period of time.

Nothing set forth above would change the rules established in the Tier 1 standards which allow equipment manufacturers to use up existing stocks of noncomplying engines at the time a new standard takes effect.

Engines less than 50 hp. EPA will propose flexibilities as described above for equipment manufacturers who install <50 hp engines into their equipment, except as follows:

(1) Equipment manufacturers will be allowed to install unregulated engines instead of Tier 1 engines.

(2) The flexibilities will expire after a total of four years. When they expire manufacturers must install certified engines in all equipment.

(3) A delay of the effective date for the <50 hp Tier 2 standards does not affect the expiration date of the flexibilities.

b. Engine Manufacturer ABT and Continued Sales of Previous-Standard Engines

EPA finalized an averaging, banking, and trading (ABT) program in its Tier 1 rule to help engine manufacturers meet the new standards. Consistent with the NPRM for heavy-duty on-highway engines, EPA will propose to modify the existing ABT program to eliminate any limit on credit life, to eliminate any discounts in the way credits are calculated, and to make ABT available for NMHC+NOx and PM. These provisions will apply to all of the standards set forth in Section 2 except as discussed below. In recognition of the role ABT plays in facilitating the introduction of new standards, EPA will reassess the appropriateness of these provisions as part of the feasibility review discussed in Section 4. The Signatories recognize that the manufacturers have agreed to the standards set forth in this SOP on the condition that the changes that EPA will propose in the ABT program are finalized and made a part of these standards.

EPA will also propose three special provisions for the ABT program for engines rated at less than 25 hp. First, no credits generated from the sale of these engines would be allowed to be used to demonstrate compliance for engines rated above 25 hp. Second, all credits generated from the sale of Tier 1 under 25 hp engines would expire at the end of 2007. Finally, credits from the sale of Tier 1 under 25 hp engines would only be generated by engine families with family emission limits of less than 5.6 g/hp-hr (7.5 g/kW-hr) for NMHC+NOx credits and 0.60 g/hp-hr (0.80 g/kW-hr) for PM credits, and these credits would be calculated against these baseline levels rather than against the actual Tier 1 standard levels.

In addition to these ABT provisions, EPA will propose that engine manufacturers be allowed to continue to build and sell the engines needed to meet the market demand created by the equipment manufacturer flexibility program set forth above. To avoid the creation of unfair business advantages, the engine manufacturer Signatories agree that, if they decide to continue the production of such engines, they will make them available for sale at reasonable prices to all interested buyers.

Finally, EPA also will propose to allow engine manufacturers to produce unregulated, Tier 1, or Tier 2 engines, as the case may be, to meet customer needs for replacement engines, so long as manufacturers comply with the replacement engine regulations that EPA is developing.

6. Harmonization

The participants in this SOP recognize the value that harmonizing standards within the United States would have on the cost of producing engines and equipment. EPA and the California Air Resources Board will pursue harmonized standards and test procedures for nonroad engines covered by this SOP such that an engine family tested and certified by EPA could be sold in California and, similarly, an engine family tested and certified in California could be sold in the rest of the country. California acknowledges that the emission standards set forth in this SOP meet its needs for emission reductions for the engines covered by this SOP. However, if these standards should not be implemented as proposed, California's obligations to comply with State and Federal law, including its State Implementation Plan, take precedence over this SOP.

Furthermore, the global nature of the nonroad equipment and engine markets argues for maximum harmonization between the U.S. standards and test procedures and those of other nations. In particular, the European Union has developed standards very similar to EPA's Tier 1 standards and has proposed its own Tier 2 standards. The Signatories support the goal of continued harmonization and intend to work with the EU, Japan, and other regulatory bodies in developing harmonized future standards, including provisions for implementation flexibility. Harmonized standards and test

procedures will be pursued in the program developed under this SOP to the maximum extent possible, provided that these measures do not compromise the other provisions of this SOP or the primary purpose of the program, which is to meet the air quality needs of the United States.

7. Fuels and Lower Emitting Alternatives

The standards set forth above contemplate the possibility of transferring on-highway technology to nonroad engines. The Signatories recognize that: (1) on-highway engines currently are operated on higher quality fuel than nonroad engines, (2) fuel composition has a significant impact on emission performance, (3) changes in the composition and improvements in the quality of nonroad fuels may be needed to make the Tier 3 standards technologically feasible and otherwise appropriate under the Act.

A number of states and other interested parties have expressed strong interest in programs to reduce emissions from nonroad engines beyond the levels established in this SOP. These parties believe that if a program were in place to certify low emitting engines (both diesel and alternative fuel engines), a market for these engines could be created through a variety of incentives including, but not limited to, marketable emission credits and the prominent labeling of low-polluting equipment as such. This certification program would be dependent on the establishment of a test procedure which reasonably evaluates the effectiveness of these engines in achieving real in-use emissions reductions.

Therefore, EPA shall propose an optional program for the certification of very low-emitting engines. This program would include, as needed, optional test procedures and standards that would encourage the sale of engines providing benefits beyond those corresponding to the program described elsewhere in this SOP. In addition, EPA will consider other programs to encourage the use of low-emitting engines and emission-reducing fuels.

8. Durability

All Signatories recognize that it is important that emissions control be maintained throughout the life of the engine. The Signatories will work together to develop appropriate measures which ensure that emission improvements are maintained in use.

9. Certification and Compliance

All Signatories recognize that it is important to minimize the costs associated with certification and they commit to working together to streamline and simplify the certification process. Further, the Signatories acknowledge that the standards set forth

in Section 2 of this SOP are based on the assumption that there will be no changes to the enforcement program adopted as part of the Tier 1 rule, except as specifically set forth in this SOP. Finally, the Signatories also recognize that engine manufacturers will be required to undertake significant engineering challenges in relatively short time frames in order to meet the Tier 2 and Tier 3 standards including the challenge of stabilizing initial production variability. Therefore, EPA will only impose selective enforcement audits (SEA's) during the first year in which a standard is in effect for those engine families where strong evidence exists that SEA failure would be likely.

10. Research Agreement

The Signatories recognize the benefits of a joint industry/government research program with the goal of developing engine technologies which can meet and exceed the standards for nonroad engines outlined in this SOP. The Signatories will undertake development of a separate research agreement with goals of reducing NOx emissions to 1.5 g/hp-hr (2.0 g/kW-hr) and PM emissions to 0.05 g/hp-hr (0.07 g/kW-hr), while maintaining attributes of current nonroad diesel engines such as performance, reliability, durability, safety, efficiency, and compatibility with nonroad equipment. These characteristics have allowed current nonroad diesel engines to serve as the pillar of the international nonroad equipment industry. This research agreement would include certain of the industry signatories below, EPA, ARB, and other organizations, such as the U.S. Department of Energy, as are approved by the participants.

ATTACHMENT 1 -- CALIFORNIA REGULATIONS FOR NEW 1996 AND LATER OFF-ROAD COMPRESSION-IGNITION ENGINES

ATTACHMENT 2 -- AMENDMENTS TO TITLE 13, CALIFORNIA CODE OF REGULATIONS, CHAPTER 2, ARTICLES 2.1, 2.3, and 2.4; PROCEDURES FOR IN-USE VEHICLE VOLUNTARY AND INFLUENCED RECALLS; IN-USE VEHICLE ENFORCEMENT TEST PROCEDURES; AND PROCEDURES FOR REPORTING FAILURES OF EMISSION-RELATED COMPONENTS.

ATTACHMENT 3 — CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR NEW 1996-1999 HEAVY-DUTY OFF-ROAD COMPRESSION-IGNITION ENGINES, PART I-A

ATTACHMENT 4 — CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR NEW 2000 AND LATER OFF-ROAD COMPRESSION-IGNITION ENGINES, PART I-B

ATTACHMENT 5 — CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR NEW 1996 AND LATER OFF-ROAD COMPRESSION-IGNITION ENGINES, PART II

ATTACHMENT 6 — CALIFORNIA SMOKE TEST PROCEDURES FOR NEW 1996-1999 OFF-ROAD COMPRESSION-IGNITION ENGINES, PART III

ATTACHMENT 7 — AMENDMENTS TO TITLE 13, CALIFORNIA CODE OF REGULATIONS, CHAPTER 9, DIVISION 3, ARTICLE 1; SMALL OFF-ROAD ENGINES

ATTACHMENT 8 — AMENDMENTS TO CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 1995 AND LATER SMALL OFF-ROAD ENGINES

Exhibit E

Winston H. Hickox
Agency Secretary

Air Resources Board

Alan C. Lloyd, Ph.D.
Chairman
9528 Telstar Avenue • P.O. Box 8001 • El Monte, California 91731 • www.arb.ca.gov

Gray Davis
Governor

November 29, 2001

Mail Out #MSC 01-17

TO: ALL OFF-ROAD COMPRESSION IGNITION ENGINE MANUFACTURERS AND OTHER INTERESTED PARTIES

RE: REQUEST FOR INFORMATION ON THE DEVELOPMENT OF EMISSION CONTROL TECHNOLOGIES CAPABLE OF MEETING TIER 2 AND TIER 3 OFF-ROAD COMPRESSION IGNITION EMISSIONS STANDARDS AND BEYOND

The Air Resources Board (ARB) is conducting an investigation into the development of emission control technologies capable of meeting California's Tier 2 and Tier 3 off-road compression ignition (diesel) standards. As such, diesel engine manufacturers are asked to provide ARB with all technical or logistical information in their possession that could better assist ARB in evaluating industry's capabilities and the feasibility of meeting upcoming implementation schedules. Specifically, ARB is interested in learning which control technologies are favored by manufacturers and why, the levels of emission reductions achievable by these technologies regarding product lines, the expected durability and maintenance requirements for these technologies, and the costs involved with their implementation. Of particular interest to ARB is the ability of these technologies to maintain emissions at, or below, required standards throughout the engine's useful life (durability period) and over the range of commercially available fuels including Federal non-road diesel and California diesel.

Furthermore, ARB requests that engine manufacturers provide all information related to the development of NOx and PM aftertreatment technologies for the off-road sector. This information will assist ARB in assessing the potential benefits of emerging technologies, and will provide significant direction regarding off-road regulatory development in the future. ARB estimates that air quality in much of California will still be in non-attainment of Federal ambient air quality standards even after the completed phase-in of Tier 2 and Tier 3 off-road diesel engine emissions standards. As such, further methods for reducing emissions from compression ignition engines must be considered for development and introduction into the marketplace. ARB believes that diesel engine exhaust aftertreatment technologies capable of performing at levels similar to those needed to meet 2007 model year on-road heavy-duty diesel engine standards will be a necessary constituent in achieving this goal.

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our Website: http://www.arb.ca.gov.

Specific examples of the information that ARB is requesting are listed in an attachment to this letter. We request that all submissions, at a minimum, address these examples. However, additional information illustrating proprietary techniques, perspectives, and concerns are also requested. Data may be provided in any format including, but not limited to, reports, tables, graphs, charts, and presentations. Summarized analyses and conclusions, where available, will be greatly appreciated. Please be sure to mark all material of a sensitive nature as confidential. Submissions not identified as confidential may become part of the public record, and thereafter referenced in agency publications or at ARB sponsored workshops and board hearings.

ARB appreciates your assistance in this investigation. Please submit all information to the following address by Monday, December 31, 2001:

Air Resources Board
9528 Telstar Avenue
Off-Road Controls Section, Annex II
El Monte, CA 91731
Attn: Jeffrey Lowry

If you have questions or need clarification with respect to any of the requests in this letter, please contact Ms. Jackie Lourenco, Manager, or Mr. Jeffrey Lowry, Staff Air Pollution Specialist, in the Off-Road Controls Section, at (626) 575-6676 and (626) 575-6841, respectively.

Sincerely,

Michael W. Carter, Chief
Emissions Research and Regulatory Development Branch

Attachment

INFORMATION REQUEST FOR OFF-ROAD EMISSIONS TECHNOLOGIES

Please respond to the following requests by December 31, 2001. Classified information should be clearly marked on each page with the identifier "CONFIDENTIAL."

Identification of Technologies:

1) Provide a comprehensive list of all emission control technologies currently employed by your off-road product lines. Indicate whether the technologies were developed in-house, or supplied by a vendor. Identify vendors by name.

2) Provide a list of emission control technologies that your off-road product lines have, or will incorporate to meet Tier II emissions standards. Indicate whether the technologies were developed in-house, or supplied by a vendor. Identify vendors by name.

3) Provide a list of emission control technologies that your off-road product lines have, or will incorporate to meet Tier III emissions standards. Indicate whether the technologies were developed in-house, or supplied by a vendor. Identify vendors by name.

4) Provide a list of exhaust aftertreatment control technologies for particulate matter, oxides of nitrogen, and hydrocarbons, that your organization has, or is currently investigating. Indicate whether the technologies were developed in-house, or supplied by a vendor. Identify vendors by name.

Description of Technologies:

5) Provide a detailed description of all the technologies referenced above regarding functionality, operating conditions (e.g., exhaust temperature range), applicability, physical dimensions, and ease of integration into existing design packages.

6) List and describe all powertrain and chassis design changes that were/are needed to accommodate each emissions control technology.

7) Provide a corresponding list of accessory components, substances, or procedures that are needed for these technologies to function properly (e.g., NOx sensor, urea, or periodic off-board regeneration).

8) Describe maintenance procedures for each technology (if any) and the frequency of required maintenance.

9) Provide itemized cost estimates for each technology and associated accessories including component cost, R&D, etc.

Emissions Performance:

10) For each technology identified, provide test results demonstrating the level of emissions reductions that can be achieved relative to the age of the engine when new and at the end of its useful life.

11) Identify all parameters that were used to optimize emissions performance (e.g., filter loading and size, exhaust temperature, proximity of filter in exhaust stream, etc.)

12) Provide test results illustrating emissions reductions when using federal non-road diesel fuel, California diesel fuel, and low sulfur blends such as ARCO EC-Diesel fuel. Identify the concentrations of sulfur and aromatics, and the cetane number for each of the fuels tested.

13) Provide test results illustrating emissions reductions during operation on the 8 Mode (Steady-State ISO 8178-4 C1), Federal Test Procedure (FTP), Non-Road FTP, and Not-To-Exceed (NTE) driving cycles.

14) Identify and quantify any synergistic side-effects (e.g., increased NO_2 formation) resulting from the use of these technologies.

Durability Effects:

15) Provide data and/or an engineering evaluation regarding the specific impacts that the emission control technologies would have on powertrain or chassis wear.

16) Quantify the effect (if any) that each technology would have on fuel consumption.

17) Quantify the effect (if any) that each technology would have on oil consumption or oil replacement intervals.

18) Provide engine tear down and oil analyses results and records for engines with the identified emission control technologies.

Logistical Information:

19) Identify the percentage of engines in your product lines, if any, that take advantage of Tier II implementation flexibility provisions. Identify the model year(s) which correspond to the applied percentages.

20) Identify concerns related to the implementation of emission control technologies studied by your organization.

Exhibit F

State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR RULEMAKING

PUBLIC HEARING TO CONSIDER AMENDMENTS TO THE CALIFORNIA OFF-ROAD EMISSIONS REGULATION FOR COMPRESSION-IGNITION ENGINES AND EQUIPMENT

Date of Release: **October 22, 2004**
Scheduled for Consideration: **December 9, 2004**

This report has been reviewed by the staff of the California Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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EXECUTIVE SUMMARY

In January 2000, the Air Resources Board (ARB of Board) adopted amendments to the off-road emissions regulation for 2000 and later compression-ignition (diesel) engines and equipment. Those amendments established more stringent exhaust standards for particulate matter (PM), oxides of nitrogen (NOx), and non-methane hydrocarbon (NMHC) than were previously required. Furthermore, the amendments harmonized California's off-road diesel requirements with those of the United States Environmental Protection Agency (U.S. EPA). The 2000 standards, termed Tier 2 and Tier 3, are ongoing, and staff estimates that the statewide emissions inventory[1] will be reduced by 8 tons-per-day PM, 83 tons-per-day NOx, and 18 tons-per-day NMHC in 2010 because of them. The Board also adopted in-use durability requirements and an autonomous recall/warranty program in 2000 that invested California with full enforcement authority to ensure the regulatory compliance of off-road diesel engines throughout their entire useful lives.

Despite the significant improvements to air quality resulting from the Tier 2 and Tier 3 standards, many Californians are still plagued with unhealthful air. ARB estimates that over 50 percent of the State's air basins will be in violation of the federal eight hour ambient air quality standard beyond attainment due-dates if additional control measures are not undertaken to address the need for more reductions. Staff has recognized since the 2000 off-road diesel rulemaking that additional emission reductions were possible from the off-road sector with the incorporation of advanced emission control technologies.

Off-road diesel engines are similar to on-road diesel engines in design, but off-road emission control capability typically lags behind on-road capability. This is because of the added complexity in designing systems that will function reliably for the many different applications of off-road diesel engines. However, with cleaner standards now required for heavy-duty on-road diesel engines beginning in 2007 (ARB 2001), staff believes the time is appropriate to set similar standards for California's off-road diesel engines.

This report presents staff's proposal to amend existing regulations to harmonize with the requirements published by U.S. EPA in the Federal Register on June 29, 2004, to achieve a greater degree of emission reductions from non-preempt off-road diesel engines. The federal Clean Air Act preempts California from setting emission standards for new off-road engines rated less than 130 kilowatts (kW) used in farm or construction equipment ("preempt engines"). Because of this, staff worked diligently with U.S. EPA to develop a fourth tier (Tier 4) of emissions standards that would ensure the most stringent, technologically feasible standards for all of California's off-road diesel engines. The resulting federal Tier 4 standards are based on the use of advanced aftertreatment technologies, which will reduce PM and NOx emissions from new engines by up to 95 percent compared to previous emission requirements. This represents a significant

[1] Estimated 2010 benefits are based on July, 2004, off-road emissions inventory data, and may differ from earlier calculations.

reduction in emissions for California's preempt engines, which will constitute 71 percent of the entire off-road diesel population in 2020.

Staff's proposal to harmonize with the federal Tier 4 requirements would provide equally stringent standards for the remaining non-preempt engines in California. This would also preserve California's authority to ensure timely compliance and to enforce the regulation as necessary for these engines. Furthermore, harmonization serves the interest of the off-road industry in that resources would not have to be invested to comply with separate State and federal requirements.

In addition to the emissions standards, this proposal also mirrors other aspects of the adopted federal rule including requirements for not-to-exceed (NTE) limits, incentives to engine and equipment manufacturers for the early introduction of engines with advanced aftertreatment, new test procedures and test cycles, enhanced in-use compliance provisions, and transitional compliance assistance for engine and equipment manufacturers. As a package, these requirements would help assure that the air quality benefits of the proposed standards are achieved and that engines remain cleaner in-use longer. The harmonization of compliance programs such as averaging, banking, and trading, and equipment manufacturer flexibility should help to ease any administrative burdens and allow industry to maintain focus on the technical aspects of emission reductions.

Staff's proposal also supplements the federal rule in a few small, but important ways intended to provide additional safeguards for a more identifiable and enforceable deployment of flexibility allowances in California. To minimize the potential for abuse, staff proposes more descriptive labeling content requirements for flexibility engines to facilitate their identification by ARB inspectors and to provide a clear reference to original certification standards in the cases of rebuilding or repair. Staff also proposes to keep its autonomous in-use warranty/recall program to better address violations of the requirements from a California perspective. Neither of these changes is expected to encumber compliance nor incur additional implementation costs.

In 2020, the combined statewide benefits of staff's proposal and the federal rule would be approximately 6.9 tons per day PM, 72.8 tons per day NOx, and 3.0 tons per day NMHC, based on ARB's current off-road emissions inventory modeling. The estimated California cost-effectiveness associated with adoption of staff's proposal would be approximately $0.58 per pound of combined NMHC and NOx reduced, and $7.55 per pound of PM reduced. These estimates are based on the federal calculation of cost-effectiveness, appropriately adjusted to reflect what California's costs would be without harmonization. In actuality, however, there are no costs to the State associated with staff's proposal since U.S. EPA's estimates already include California's expenses. Based on these conclusions, staff recommends that the Board adopt this proposal.

1. INTRODUCTION

Compression-Ignition engines (hereafter "diesel engines") are used in a variety of off-road applications, and are often the preferred choice where durability and fuel economy are primary considerations. Some familiar examples include tractors, excavators, portable generators, transport refrigeration units (TRUs), irrigation pumps, welders, compressors, scrubber/sweepers, and a wide array of other agricultural, construction, and general industrial equipment. Although diesel engines are used extensively to propel other off-road equipment such as locomotives and commercial marine vessels, engines in those applications are not considered under this proposal.

The Air Resources Board (ARB or Board) and the United States Environmental Protection Agency (U.S. EPA) have made significant strides in controlling air pollution from off-road sources in recent years. Together, the two agencies have adopted three tiers of increasingly stringent emissions standards for off-road diesel engines (referred to as "nonroad diesel engines" in U.S. EPA publications). The first tier began in California in 1995 and the third tier will be phased-in across all applicable power categories by 2008. Despite these efforts, many regions of the State still suffer from unhealthy levels of air pollution.

To further improve California's air quality, and as agreed upon according to the settlement agreement amendments to the 1994 Ozone State Implementation Plan (SIP) (see subsection 3.3), staff is proposing that the Board adopt a fourth tier (Tier 4) of exhaust emission standards for off-road diesel engines in California. This is a crucial next step for improving air quality, where further reductions of particulate matter (PM) and ozone precursors are required to protect public health and to comply with federal and State air quality standards for ozone.

However, the federal Clean Air Act (CAA) Amendments of 1990 preempt California from regulating exhaust emissions from new farm and construction equipment under 130 kilowatts (kW), and ARB must rely on U.S. EPA to establish effective regulations for these preempt engines, which are a significant source of emissions in California. In 2020, approximately 71 percent of the roughly 560,000 land-based diesel engines in California will be under the exclusive regulatory authority of the federal government. This would be equivalent[2] to the ozone precursor emissions from 3.6 million passenger cars and the particulate emissions from 8.7 million passenger cars in 2020.

On May 11, 2004, the U.S. EPA Administrator, Michael Leavitt, signed the Clean Air Nonroad Diesel Rule into law, which promulgates Tier 4 standards for new nonroad diesel engines that can reduce emissions by up to 95 percent compared to previous standards

[2] The comparisons utilize data from the off-road diesel emissions inventory database (May 2004) and the EMFAC2002 V2.2 04-03-2003 on-road model

(69 Fed. Reg. 38958 (2004)). These new standards are based on the same advanced exhaust aftertreatment technologies that are likely to be utilized by heavy-duty on-road diesel engines beginning in 2007 (U.S. EPA 2001). U.S. EPA also adopted improved certification provisions including a transient test cycle, which will allow emission evaluations to be made under more appropriate engine operating conditions, and Not-To-Exceed (NTE) limits to verify emissions performance in-use. Staff's proposal harmonizes with the federal Tier 4 program, while maintaining ARB's enforcement authority to ensure timely compliance and emission reductions. Adoption of this proposal by the Board would provide equally stringent emission standards for California's non-preempt portion of engines.

This report has twelve sections. The Introduction and Background provide an overview and brief historical account of previous and existing emission control measures affecting the off-road diesel sector in California. Following those discussions is the Need for Control section, which explains why the proposed requirements are necessary. This is followed by a Summary of staff's proposal and a description of the Differences between the California and federal programs. Next is a discussion on Technology and Feasibility. The Environmental Impacts and Cost-Effectiveness of the proposal are discussed in the section after that, followed by the proposal's Economic Impacts and the Regulatory Alternatives considered. This is again followed by a discussion of Remaining Issues that arose during the development of the proposal. Staff's Conclusions and Recommendations are then summarized, followed by a list of the References used in this report.

2. BACKGROUND

This section provides a description of California's authority, existing off-road diesel regulations, emissions inventory, U.S. EPA programs, and the steps taken to inform the public about staff's proposal to amend the regulations.

2.1. Authority

California is the only State allowed to adopt emission requirements that are different from those of the federal government. This is appropriate since California has the worst air quality in the nation[3], and as such, has special emission control needs that may not be necessary for the rest of the country. The following subsection provides reference to the applicable legal citations that give California this authority.

Section 209(e)(2)(A) of the federal CAA authorizes California to adopt and enforce emission standards, and other requirements, for off-road engines and equipment, not

[3] The South Coast and San Joaquin Valley Air Basins, for example, are the only areas in the nation designated by U.S. EPA as "severe-17" and "extreme" zones for ozone non-attainment, respectively. This is based on 8-hour assessments in 40 CFR 81.305, http://www.epa.gov/ozonedesignations/part81r8c.pdf, dated June 15, 2004.

subject to federal preemption, so long as the California standards "will be, in the aggregate, at least as protective of public health and welfare as applicable Federal standards." California must apply for, and receive authorization from the U.S. EPA before federal requirements are waived and ARB may enforce its regulations.

In 1988, the State Legislature enacted the California Clean Air Act (CCAA), which declared that attainment of State ambient air quality standards is necessary to promote and protect public health, particularly the health of children, the elderly, and those with respiratory illness. The Legislature also directed that these standards be attained by the earliest practicable date.

Health and Safety Code (HSC) sections 43013 and 43018 authorize and direct ARB to achieve the maximum feasible and cost effective emission reductions from all mobile source categories, including off-road diesel engines and equipment.

2.2. Preemption

Along with authorizing California to set emissions standards for off-road engines and equipment, the federal CAA also prohibits the states, including California, from regulating certain types of engines and equipment. Section 209(e)(1)(A) of the federal CAA explicitly preempts California from regulating emissions from new farm and construction engines and equipment under 130 kW ("preempt engines").

Because only the U.S. EPA has authority to establish emission standards for preempt engines, ARB staff took an active role in working with U.S. EPA to develop a national emissions program that would cover those off-road diesel engines in California that ARB cannot regulate. Staff's proposal covers the remaining non-preempt engines, and harmonizes with the federal rule, to the extent feasible, to minimize any confusion and expenses that could result from significantly different State and federal requirements. A list of equipment types that are subject to federal preemption is included at the end of this report in Appendix A ("List of Preempted Off-Road Applications").

As required under CAA section 209(e)(2)(A), ARB will request U.S. EPA authorization for the adoption and enforcement of standards and other requirements relating to the control of emissions from non-preempt engines. Because ARB's proposed regulations closely mirror the federal requirements for these engines, staff believes they would be, in the aggregate, at least as protective of public health and welfare as the applicable federal Tier 4 standards. Further, because the emission reductions from these proposed regulations are necessary to meet the State's air quality commitments, staff's proposal would not be considered arbitrary or capricious.

2.3. Existing Regulations

Federal requirements notwithstanding, there are currently three tiers of increasingly

stringent emission standards required for off-road diesel engines. Particulate matter (PM), oxides of nitrogen (NOx), non-methane hydrocarbons (NMHC), and carbon monoxide (CO) are the pollutants regulated by these requirements, though not always collectively. Off-road standards are unique in that they vary according to an engine's power rating, and have been implemented in stages rather than all at once in a single year. NMHC and NOx are usually combined into a single standard due to the inverse reciprocal relationship of those pollutants in untreated exhaust. However, separate NMHC and NOx standards will be necessary to support the advent of aftertreatment on off-road engines. The history and effects of the existing off-road diesel standards are briefly discussed in the following subsection.

2.3.1. Tier 1 Standards

The very first emission standards for new off-road diesel engines were adopted for engines less than 19 kW as part of the California requirements for 1995 and later small off-road engines (ARB 1994). Subsequently, in 1992, the Board approved standards for off-road diesel engines 130 kW and greater. These standards, which were implemented beginning in 1996, targeted NOx emission reductions without an increase in NMHC or PM emissions. The 130 kW boundary was chosen to avoid preemption issues in the implementation of the regulation rather than for technical or cost-effectiveness reasons.

The goal of initial off-road diesel control was to reduce emissions using the most feasible control technologies that would not require a need to change the packaging (shape) of the engine (ARB 1991). The majority of engine modifications that have been made to comply with the Tier 1 standards are fuel injector and fuel injection timing changes, combustion chamber enhancements, and the incorporation of engine after-coolers. Tier 1 has resulted in approximately a 50 percent drop in NOx emissions compared to previously uncontrolled off-road diesel engines of similar power. Following ARB's adoption of initial standards, U.S. EPA promulgated a substantially similar program for engines 37 kW and greater (see 40 CFR 89).

2.3.2. Tier 2 Standards

In 1992, the Board also adopted a second phase of more stringent emission standards for engines 130 = kW = 560 to begin in 2000. However, in 1998, U.S. EPA promulgated a slightly different version of California's 2000 standards plus a third, more stringent phase of emission standards to be implemented starting in 2006 (U.S. EPA 1998). To honor the Statement of Principles (SOP)[4] agreement, ARB went back to the Board in 2000 to fully align California's standards and implementation schedules with U.S. EPA's requirements (ARB 1999). Engines greater than 560 kW became applicable under the harmonized

[4] An agreement signed in 1995 by ARB, U.S. EPA, and engine manufacturers that called for the creation of multiple tiers of more stringent emissions standards in exchange for harmonized California and federal regulations, as feasible.

regulation in 2000, and the more stringent standards served to address ARB's 1994 State Implementation Plan (SIP) commitments.

Current Tier 2 requirements, as they have come to be referred, are scheduled to be completely phased-in by 2006, and encompass the entire power spectrum of diesel off-road engine applications including those above 560 kW and those under 19 kW. Tier 2 standards were originally intended to be equivalent in stringency to the 1991 on-road heavy-duty diesel engine standards, and are based on the emission control technologies used by those engines. The harmonized Tier 1 and Tier 2 standards included durability provisions[5] to ensure that the standards would continue to be met throughout the useful life of the engine. Fuel injection timing and combustion refinements, turbo/super charging, and air-to-air after-cooling have been the primary engine changes needed by most manufacturers to comply with the Tier 2 standards. This has resulted in tailpipe reductions of 21 to 39 percent for NMHC+NOx with respect to the previous Tier 1 standards, and 41 to 61 percent for PM for power categories that were previously uncontrolled.

2.3.3. Tier 3 Standards

Tier 3 off-road diesel standards are scheduled to begin in 2006 and are applicable to engines 37 = kW = 560. They will reduce NMHC+NOx emissions for most power categories by an additional 40 percent compared to existing Tier 2 standards. However, Tier 3 will not reduce PM emission levels beyond existing Tier 2 levels.

Some off-road diesel engines will comply with Tier 3 requirements in 2005, one year earlier than required by regulation. It was discovered that certain engine manufacturers were designing on-road diesel engines in the latter 1990s that intentionally circumvented emission requirements when operated outside the region of a certification test cycle, or off-cycle. Emissions were low when tested, but calibrations changed during off-cycle operation to favor better fuel economy at the expense of higher emissions. To avoid recalling engines with these "defeat devices", the engine manufacturers reached a settlement agreement with ARB and U.S. EPA in which they committed to a number of projects to advance the causes of improved air quality. One of the projects agreed upon in the consent decree/settlement agreement is for certain engine manufacturers to advance the introduction of Tier 3 compliant engines. To satisfy this commitment, those diesel engine manufacturers are obligated to implement the Tier 3 standards on engines rated between 225 and 560 kW, inclusive, in 2005 instead of 2006.

The control technologies that engine manufacturers are likely to use to comply with Tier 3 requirements will be enhanced combustion techniques including variable-timing overhead valve configurations, higher pressure fuel injection, exhaust gas recirculation (EGR), lean burn catalysts, and electronic engine management systems. More advanced

[5] Durability provisions were not retroactively applied to Tier 1 engines, only to those rated less than 37 kW after the 2000 model year.

aftertreatment technologies are not expected to be used to comply with the Tier 3 requirements because most of these technologies are sensitive to sulfur, and diesel fuel with less than 15 parts-per-million sulfur by weight (ppmw) for the off-road sector will not be available nationally until 2010 (USEPA 2004), although it will be available in California in 2006. Tables 2.1 - 2.3 below show the current California off-road diesel standards.

Table 2.1
Off-Road Diesel Exhaust Standards < 37kW
SORE, Tier 1, and Tier 2

POWER CATEGORY	DURABILITY PERIOD	STANDARD [1]	MODEL YEAR	NMHC+NOx	NMHC	NOx	CO	PM
				grams per kilowatt-hour [grams per brake horsepower-hour]				
kW < 8 [hp < 11]	NONE	SORE	1995	16/13.4 [2] [12/10]	—	—	402 [300]	1.2 [0.90]
			1996 - 1999		—	—	469 [350]	
	3000 HOURS OR 5 YEARS	Tier 1	2000 - 2004	10.5 [7.8]	—	—	8.0 [6.0]	1.0 [0.75]
		Tier 2	2005 - 2007	7.5 [5.6]	—	—		0.80 [0.60]
8 = kW < 19 [11 = hp < 25]	NONE	SORE	1995	16/13.4 [2] [12/10]	—	—	402 [300]	1.2 [0.90]
			1996 - 1999		—	—	469 [350]	
	3000 HOURS OR 5 YEARS	Tier 1	2000 - 2004	9.5 [7.1]	—	—	6.6 [4.9]	0.80 [0.60]
		Tier 2	2005 - 2007	7.5 [5.6]	—	—		
19 = kW < 37 [25 = hp < 50]	5000 HOURS OR 7 YEARS [3]	Tier 1	2000 [4] - 2003	9.5 [7.1]	—	—	5.5 [4.1]	0.80 [0.60]
		Tier 2	2004 - 2007	7.5 [5.6]	—	—		0.60 [0.45]

Notes:
1 Standards that first become applicable in 2000 or later do not apply to engines less than 50 cubic centimeters in displacement
2 Small off-road engine standards are subdivided by engine displacement - Class I (65 = cc < 225) and Class II (cc = 225), respectively
3 The durability period for constant speed engines rated = 3,000 rpm is 3,000 hours or 5 years, whichever occurs first
4 The federal Tier 1 standards for this power category began in 1999

Table 2.2
Off-Road Diesel Exhaust Standards 37 = kW < 225
Tier 1, Tier 2, and Tier 3

POWER CATEGORY	DURABILITY PERIOD	STANDARD	MODEL YEAR	NMHC+NOx	NMHC	NOx	CO	PM
				grams per kilowatt-hour [grams per brake horsepower-hour]				
37 = kW < 56 [50 = hp < 75]	8000 HOURS OR 10 YEARS	Tier 1	2000 [5] - 2003	—	—	9.2 [6.9]	—	—
		Tier 2	2004 - 2007	7.5 [5.6]	—	—	5.0 [3.7]	0.40 [0.30]
		Tier 3 [6]	2008 - 2011	4.7 [3.5]	—	—		
56 = kW < 75 [75 = hp < 100]	8000 HOURS OR 10 YEARS	Tier 1	2000 [5] - 2003	—	—	9.2 [6.9]	—	—
		Tier 2	2004 - 2007	7.5 [5.6]	—	—	5.0 [3.7]	0.40 [0.30]
		Tier 3	2008 - 2011	4.7 [3.5]	—	—		
75 = kW < 130 [100 = hp < 175]	8000 HOURS OR 10 YEARS	Tier 1	2000 [7] - 2002	—	—	9.2 [6.9]	—	—
		Tier 2	2003 - 2006	6.6 [4.9]	—	—	5.0 [3.7]	0.30 [0.22]
		Tier 3	2007 - 2011	4.0 [3.0]	—	—		
130 = kW < 225 [175 = hp < 300]	8000 HOURS OR 10 YEARS	Tier 1	1996 - 2002	—	1.3 [1.0]	9.2 [6.9]	11.4 [8.5]	0.54 [0.40]
		Tier 2	2003 - 2005	6.6 [4.9]	—	—	3.5 [2.6]	0.20 [0.15]
		Tier 3	2006 - 2010	4.0 [3.0]	—	—		

Notes:

5 The federal Tier 1 standards for this power category began in 1998

6 Manufacturers may optionally certify engine families to the interim Tier 4 standards for this power category through 2012

7 The federal Tier 1 standards for this power category began in 1997

Table 2.3
Off-Road Diesel Exhaust Standards = 225 kW
Tier 1, Tier 2, and Tier 3

POWER CATEGORY	DURABILITY PERIOD	STANDARD	MODEL YEAR	NMHC+NOx	NMHC	NOx	CO	PM
				grams per kilowatt-hour [grams per brake horsepower-hour]				
225 = kW < 450 [300 = hp < 600]	8000 HOURS OR 10 YEARS	Tier 1	1996 - 2000	—	1.3 [1.0]	9.2 [6.9]	11.4 [8.5]	0.54 [0.40]
		Tier 2	2001 - 2004	6.4 [4.8]	—	—	3.5 [2.6]	0.20 [0.15]
		Tier 3	2006 [6] - 2010	4.0 [3.0]	—	—		
450 = kW = 560 [600 = hp = 750]	8000 HOURS OR 10 YEARS	Tier 1	1996 - 2001	—	1.3 [1.0]	9.2 [6.9]	11.4 [8.5]	0.54 [0.40]
		Tier 2	2002 - 2004	6.4 [4.8]	—	—	3.5 [2.6]	0.20 [0.15]
		Tier 3	2006 [6] - 2010	4.0 [3.0]	—	—		
kW > 560 [hp > 750]	8000 HOURS OR 10 YEARS	Tier 1	2000 - 2005	—	1.3 [1.0]	9.2 [6.9]	11.4 [8.5]	0.54 [0.40]
		Tier 2	2006 - 2010	6.4 [4.8]	—	—	3.5 [2.6]	0.20 [0.15]

Notes:
6 Certain manufacturers are required to comply with these standards beginning in 2005 per the consent decree settlement agreement

2.4. Emissions Inventory

The emissions data referenced in this subsection were obtained from the publicly available 2004 California Almanac of Emissions and Air Quality[6] and the off-road emissions inventory database. Brake dust and tire wear, although significant sources of PM, are not included in the following analyses since the focus of this report is on exhaust emissions. The reactive organic gas (ROG[7]) component of hydrocarbon emissions from evaporative losses is also not included in the comparisons for the same reason. The analyses do not reflect the inclusion of federal or ARB proposed Tier 4 standards. Tier 4 emission benefits will be identified during the discussion on environmental impacts in subsection 7.1.1 of this

[6] Almanac data can de downloaded at http://www.arb.ca.gov/aqd/almanac/almanac04/almanac04.htm.
[7] The terms "ROG" and "NMHC" are used synonymously in this report to represent the component of hydrocarbon most likely to form ozone. The pie chart comparisons are expressed in units of ROG to reflect inventory modeling parameters, and standards are expressed in units of NMHC.

report. All emission estimates are statewide and annual averages. Figures 2.1, 2.2, and 2.3, below, show the relative contributions of the three categories of mobile emission sources.

Figure 2.1 Mobile ROG

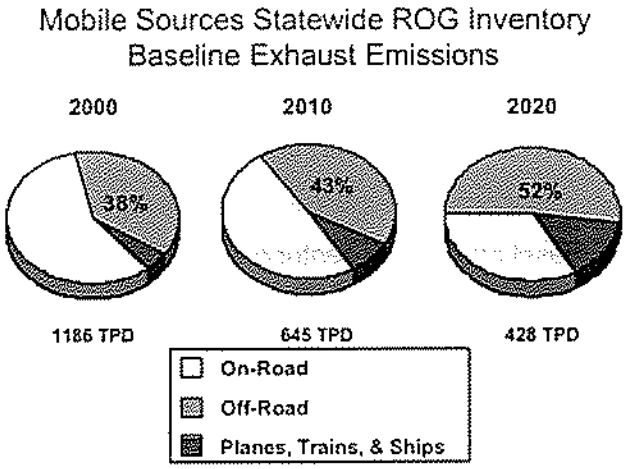


Figure 2.2 Mobile NOx

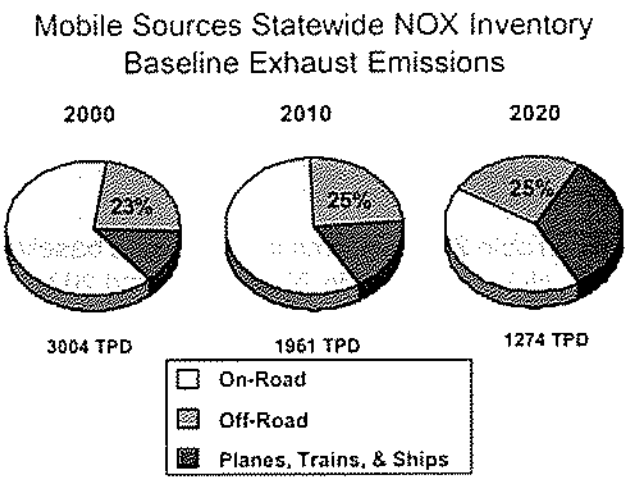
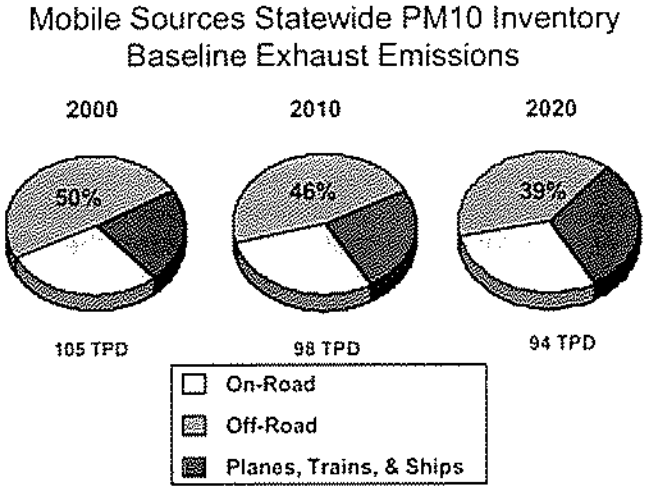


Figure 2.3 Mobile PM



Although the mobile source emissions inventory is decreasing overall as a result of State and federal regulations, the figures show that both ROG and NOx resulting from the use of land-based off-road engines (hereafter "off-road engines"[5]) generally become a greater

[5] The off-road estimates include recreational marine engines, but not trains, planes, or commercial ships.

portion of the remaining emissions through calendar year 2020. The PM[9] percentage decreases, but off-road engines remain a significant source of PM from all mobile sources at 39 percent in 2020. Increased off-road activity and more stringent control of on-road heavy-duty trucks are largely responsible for the trends in ROG and NOx. Flat sales of agricultural equipment and the lack of comparably stringent standards for planes, trains, and ships explain the trend for PM.

Though not shown[10] in the figures above, off-road diesel engines are projected to account for 20 percent (249 TPD) of the total mobile source inventory for NOx and 18 percent (17.3 TPD) of the total mobile source inventory for PM in 2020. They are also projected to make up 36 percent of the total statewide inventory of PM that occurs exclusively from diesel exhaust, or diesel PM, in 2020.

Table 2.4 compares the statewide baseline off-road diesel emission inventories for PM, NOx, and ROG in 2000, 2010, and 2020. These baseline estimates include the effects of State and federal requirements through Tier 3; however, they do not include emissions from locomotives, airplanes, or marine engines. The baseline data also reflect PM benefits resulting solely from the use of 15 ppmw sulfur diesel fuel in California after 2006. ARB estimates that direct diesel particulate matter emissions, due to the low-sulfur fuel alone, would be reduced by about four percent due to the lower engine-out formation of sulfates (ARB 2003). This would include virtually all off-road diesel engines currently produced and those expected to be produced without advanced particulate emission control technologies.

Table 2.4 also shows the contribution of emissions from off-road diesel engines categorized into groups that can and cannot be regulated by California. The number of non-preempt engines -- those that ARB can regulate -- varies slightly from year to year due to fluctuations in consumer demand, but on the whole it is roughly 29 percent of the total number of off-road diesel engines in California. However, emissions do not necessarily follow the population fraction. For example, non-preempt NOx emissions exceed the population fraction and account for approximately 40 percent of the NOx inventory attributed to all off-road diesel engines in the State. Furthermore, non-preempt engines are projected to be responsible for the majority of NOx and NMHC emission reductions. This is discussed in greater detail in subsection 7.1.1.

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[9] PM and PM10 are virtually the same component in diesel exhaust; therefore, the terms are used synonymously in this report.

[10] The NOx and PM percentages were obtained by comparing the 2020 off-road diesel data in Table 2.4 with the 2020 total mobile sources inventory data in Figures 2.2 and 2.3. The total statewide inventory percentage contribution of PM from off-road diesel engines in 2020 was calculated using the off-road diesel data in Table 2.4 and an assessment of 47.4 tons per day total statewide diesel exhaust PM from the 2004 California Almanac of Emissions and Air Quality.

Table 2.4
Off-Road Diesel Baseline Emission Inventories
Statewide Annual Averages

Government Jurisdiction	Pollutant	Emissions Inventory (tons per day)		
		2000	2010	2020
California Authority Non-Preempt Engines	PM [1]	11.6	7.1	5.1
	NOx	236.1	157.2	101.0
	ROG	23.5	13.4	9.6
Federal Authority Preempt Engines	PM [1]	27.6	21.9	12.2
	NOx	352.4	251.3	148.0
	ROG	51.3	33.6	15.3
Total	PM [1]	39.2	29.0	17.3
	NOx	588.5	408.5	249.0
	ROG	74.8	47.0	24.9

Notes:
1 PM estimates have been adjusted to reflect 15 ppmw sulfur fuel reductions after 2006

2.5. Federal Rules

In addition to the diesel Tier 1, Tier 2, and Tier 3 regulations already mentioned, U.S. EPA promulgated Tier 4 emissions standards on June 29, 2004 (see "Control of Emissions from New and In-Use Nonroad Diesel Engines," (40 CFR 1039, Subpart U)). The new emission standards are based on the same advanced exhaust aftertreatment technologies likely to be employed by heavy-duty diesel on-road engines beginning in 2007. ARB is proposing to adopt the federal Tier 4 standards for non-preempt off-road diesel engines in California. The federal rule also contains a two step requirement to reduce the level of sulfur in nonroad diesel fuel, first to 500 ppmw in 2007 and then to 15 ppmw in 2010. California has already adopted a 15 ppmw sulfur diesel fuel program for California that starts in 2006.

U.S. EPA has also adopted a rule that sets emissions standards similar to nonroad diesel Tier 2 standards for recreational marine engines rated equal to and above 37 kW (see "Control of Air Pollution from Marine Diesel Engines," 40 CFR 94). Recreational marine diesel engines less than 37 kW have previously been controlled to the same standards as land-based diesel engines, and are commonly included in the emissions estimates for off-road land-based diesel engines. Additional standards for these engines may be

considered in a separate rulemaking.

2.6. Public Process

On November 29, 2001, ARB solicited input from off-road engine manufacturers and other stakeholders regarding the development of advanced aftertreatment technologies for off-road diesel engines in ARB Mailout MSC 01-17. The purpose of this request was to learn how far the technologies had progressed and to understand industry's concerns regarding implementation, timing, and durability.

ARB held public discussions regarding future off-road diesel standards at the Clean Air Plan workshop and SIP Summit in Sacramento, CA, between February, 2002, and January, 2004.

The Executive Officer of the ARB, Catherine Witherspoon, testified at two U.S. EPA hearings on June 10, and June 17, 2003, regarding U.S. EPA's then proposed Tier 4 rulemaking and ARB's intention to align with its provisions.

On August 23, 2004, staff posted a letter to the ARB website[11] stating ARB's intent to adopt standards for California's off-road diesel engines at the December 9, 2004, Board Hearing that would harmonize with U.S. EPA's Tier 4 standards. An electronic announcement was sent to all subscribers of the Mobile Source List Serve that same day to inform all interested parties that the letter had been posted.

3. NEED FOR CONTROL

This section provides the rationale behind ARB's proposal for more stringent exhaust standards and test procedures.

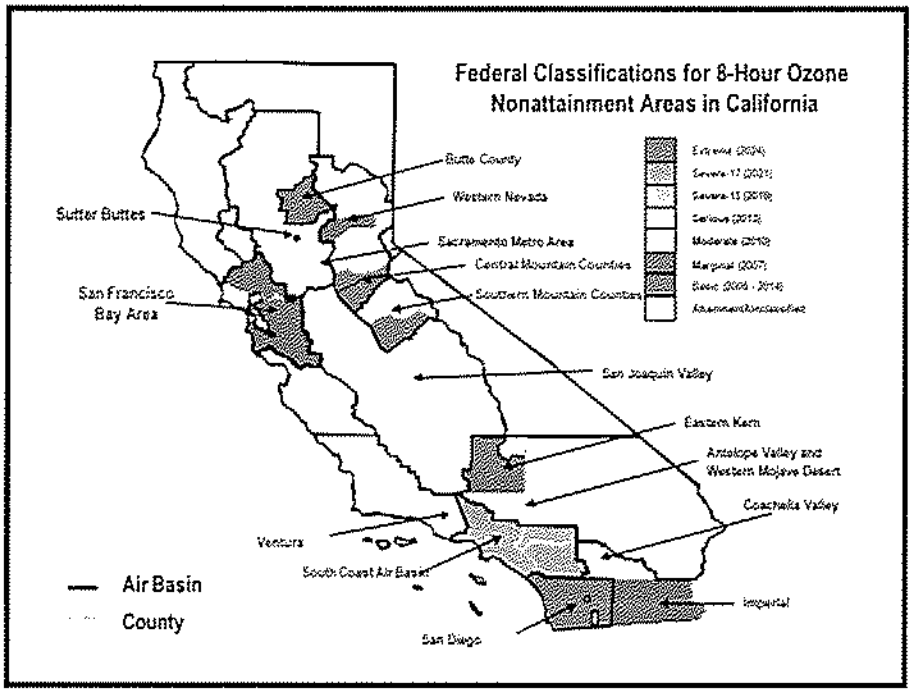
3.1. Overview

The emission standards being proposed would significantly reduce the human health and environmental impacts of PM and ground-level ozone. This section summarizes the air quality rationale for the proposed new standards.

Figure 3.1 below identifies air basins and counties that are in non-attainment with the recently adopted federal eight-hour standard for ozone.

[11] http://www.arb.ca.gov/msprog/offroad/orcomp/orcomp.htm/intentletter08232004.pdf

Figure 3.1
Eight Hour Ozone Non-Attainment Areas in California



Over 50 percent of California's air basins fall within this designation. Mobile sources presently[12] account for 68 percent of the total ozone precursors statewide (including evaporative emissions[13]), and the exhaust from off-road diesel engines is responsible for 20 percent of the NOx from all mobile sources, and 33 percent of the total NOx contribution from diesel mobile sources exclusively.

3.2. Diesel Exhaust

In order to start a diesel engine, finely misted fuel is injected, directly, or indirectly via a prechamber, into the engine's cylinder(s) with air that has been heated by piston compression. The power output of the engine is controlled by regulating the amount of fuel injected, unlike spark-ignition engines, which generally increase or decrease power by regulating the amount of air entering the engine. The heat of the compressed air in a diesel engine evaporates the fuel, which then ignites as it mixes with oxygen under high temperature and pressure inside the cylinder(s). Diesel fuel typically has a much higher sulfur content than gasoline, currently 140 ppmw on average in California (ARB 2003), and a lower evaporation rate making it suitable in diesel applications. Diesel engines operate best under lean air/fuel ratios (more air than fuel), which leaves behind excess oxygen.

[12] Estimates are for the 2003 calendar year.
[13] Evaporative emissions are included in this comparison because it includes all mobile and statewide sources, not just exhaust.

The pollutants of most concern in diesel exhaust are PM and NOx. NMHC and CO are also present, but are not emitted at comparably high levels due to their propensity to oxidize in the combustion chamber with abundant oxygen. The low evaporation rate of diesel fuel also helps in relegating evaporative emissions to insignificant levels.

3.2.1. Particulate Matter

Particulate matter from diesel exhaust is made primarily of four components:

- solid carbon soot,
- volatile and semi-volatile organic matter,
- inorganic solids (ash), and
- sulfate.

The formation of the solid carbon soot portion of PM is inherent in diesel engines due to the heterogeneous distribution of fuel and air in a diesel combustion system. Diesel combustion is designed to allow for lean combustion (excess oxygen) giving good efficiencies and low CO and NMHC emissions, with a small region of rich (excess fuel) combustion within the fuel injection plume. It is within this excess fuel region that PM is formed when high temperatures and a lack of oxygen cause the fuel to pyrolize[14], forming soot. Much of the soot formed in the engine is burned during the combustion process as the soot is mixed with oxygen in the cylinder at high temperatures. Any soot that is not fully burned before the exhaust valve is opened will be emitted from the engine as diesel PM.

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

The inorganic solids (ash) in diesel PM come primarily from metals found in engine oil and, to a certain extent, from engine wear. Ash makes up a very small portion of total PM such that it is often not listed as a PM component and has no impact on compliance with PM emission standards. However, it does impact the maintenance of PM filter technologies because, in aggregate over a very long period of time, ash accumulation in the PM filter can reach a level such that it must be cleaned from the filter.

The sulfate portion of diesel PM is formed from sulfur present in diesel fuel and engine lubricating oil that oxidizes to form sulfuric acid, and then condenses in the atmosphere to

[14] Pyrolization is the process of using high temperature in an anaerobic environment to break down organic matter and release volatile organic products.

form sulfate PM. Approximately two percent of the sulfur that enters a diesel engine from the fuel is emitted directly from the engine as sulfate PM. The balance of the sulfur content is emitted from the engine as SO2 (RIA4 2004).

3.2.1.1. NOx Relationship

In addition to directly-emitted PM, secondary nitrate (a.k.a. indirect) PM accounts for a substantial fraction of the airborne particulate matter in some areas of California. This type of PM consists primarily of ammonium nitrate and represents about 25 percent of measured PM10 in the Los Angeles Basin (U.S. EPA 1997). Fine secondary nitrate particles are produced in the atmosphere from the NOx emitted by diesel engines and other sources. ARB believes that the control of secondary nitrate PM will be critical in meeting California's air quality attainment goals for the future.

3.2.1.2. Health Issues

The need for lower emission standards to protect public health, especially with respect to diesel PM, has prompted regulatory efforts throughout the world. Since virtually all particles in diesel particulate matter are 10 microns or less in diameter (PM10), with approximately 94 percent of them less than 2.5 microns in diameter (PM2.5), diesel particulate matter is readily respirable and can effectively reach the lowest airways of the lungs along with adsorbed compounds that are known as, or suspected of being, mutagens and carcinogens (SRP 1998). Accordingly, both ARB and U.S. EPA have identified diesel PM as a likely human carcinogen. Exposure to respirable diesel PM is associated with lung cancer, acute respiratory infection, exacerbation of asthma, increased hospital admissions, and an increase in mortality among the elderly and those with chronic heart and lung disease.

The estimated health risk from diesel PM is higher than the risk from all other toxic air contaminants combined. ARB estimates that 70 percent of the known statewide cancer risk from outdoor air toxics is attributable to diesel PM (Almanac 2004). Statewide, the estimated average lifetime potential cancer risk associated with diesel PM emissions is approximately 540 extra cases per million people[15], or 250 extra cases per year (Almanac 2004 and RRP 2000). In the South Coast Air Basin, the potential lifetime cancer risk associated with diesel PM emissions is estimated to be 720 extra cases per million people[16] (Almanac 2004), or approximately 150 extra cases per year (Almanac 2004 and Census 2000). Communities that adjoin busy roads and freeways, distribution centers, and other locations with large concentrations of diesel engines are particularly at risk.

Health impacts from exposure to the fine particulate matter component of diesel exhaust, PM2.5, have been calculated for California, using concentration-response equations from

[15] These potential risk rates are based on 1.8 ug/m^3 average ambient PM concentration and are averaged over a 70 year lifespan.

[16] This estimate is for calendar year 2000 and distributes the risk over an average lifespan of 70 years.

several epidemiological studies (Lloyd & Cackette 2001). Both mortality and morbidity effects could be associated with exposure to either direct diesel PM2.5 or indirect diesel PM2.5, the latter of which arises from the conversion of diesel NOx emissions in the atmosphere to PM2.5 nitrates.

In California, the average population weighted exposure to directly emitted diesel PM2.5 is 1.8 micrograms per cubic meter (µg/m3). Long-term exposure to ambient concentrations of diesel PM2.5 at this level is estimated to have led to a range of about 2,000 to 2,500 premature deaths, statewide, for the year 2000. Indirect diesel PM2.5 (at 0.81 µg/m3 concentration level) is also estimated to contribute to an additional 900 premature deaths, although the mortality estimates may include some premature deaths due to cancer, because the epidemiological studies did not identify the cause of death.

Exposure to fine particulate matter, including diesel PM2.5, can also be linked to a number of heart and lung diseases. For example, it was estimated that statewide, on average, 2500 hospital admissions for chronic obstructive pulmonary disease, pneumonia, cardiovascular disease, and asthma were associated with exposure to direct diesel PM2.5. An additional 1,100 admissions were linked to exposure to indirect diesel PM2.5.

Staff's proposal, discussed in detail in subsection 4.2.1, will require PM reductions up to 95 percent more than currently required for new off-road diesel engines.

3.2.2. Ozone

Ground-level ozone is created by the photochemical reaction between NOx and ROG. Breathing ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, shortness of breath, and congestion. It can worsen bronchitis, emphysema, and asthma. Ozone can also reduce lung function and inflame the linings of the lungs. Repeated exposure may permanently scar lung tissue.

The elderly, children, and people with compromised respiratory systems are among those persons who may be most affected by exposure to ozone. However, healthy people can also experience difficulty breathing when exposed to ozone pollution. Because ozone forms in hot weather, anyone who spends time outdoors in the summer may be affected, particularly children, outdoor workers and people exercising. Many Californians live in areas where the federal ozone health standards are exceeded.

Ground-level ozone also damages vegetation and ecosystems. It leads to reduced agricultural crop and commercial forest yields, reduced growth and survivability of tree seedlings, and increased susceptibility to diseases, pests, and other stresses such as harsh weather. Ground-level ozone also damages the foliage of trees and other plants, affecting the landscape of cities, parks and forests, and recreational areas. NOx also contributes to acid deposition and the overgrowth of algae in coastal estuaries.

3.3. State Implementation Plan (SIP)

Off-road diesel engine standards will be a part of California's post-2010 control strategy for attaining the eight-hour ozone and PM2.5 air quality standards. The emission benefits from these standards will be incorporated into future SIPs. A commitment for ARB to consider adoption of more stringent emission standards for off-road diesel engines is included in an agreement to settle a lawsuit filed over the 1994 SIP as discussed below.

In 1997, three environmental groups, namely Communities for a Better Environment, the Coalition for Clean Air, and the Natural Resources Defense Council, filed a complaint in the United States District Court for the Central District of California. The lawsuit was filed against ARB, the South Coast Air Quality Management District, and U.S. EPA related to California's progress in achieving the 1994 SIP commitments. ARB reached a settlement agreement with these groups in January 1999, which was amended most recently in July 2003, to include additional elements (SSA 2003). Although the 2003 SIP revision is intended to replace the State's original commitments under the 1994 SIP for the South Coast, the settlement agreement will remain in place until ARB fulfills its obligations as outlined.

The agreement contains a schedule under which ARB committed to achieving the remaining near-term emission reductions from the 1994 SIP. ARB also committed to submit to the Board, and propose for adoption, a number of specific measures including the adoption of more stringent emission standards for off-road diesel engines no later than December 31, 2004. The amendments to the off-road diesel regulation proposed in this report are intended to fulfill ARB's commitment with respect to the settlement agreement.

4. SUMMARY OF PROPOSED REGULATIONS

The staff recommends that the Board amend sections 2420, 2421, 2423, 2424, 2425, and 2327, Title 13, California Code of Regulations, as set forth in Attachment 1: "Proposed Amendments to the California Regulations for 2006 and Later Off-Road Compression-Ignition Engines and Equipment" and Attachment 2: "Proposed Amendments to the California Exhaust Emission Standards and Test Procedures for New 2008 and Later Tier 4 Off-Road Compression-Ignition Engines and Equipment, Part I-C" of this report. The proposed regulatory language is intended to harmonize California's exhaust emission requirements for new off-road diesel engines with those published by U.S. EPA on June 29, 2004 (69 FR 38958-39273), with minor differences as discussed in section 5 of this report. Although the California and federal programs for diesel engines will be similar upon adoption of this proposal, ARB will retain its authority to further regulate off-road mobile sources in the future and its ability to enforce the regulations in California.

In sum, the proposed amendments require new off-road diesel engines to meet more

stringent exhaust emission standards for PM, NOx, NMHC, and CO than are currently required. Enhancements to test procedures and the certification process are proposed to ensure meaningful compliance with the new standards and to provide compliance flexibility without sacrificing air quality benefits. The following subsections discuss the major provisions of the staff proposal in further detail.

The amendments, which are discussed below, can be categorized as follows:

- Applicability
- Tier 4 Emission Standards and Implementation Schedules
- Enhanced Certification Requirements
- Enhanced Test Procedures, and
- Expanded Compliance Flexibility Provisions
- Miscellaneous

4.1. Applicability

The provisions in this proposal continue to apply to off-road diesel engines produced for sale in California with the exception of engines with a per cylinder displacement of less than 50 cubic centimeters, engines used to propel locomotives, underground mining equipment, marine vessels, aircraft, preempt engines and equipment, and off-road military tactical vehicles or equipment that have been exempted from regulations under the federal national security exemption.

Recreational marine engines less than 37 kW are the significant omission with respect to the applicability of the Tier 4 proposal compared to previous off-road diesel regulations. U.S. EPA has chosen instead to regulate these engines under a future rulemaking that would consolidate all diesel marine engines less than 30 liters per cylinder. Comments on the need for, and the feasibility of, more stringent recreational marine diesel standards regarding this rulemaking are currently being solicited. In response, ARB intends to recommend that U.S. EPA promulgate a PM standard based on the reduction capacity of oxidation catalysts in the near-term, to be followed with advanced aftertreatment equivalent levels in the 2013 time frame. The precedent for aftertreatment-based standards on watercraft has already been established in California with ARB's adoption of catalyst-forcing standards for 2009 gasoline fueled inboard and sterndrive boats (ARB 2001b). Staff believes that the technology needed to adapt diesel exhaust aftertreatment to a marine environment would be nearly identical to the technology needed for gasoline marine engines. Until new standards are adopted, recreational marine engines will continue to meet the previous tiers of off-road standards, as appropriate.

4.2. Standards and Implementation Schedules

This section explains proposed exhaust standards, crankcase standards, not-to-exceed limits, and smoke test standards. Table 4.1 below identifies the model year when the new Tier 4 requirements are first applicable for each engine power category.

Table 4.1
Applicability by Model Year

Power Category	Model Year
kW < 19	2008 [1]
19 = kW < 56	2008 [2]
56 = kW < 130	2012
130 = kW = 560	2011
kW > 560	2011

Notes:
1 Hand-start, air cooled, direct injection engines below 8 kW are not be subject to the PM standard until the 2010 model year.
2 Engines 37 = kW < 56 may opt out of meeting interim standards by complying with final standards early in the 2012 model year.

4.2.1. Exhaust Emission Standards

Staff proposes that the Board adopt more stringent PM, NOx, and NMHC emission standards for new off-road diesel engines as outlined and scheduled in Table 4.2 below. The standards would be the same as those adopted federally in the U.S. EPA Tier 4 rulemaking. Staff is not proposing more stringent CO standards. Current emission standards for all pollutants would continue to apply until the more stringent proposed emission standards become effective.

Interim Tier 4 standards, targeting 50 percent tailpipe reductions in PM, would be introduced beginning with the 2008 model year for engines less than 56 kW, and ultra stringent PM and/or NOx standards based on advanced aftertreatment technologies would begin phasing-in on engines greater than and equal to 19 kW in 2011. The final Tier 4 standards would reduce tailpipe emissions upwards of 90 percent compared to previous

off-road diesel standards. The proposed off-road aftertreatment based standards are modeled after the 2007 on-road heavy-duty diesel standards.

By 2020, the proposed Tier 4 off-road diesel standards would reduce the statewide PM emissions inventory by 40 percent, the NOx inventory by 29 percent, and the NMHC inventory by 12 percent. Reductions in NOx will also reduce secondary nitrate PM emissions. The resulting emission reductions will translate into needed improvements in air quality in California and assist in attaining applicable ambient air quality standards. The benefits of this proposal are discussed in detail in subsection 7.1 of this report.

Table 4.2
Proposed Tier 4 Off-Road Diesel Emission Standards

MAXIMUM ENGINE POWER	MODEL YEAR	TYPE	PM	NMHC+NOX	NMHC	NOX	CO
			grams per kilowatt-hour				
kW < 19	2008 and later	FINAL	0.40 [1]	7.5	-	-	8.0/6.6 [2]
19 = kW < 37	2008 - 2012	INTERIM	0.30	7.5	-	-	5.5
	2013 and later	FINAL	0.03	4.7			
37 = kW < 56 [3]	2008 - 2012	INTERIM	0.30	4.7	-	-	5.0
	2013 and later	FINAL	0.03				
56 = kW < 75	2012 - 2014 [4]	PHASE-IN	0.02	-	0.19	0.40	5.0
		PHASE-OUT		4.7	-	-	
		ALT NOx		-	0.19	3.4 [5]	
	2015 and later	FINAL				0.40	
75 = kW < 130	2012 - 2014 [4]	PHASE-IN	0.02	-	0.19	0.40	5.0
		PHASE-OUT		4.0	-	-	
		ALT NOx		-	0.19	3.4 [5]	
	2015 and later	FINAL				0.40	
130 = kW = 560	2011 - 2013	PHASE-IN	0.02	-	0.19	0.40	3.5
		PHASE-OUT		4.0	-	-	
		ALT NOx		-	0.19	2.0	
	2014 and later	FINAL				0.40	
560 kW < GEN [6] = 900 kW	2011 - 2014	INTERIM	0.10	-	0.40	3.5	3.5
	2015 and later	FINAL	0.03		0.19	0.67	
GEN > 900 kW	2011 - 2014	INTERIM	0.10	-	0.40	0.67	3.5
	2015 and later	FINAL	0.03		0.19		
ELSE [7] > 560 kW	2011 - 2014	INTERIM	0.10	-	0.40	3.5	3.5
	2015 and later	FINAL	0.04		0.19		

Notes:

1 The Tier 4 PM standard for hand-start, air cooled, direct injection engines below 8 kW is 0.60 g/kW-hr, but is not required until 2010.

2 The CO standard is 8 g/kW-hr for engines below 8 kW and 6.6 g/kW-hr for engines 8 = kW < 19.

3 Engine families in this power category may alternately meet Tier 3 PM standards from 2008-2011 in exchange for introducing final PM standards in 2012.

4 Manufacturers have the option of complying with the Tier 4 standards over a two year period at 50% per year using banked Tier 2 credits or over a three year period at 25% per year without the use of credits. The three year phase-in period is shown as the more likely option. The 2014 model year cannot extend beyond December 30, 2014, when the 3 year phase-in option is used.

5 This Manufacturers may comply with the standards during the transitional implementation years using either a phase-in / phase-out approach or by using the Alternate NOx approach. The three year 25% alternate NOx standard is shown as it corresponds to the three year phase-in period shown in the table. The two year 50% phase-in NOx standard would be 2.3 g/kW-hr.

6 "GEN" refers to generator engines only.

7 "ELSE" refers to all mobile machinery excluding generator engines.

4.2.1.1. Power Category Reclassification

The new Tier 4 standards would be phased-in according to power category. Tier 4 power categories differ from previous power categories in that there are now only five distinct groupings, whereas nine existed before. The five Tier 4 power categories are shown in Table 4.2 above with alternating gray and white shading. Fewer categories reduce the burden on engine manufacturers at certification and allow more compliance options for equipment manufacturers without sacrificing long-term post 2014 air quality benefits. For example, more equipment flexibility allowances would be available within a power category that could potentially be used to address problematic applications over a longer period of time; however, the total number of flexibility allowances for all power categories would remain the same. Additionally, the previous power category defined by engines 37 = kW < 75 has been split into two separate categories defined by engines 37 = kW < 56 and engines 56 = kW < 75. This regrouping would more closely match the degree of challenge involved in transferring advanced emission control technology from highway engines to off-road engines by limiting advanced NOx aftertreatment requirements to engines greater than and equal to 56 kW. This would ease the burden of certifying engines between 37 = kW < 56 due to the less rigorous NOx standards.

4.2.1.2. Phase-in Allowances

A new feature for diesel off-road standards in staff's Tier 4 proposal is the gradual phasing-in of aftertreatment NOx standards for some power categories. Manufacturers would be allowed to continue producing engines that meet previously certified levels of NMHC+NOx emissions for a portion of new sales (hereafter phase-out engines) during years for which the phase-in provisions are permitted. Generally speaking, up to 75 percent of the engines produced in the 56 = kW < 130 power category from 2012 through 2014 could be phase-out engines, and 50 percent would be permitted in the 130 = kW = 560 category from 2011 through 2013. Other compliance options exist for these categories as explained in the attached regulations and test procedures including the use of alternate NOx standards for all engines in lieu of phase-in/phase-out implementation. These are the same allowances adopted by U.S. EPA in the federal nonroad Tier 4 rule.

4.2.2. Not-To-Exceed (NTE) Limits

The NTE limits have been developed as a means to confirm the emissions performance of engines under all normal in-use operating conditions, not just those encountered during certification testing. In the past, some diesel manufacturers were designing their engines to perform differently depending on whether they were operated on a certification test cycle or off-cycle (see subsection 2.3.3). This had a negative impact on emissions despite the fact that the engines were meeting the certification limits. To ensure against a similar occurrence in the future, staff proposes that the Board adopt NTE limits and test procedures for new off-road diesel engines to align with federal Tier 4 NTE requirements beginning in 2011. These limits and test procedures are similar to those that U.S. EPA and ARB have adopted for 2007 and later heavy-duty on-road diesel engines. Table 4.3 below shows the NTE starting date that would correspond to each power category.

Table 4.3
NTE Implementation Schedule

Power Category	NTE Implementation Model Year [1,2]
kW < 19	2013
19 = kW < 56	2013 [3,4]
56 = kW < 130	2012 [4]
130 = kW = 560	2011 [4]
kW > 560	2011

Notes:

1. All engines in a given power category are required to meet the NTE limits.
2. NTE limits are not applicable for NOx and NMHC on phase-out engines that are certified to the same numeric limits or FELs as engines which were previously certified under the Tier 3 requirements.
3. NTE limits would apply in 2012 for engines in the 37 = kW < 56 power category that do not comply with 2008 interim Tier 4 standards.
4. NTE limits do not apply for engines certified to transient alternate FELs (ALT 20%) unless those engines are also certified to optional transient standards.

For off-road diesel engines subject to NTE limits, the engine manufacturer would be required to state in the application for certification that the engine is able to meet the NTE limits under all conditions that may reasonably be expected to occur in normal equipment operation and use. Manufacturers would be required to maintain a detailed description of all testing as specified in the test procedures, engineering analysis, and other information that forms the basis for this statement.

For a limited time, engine manufacturers would be permitted to certify an engine family with NTE deficiencies. The NTE deficiency provision would allow the Executive Officer to certify a nonroad diesel engine as compliant although some specific NTE limits may not be fully met. This provision provides a means of relief to address the occurrence of unanticipated

technical problems, which are limited in nature but, cannot be resolved in time to meet production schedules. The number of NTE deficiencies that a manufacturer can apply for during the first three model years of the NTE requirement is unlimited. However, manufacturers would not be allowed to apply for more than three deficiencies per engine family for the fourth through seventh model years, and no deficiencies would be granted after the seventh model year.

Table 4.4 below shows the methodology that would be used to determine NTE thresholds for each applicable pollutant. The detailed NTE requirements, including how to perform an emissions test, can be found in the attached test procedures.

Table 4.4
Criteria for Determining NTE Limits [1]

Pollutant	Apply NTE Multiplier of 1.25 when ...	Apply NTE Multiplier of 1.50 when ...
NOx	NOx Standard or FEL = 2.5 g/kW-hr	NOx Standard [2] or FEL< 2.5 g/kW-hr
NMHC	NOx Standard or FEL = 2.5 g/kW-hr	NOx Standard [2] or FEL< 2.5 g/kW-hr
NMHC+NOx	NMHC+NOx Standard or FEL = 2.7 g/kW-hr	NMHC+NOx Standard [2] or FEL< 2.7 g/kW-hr
PM	PM Standard or FEL = 0.07 g/kW-hr	PM [2] Standard or FEL [3]< 0.07 g/kW-hr
CO	Always	Never

1 Other provisions as specified in the test procedures may affect the calculation of NTE limits.
2 Engines must be certified to these limits without the use of ABT credits.
3 For engines certified to a PM FEL less than or equal to 0.01 g/kW-hr, the PM NTE limit shall be 0.02 g/kW-hr.

4.2.3. Universal Closed Crankcase Requirement

Staff proposes to amend the regulations to require closed crankcase requirements for all off-road diesel engine engines including those previously exempted due to turbochargers, pumps, blowers, or superchargers used for air induction. These changes would become effective beginning in 2008 and phased-in by power category (see Table 4.1 above). Optionally, crankcase emissions may be vented to the atmosphere if these emissions are added to the total of exhaust emissions and so long as the deterioration of crankcase emissions is taken into account for the purposes of certification and in-use testing (see subsection 4.4.5). This provision would align crankcase requirements with 2007 federal heavy-duty highway and California heavy-duty on-road requirements.

4.2.4. Smoke Test Standards

Staff proposes to amend the smoke requirements for new off-road diesel engines to align with federal Tier 4 smoke standards. These changes would become effective beginning in 2008 and phased-in by power category (see Table 4.1 above). With this change, engines employing a particulate filter and certified to a Family Emission Limit (FEL) of 0.07 g/kW-hr

or lower would be exempted from this requirement. Smoke levels would need to take into account the effects of deterioration for certification and in-use testing. The particulate filter should effectively eliminate all visible smoke from an engine so equipped. Single-cylinder engines, propulsion marine engines, and constant-speed engines would continue to be exempted from this requirement.

4.3. Early Introduction Incentives for Engine Manufacturers

To encourage the early introduction of Tier 4 off-road diesel engines in California, staff proposes to align with the provisions in U.S. EPA's final rule allowing engine manufacturers to benefit from producing engines certified to the Tier 4 standards prior to the 2011 model year. In exchange for the early introduction of these engines, engine manufacturers would be allowed to make fewer Tier 4 engines after 2011, a concept that U.S. EPA terms "engine offsets" to avoid confusion with Averaging, Banking, and Trading (AB&T) program credits. The number of offsets that could be generated would depend on the degree to which the engines are able to meet, or perform better than, the final Tier 4 standards.

Table 4.5 summarizes the requirements and available offsets for engine manufacturers in this program. As the purpose of the incentive is to encourage the introduction of clean technology engines earlier than required, actual emission standard levels would need to be met, and met early, by qualifying engines to earn the early introduction offsets. In other words, the standards must be met without the use of AB&T credits, and actual production of the engines must begin by September 1 of the year prior to the first model year when the standards would otherwise be applicable. Also, to avoid double-counting, the early incentive engines can earn either engine offsets or AB&T emissions credit, but not both. Note that this is different from the approach taken in the early Tier 4 incentive program for equipment manufacturers (see subsection 4.7.2.6) where incentives for both the engine manufacturer (AB&T credits) and the equipment manufacturer (flexibilities) are needed to ensure a successful early introduction of clean engines. Since 15 ppmw sulfur diesel fuel will be readily available in California by 2007, staff proposes to allow engine manufacturers to begin certifying engines to the very low emission levels required for eligibility in this incentive program, beginning with the 2007 model year.

An important aspect of the early incentive provision is that it must be done on an engine count basis. That is, a diesel engine meeting new standards early would count as one and one half diesel engines later. This contrasts with a provision done on an engine percentage basis which would count one percent of diesel engines early as one and one half percent of diesel engines later. Basing the incentive on an engine count basis removes the uncertainty regarding fluctuations in engine sales for different model years.

Another important aspect of this program is that it is limited to engines sold prior to the 2013 model year for engines 19 = kW < 56, prior to the 2012 model year for engines 56 = kW < 130, and prior to the 2011 model year for engines 130 = kW = 560. In other words, as in the heavy-duty on-road diesel program, nonroad diesel engines sold during

the transitional "phase-in" model years would not be considered "early" introduction engines and would therefore not be eligible for generating early introduction offsets. However, such engines and vehicles would still be able to generate AB&T credits. Because engines over 560 kW have no phase-in provisions, staff proposes to allow offsets for early incentive engines in this power category for any model year prior to 2015. For the same reason, there is no PM-only offset for these engines. As with the phase-in itself, and for the same reasons, an early introduction engine could only be used to offset engines in the same engine power category as the offset-generating engine.

Table 4.5
Incentives for Engine Manufacturers

EARLY INTRODUCTION	POWER CATEGORY	QUALIFYING STANDARDS [1] g/kW-hr	PER-ENGINE INCENTIVE
Final Tier 4 PM-Only [2]	19 = kW < 56	0.03 PM	3 for 2 PM-Only
	56 = kW < 560	0.02 PM	
Final Tier 4 ALL	19 = kW < 56	0.03 PM / 4.7 NMHC+NOx	3 for 2
	56 = kW = 560	0.02 PM / 0.40 NOx / 0.19 NMHC	
	GEN > 560	0.03 PM / 0.67 NOx / 0.19 NMHC	
	ELSE > 560	0.04 PM / 3.5 NOx / 0.19 NMHC	
Ultra Low NOx	kW = 19	Final Tier 4 PM & NMHC / 0.20 NOx	2 for 1

Notes:
1 Engines must also meet the Tier 4 crankcase emissions requirements and must be certified for all other Tier 4 requirements such as transient testing and Not-To-Exceed testing as appropriate.
2 Offsets must be earned prior to the start of phase-in requirements in applicable engine groups (prior to 2013 for 19=kW<56 engines, prior to 2012 for 56=kW<130 engines, prior to 2011 for 130=kW=560 engines, prior to 2015 for >560 kW engines)

4.4. Certification

The amendments in this section are related to labeling, executive orders, test fuel, test procedures, deterioration factors, and definitions.

4.4.1. Labeling

This section proposes federal alignment with most aspects of the labeling requirements for off-road diesel engines and equipment as well as some California specific changes.

4.4.1.1. Flexibility Label Content

Staff generally proposes to align with federal labeling requirements for new off-road diesel engines, except that the label must state that the engine complies with California or both California and U.S. EPA regulations.

However, staff also proposes a modified version of the label content for engines that qualify under the transitional flexibility provisions for equipment manufacturers (flexibility engines). This proposal, including revised labeling content, is discussed in detail in subsection 5.1.1.

4.4.1.2. Rebuilt Labeling Prohibition

Staff also proposes to adopt language prohibiting the removal of the original label from off-road diesel engines that have been rebuilt or remanufactured. This proposal is discussed in detail in subsection 5.2.

4.4.2. Executive Orders

Staff proposes to amend the current regulations to clarify that engines certified under the transitional flexibility provisions for equipment manufacturers, discussed in subsection 4.7 of this report, must be covered by an Executive Order. The Executive Order need not be current for the year in which the engine is used as a flexibility allowance, but may have been issued previously so long as the engine was certified to the appropriate standards required by the flexibility provision. This requirement is discussed in detail in subsection 5.1.2.

4.4.3. Test Fuel

Staff proposes to align with the federal nonroad rule regarding the use of ultra low-sulfur diesel fuel (15 ppmw) as the certification test fuel for all engines in 2011 and as likewise permitted for new engines in previous years. Since ultra low-sulfur diesel fuel will be the only fuel available to the California off-road market by 2007, previously uncertified new engine families for that year may also use ultra low-sulfur fuel as their certification test fuel. Carry-over engine families that have previously been certified using higher sulfur content certification fuel must continue to certify using that fuel.

4.4.4. Test Procedures

The current off-road diesel test procedures "California Exhaust Emission Standards and Test Procedures for New 2000 and Later Off-Road Compression-Ignition Engines and Equipment, Part I-B" will continue to apply through 2007 and beyond as applicable to engines and equipment designed to comply with the Tier 1, Tier 2, or Tier 3 standards. New test procedures applicable beginning in 2008 for engines designed to meet the Tier 4 standards are proposed for adoption by the Board and are equivalent to the federal requirements in 40 CFR, Part 1039 and the documents incorporated by reference. A copy of the new test procedures is included at the end of this report in Attachment 2. Staff's proposed amendments to the current test procedures to restrict applicability to pre-Tier 4 engines and equipment are included in Attachment 3: "Proposed Amendments to the California Exhaust Emission Standards and Test Procedures for New 2000 and Later Tier 1, Tier 2, and Tier 3 Off-Road Compression-Ignition Engines and Equipment, Part I-B."

The Tier 4 emission standards proposed in subsection 4.2.1 are based on using the existing steady-state (modal) test cycle or alternative Ramped-Modal Cycle and a new transient test cycle specific to off-road engines. A new steady-state test cycle would also be specified as an alternative for transport refrigeration units (TRU)s. PM measurement techniques have also been modified. The following subsection briefly describes the most significant proposed amendments to the test procedure provisions.

4.4.4.1. Ramped-Modal Cycle (RMC) Alternative

The optional RMC steady-state test cycle is a modified version of the existing steady-state test cycle which allows continuous PM sampling through a single filter. The RMC permits more consistent and reliable emissions testing of diesel engines with add-on emission control components and eliminates the downtime between modes. It also permits the sampling of emissions to be done on a composite basis for the whole test as opposed to sampling emissions mode-by-mode. This continuous emission sampling approach allows regeneration events from devices such as particulate traps to be captured more reliably and with greater repeatability. Engine manufacturers would benefit from using this optional cycle by virtue of the reduced cost in going to a single filter. Further, their test runs will be subject to less test cell "tuning" and fewer test runs will be needed to "fit" the emission test cycle to the dynamometer in order to operate a particular engine (U.S. EPA 2004).

4.4.4.2. Off-Road Transient Test Cycle

The Nonroad Transient Composite (NRTC) test cycle, as the name implies, is the compilation of a number of cycles developed by U.S. EPA to reproduce realistic operating conditions for equipment such as backhoes, dozers, and other off-road equipment. It supplements the existing off-road steady-state test cycle such that the majority of off-road diesel engines subject to the proposed Tier 4 requirements would be required to certify using both test cycles. The NRTC captures transient emissions over much of the typical off-road engine operating range, and helps to ensure effective control of the regulated pollutants. This new transient requirement is expected to significantly reduce in-use exhaust emissions from off-road diesel engines by providing a more thorough and realistic evaluation of emission control system performance. Proper transient testing captures engine emissions from the broad range of engine speed and load combinations that the engine may encounter in-use, while steady-state testing captures emissions at the eight operating points that are typical for off-road diesel engines. Transient testing will also identify emissions that result from speed and load fluctuations due to turbocharger engagement, throttle lag, etc (U.S. EPA 2004).

Transient testing would be required according to the implementation schedule shown in Table 4.6 below. In general, the requirement is applicable to all engines at the time those engines are first equipped with advanced aftertreatment technologies for reducing

emissions of PM or NOx. Testing would not be required for diesel engines rated above 560 kW or constant speed engines; nor would it be required for measuring NMHC, NOx, and CO on phase-out[17] or flexibility engines.

Table 4.6
Transient Test Cycle Implementation Schedule

Power Category [1]	Model Year Implementation [2]
kW < 19	2013
19 = kW < 56	2013
56 = kW < 130	2012
130 = kW = 560	2011

Notes:
1 Transient testing is not required for engines > 560 kW
2 Transient testing is not required for gaseous pollutants on phase-out engines or flex engines

4.4.4.3. Cold Start Transient Testing

To better approximate actual in-use emissions, the transient test procedure includes the effects of engine operation after an extended period of inactivity (cold soak). Since most advanced exhaust aftertreatment technologies work less efficiently when cold, it is critical to address cold-start emissions in the measurement test procedures. U.S. EPA has determined, based on test data provided by industry, that a five percent weighting factor is appropriate for categorizing the effects of cold-start emissions. This is based on the scenario of an off-road engine with an overnight soak and a total of seven hours of operation over the course of a workday. At this weighting, engine manufacturers would likely need to take cold-start emissions into consideration when designing emission control strategies.

4.4.4.4. Transport Refrigeration Unit (TRU) Test Cycle

Staff's proposal includes a provision for a four-mode steady-state test cycle designed specifically for engines used in TRU applications. This test cycle is more representative of TRU operation than the other steady-state cycles currently available and it may be used by engine manufacturers in lieu of normal steady-state testing to certify their TRU engines. Engine manufacturers opting to use the TRU test cycle will be able to test their engines under a broad range of intermediate test speeds at specified test cycle engine load points.

[17] This exemption applies only to phase-out engines that are certified to the same gaseous standards or FELs as previously certified Tier 3 engines.

4.4.4.5. PM Measurement Techniques

Staff's proposal includes changes to the test procedures to improve the precision of emission measurements. In general, the requirements would be nearly identical to the test procedures adopted for implementation on 2007 and later heavy-duty on-road diesel engines. Most noteworthy of the changes are those directed at improving the accuracy and precision of PM measurements. These include changes to the type of PM filters that are used and improvements in how PM filters are weighed before and after emission measurements, including requirements for more precise microbalances. A single filter methodology would replace the existing multiple filter methodology for engines with particulate filters. The single filter proposal would represent a cost savings to engine manufacturers.

4.4.5. Deterioration Factors

The purpose of this amendment is to ensure that technologies with undemonstrated durability in off-road applications, such as particulate filters and NOx adsorbers, demonstrate compliance with the proposed emission requirements throughout their useful lives. Further, manufacturers that choose to vent crankcase emissions to the exhaust or atmosphere in lieu of meeting a closed system requirement must consider deterioration of these emissions when certifying their engines.

Listed below are proposed amendments applicable to the use of deterioration factors:

(1) Additive deterioration factor for exhaust emissions. Except as specified in paragraph (2) below, an additive deterioration factor must be used for exhaust emissions. An additive deterioration factor for a pollutant is the difference between exhaust emissions at the end of the useful life and exhaust emissions at the low-hour test point. In these cases, the manufacturer would adjust the official emission results for each tested engine at the selected test point by adding the factor to the measured emissions. If the factor is less than zero, zero would be used. Additive deterioration factors would need to be specified to one more decimal place than the applicable standard.

(2) Multiplicative deterioration factor for exhaust emissions. The use of a multiplicative deterioration factor would be allowed if good engineering judgment calls for the deterioration factor for a pollutant to be the ratio of exhaust emissions at the end of the useful life to exhaust emissions at the low-hour test point. For example, if aftertreatment technology is used, it may be appropriate to use a multiplicative deterioration factor. The manufacturer could then adjust the official emission results for each tested engine at the selected test point by multiplying the measured emissions by the deterioration factor. If the factor is less than one, one would be used. A multiplicative deterioration factor may not be appropriate in cases where testing variability is significantly greater than engine-to-engine variability. Multiplicative deterioration factors would need to be specified to one more

significant figure than the applicable standard.

(3) Deterioration factor for smoke. Deterioration factors for smoke would always be additive, as described in paragraph (1) above.

(4) Deterioration factor for crankcase emissions. If an engine vents crankcase emissions to the exhaust or to the atmosphere, the manufacturer must account for crankcase emission deterioration, using good engineering judgment. Separate deterioration factors may be used for crankcase emissions of each pollutant (either multiplicative or additive). Alternatively, combined deterioration factors may be used that include exhaust and crankcase emissions together for each pollutant.

4.4.6. Definitions

This section provides background on two key terms that are defined in the U.S. EPA nonroad rule. Staff proposes alignment with the definitions of these terms.

4.4.6.1. Maximum Engine Power

In order to assign standards more objectively, staff proposes to align with the federal nonroad definition for "Maximum Engine Power." The proposed definition provides more standardized guidance than the previously utilized terms "rated power" and "power rating" for determining which power category an engine belongs to and the applicable standards it must meet. An engine's maximum power is the maximum brake power point on the nominal power curve for the engine configuration. The nominal power curve of an engine configuration is the relationship between maximum available engine brake power and engine speed for an engine, using the mapping procedures of 40 CFR, Part 1065, based on the manufacturer's design and production specifications for the engine. This information may also be expressed by a torque curve that relates maximum available engine torque with engine speed. The nominal power curve must be within the range of the actual power curves of production engines considering normal production variability.

4.4.6.2. Maximum Test Speed

Staff proposes alignment with the federal definition of "Maximum Test Speed" as found in 40 CFR, Part 1065.515. This definition of maximum test speed is the single point on an engine's normalized maximum power versus speed curve that lies farthest away from the zero-power, zero-speed point. This is intended to ensure that the maximum speed of the test is representative of actual engine operating characteristics and is not improperly used to influence the parameters under which their engines are certified. In such cases where the definition of maximum test speed results in an engine speed that is unrepresentative of in-use operation, the Executive Officer would have authority to specify a different maximum speed if the manufacturer can show that the alternative is more representative (see 40 CFR, Part 1065.10(c)).

4.5. Durability and Warranty Provisions

The U.S. EPA nonroad rule did not make significant changes to the useful life, warranty, recall testing periods, selective enforcement audit, or emissions related maintenance requirements. Staff therefore proposes to retain its already harmonized provisions for these requirements, with the addition of an updated list of emission related components to more thoroughly reflect the emergence of advanced aftertreatment technologies. However, other provisions have been modified or appended such as in-use testing, defect reporting, replacement engine provisions, separate aftertreatment shipments, and in-use compliance margins. These changes are addressed below. Except as noted, staff proposes to adopt these amended or appended provisions to align with the federal requirements.

4.5.1. In-Use Testing

U.S. EPA does not specify an in-use testing program for Tier 4 engines in its final rulemaking, although it does obligate manufacturers (at least on paper) to certify engines that will meet NTE limits during in-use operation. Both U.S. EPA and ARB are currently developing in-use NTE test programs for off-road diesel engines patterned after a program that is being developed for on-road heavy-duty diesel vehicles. These in-use NTE requirements are expected to provide superior verification of emission performance in the field and to eventually become the in-use testing program for those engines. Staff proposes to harmonize with U.S. EPA regarding NTE certification requirements now and with in-use NTE requirements in the future. However, for the time being at least, California proposes to retain its own in-use compliance and recall program for off-road diesel engines as previously adopted under Articles 2.1 - 2.3, Chapter 2, Title 13, California Code of Regulations. No changes to that program are proposed.

4.5.2. Defect Reporting Requirements

U.S. EPA has amended its defect reporting requirements for Tier 4 engines such that investigations and reports would be triggered by a number of incidences that are proportional to engine power and the number of engines in an engine family, rather than to a fixed percentage as was previously practiced. The new approach should result in fewer overall defect reports being submitted by manufacturers than would otherwise be required under the old defect-reporting requirements because the number of defects triggering the submission requirement rises with the engine family size.

As shown in Table 4.7, an investigation threshold of 10 percent of total production, or 50 engines, whichever is greater, for any single engine family in one model year shall apply to engines less than or equal to 560 kW. In addition, a defect-reporting threshold of two percent of total production or 20 engines will apply, whichever is greater. For engines greater than 560 kW, the same percentage thresholds apply, but the percentage values will be extended down to smaller engine families to reflect their disproportionate contribution to

total emissions. For these engines, the absolute thresholds are 25 engines for investigations and 10 or 15 engines for defects.

Further, manufacturers are now obligated to track and report available warranty claims and any other available information from dealers, hotlines, diagnostic reports, or field-service personnel to identify possible defects. Staff proposes to align with U.S. EPA regarding defect reporting requirements, which are presented in more detail in Attachment 1 and Attachment 2.

Table 4.7
Investigation and Defect-Reporting Thresholds
for Varying Sizes of Engine Families

Engine Size	Investigation Threshold	Defect-reporting Threshold
= 560 kW	Less than 500: 50 500-50,000: 10% 50,000+: 5,000	Less than 1,000: 20 1,000-50,000: 2% 50,000+: 1,000
> 560 kW	Less than 250: 25 250+: 10%	Less than 150: 10 150-750: 15 750+: 2%

4.5.3. Replacement Engines

In California, manufacturers are currently required to submit a report on the number and types of replacement engines they sell at the end of a model year. U.S. EPA added regulatory language to its Tier 4 rule to address concerns that manufacturers could potentially use the replacement-engine provisions to produce large numbers of previous-tier engines. Specifically, U.S. EPA included a statement that manufacturers may not use the replacement-engine exemption to circumvent the regulations. In addition, U.S. EPA plans to use the data-collection provision to ask manufacturers to report the number of engines they sell under the replacement-engine exemption. Staff proposes to incorporate similar language for its replacement engine regulatory requirements. Staff also proposes to extend the reporting requirements to include 2006 and later model year replacement engines. Subsection 5.3 provides additional information regarding this proposal.

4.5.4. Separate Aftertreatment Shipment

U.S. EPA promulgated provisions that allow engine manufacturers to ship engines to equipment manufacturers without aftertreatment devices installed or otherwise included as

part of the engine shipment. This allowance would temporarily exempt engines from final assembly in cases where it would be impractical to install aftertreatment devices on the engine before shipment or where shipping the engine with aftertreatment already installed would require it to be disassembled and reinstalled when the engine was placed in the equipment. To ensure that the aftertreatment device is properly installed and used with the engine that it was certified with, the federal rule requires the following:

- Engine manufacturers are required to include the aftertreatment devices in the price of the engine and provide detailed and clear instructions so that the equipment manufacturer can readily install the engine and its components in a configuration covered under the executive order held by the engine manufacturer.

- Engine manufacturers must have a contractual agreement obligating the equipment manufacturer to complete the final assembly into a certified configuration.

- Engine manufacturers must ship any aftertreatment devices directly to the equipment manufacturer or arrange for their shipment from an aftertreatment device supplier.

- Engine manufacturers must tag the engines and keep records.

- Engine manufacturers must obtain annual affidavits from each equipment manufacturer as to the parts and part numbers that the equipment manufacturer installed on each engine.

- Engine manufacturers must conduct a limited number of audits of equipment manufacturers' facilities, procedures, and production records to monitor adherence to the instructions it provided.

Ultimately, the engine manufacturer is responsible for the in-use compliance of the engine as installed. Staff proposes to adopt the federal language for the separate catalyst shipment allowance and associated requirements.

4.5.5. Other Issues

U.S. EPA also made some minor changes to the compliance program. These changes are summarized in Table 4.8 and referenced by section. Staff believes that these changes are straightforward and non-controversial. A detailed explanation can be found in staff's proposed regulations and test procedures for Tier 4 off-road diesel engines in Attachment 1 and Attachment 2 of this report, respectively.

Table 4.8
Regulatory Changes

Issue	Federal Regulatory Provision
Applicability to alcohol-fueled engines	§§1039.101, 1039.107
Prohibited controls	§1039.115
Emission-related maintenance instructions	§1039.125
Engine installation instructions	§1039.130
Engine labels	§§1039.20, 1039.135, 1068.320
Engine family definition	§1039.230
Test engine selection	§1039.235
Deterioration factors	§1039.240
Engines that use noncommercial fuels	§1039.615
Use of good engineering judgment	§1068.5
Separate shipment of aftertreatment	§1068.260
Exemptions	40 CFR 1068 Subpart C
Importing engines	40 CFR 1068 Subpart D
Hearings	40 CFR 1068 Subpart G

4.5.6. Temporary In-Use Compliance Margins

To reduce the risk of non-compliance in the early years of the Tier 4 regulation, staff proposes that in-use standards be "cushioned" by the addition of an error margin to the certification standards. This would align with federal requirements and would provide assurance to off-road engine manufacturers that they will not face recall if they exceed certification standards by a small amount during this transition to cleaner diesel technologies. Although off-road manufacturers are expected to benefit greatly from the experiences gained in the on-road sector, which must meet similar standards several years earlier, designing an engine to meet the diversity of applications in the off-road sector will still be challenging. The allowance would provide relief for a limited number of model years after the Tier 4 off-road standards take effect and would be similar to the provisions for 2007 and later on-road heavy-duty diesel engines.

Table 4.9 below shows the compliance margins being proposed and their applicability.

Table 4.9
Add-On Levels Used in Determining In-Use Standards

Engine Power	Model Years	NOx		PM
		Add-On Level [1] (g/kW-hr)	For Operating Hours	Add-On Level [2] (g/kW-hr)
19 = kW < 56	2013 - 2014	none		0.01
56 = kW < 130	2012 - 2016	0.16	= 2000	0.01
		0.25	2001 - 3400	
		0.34	> 3400	
130 = kW = 560	2011 - 2015	0.16	= 2000	0.01
		0.25	2001 - 3400	
		0.34	> 3400	
kW > 560	2011 - 2016	0.16	= 2000	0.01
		0.25	2001 - 3400	
		0.34	> 3400	

1 Applicable only to those engines certifying to standards or with FELs at or below 2.1 g/kW-hr NOx
2 Applicable only to those engines certifying to standards or with FELs at or below the Tier 4 PM standards (0.02 g/kW-hr for 56 = kW = 560 engines, 0.03 g/kW-hr for 19 = kW < 56 engines and for > 560 kW engines in generator sets, and 0.04 g/kW-hr for all other > 560 hp engines).

4.6. Averaging, Banking, and Trading Program

California's existing regulations for off-road diesel engines include an averaging, banking, and trading (AB&T) program that mirrors the administrative provisions of the federal program. Manufacturers are required to fulfill the same reporting and authorization requirements to ARB regarding engines certified in California as they are to U.S. EPA regarding engines certified nationally. However, the California program does not restrict the generation and use of AB&T credits within State borders, nor does it use a separate calculation for determining credits, but rather allows California credits to be accounted for under the federal program and used accordingly. The current AB&T program is applicable to NMHC, NOx, and PM emissions and the Tier 4 AB&T program would continue to be applicable to these same pollutants. In U.S. EPA's final rule, the basic structure of the existing AB&T program was retained, but a number of changes were made to accommodate the implementation of the new Tier 4 emission standards. These changes to the AB&T program are intended to enhance the ability of engine manufacturers to meet the more stringent Tier 4 standards while limiting the production of very high-emitting engines. The new AB&T program also aims to avoid any unnecessary delays in the transition to new exhaust emission control technologies.

Staff is proposing that the Board adopt the amended federal AB&T program provisions.

Since the proposed AB&T program for use in California would be identical in nature to the federal AB&T program, staff is not providing an exhaustive explanation of the specific requirements. Only the major provisions of the program are discussed below. The complete proposed AB&T program provisions can be found in Attachment 2 of this report.

4.6.1. Family Emission Limit (FEL) Caps

The existing AB&T program for off-road diesel engines includes FEL caps, or limits, on the maximum emission levels from credit-using engine families. No engine family may be certified above these FEL caps. These limits provide manufacturers with compliance flexibility while protecting against the introduction of unnecessarily high-emitting engines.

Table 4.10 contains the proposed FEL caps and the effective model year for the FEL caps (along with the associated proposed Tier 4 standards). As proposed, a new transient test will be required for most engines, as well as the current steady-state test. The FEL established by the engine manufacturer will be used as the enforceable limit for the purpose of compliance testing under both test cycles. In addition, under the NTE limits, the FEL times the appropriate multiplier will be used as the enforceable limit for the purpose of such compliance testing.

Table 4.10
FEL Caps for the Tier 4 Standards in the AB&T Program

Power Category	Model Year	NOx or (NMHC+NOx) Standard	NOx or (NMHC+NOx) FEL Cap	PM Standard	PM FEL Cap
		g/kW-hr			
kW < 19	2008 +	(7.5) [1]	(10.5) [1] for < 8 kW (9.5) [1] for = 8 kW	0.40 [2]	0.80
19 = kW < 37	2008 - 2012	(7.5) [1]	(9.5) [1]	0.30	0.60
	2013 +	(4.7) [3]	(7.5) [3]	0.03	0.05 [4]
37 = kW < 56	2008 - 2012 [5]	(4.7) [1]	(7.5) [1]	0.30	0.40
	2013 + [6]			0.03	0.05 [4]
56 = kW < 130	2012 +	0.40	0.80 [7,8,9]	0.02	0.04 [4]
130 = kW = 560	2011 +	0.40	0.80 [7,8,9]	0.02	0.04 [4]
kW > 560	2011 - 2014	3.5	6.2	0.10	0.20
		0.67 [9]			
Generator Sets kW > 560	2015 +	0.67	1.07 [7]	0.03	0.05 [4]
Else kW > 560	2015 +	3.5	6.2	0.04	0.07 [4]

Notes:

1 This is the previous tier combined (NMHC+NOx) standard or FEL cap. These levels are not being revised and are listed here solely for reference.

2 A manufacturer may delay implementation until 2010 and then comply with a PM standard of 0.60 g/kW-hr for air-cooled, hand-startable, direct-injection engines under 8 kW.

3 This is a combined (NMHC+NOx) standard or FEL cap.

4 As described in the following section, a small number of engines are allowed to exceed this FEL cap.

5 The FEL caps do not apply if the manufacturer opts out of the 2008 standards. In such cases, the existing Tier 3 standards and FEL caps continue to apply.

6 The FEL caps apply in model year 2012 if the manufacturer opts out of the 2008 standards.

7 For engines certified as phase-out engines, the NMHC+NOx FEL caps for the Tier 3 standards apply.

8 For engines certified to the alternative NOx standards during the phase-in, the NOx FEL caps shown in Tables 4.12 and 4.13 apply.

9 The 0.67 g/kW-hr NOx standard applies only to engines above 900 kW used in generator sets.

4.6.2. Limited Use of Higher FEL Caps

U.S. EPA is allowing a limited number of engines to have a higher FEL than the caps noted in Table 4.10 under certain circumstances. The FEL cap for such engines would be set based on the level of the standards that applied in the year prior to the new standards and will allow manufacturers to produce a limited number of engines certified to these

earlier standards in the Tier 4 timeframe. The allowance to certify up to these higher FEL caps will apply to Tier 4 engines 19 = kW = 560 beginning as early as the 2011 model year, and will apply to engines above 560 kW starting with the 2015 model year. The provisions are intended to provide some limited flexibility for engine manufacturers as they make the transition to the aftertreatment-based Tier 4 standards while ensuring that the vast majority of the engines are converted to the low-emission technologies expected under the Tier 4 program.

Staff is proposing to adopt the same limited use provision for higher FEL caps. Under these provisions, a manufacturer would be allowed to certify up to 40 percent of its engines above the FEL caps shown in Table 4.10 over the first four years the aftertreatment-based Tier 4 standards take effect. This percentage would be calculated as a cumulative total of the percent of engines exceeding these FEL caps in each year over the four years. A maximum of 20 percent would be allowed in any give year. After the fourth year the Tier 4 standards apply, the allowance to certify engines using the higher FEL caps will still be available but for no more than five percent of the engines a manufacturer produces in each power category in a given year.

Table 4.11 presents the model years, percent of engines, and higher FEL caps that will apply under these allowances. Engines certified under these higher FEL caps during the first four years would not be required to perform transient testing or NTE testing, and air-charged engines 56 = kW = 560 would not be required to have closed crankcase controls. However, beginning in the fifth year, when the five percent allowance takes effect, these engines will be considered Tier 4 engines and all other requirements for Tier 4 engines will also apply, including the Tier 4 NMHC standard, transient testing, NTE testing, and closed crankcase controls.

Table 4.11
Allowance for Limited Use of FEL Caps Higher than Tier 4 FEL Caps

Power Category	Model Years	Engines Allowed to have Higher FELs	NOx FEL Cap (g/kW-hr)	PM FEL Cap (g/kW-hr)
19 ≤ kW < 56	2013-2016 [1]	40% [2]	Not applicable	0.30
	2017 + [1]	5%		
56 ≤ kW < 130	2012 - 2015	40% [2]	4.4 [3] for hp < 75 3.8 [3] for hp ≥ 75	0.40 [4] for hp < 75 0.30 [4] for hp ≥ 75
	2016 +	5%		
130 ≤ kW ≤ 560	2011 - 2014	40% [2]	3.8 [3]	0.20 [4]
	2015 +	5%		
> 560 kW	2015 - 2018	40% [2,5]	3.5	0.10
	2019 +	5%		

Notes:
1 For manufacturers choosing to opt out of the 2008 model year Tier 4 standards for engines 37 = kW < 56 and instead comply with the Tier 4 standards beginning in 2012, the 40% allowance would apply to model years 2012 through 2015, and the 5% allowance would apply to model year 2016 and thereafter.
2 Compliance with 40% limit is determined by adding the percent of engines that have FELs above the FEL caps shown in Table 4.10 in each of the four years. A manufacturer may not have more than 20% of its engines exceed the FEL caps shown in Table 4.10 in any model year in any power category.
3 The allowance to certify to the higher NOx FEL cap is not applicable during the phase-in period.
4 The higher PM FEL cap is applicable to phase-out engines only during the phase-in period.
5 The limits of 40% or 5% allowed to exceed the NOx FEL cap would apply to engines used in generator sets only. (Engines > 560 kW used in other machines are allowed to have a NOx FEL as high as 6.2 g/kW-hr.) The limits of 40% or 5% allowed to exceed the PM FEL cap would apply to all engines above 560 kW.

4.6.3. Restrictions

Under the Tier 4 program, manufacturers could simultaneously produce two different groups of 56 = kW = 560 engines during the NOx phase-in period. In one group ("phase-out engines"), engines would certify to the applicable Tier 3 NMHC+NOx standard and be subject to the NMHC+NOx AB&T restrictions and allowances previously established for Tier 3. In the other group ("phase-in engines"), engines would certify to the 0.40 g/kW-hr NOx standard, and be subject to the restrictions and allowances under Tier 4. Although engines in the two groups would be certified to different standards, manufacturers would be allowed to transfer credits across these two groups of engines with the following adjustment to the amount of credits generated.

Manufacturers will be able to use credits generated during the phase-out of engines certified to the Tier 3 NMHC+NOx standard to average with engines certified to the

0.40 g/kW-hr NOx standard, but these credits would be subject to a 20 percent devaluation to compensate for the contribution of NMHC in the Tier 3 standard. Thus, each gram of NMHC+NOx credits from the phase-out engines will be worth 0.8 grams of NOx credits in the new AB&T program. The ability to average credits between the two groups of engines will give manufacturers a greater opportunity to gain experience with the low-NOx technologies before they are required to meet the final Tier 4 standards across their full production. The 20 percent discount will also apply, for the same reason, to all NMHC+NOx credits used for averaging purposes with the NOx standards for engines equal to and greater than 56 kW.

Another restriction will be that manufacturers may only use credits generated from other Tier 4 engines or from engines certified to the previously applicable tier of standards, except for engines in the power category 37 = kW < 56. Manufacturers would be allowed to use previously generated Tier 2 credits to demonstrate compliance with the interim Tier 4 standards in 2008 for this power category. Manufacturers that choose instead to comply with the Tier 3 standards in 2008 and only the final Tier 4 standards in 2012 would not be allowed to use Tier 2 credits on Tier 4 engines. Only Tier 3 credits could be used under the standard provisions.

An additional restriction concerns the use of AB&T credits above the 560 kW threshold. Because the standards for Tier 4 engines greater than 560 kW will not be based on the use of PM aftertreatment technology in 2011, or NOx aftertreatment for all engines except generators in 2015, manufacturers will not be allowed to use credits from these engines to demonstrate compliance with engines equal to and below 560 kW.

4.6.4. NOx FEL Caps for Engines Certified to the Alternative NOx Standards

As proposed, a set of alternative NOx standards will be allowed for those manufacturers that need to certify "split" engine families during the phase-in years. These engines will be allowed to participate in the AB&T program. Table 4.12 presents the FEL caps that will apply to engines certified to the alternative NOx standards during the phase-in years.

Table 4.12
NOx FEL Caps for Engines Certified to the Alternative NOx Standards

Power Category	Alternative NOx Standard (g/kW-hr)	NOx FEL Cap (g/kW-hr)
56 = kW < 130 50/50/100 phase-in option	2.3	3.0
56 = kW < 130 25/25/25/100 phase-in option	3.4	4.4 (for 56 = kW < 75) 3.8 (for 75 = kW < 130)
130 = kW = 560	2.0	2.7

Since manufacturers will be allowed to use AB&T for demonstrating compliance with the alternative standards for engines 56 = kW = 560, manufacturers will also be allowed to exceed the FEL caps noted in Table 4.12. These would be included in the 40 percent of engines allowed to exceed the FEL caps over the first four years in which the Tier 4 standards are in effect. Table 4.13 presents the NOx FEL caps that would apply to engines certified under the alternative standards limited by the 40 percent cap over the first four years. For manufacturers certifying under the reduced phase-in option (25/25/25/100 percent), engines may not exceed the FEL cap during the years the alternative standard applies.

Table 4.13
Limited Use NOx FEL Caps Under the Alternative NOx Standards

Power Category	Model Years	NOx FEL Cap (g/kW-hr)
56 = kW < 130 50/50/100 phase-in option	2012-1013	4.4 for kW < 75 3.8 for kW = 75
130 = kW = 560	2011-2013	3.8

All AB&T program provisions are described in greater detail in the proposed regulatory amendments, standards and test procedures in Attachment 1 and Attachment 2 of this report, respectively.

4.7. Equipment Manufacturer Transitional Flexibility Provisions

The sections that follow describe the main components of the U.S. EPA Tier 4 flexibility program, which is similar to the proposed California provisions with the exception of labeling requirements for flexibility engines. California's proposed modifications to the label content are discussed in subsection 4.7.2.9.

4.7.1. Original Flexibility Program

California incorporated U.S. EPA's transitional flexibility program for equipment manufacturers as part of the Tier 2 and Tier 3 amendments to the off-road diesel regulation. This original program is still in the early stages of implementation, but to date the program appears to be working as intended with most equipment manufacturers having used up only a portion of their allowances according to U.S. EPA data.

Engines that do not meet current model year emissions standards, but which have been previously certified, and can be used by equipment manufacturers in their existing product offerings without significant modification, are eligible to be sold new under the provisions of the transitional flexibility program for equipment manufacturers. The flexibility program is intended to provide relief in the event that an engine supplier does not provide enough lead time for an equipment manufacturer to modify the chassis of a particular piece of equipment to accommodate a new engine that may be packaged significantly differently than the previous model. Each equipment manufacturer is permitted to install previously certified engines in equipment adding up to 80 percent of one year's national production spread out over a period of seven years. There are additional allowances for small volume manufacturers and for hardship situations that can extend the percent of production allowances. The provisions of this original program were not intended to be used beyond the 2014 model year.

Equipment manufacturers do not need to apply for permission to use these provisions; however, engine manufacturers must annually submit a list of equipment manufacturers requesting flexibility engines, including engine models and quantities, as part of their certification applications. The program is administered on a national level by U.S. EPA, and California is a special participant entitled to the same reporting, notification, and approval authority as U.S. EPA for engines sold within the State. There are no limits on the number of flexibility engines that can be sold in a particular state so long as the total from all states does not exceed 80 percent of the national sales for one year.

Under this original program, flexibility engines were not specifically required to posses emission labels indicating their participation in the program. Some manufacturers have voluntarily attached labels to their flex engines, but in most cases the information they provide serves little purpose in helping to identify the specifications of the engine.

4.7.2. Tier 4 Flexibility Program

In its Tier 4 rulemaking, U.S. EPA adopted a new round of flexibility provisions for equipment manufacturers to help ease the transition to Tier 4 requirements. Although modeled after the original program, this new provision includes several new and enhanced features to protect against possible abuses and to provide better understanding of the extent to which the flexibility provisions are being used and distributed. No longer allowed is the provision for using uncertified engines in applications below 37 kW. The Tier 4 program also identifies new opportunities for flexibility not provided for in the original proposal. The following subsections summarize the main components of the program, including a supplement to the federal program proposed by staff to ensure a more identifiable and enforceable deployment of flexibility provisions in California through more descriptive engine labels.

4.7.2.1. Percent-of-Production Allowances

The percent of production allowances under the Tier 4 flexibility program remain the same as under the original program. Each equipment manufacturer is allowed to produce flexibility engines over a seven year period in cumulative quantities that sum up to 80 percent of a single year's national production at the end of the seven year period. The allowances would apply separately to each of the five Tier 4 power categories, as defined in subsection 4.2.1.1, with eligibility beginning the year Tier 4 standards first apply to that category. With fewer Tier 4 power categories than under the previous program, more engine families will populate each category resulting in proportionately more flexibility allowances that could potentially be used to extend the lead time for bringing an especially challenging engine family into compliance with the Tier 4 standards. Table 4.14 shows the applicable usage periods for each power category.

Table 4.14
Flexibility Usage Periods

Power Category	Flexibility Program	Flexibility Period Options (Model Years)	Flexibility Standards
< 19 kW	Tier 2/3	2000 - 2006	Pre-controlled
	Tier 4	2008 - 2014	Tier 2 Standards
19 = kW < 37	Tier 2/3	1999 - 2005	Pre-controlled
	Tier 4	2008 - 2014	Tier 2 Standards
	Tier 4 Delayed	2012 -2018	Model Year 2008 Tier 4 Standards
37 = kW < 56	Tier 2/3	2004 - 2010	Tier 1 Standards
	Tier 4	2008 - 2014 [1]	Tier 3 Standards
	Tier 4 Delayed	2012 - 2018	Model Year 2008 Tier 4 Standards
56 = kW < 75	Tier 2/3	2004 - 2010	Tier 1 Standards
	Tier 4	2012 - 2018	Tier 3 Standards
	Tier 4 Delayed	2014 - 2020	Model Year 2012 Tier 4 Standards
75 = kW < 130	Tier 2/3	2003 - 2009	Tier 1 Standards
	Tier 4	2011 - 2017	Tier 3 Standards
	Tier 4 Delayed	2014 - 2020	Model Year 2011 Tier 4 Standards
130 = kW = 560	Tier 2/3	2003 - 2009 [2]	Tier 1 Standards
		2001 - 2007 [3]	
		2002 - 2008 [4]	
	Tier 4	2011 - 2017	Tier 3 Standards
	Tier 4 Delayed	2014 - 2020	Model Year 2011 Tier 4 Standards
> 560 kW	Tier 2/3	2006 - 2012	Tier 1 Standards
	Tier 4	2011 - 2017	Tier 2 Standards
	Tier 4 Delayed	2015 - 2021	Model Year 2011 Tier 4 Standards

Notes:
1 This usage period is only available if interim Tier 4 standards have been met starting in 2008.
2 Applies to the power range 130 = kW < 225.
3 Applies to the power range 225 = kW < 450.
4 Applies to the power range 450 = kW = 560.

Staff estimates that the entire 80 percent flexibility allowance, if used to its maximum extent by all equipment manufacturers, would result in a one percent increase in NOx emissions (2.1 TPD) and about a six percent increase in PM emissions (0.6 TPD), statewide, in 2020. However, the equipment manufacturer flexibility program is a key factor in assuring

sufficient lead time to implement the Tier 4 standards as scheduled.

Regarding flexibility allowances, the following engines would not have to be included in the equipment manufacturer's percent of production calculations: 1) diesel off-road equipment using engines built before the effective date of the Tier 4 standards, 2) equipment using engines certified to the previous Tier of standards under any small business provision, 3) all engines certified to the Tier 4 standards, including those engines that produce emissions at higher levels than the standards, but for which an engine manufacturer uses AB&T credits to demonstrate compliance (they would count as Tier 4 complying engines), and 4) engines that meet the Tier 4 PM standards, but are allowed to meet the Tier 3 NMHC+NOx standards during the phase-in period (they would also count as Tier 4 complying engines).

4.7.2.2. Delayed Implementation Option

A provision of the Tier 4 flexibility program allows equipment manufacturers to choose when to begin using flexibility allowances. As shown in Table 4.14 above, the start of the seven year period may generally be delayed to coincide with the commencement of final Tier 4 standards rather than the start of interim standards. Allocations for engines less than 19 kW must be used starting in 2008 since no interim standards are specified for this range of engines.

Although this provision has the potential to delay the promulgation of final Tier 4 standards from a fleet-wide perspective, there would be no loss in long-term emission benefits according to U.S. EPA since the flexibility engines under the delay schedule will have to meet more stringent standards than under the non-delay schedule. Furthermore, more engines with particulate filters will be introduced during the interim standards period to make up for the unused flexibility engines resulting in greater short-term PM benefits than under the non-delay schedule.

4.7.2.3. Small Volume Allowances

The Tier 4 flexibility program provides a choice between the same relief for small volume manufacturers as under the original flexibility program, or an optional provision that would allow fewer allowances per power category, but which could be spread out over multiple engine families.

Under the original proposal, a manufacturer would be allowed to exceed the 80 percent of production total for its flexibility allowances and produce a total of 700 flexibility engines per power category to be used over seven years in no more than 200 engine increments per year per power category. Further, this allowance applies to only one engine family per power category for the duration of the seven years. Since some small volume manufacturers produce several engine families in a year, this relief may not go far enough.

The alternate small volume allowance addresses this situation by permitting a total of 525 flex engines to be produced per power category over a seven year period for use in applications less than 130 kW with no more than 150 flex engines to be used per year per power category. For applications requiring engines greater than or equal to 130 kW, a manufacturer may produce a total of 350 flex engines per power category to be used over seven years in 100 engine increments per year per power category. There is no limit on the number of engine families for which these alternate allowances apply.

4.7.2.4. Technical Hardship Allowances

Staff recommends adoption of a new provision for the Tier 4 flexibility program that would allow equipment manufacturers to petition additional relief on the basis of technical or engineering hardships. Allowances of up to 70 percent in addition to the 80 percent of production allowance (150 percent total) could be granted should the manufacturer be able to justify the need. This new provision would be available to all equipment manufacturers, but would only be applicable when the equipment manufacturer is different from the engine manufacturer. In other words, a vertically integrated manufacturer, i.e., a manufacturer who produces both engines and equipment, could petition additional flexibility allowances, but only if that manufacturer was installing an engine from another manufacturer into one of its own chassis, or vice versa. This provision is most likely to benefit non-integrated equipment manufacturers who may be at a technical disadvantage with respect to manufacturers who produce both engines and equipment, and who can rely on other programs such as AB&T to ease the burden of compliance, if necessary.

This additional flexibility allowance would only be available for the Tier 4 power categories 19 = kW = 560 since engines less than 19 kW will not require advanced aftertreatment, and nearly all of the equipment above 560 kW is produced by manufacturers qualifying for small volume allowances described in subsection 4.7.2.3.

Appeals for relief under this provision would need to be made in writing to the Chief of the Mobile Source Operations Division and would be decided on a case-by-case basis. The equipment manufacturer would have the burden of demonstrating the existence of extreme technical or engineering hardship conditions that are beyond its control. It must also demonstrate that it has exercised reasonable precautions to avoid the situation. The exemption could only be granted upon written application setting forth essentially why the previously successful relationship between engine and equipment manufacturer has not provided adequate lead time to address a particular equipment model.

An application for technical hardship exemption would not be granted unless the equipment manufacturer demonstrates that the full 80 percent allowed under the percent of production allowance is reasonably expected to be used up in the first two years of the seven-year flexibility period. Furthermore, any technical hardship allowance would have to be used up within two years after the Tier 4 percent of production allowances start for any power category.

4.7.2.5. Retroactive Use of Flexibilities

The Tier 4 flexibility program allows equipment manufacturers to start using a limited number of their Tier 4 flexibility allowances, including small volume allowances, once the seven-year period of the original flexibility program expires. In this way, a manufacturer could continue exempting a troublesome Tier 3 application, if necessary, beyond the allotted time of the original flexibility program. Equipment manufacturers may use no more than 10 percent of their Tier 4 percent of production allowances, or up to 100 of their Tier 4 small volume allowances, prior to the commencement of the Tier 4 standards for each power category. Flexibility allowances provided under the technical hardship provision cannot be used retroactively.

Using Tier 4 allowances early will reduce the number of allowances available for transitioning to the Tier 4 standards. The amount of equipment utilized early will be subtracted from the total Tier 4 allowances, leaving the remainder to be applied in the normal timeframes. The short-term emissions impact associated with the early use of flexibility allowances in California would likely be negligible.

4.7.2.6. Early Introduction Incentives for Equipment Manufacturers

In addition to the flexibility provisions already mentioned, equipment manufacturers may earn unlimited additional allowances for the early introduction of Tier 4 compliant engines. This incentive provision is generally applicable to engines 19 = kW = 560, and conditionally applicable to engines above 560 kW.

The purpose of this provision is to allow equipment manufacturers an opportunity to share in the benefits for the early introduction of cleaner engines. Previously, only the engine manufacturer was the beneficiary of early introduction credits, but this provision transfers the incentive to the equipment manufacturer so long as that manufacturer meets certain criteria. If the equipment manufacturer fails to meet the requisite conditions, or declines the flexibility allowance, the early introduction benefits fall back to the engine manufacturer (see subsection 4.3 for details).

Equipment manufacturers installing engines complying with the final Tier 4 standards would earn one flexibility allowance for each early Tier 4 compliant engine used in its equipment. Equipment manufacturers installing engines 56 = kW = 560 that comply with the final Tier 4 PM standard and the alternative NOx standard would earn one-half of a flexibility allowance for each early Tier 4 engine used in its equipment. Table 4.15 below illustrates some of the criteria for determining an early Tier 4 engine and the earned flexibility benefits.

Table 4.15
Offset Generating Incentives for Equipment Manufacturers

POWER CATEGORY	QUALIFYING STANDARDS (g/kW-hr)	INSTALLATION DEADLINE	FLEXIBILITY ALLOWANCE
19 = kW < 56	0.03 PM / 4.7 NMHC+NOx	December 31, 2012 [1]	1 for 1
56 = kW = 130	0.02 PM / 0.40 NOx / 0.19 NMHC	December 31, 2011	1 for 1
	0.02 PM / 3.4 NOx / 0.19 NMHC [2]		1 for 2
130 = kW = 560	0.02 PM / 0.40 NOx / 0.19 NMHC	December 31, 2010	1 for 1
	0.02 PM / 2.0 NOx / 0.19 NMHC [2]		1 for 2
GEN > 560	0.03 PM / 0.67 NOx / 0.19 NMHC	December 31, 2014	1 for 1
ELSE > 560	0.04 PM / 3.5 NOx / 0.19 NMHC		

Notes:
1 The installation date for 37 = kW < 56 engines purchased from manufacturers choosing to opt out of the 2008 model year Tier 4 standards and instead comply with the Tier 4 standards beginning in 2012 would be December 31, 2011
2 To be eligible, engines must meet the 0.02 g/kW-hr PM standard and the alternative NOx standards

Benefits would be generated and used on an engine power basis across any of the power categories within the 56 = kW = 560 power range. For example, an early introduction of seventy-five 500 kW engines could be used to offset three-hundred and seventy-five 100 kW engines (75*500 kW = 375*100 kW = 37,500 kW). Other restrictions apply regarding the generation and use of early introduction allowances pertaining to engines greater than 560 kW.

To provide assurance that early Tier 4 compliant engines will be placed into equipment within a reasonable time frame, engine manufacturers are required to certify candidate engines before September 1 of the year before the Tier 4 standards take effect in order for them to be eligible to earn offset generating credits. Similarly, equipment manufacturers must install offset generating engines in equipment before January 1 of the year before the Tier 4 standards take effect to claim credits. Compliance with transient testing requirements, as applicable, NTE limits, and closed crankcase requirements are also required for the early introduction allowances.

4.7.2.7. Economic Hardship Allowance

The Tier 4 flexibility program also contain a safety-valve provision whereby an equipment manufacturer that does not make its own engines could obtain limited additional relief by providing evidence that, despite its best efforts, it cannot meet the implementation dates, even with all the flexibility provisions outlined above. Such a situation might occur if an

engine supplier, without a major business interest in the equipment manufacturer, were to change or drop an engine model very late in the implementation process.

Appeals for hardship relief must be made in writing to the Chief of the Mobile Source Operations Division, must be submitted before the earliest date of noncompliance, must include evidence that failure to comply was not the fault of the equipment manufacturer (such as a broken contract), and must include evidence that serious economic hardship to the company would result if relief is not granted. Staff intends to work with the applicant to ensure that all other remedies available under the flexibility provisions are exhausted before granting additional relief, and would limit the period of relief to no more than one year. Manufacturers should be able to complete their strategy on how they will meet a new emission standard within the first year of implementation. Therefore, applications for hardship relief would only be accepted during the first year after the effective date of an applicable new emission standard.

Staff would like to make clear that it expects this provision to be rarely used. Each granting of relief would be treated as a separate agreement with no prior guarantee of success, and with the inclusion of measures, agreed to in writing by the equipment manufacturer, for recovering the lost environmental benefit.

4.7.2.8. Existing Inventory Allowance and Replacement Engines

Staff proposes to extend provisions for equipment manufacturers to continue using engines built prior to the effective date of the Tier 4 standards to further ease the transition to the Tier 4 standards. Federal anti-stockpiling language will be appended to the provision to harmonize with U.S. EPA.

4.7.2.9. Flexibility Engine Labeling Requirements

Staff proposes to adopt more descriptive labeling requirements for engines produced under the equipment manufacturer flexibility provisions described above than those adopted by U.S. EPA in its final Tier 4 rule. This proposal, including the revised label content, is discussed at length in subsection 5.1.1.

4.7.2.10. Import Restrictions

The original flexibility program treats foreign importers as individual equipment manufacturers with respect to the allocation of flexibilities. As a group, these importers could potentially combine for more flexibility allowances than 80 percent of the foreign equipment manufacturer's production for the United States market by each claiming to qualify under the small volume flexibility provision.

To address this potential for abuse, staff proposes to align with federal requirements specifying that only those off-road equipment manufacturers that install engines and have

primary responsibility for designing and manufacturing equipment will qualify for the allowances, or other relief, provided under the Tier 4 flexibility provisions. Foreign equipment manufacturers who comply with the provisions discussed in the proposed regulations and test procedures, found in Attachment 1 and Attachment 2 of this report, respectively, will receive the same allowances and other transitional provisions as domestic manufacturers. Importers with little involvement in the manufacturing and assembling of equipment will not receive any allowances or other transitional relief directly, but may import flexibility equipment if it is covered by an allowance or transitional provision associated with a foreign equipment manufacturer. These provisions allow transitional allowances and other provisions to be used by foreign equipment manufacturers in the same way as domestic equipment manufacturers, while limiting the potential for abuse.

Additionally, foreign equipment manufacturers that participate in the flexibility program will be required to post a monetary bond for engines imported into the United States. The bond requirement is necessary for ensuring that foreign equipment manufacturers are subject to the same level of enforcement as domestic equipment manufacturers, and for collecting any judgments assessed against a foreign equipment manufacturer for violations of flexibility provisions.

4.7.2.11. Enforcement and Recordkeeping Requirements

Staff proposes to extend the enforcement and recordkeeping requirements from the original flexibility program such that engine manufacturers would be allowed to continue to build and sell engines to meet the market demand created by the flexibility program, provided they receive written assurance from the equipment manufacturers that such engines are being procured for this purpose. Engine manufacturers who participate in this program would be required to annually provide copies of letters from equipment manufacturers requesting such engines to the Chief of the Mobile Source Operations Division.

Equipment manufacturers choosing to take advantage of the allowances must:

(1) keep records of the production of all pieces of equipment produced for sale (on a national basis) exempted under the allowance provisions for at least two full years after the final year in which allowances are available for each power category;

(2) record the serial and model numbers and dates of production of equipment and installed engines, rated power of each engine, and the calculations used to verify that the allowances have not been exceeded in each power category; and

(3) make these records available to the Executive Officer upon request.

Secondary manufacturers who purchase new equipment, modify or re-label it (i.e., privately branded equipment), and resell it as new equipment would be subject to the regulations in

the same way as independent dealers and distributors. The equipment manufacturer flexibility provisions would only apply to the manufacturer who originally installs the engine into the equipment.

All companies/manufacturers that are under the control of a common entity, and that meet the definition of an off-road equipment manufacturer, must be considered together for the purposes of applying exemption allowances. This would provide certain benefits for the purpose of pooling exemptions but would also preclude the abuse of the small volume allowances that would exist if companies could treat each operating unit as a separate equipment manufacturer.

Staff recognizes that the Tier 4 flexibility program may involve a certain amount of complexity and administrative burden; however, this program is entirely voluntary and manufacturers not wishing to participate do not have to do so.

4.7.2.12. Notification and Reporting Requirements

As in the federal rule, staff proposes that equipment manufacturers wishing to participate in the Tier 4 flexibility program be required to notify the Chief of the Mobile Source Operations Division prior to using Tier 4 allowances. No such requirement exists in the original flexibility program. Equipment manufacturers would be required to submit their written notification before the first calendar year in which they intend to use the transitional provisions. Adoption of this notification requirement would help to ensure that flexibility allowances are used appropriately in California.

The specific information to be provided to the Chief of the Mobile Source Operations Division would be:

(1) the equipment manufacturer's name, address, and contact person's name, phone number;

(2) the allowance program that the equipment manufacturer intends to use by power category;

(3) the calendar years in which the equipment manufacturer intends to use the exception;

(4) an estimation of the number of engines to be exempted under the flexibility provisions by power category;

(5) the name and address of the engine manufacturer from whom the equipment manufacturer intends to obtain exempted engines; and

(6) identification of the equipment manufacturer's prior use of Tier 2 and Tier 3 flexibility

provisions.

Staff also proposes to adopt new reporting requirements such that equipment manufacturers participating in the flexibility program would be required to submit an annual accounting to the Chief of the Mobile Source Operations Division showing their calculated number of maximum flexibility allowances by power category based on sales from the previous year. Equipment manufacturers would also have to report the number of flexibilities used and the percent of production these allowances represent for the current year. Each report would include a cumulative calculation (both total number and, if appropriate, the percent of production) for all years the equipment manufacturer is using the flexibility provisions for each of the Tier 4 power categories. This proposal is consistent with the reporting requirements of the federal Tier 4 flexibility program.

4.8. Miscellaneous

Staff proposes to amend the preemption reference in Title 13 CCR, 2420(a)(1) to clarify that new locomotive engines are not subject to California's off-road diesel regulation. Title 13 CCR, 2420(a)(1) currently references Section 209(e)(1)(A) of the Federal Clean Air Act (42 U.S.C. 7543(e)(1)(A)) when identifying preempt engines and equipment that are outside the scope of applicability of the regulation. However, the preemption for new locomotive engines is found in Section 209(e)(1)(B) of the Federal Clean Air Act; therefore, the current preemption reference could be interpreted not to include new locomotive engines, which is not the intent. Staff proposes to change the reference to "Section 209(e)(1) of the Federal Clean Air Act (42 U.S.C. 7543(e)(1))," which would then encompass all preemption engines as being outside the scope of the regulation.

Staff also proposes to extend the voluntary provisions for designating Blue Sky Series engines for Tier 1, Tier 2, and Tier 3 engines. Current requirements do not extend beyond the 2004 model year. This change would harmonize with current U.S. EPA requirements.

5. DIFFERENCES BETWEEN CALIFORNIA AND FEDERAL REGULATIONS

Staff has endeavored to harmonize California's off-road diesel proposal with the provisions of U.S. EPA's Clean Air Nonroad Diesel Final Rule (40 CFR, Part 1039 and incorporated Parts). To this end, ARB staff recommends that the Board adopt the majority of provisions outlined in the federal rule, including all emission standards and implementation schedules for California's non-preempt diesel engines. However, staff's proposal differs from the federal program in some relatively minor, but important ways that are necessary to protect the air quality benefits of the Mobile Source program. These differences are primarily documentary in nature and do not present any technical obstacles for the off-road industry to overcome. Staff is also proposing to retain its autonomous In-Use Compliance and Recall Program previously adopted by the Board in 2000 as part of the regulatory amendments for 2000 and later compression-ignition engines.

5.1. Flexibility Program for Equipment Manufacturers

Although staff is in conceptual agreement with the provisions of the federal Tier 4 flexibility program for equipment manufacturers, additional safeguards are needed to ensure a more identifiable and enforceable deployment of flexibility provisions in California.

5.1.1. Flexibility Engine Labeling

U.S. EPA recognized the need for labeling flexibility engines in its Tier 4 rule, and now requires both the engine and equipment manufacturer to affix labels indicating that these engines are to be used only according to flexibility provisions under penalty of law. Labeling was not specifically required under the original flexibility program adopted as part of the Tier 2/3 regulation. Although U.S. EPA's new labeling requirement is a step in the right direction, it does not go far enough in describing emissions performance to provide verification of whether or not the flexibility engine has been correctly placed in service. The table below is provided to show an example of why the U.S. EPA labeling requirement, without an engine family designation, is inadequate. The table lists the certification level that flexibility engines must meet depending on when the manufacturer first begins using flexibility allowances. According to the table, Tier 3 engines could be used as flexibility allowances in the 19 = kW < 56 power category from 2008-2014, but interim Tier 4 engines must be used if the allowances are delayed until 2012-2018. Consequently, there is a three year overlap from 2012-2014 during which the certification level of the flexibility engine could not be directly ascertained from the U.S. EPA emissions label. The other power categories are subject to the same or similar type of confusion.

Table 5.1
Tier 4 Flexibility Usage Periods

Power Category	Flexibility Period Options (Model Years)	Flexibility Standards
< 19 kW	2008 – 2014	Tier 2 Standards
19 = kW < 56	2008 - 2014 [1]	Tier 3 Standards [2]
	2012 – 2018	Model Year 2008 Tier 4 Standards
56 = kW < 130	2012 – 2018	Tier 3 Standards
	2014 – 2020	Model Year 2012 Tier 4 Standards
130 = kW = 560	2011 – 2017	Tier 3 Standards
	2014 – 2020	Model Year 2011 Tier 4 Standards
> 560 kW	2011 – 2017	Tier 2 Standards
	2015 – 2021	Model Year 2011 Tier 4 Standards

Notes:
1 This usage period is available for allowances greater than or equal to 37kW only if interim Tier 4 standards have been met starting in 2008.
2 Flexibility allowances under 37kW may contain engines certified to the Tier 2 standards.

In practical terms, this means that ARB field investigators would not be able to determine the appropriateness of these flexibility engines upon inspection. Although it may be possible to verify the emissions performance of the engines post inspection by contacting the engine manufacturer directly, this diverts resources and hinders the field inspector's ability to identify violations and enforce the regulation in a timely manner. Furthermore, should the flexibility engine ever need to be rebuilt or repaired, U.S. EPA's label would not be able to provide an adequate reference for determining that the engine had been rebuilt to at-least the original emissions specifications as required, or that correct replacement parts had been used to repair an emissions related malfunction.

Staff is aware that some manufacturers are voluntarily labeling their flexibility engines, and other manufacturers have been requested by staff to begin labeling or to provide more descriptive labeling content. However, a strictly voluntary program does not provide the assurance of compliance and may not result in a standardized application of the remedy. Therefore, staff proposes to amend existing regulations such that the label to be attached by the engine manufacturer must include the engine family name to which the flexibility engine was originally certified. In this way, ARB field investigators would be able to immediately identify a flexibility engine and know the standards to which it was certified. This knowledge would aid the investigator in determining that all required emission control equipment was present on the engine, and that it had not been tampered with. The label would also be used to identify whether or not the engine is a candidate for a future retrofit or re-power control measure in California. Although this amendment applies to the engine

manufacturer only, both engine and equipment manufacturers would be held responsible for ensuring that the flexibility engine possesses the correct label at the time of sale.

Staff also proposes that this amendment take effect earlier than required under the federal rule, and apply to Tier 2/3 engines used as flexibility allowances beginning in 2006. Under this proposal, one of two labels with modified statements of compliance would be affixed to the engine to differentiate between participation in the original Tier 2/3 flexibility program or the new Tier 4 flexibility program. The proposed statement of compliance for these labels would read as follows:

Engines Allowed Under the New Tier 4 Flexibility Program
"THIS ENGINE BELONGS TO FAMILY _____._____ AND MEETS ARB EMISSION STANDARDS UNDER 13 CCR 2423(d). SELLING OR INSTALLING THIS ENGINE FOR ANY PURPOSE OTHER THAN FOR THE EQUIPMENT FLEXIBILITY PROVISIONS CITED MAY BE A VIOLATION OF STATE LAWS SUBJECT TO CIVIL PENALTY."

Uncertified Engines Less Than 37 kW Allowed Under the Tier 2/3 Flexibility Program
"THIS ENGINE QUALIFIES FOR USE IN EQUIPMENT RATED BELOW 37 KW AND IS EXEMPT FROM CURRENT MODEL YEAR EMISSION STANDARDS UNDER THE ARB EQUIPMENT FLEXIBILITY PROVISIONS IN 13 CCR 2423(d). SELLING OR INSTALLING THIS ENGINE FOR ANY PURPOSE OTHER THAN FOR THE EQUIPMENT FLEXIBILITY PROVISIONS CITED MAY BE A VIOLATION OF STATE LAW SUBJECT TO CIVIL PENALTY."

The revised statement of compliance does not preclude the referencing of similar federal requirements that would be satisfied simultaneously by meeting the provisions of Section 2423(d). Furthermore, the Executive Officer may, upon request, approve alternate labeling specifications provided that they meet the intent of this requirement.

5.1.2. Executive Order Clarification

Staff proposes to amend the existing regulations to more clearly indicate that non-preempt engines certified under the flexibility provisions for equipment manufacturers must be covered by an Executive Order. The Executive Order need not be current for the year in which the engine is used as a flexibility allowance, but may have been issued previously so long as the engine was certified to the appropriate standards required by the flexibility provision.

Title 13 CCR, 2420(a)(3) defines the scope of applicability for needing an Executive Order as "Every new off-road compression-ignition engine that is manufactured for sale, sold, offered for sale, ... into California ... subject to any of the standards prescribed in this article [Article 4] ..."

ARB interprets this language to include engines sold under the transitional flexibility

provisions for equipment manufacturers. In its amendment, staff intends to clarify that Executive Orders are required for all engines, including flexibility engines. Title 13, CCR 2423(d)(1)(A) currently reads as follows:

> "Equipment rated at or above 37kW. For off-road equipment and vehicles with engines rated at or above 37kW, a manufacturer may take any of the actions identified in the 2000 and Later Test Procedures (Section 89.1003(a)(1)) for a portion of its California-directed production volume of such equipment and vehicles during the seven years immediately following the date on which Tier 2 engine standards first apply to engines used in such equipment and vehicles, provided that the seven-year sum of the U.S.-directed portions in each year, as expressed as a percentage for each year, does not exceed 80, and provided that all such equipment and vehicles or equipment contain only Tier 1 engines;"

The reference to 40 CFR, Part 89.1003(a)(1) provides a list of otherwise prohibited actions that may be applied to flexibility engines. It reads:

> "The following acts and the causing thereof are prohibited:

(i) In the case of a manufacturer of new nonroad engines, vehicles, or equipment for distribution in commerce, the sale, or the offering for sale, or the introduction, or delivery for introduction, into commerce, of any new nonroad engine manufactured after the applicable effective date under this part, or any nonroad vehicle or equipment containing such engine, unless such engine is covered by a certificate of conformity issued (and in effect) under regulations found in this part.

(ii) In the case of any person, except as provided in subpart G of this part, the importation into the United States of any new nonroad engine manufactured after the applicable effective date under this part, or any nonroad vehicle or equipment containing such engine, unless such engine is covered by a certificate of conformity issued (and in effect) under regulations found in this part."

At first glance, this may appear to exempt flexibility engines from requiring an Executive Order[18]; however, this would be inconsistent with language in the same section that requires "... all [flexibility] equipment and vehicles or equipment [to] contain only Tier 1 engines;" In order to qualify as a Tier 1 engine, the engine must have been previously certified to the Tier 1 standard and thereby covered by an Executive Order. The purpose, therefore, of 40 CFR, Part 89.1003(a)(1) is not to exempt flexibility engines from needing an Executive Order, but to exempt them from needing an Executive Order current to the year in which the flexibility engines are used.

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[18] A "certificate of conformity" is synonymous to an Executive Order for the purpose of this reference (Section 89.2, California Exhaust Emission Standards and Test Procedures for New 2000 and Later Off-Road Compression-Ignition Engines, December 28, 2000).

U.S. EPA has attempted to clarify this provision in its final rule by referencing a new section, 40 CFR, Part 1068.101(a)(1), which essentially rewords the prohibited actions language in 40 CFR, Part 89.1003(a)(1) by adding the qualifying statement that "... engines must have a valid certificate of conformity for its model year ..." It therefore follows that flexibility engines would be exempt from this otherwise prohibited action, which means that flexibility engines do not have to be covered by a certificate of conformity/executive order for "... its model year ..." or in other words, for the model year in which it is sold. The full text of 40 CFR, Part 1068.101(a)(1) is copied below:

> "You may not sell, offer for sale, or introduce or deliver into commerce in the United States or import into the United States any new engine or equipment after emission standards take effect for that engine or equipment, unless it has a valid certificate of conformity for its model year and the required label or tag. You also may not take any of the actions listed in the previous sentence with respect to any equipment containing an engine subject to this part's provisions, unless the engine has a valid certificate of conformity for its model year and the required engine label or tag. This requirement also covers new engines you produce to replace an older engine in a piece of equipment, unless the engine qualifies for the replacement-engine exemption in Sec. 1068.240. We may assess a civil penalty up to $31,500 for each engine in violation."

Staff believes this is an awkward means of clarifying the requirement that flexibility engines must have been previously certified and covered by a Certificate of Conformity, or an Executive Order, and might still be subject to misinterpretation. Therefore, staff instead proposes to remove all references to 40 CFR, Part 89.1003(a)(1) in the California regulations pertaining to flexibility allowances and to create a subsection stating plainly that:

> "Engines used in accordance with the transitional flexibility provisions for equipment manufacturers described in section 2423(d) must be covered by an Executive Order. The Executive Order need not be current for the year in which the engine is claimed as a flexibility allowance, but may have been issued previously so long as the engine was certified to the appropriate standards required by the flexibility provision."

An Executive Order is needed in addition to, or in lieu of, a federal Certificate of Conformity so that ARB has the authority to enforce non-preempt engines found to be in violation of the off-road diesel regulations. Engines used as flexibility allowances prior to the adoption of this amendment would not be subject to enforcement actions retroactively.

5.2. Rebuild Labeling Prohibition and Supplemental Label Requirement

Staff proposes to adopt language prohibiting the removal or defacing of the original emissions label from non-preempt off-road diesel engines that have been rebuilt or

remanufactured. The rebuilder or remanufacturer must take care to protect the original label from the effects of sandblasting, acid dipping, or any other restorative process. A supplemental label must be affixed to the rebuilt or remanufactured engine indicating the date of renovation and other pertinent information, but must not obscure in any way the visibility of the original label or imply that the rebuilt or remanufactured engine is "new" or that it belongs to an engine family other than the one to which it was originally certified. Retaining the original label offers proof, and a means to verify, that the engine was "rebuilt to a certified configuration of the same or later model year as the original engine" as required by 40 CFR, Part 89.130(c) and 40 CFR, Part 1068.120(f). Furthermore, the original label will be used to identify whether or not the rebuilt or remanufactured engine can be used in a future retrofit or re-power control measure. ARB investigators have discovered that the replacement of engine labels is a common practice among some engine re-builders.

Notwithstanding, the original label on any engine that is remanufactured to "like-new" condition and which is recertified to current-year emission requirements including all durability and warranty provisions, must be removed by the remanufacturer and replaced with one identifying the engine as belonging to a family meeting current-year emission requirements. A supplemental label may be affixed by the remanufacturer, if desired, but must adhere to the requirements for supplemental labels described in the paragraph above.

5.3. Extension of Replacement Engine Reporting Requirements

When replacing a California certified off-road diesel engine, equipment manufacturers are required to use the cleanest engines whenever feasible. However, if newer, cleaner engines do not "fit" into older equipment, the engine manufacturer may continue to produce replacement engines that are identical in configuration in all material respects to the original engine being replaced provided that 1) the engine manufacturer has ascertained that no certified lower-emitting engine is available, 2) the replacement engine is properly labeled as a replacement engine, and 3) the actual number of replacement engines produced for California is reported annually.

Currently, manufacturers are only required to satisfy the replacement engine reporting requirements, including an inventory of engines sold and proof that every effort was made to find a cleaner replacement, through the 2004 model year. Staff proposes to extend the reporting requirements for replacement engines to 2005 and subsequent model years.

5.4. In-Use Compliance/Recall Program

U.S. EPA has recall procedures in place to ensure that certified engines meet the emission standards over the useful life of the engine. California incorporated off-road language into its own in-use compliance and recall program under Articles 2.1 - 2.3, Chapter 2, Title 13, California Code of Regulations in 2000. Staff is proposing no changes

to its In-Use Compliance/Recall Program. The program will continue to be applicable to all non-preempt off-road diesel engines in California, including those meeting the Tier 4 standards and those used as flexibility allowances. California reserves the right to investigate and recall engines found to be in violation of the regulations apart from U.S. EPA, if necessary.

The California program for in-use compliance/recall should not cause manufacturers any significant burden. The program procedures would only be performed when needed (i.e., when information might indicate a problem with meeting the emission standards). This proposal will allow the ARB to continue to ensure that engines are meeting the emission standards, regardless of any subsequent changes to the federal programs.

6. TECHNOLOGY AND FEASIBILITY

This section discusses the most likely technologies to be employed in meeting the Tier 4 standards, and the feasibility of implementing them in the timeframes proposed.

6.1. Federal Feasibility Review

The technological feasibility of the proposed standards has already been thoroughly evaluated by U.S. EPA as part of their Regulatory Impact Analysis. Staff concurs with U.S. EPA's conclusion that given the timing of the emissions standards proposed in the federal final rule, and this report, and the availability and continuing development of emission control technologies, off-road diesel engines can be designed to meet the proposed Tier 4 standards in the lead time provided.

The thoroughness of the U.S. EPA analysis, and staff's concurrence with that analysis, render redundant any exhaustive discussion of technological feasibility in this report. This Section will, therefore, briefly discuss some of the likely control strategies. Much of the information contained herein is derived from Chapter 4 of U.S. EPA's Regulatory Impact Analysis: Technologies and Test Procedures for Low-Emission Engines.

6.2. Summary of Technologies

In general, manufacturers of off-road diesel engines are expected to use emission controls similar to those already in use by the manufacturers of on-road diesel engines, although effectiveness could vary due to the different operating conditions experienced by off-road engines and the wide variety of applications.

Arguably the most challenging consideration in transferring advanced emission control technologies to the off-road will be exhaust temperature. Exhaust temperature is critical for the regeneration of catalyzed exhaust emission control devices. The following abridgment will focus primarily on PM and NOx aftertreatment, which staff believes to be the most likely means of achieving final Tier 4 standards. However, some of the technologies for meeting

interim standards will also be discussed. For the most part, staff is summarizing the feasibility studies already performed by U.S. EPA and documented in its Regulatory Impact Analysis pertaining to the final nonroad diesel regulation. To complement this, staff also provides the results of an ARB / U.S. EPA funded test program by Southwest Research Institute that evaluated the performance of particulate filters and ultra low-sulfur diesel fuel on three diesel engines.

6.2.1. Exhaust Temperature Management

The primary concern for catalyst-based emission control technologies is exhaust temperature. In general, exhaust temperature increases with engine power and can vary dramatically as engine power demands vary. For catalyzed diesel particulate filters (CDPFs), exhaust temperature determines the rate of filter regeneration, and if too low, causes a need for supplemental means to ensure proper filter regeneration. A CDPF controls PM emissions under all conditions and can function properly even when exhaust temperatures are low for an extended time and the regeneration rate is lower than the soot accumulation rate, provided that occasionally exhaust temperatures, and the soot regeneration rate, are increased enough to regenerate the CDPF. Similarly, there is a minimum temperature (e.g., 200° Celsius) for NOx adsorbers below which regeneration is not readily feasible and a maximum temperature (e.g., 500° Celsius) above which NOx adsorbers are unable to effectively store NOx. Therefore, there is a need to match diesel exhaust temperatures to conditions for effective catalyst operation under the various operating conditions of off-road engines.

U.S. EPA has conducted an analysis of various operating cycles and various engine power density levels to better understand the matching of off-road engine exhaust temperatures, catalyst installation locations, and catalyst technologies. This study, documented in U.S. EPA's Regulatory Impact Analysis, shows that for many engine power density levels and equipment operating cycles, exhaust temperatures are quite well matched to catalyst temperature window characteristics. In particular, the nonroad transient composite test cycle was shown to be well matched to the NOx adsorber characteristics with estimated performance in excess of 90 percent for a turbocharged diesel engine tested under a range of power density levels. The analysis also indicated that the exhaust temperatures experienced over the nonroad transient test cycle are better matched to the NOx adsorber catalyst temperature window than the temperatures that would be expected over the highway Federal Test Procedure (FTP) test cycle.

Still, some off-road engines may experience in-use conditions requiring the use of temperature management strategies (e.g., active regeneration) to effectively use the NOx adsorber and CDPF systems. Accordingly, the cost analysis estimates for meeting Tier 4 standards assumes that all off-road engines complying with a PM standard of 0.04 g/kW-hr or lower will have an active means to control temperature, although some applications likely may not need one. Based on U.S. EPA's analyses, staff does not believe that there are any off-road engine applications above 19 kW for which active temperature management

will not work.

6.2.2. PM Control Technologies

The following is a summary of technologies expected to be used to meet the Tier 4 PM standards.

6.2.2.1. In-Cylinder Control

The soot portion of PM emissions can be reduced by increasing the availability of oxygen within the cylinder for soot oxidation during combustion. Oxygen can be made more available by either increasing the oxygen content in-cylinder or by improving the mixing of the fuel and oxygen in-cylinder. Several current technologies can influence oxygen content and in-cylinder mixing, including improved fuel-injection systems, air management systems, and combustion system designs. In addition to enabling compliance with required emission standards, the application of better combustion system technologies across the broad range of off-road applications offers an opportunity for significant reductions in engine-out PM emissions and possibly for reductions in fuel consumption.

6.2.2.2. Diesel Oxidation Catalysts

Diesel oxidation catalysts (DOCs) are the most common form of diesel aftertreatment technology today and have been used for compliance with the PM standards for some on-road diesel engines since the early 1990s. DOCs reduce diesel PM by oxidizing a small fraction of the soot emissions and a significant portion of the SOF emissions. In general, the DOC's effectiveness to reduce PM emissions is normally limited to approximately 30 percent because the SOF portion of diesel PM for modern diesel engines is typically less than 30 percent, and because the DOC typically increases sulfate emissions, reducing the overall effectiveness of the catalyst. Limiting fuel sulfur levels to 15 ppmw allows DOCs to be designed for maximum effectiveness (nearly 100% control of SOF with highly active catalyst technologies) since their control effectiveness is not reduced by sulfate formation. The sulfate formation rate is still high, but because the sulfur level in the fuel is low, the resulting PM emissions are well controlled.

DOC effectiveness to control NMHC and CO emissions are directly related to the "activity" of the catalyst material used in the DOC washcoat. Highly active DOCs can reduce NMHC emissions by 97 percent while low activity catalysts realize approximately 50 percent NMHC control. Today, highly active DOC formulations cannot be used for NMHC and CO control because the sulfur in current diesel fuel leads to unacceptable sulfate PM emissions. However, with the low-sulfur diesel fuel that will be available under this program, DOCs will be able to provide substantial control of these pollutants. The use of DOCs is likely to factor in heavily as part of an overall compliance strategy for engines meeting the interim PM standards in 2008. For those engines, DOCs would also provide significant reductions in CO and NMHC. Oxidation catalyst technologies (i.e., DOCs and

CDPFs) generally will also be an effective tool for ensuring compliance with the NTE provisions of the Tier 4 program. In addition, test data show that toxics such as polycyclic aromatic hydrocarbons (PAHs) can be reduced by more than 80 percent with a DOC (RIA4 2004).

6.2.2.3. Diesel Particulate Filters

CDPFs have been shown to be very effective at reducing PM mass by dramatically reducing the soot and SOF portions of diesel PM. In addition, recent data show that they are also very effective at reducing the overall *number* of emitted particles when operated on ultra low-sulfur fuel (RIA4 2004). CDPFs have been shown to reduced particle count by over 95 percent, including some of the smallest measurable particles (< 50 nanometers). The combination of CDPFs with ultra low-sulfur fuel is expected to result in very large reductions in both PM mass (> 90 percent) and the number of ultra-fine particles. CDPFs are also capable of decreasing NMHC in excess of 90 percent.

Engine operating conditions have little impact on the particulate trapping efficiency of CDPFs, so 90 percent and greater efficiencies for elemental carbon particulate matter will apply to engine operation within the NTE zone and over the regulated transient cycles. These efficiencies will also be realized over steady-state test conditions such as the International Standards Organization C1 schedule. However, CDPF performance is dependent on the filter's ability to regenerate accumulated particulates and on sulfate formation. Sulfate formation will reduce the measured removal rate of particulates at some NTE operating conditions and some steady-state modes, even when using 15 ppmw sulfur diesel fuel. Additionally, a minimum operating temperature must be achieved for CDPF regeneration to occur. Exhaust temperature can vary significantly depending on operation and duty-cycle, and may not be sufficient to initiate regeneration for some off-road applications using a passive system. For these applications, an active diesel particulate filter system (i.e., one that requires external heat) may be necessary to ensure that temperature remains high enough, long enough to allow regeneration to occur. Although not typically an issue with new engines, excessive oil consumption can also reduce the efficiency of passive CDPFs due to the high content of sulfur in the lubricating oil. Active particulate filters may be needed to ensure regeneration for these engines.

Recent testing by the Southwest Research Institute (SwRI), in San Antonio, Texas, under joint contract with ARB and U.S. EPA, clearly demonstrated that the proposed Tier 4 PM standards are achievable on off-road diesel engines using passive particulate filters and ultra low-sulfur diesel fuel. The engines evaluated were a 1999 Caterpillar 3408 rated at 358 kW, a 1999 Cummins QSL9 rated at 242 kW, and a prototype development engine based on a 1995 Deere 4045T rated at 81 kW. All three engines were tested on a number of transient and steady-state test cycles, including the nonroad transient composite test cycle, with and without particulate filters. Emissions performance with passive filters was typically well below the 0.02 g/kW-hr proposed PM standard. Table 6.1, below, shows the PM results for each engine as evaluated on the nonroad transient composite and the C1

steady-state test cycles. Particulate filters were supplied by DCL, Inc., and Engine Control Systems, Inc., with substrates from Corning and Delphi (SwRI 2004). Based on the results of this study, staff believes that engine manufacturers should have great success in employing CDPF technology as proposed.

Table 6.1
Catalyzed Diesel Particulate Filter Testing at SwRI
Transient and Steady-State PM Results
Caterpillar, Deere Development Engine, and Cummins

Engine	Test Cycle [1]	PM (g/kW-hr)		Reduction [2]
		Engine Out	w/ Filter	
CAT 3408	Transient	0.343	0.012	96 %
	Steady-State	0.170	0.015	91 %
DDE 4045P	Transient	0.192	0.017	91 %
	Steady-State	0.173	0.013	92 %
CUM QSL9	Transient	0.208	0.007	97 %
	Steady-State	0.159	0.011	93 %

Note:
1 Transient testing was performed on the U.S. EPA nonroad transient composite test cycle and steady-state testing was performed on the 8-mode C1 test cycle.
2 The sulfur content of the fuel used in these evaluations was measured by SwRI to be 12 parts per million by weight

6.2.3. NOx Control Technologies

The rate of NOx formation in the combustion chamber is exponentially related to peak cylinder temperatures and is also strongly related to nitrogen and oxygen content. NOx control technologies for diesel engines have traditionally focused on reducing emissions by lowering the peak cylinder temperatures and by decreasing the oxygen content of the intake air.

6.2.3.1. In-Cylinder NOx Control

Fuel injection timing retard, fuel-injection rate control, charge air cooling, exhaust gas recirculation (EGR) and cooled EGR are some forms of in-cylinder NOx control. The use of these technologies can result in significant reductions in NOx emissions, but are limited due to practical and physical constraints of heterogeneous diesel combustion.

U.S. EPA's Highway Diesel Progress Review Report investigated the extent to which in-cylinder NOx control technologies had advanced. The report noted that a number of

diesel engine manufacturers introduced cooled EGR systems on their heavy-duty diesel engines in 2002 that met the 2004 emission standards for NMHC+NOx (3.4 g/kW-hr). Engine manufacturers have demonstrated that these systems can be further refined to allow NOx emissions compliant with the 2007 NOx averaging level of approximately 1.6 g/kW-hr. To reduce NOx emissions below 1.6 g/kW-hr, engine manufacturers will likely need to increase EGR flow rates. Although there are challenges to applying similar technologies to off-road diesel engines (most notably the lack of ram-air for cooling), fundamental NOx control technologies are applicable to all diesel engines. The continuing development of heavy-duty on-road diesel technologies for in-cylinder NOx control, such as cooled EGR and Caterpillar's Advanced Combustion and Emission Reduction Technology (ACERT), is a good indication that off-road diesel engines 19 = kW = 560, and non-generator off-road engines greater than 560 kW, will be able to comply with their respective Tier 4 standards.

A new form of diesel engine combustion, commonly referred to as homogenous diesel combustion, or premixed diesel combustion, can give very low NOx emissions over a limited range of diesel engine operation. In the regions of diesel engine operation over which this combustion technology is feasible (light-load conditions), NOx emissions can be reduced enough to comply with the 0.4 g/kW-hr NOx emission standard. Some engine manufacturers are already producing engines that utilize this technology over a narrow range of engine operation. Unfortunately, it is not currently feasible to apply this technology over the full range of diesel engine operation.

6.2.3.2. Lean-NOx Catalyst

Passive and active lean-NOx catalyst systems have been under development for some time. However, neither system typically yields more than a 30 percent reduction in NOx. The active lean-NOx catalyst injects a reductant[19] that serves to reduce NOx to nitrogen and oxygen (diesel fuel is typically used as the reductant). The reductant is introduced upstream of the catalyst and reduces oxygen locally allowing NOx emissions to be reduced by the catalyst.

The lean-NOx catalyst washcoat incorporates a zeolite[20] technology that acts to adsorb hydrocarbons from the exhaust stream. Once adsorbed on the zeolite, the hydrocarbons will oxidize and create an oxygen-poor region that is more conducive to reducing NOx. To promote hydrocarbon oxidation at lower temperatures, the washcoat can incorporate platinum or other precious metals. The platinum also helps to eliminate the emission of unburned hydrocarbons that can occur if too much reductant is injected, referred to as "hydrocarbon slip." With platinum, the NOx conversion can take place at the low exhaust temperatures that are typical of diesel engines. However, the presence of the precious metals can lead to production of sulfate PM.

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[19] A substance capable of bringing about the chemical reduction of another substance as it itself is oxidized.
[20] Zeolites are three-dimensional, micro-porous, crystalline solids with well-defined structures used to adsorb a variety of materials including volatile organic chemicals, isomers, and gases.

Although active lean-NOx catalysts have been shown to provide up to 30 percent NOx reduction under limited steady-state conditions, this NOx control is achieved with a fuel economy penalty upwards of seven percent due to the need to inject fuel into the exhaust stream. NOx reductions over the transient on-road FTP cycle are on the order of twelve percent due to excursions outside the optimum NOx reduction efficiency temperature range for these devices. Consequently, the active lean-NOx catalyst does not appear to be capable of enabling the significantly lower NOx emissions required by the Tier 4 NOx standards.

Passive lean-NOx catalysts use no reductant injection. The passive lean-NOx catalyst is therefore even more limited in its ability to reduce NOx because the exhaust gases normally contain very few hydrocarbons. For that reason, current passive lean-NOx catalysts are only capable of ten percent steady-state NOx reductions. Neither of the lean-NOx catalyst technologies described can provide the significant NOx reductions necessary to meet the Tier 4 standards.

6.2.3.3. NOx Adsorber

The NOx adsorber is an extension of the three-way catalyst technology developed for gasoline powered vehicles more than twenty years ago. It enhances the three-way catalyst function through the addition of storage materials on the catalyst surface that can adsorb NOx under oxygen-rich conditions. NOx adsorbers work to control NOx emissions by storing NOx on the surface of the catalyst during the lean engine operation typical of diesel engines. The adsorber then undergoes subsequent brief rich regeneration events through the injection of a reductant (typically fuel) where the NOx is released and reduced across precious-metal catalysts. The NOx storage period can be as short as 15 seconds, or as along as 10 minutes, depending on engine-out NOx emission rates and exhaust temperature. This method for NOx control has been shown to be highly effective when applied to diesel engines, but has some technical challenges associated with it. Primary among these is sulfur poisoning of the catalyst.

NOx adsorber performance can be enhanced by incorporating a CDPF into the system. Partial oxidation of the secondary fuel reductant injected into the exhaust during regeneration could lead to soot formation. Using a CDPF upstream of the NOx adsorber, but downstream of the secondary fuel injection, allows partial oxidation of the fuel hydrocarbons to occur on the surface of the CDPF. The CDPF efficiently captures any soot formed during partial oxidation of the injected fuel, preventing an increase in soot emissions. The partial oxidation reaction over the CDPF is exothermic and can be used to increase the rate of temperature rise for the NOx adsorber, similar to the use of light-off catalysts with cascade three-way catalyst systems in gasoline vehicles. The fuel economy penalty from injecting the reductant varies depending on NOx adsorber control strategy, but a typical value is about three percent.

The ability of a diesel engine equipped with a NOx adsorber to control NOx emissions consistently in excess of 90 percent is dependent on the management of temperature. When the engine and NOx adsorber-based emission control system are well matched and integrated, NOx reductions can be far in excess of 90 percent. Conversely, if exhaust temperatures are well in excess of 500° Celsius, or well below 200° Celsius, for significant periods of engine operation, NOx control efficiency may be reduced. Researchers are developing and testing new formulations designed to increase the high temperature stability of the NOx adsorber and to widen the window of operation.

A NOx/Oxygen (O_2) sensor is needed for NOx adsorber regeneration control and is a component originally designed and developed for gasoline powered vehicles. Oxygen sensors have proven to be extremely reliable and long lived in passenger car applications, which see significantly higher temperature ranges than are normally encountered on a diesel engine. There is no reason why the application of a NOx/O_2 sensor on a diesel engine should prove more difficult. While diesel exhaust can cause fouling of the NOx/O_2 sensor damaging its performance, this situation can be addressed through the application of a CDPF in front of the sensor. The CDPF then protects the sensor from PM, but does not hinder its operation.

As previously mentioned, one of the technical challenges associated with NOx adsorbers relates to sulfate poisoning. While NOx adsorbers are known to be extremely efficient at storing NOx on the surface of the catalyzing surface during lean operation, they are, unfortunately, also efficient at storing oxides of sulfur (SOx). In fact, SOx has significantly more affinity for the adsorber than NOx does and is typically not released during regeneration. Thus, sulfate compounds quickly occupy the NOx storage sites on the catalyst rendering the catalyst ineffective (poisoned) for further NOx reduction.

The stored sulfur compounds are removed by exposing the catalyst to hot and rich air-fuel ratio conditions for a brief period. Under these conditions, the stored sulfate is released and reduced in the catalyst. This sulfur removal process, called desulfation, can restore the performance of the NOx adsorber to near new operation. NOx adsorber desulfation appears to be closely related to the temperature of the exhaust gases, air-fuel ratio, and the NOx adsorber catalyst formulation. Lower air-fuel ratios work to promote the release of sulfur from the surface, promoting faster and more effective desulfation. Both U.S. EPA and ARB staff believe that the NOx adsorber will be the dominant method of meeting the final Tier 4 NOx standards.

6.2.3.4. Selective Catalytic Reduction

Selective Catalytic Reduction (SCR) is another catalyst based method for reducing NOx. It requires an ammonia reductant to be injected in the exhaust to initiate catalysis. Most SCR systems, however, are based on an ammonia variant called urea, which tends to be less toxic and easier to handle and store than other forms of ammonia. With the appropriate control system to meter urea in proportion to engine-out NOx emissions, urea

SCR catalysts can reduce NOx exhaust emissions by more than 90 percent making the technology a viable candidate for meeting the Tier 4 NOx standards. SCR systems are also much less sensitive to sulfur poisoning than the other catalyst based methods of NOx control already discussed. They have been used effectively in stationary generator sets for over five years, and more recently in mobile source applications such as trucks, locomotives, and marine engines (MECA 2003).

There are some potential drawbacks with SCR technology, however, as it requires periodic user intervention to replenish urea storages in order to continue functioning properly. Since the urea consumption rate can be on the order of five percent of the engine fuel consumption rate, urea would likely need to be replenished at almost the same intervals that the engine is refueled, unless the urea storage tank is quite large (U.S. EPA 2004). Further, the infrastructure for dispensing automotive-grade urea to diesel fueling stations does not yet exist in sufficient quantity to satisfy the demand that would be created to meet the Tier 4 NOx standards should this technology be employed exclusively by engine manufacturers. Still, these issues could be overcome with the proper incentives and through innovative thinking. An on-board diagnostics requirement to monitor urea levels, for example, could be one way to verify that urea tanks were being replenished as needed to maintain emission system performance. Other methods may be possible as well.

Although SCR is not precluded as a means to meeting the Tier 4 NOx standards, it must be stipulated that a manufacturer intending to certify using this technology would need to satisfactorily demonstrate that its engine will use urea at all times in-use before an Executive Order would be issued.

7. ENVIRONMENTAL IMPACTS AND COST-EFFECTIVENESS

This Section presents the air quality benefits and the cost-effectiveness of the proposed standards. Staff's analyses of air quality benefits are based on ARB's off-road emissions inventory database, and cost-effectiveness is based on U.S. EPA's national analysis, adjusted to reflect California expenses and emission reductions.

7.1. Air Quality Benefits

The following summarizes the air quality impacts and benefits of staff's proposal.

7.1.1. Emissions Inventory Reductions

The intent of the proposed regulation is to reduce emissions from off-road diesel engines and equipment in the most technologically feasible and cost-effective manner possible. As shown in Table 7.1, it is estimated that by 2020 California's proposed emissions standards, and those already adopted by the U.S. EPA, would result in statewide emission

reductions of 6.9 tons per day PM, 72.8 tons per day NOx, and 3.0 tons per day NMHC. These PM and NOx reductions would be equivalent[21] to taking 7.7 million passenger cars off California's highways in 2020. The baseline inventory includes all ARB and U.S. EPA's regulations currently in effect, except for the federal Tier 4 program. The federal Tier 4 program is excluded to facilitate the comparison between preempt and non-preempt emission benefits. Both the baseline and the control estimates assume the use of manufacturer flexibility provisions amounting to 80 percent over a four year period (a seven year period is allowed, but staff believes a four year period is more likely to be used) in increments of 40 percent the first year, 20 percent the next year, and 10 percent for years three and four. The data in these tables reflect the latest emissions information contained in California's off-road diesel emissions inventory database.

Table 7.1
2020 Projected Emission Benefits of the Tier 4 Proposal
Statewide Annual Averages

Government Jurisdiction	Pollutant	Emissions Inventory [1,2]		Reduction (tons per day)
		Baseline (tons per day)	Controlled (tons per day)	
California Proposal Non-Preempt Engines	PM	5.1	2.6	2.5
	NOx	101.0	62.2	38.8
	NMHC	9.6	7.8	1.8
Federal Authority Preempt Engines	PM	12.2	7.8	4.4
	NOx	148.0	114.0	34.0
	NMHC	15.3	14.1	1.2
Total	PM	17.3	10.4	6.9
	NOx	249.0	176.2	72.8
	NMHC	24.9	21.9	3.0

Notes:
1 PM estimates have been adjusted to reflect 15 ppmw sulfur fuel reductions after 2006
2 Emissions from recreational marine engines are not included in these estimates

Table 7.2 shows the estimated total population of engines by power category in 2020 as well as a projection of those engines expected to meet the Tier 4 standards at that time.

[21] The comparison was made for ozone precursor emissions only using data from the off-road diesel emissions inventory database (May 2004) and the EMFAC2002 V2.2 04-03-2003 on-road model. An equivalent particulate emissions comparison would correlate to the removal of 13.6 million passenger cars in 2020.

These projections are based on meeting the interim Tier 4 standards, at a minimum, and take into account the same flexibility usage rates described earlier in subsection 7.1.1. As expected, the majority of engines less than 19 kW would be Tier 4 compliant in 2020 since the standards for that category, as proposed, begin in 2008. The 19 = kW < 56 category is also heavily dominated by Tier 4 engines, but engines in this power range do not turn-over as quickly as engines rated less than 19 kW; therefore, the percent of the fleet meeting Tier 4 standards is less than that for the previous power category despite the same implementation starting date. The 56 = kW < 130 category begins meeting Tier 4 standards later than the rest of the power categories, in 2012, and this is evidenced by a relatively low percentage of engines meeting the Tier 4 standards. The standards for the 130 = kW = 560 and the over 560 kW categories begin one year earlier, in 2011, and have a higher rate of Tier 4 compliant engines.

Table 7.2
2020 Engine Populations by Power Category

Power Category	Total Engines [1]	Tier 4 Engines [1,2]	
kW < 19	117,978	112,216	95 %
19 = kW < 56	190,941	149,117	78 %
56 = kW < 130	191,687	106,778	56 %
130 = kW = 560	59,634	38,261	64 %
kW > 560	1,185	826	70 %
TOTAL	561,425	407,198	73 %

Notes:
1 All representations are for combined preempt and non-preempt engines
2 Estimates are based on 40/20/10/10 flexibility usage rates

Table 7.3 shows the benefits of the combined staff proposal and federal Tier 4 rule for two of the largest air basins in California, namely the South Coast Air Basin and the San Joaquin Valley Air Basin. Together these two air basins are home to almost half of all the off-road diesel engines in California and their associated emissions.

Table 7.3
2020 Benefits of the Tier 4 Proposal for Select Air Basins

Air Basin	Pollutant	Emissions Inventory [1,2,3]		Reduction (tons per day)
		Baseline (tons per day)	Controlled (tons per day)	
South Coast (157,059 Engines)	PM	5.2	3.1	2.1
	NOx	69.7	49.3	20.4
	NMHC	7.1	6.3	0.8
San Joaquin Valley (111,401 Engines)	PM	2.9	1.7	1.2
	NOx	43.8	31.0	12.8
	NMHC	4.4	3.8	0.6

Notes:
1 All calculations are annual average estimates expressed as statewide preempt plus non-preempt ratios
2 PM estimates have been adjusted on pre-Tier 4 equipment to reflect 15 ppmw sulfur fuel reductions
3 Emissions from recreational marine engines are not included in these estimates

7.1.2. Toxic Air Contaminants

Diesel exhaust is a mixture of many gases and fine particulate coated with organic substances. Over 40 chemicals in diesel exhaust have been identified by the State of California as toxic air contaminants (see Table 7.4 below). Many of the components in diesel exhaust, such as PM2.5, benzene, arsenic, dioxins, and formaldehyde, are also known carcinogens in California. Other components, such as toluene and dioxins, are known reproductive toxicants. Since the proposal will reduce PM and NMHC emissions, an added benefit will be a reduction in public exposure to the toxic compounds related to those pollutants.

Table 7.4
Toxic Air Contaminants in Diesel Exhaust

acetaldehyde	inorganic lead
acrolem	manganese compounds
aniline	mercury compounds
antimony compounds	methanol
arsenic	methyl ethyl ketone
benzene	naphthalene
beryllium compounds	nickel
biphenyl	4-nitrobiphenyl
bis{2-ethylhexyl]phthalate	phenol
1,3-butakiene	phosphorus
cadmium	polycyclic organic matter, including
chlorine	polycyclic aromatic hydrocarbons (PAHs)
chlorobenzene	propionaldehyde
chromium compounds	selenium compounds
cobalt compounds	styrene
creosol isomers	toluene
cyanide compounds	xylene isomers and mixtures
dibutylphthalate	o-xylenes
dioxins and dibenzofurans	m-xylenes
ethyl benzene	p-xylenes
formaldehyde	

Note:
California Health and Safety Code, section 39655, defines, in part, a "toxic air contaminant" as "an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health."

7.1.3. Environmental Justice

State law defines environmental justice as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies (Senate Bill 115, Solis; Stats 1999, Ch. 690; Government Code § 65040.12(c)). The Board has established a framework for incorporating environmental justice into ARB's programs consistent with the directives of State law. The policies subsequently developed apply to all communities in California, but they recognize that environmental justice issues have been raised more in the context of low income and minority communities, which sometimes experience higher exposures to some pollutants as a result of the cumulative impacts of air pollution from multiple mobile, commercial, industrial, areawide, and other sources.

Over the past twenty years, ARB, local air districts, and federal air pollution control programs have made substantial progress towards improving the air quality in California. However, some communities continue to experience higher exposures than others as a

result of the cumulative impacts of air pollution from multiple mobile and stationary sources and thus may suffer a disproportionate level of adverse health effects. Because the same ambient air quality standards apply to all regions of the State, all communities, including environmental justice communities, will benefit from the air quality benefits associated with the proposal. Alternatives to the proposed recommendations, such as maintaining the current exhaust emission standards without further reducing air pollution, would adversely affect all communities. As additional relevant scientific evidence becomes available, the off-road diesel engine standards will be reviewed again to make certain that the health of the public is protected with an adequate margin of safety.

To ensure that everyone has had an opportunity to stay informed and participate fully in the development of off-road diesel engine standards, staff has distributed information as described in subsection 2.6 of this report.

7.1.4. Health Impacts

Full implementation of staff's proposal and the federal rule would prevent approximately 900 premature deaths per year in California and account for a savings of $6.3 billion in health-related costs per year by calendar year 2030 based on the U.S. EPA scaling process for PM-related health benefits (RIA9 2004).

Additionally, 400 cases of chronic bronchitis would be prevented annually in 2030, as well as 20,000 cases of asthma exacerbations for children and 400,000 cases of restricted activity days for adults (RIA9 2004).

7.2. Cost-Effectiveness

The cost of complying with the proposed emission standards and regulations in California is not expected to be different than the cost of complying with the federal regulations. Therefore, no additional cost is anticipated from the adoption of staff's proposal. The estimated cost of complying with the standards will vary depending on the power category and model year under consideration.

The cost-effectiveness for aligning with the federal requirements in California is expected to be similar to the national cost-effectiveness (RIA9 2004) with the exception of the PM benefits attributed solely to the use of ultra low-sulfur diesel fuel. The highest federal fleet-wide cost-effectiveness of the NMHC+NOx standards is about $0.51 to $0.58 per pound of ozone precursors reduced. This compares favorably with other adopted emission control measures in California. The range of cost-effectiveness for the PM standards is expected to be $6.70 to $7.55 per pound of PM reduced after adjusting for the federal inclusion of benefits solely from the ultra low-sulfur diesel fuel, for which California has taken credit in a previous rule. The federal cost-effectiveness for PM including the benefits of ultra low-sulfur diesel fuel is $5.60 to $5.90 per pound. A more detailed summary of these estimates is provided in Appendix B: "Federal Cost-Effectiveness of the Off-Road

Compression-Ignition Emission Standards."

8. ECONOMIC IMPACTS

The proposed regulatory amendments harmonize with the federal regulations finalized on May 11, 2004. The California adoption of the standards would not impose additional costs above the costs to comply with the federal standards. The adoption is actually expected to benefit engine manufacturers, who may face production inefficiencies when they have to comply with different standards. The harmonization of the standards would reduce production inefficiencies, thereby lowering compliance costs. Therefore, staff believes that the proposed amendments would have no noticeable impact on business competitiveness, California employment, or on business creation, elimination, and expansion. This section discusses, in greater detail, the potential cost and economic impacts of the proposed amendments based on U.S. EPA findings.

8.1. Legal Requirement

Sections 11346.3 and 11346.5 of the Government Code require State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination, or creation, and the ability of California business to compete.

State agencies are required to estimate the cost or savings to any state or local agency, and school districts. The estimate is to include any nondiscretionary cost or savings to local agencies and the cost or savings in federal funding to the state.

8.2. Affected Businesses

Any business that is involved in manufacturing and/or rebuilding off-road diesel engines, and equipment manufacturers that utilize these engines in their equipment, may potentially be affected by the federal standards and the proposed State standards. U.S. EPA has identified approximately 600 off-road equipment manufacturers using diesel engines in several thousand different equipment models. There are also more than 50 engine manufacturers producing diesel engines for these applications nationwide. Also affected are businesses that operate or service diesel engines. An estimated 553,800 off-road diesel engines will be utilized in equipment and vehicles operating in California in 2010 with that number increasing to over 560,000 by 2020.

8.2.1. Estimated Costs to Engine and Equipment Manufacturers

The costs of the proposed new requirements to engine manufacturers have been

estimated and are based on U.S. EPA's Regulatory Impact Analysis for the national emission standards. Engine manufacturers will likely evaluate multiple technologies to meet the new emission standards. However, to estimate the incremental impact of the federal standards on engine costs, U.S. EPA assumed a single combination of technologies. Note that the costs presented here do not include potential savings associated with an engine averaging, trading, and banking program or the transition program (flexibilities) for equipment manufacturers. In addition, U.S. EPA assumed that engine companies who are eligible for the small business engine manufacturer specific provisions do not take advantage of the unique flexibilities the regulation provides for them, which includes the opportunity to delay compliance with the Tier 4 emission standards for a full three model years. While it is expected that manufacturers will use these flexibilities to reduce compliance costs, they are not factored into the cost analysis because they are voluntary programs. Given these assumptions, it is likely that the costs provided here are overestimated since they only relate to regulatory requirements and do not consider the voluntary flexibilities that offer the opportunity for significant cost reductions. Unless noted otherwise, all costs are in 2002 dollars.

The total costs include variable costs (for incremental hardware costs, assembly costs, and associated markups) and fixed costs (for tooling, research and development, and certification). For diesel engines, the projected compliance costs are largely due to using new technologies such as advanced emissions control technologies to meet the proposed Tier 4 emissions standards. Compliance costs for engines are broken out by horsepower category and impact year. The costs per unit change from year to year because engine standards are implemented differently in each power category. As shown in Table 8.1, the fixed cost per engine typically decreases after five years as these annualized costs are depreciated. The regulation's market impacts are primarily driven by the per-engine variable costs that remain relatively constant over time.

For off-road equipment, the majority of the projected compliance costs are due to the need to redesign the equipment. The variable cost consists of the cost of new or modified equipment hardware and of labor to install the new emission control devices. The fixed cost consists of the redesign cost to accommodate new emission control devices. The per unit compliance costs are weighted average costs within the appropriate horsepower range. The equipment compliance costs are broken out by horsepower category and impact year. As shown in Table 8.2, the majority of costs per piece of equipment are the fixed costs. The overall compliance costs per piece of equipment are less than half the overall costs associated with the same horsepower category engine (RIA10 2004).

Table 8.1
Compliance Costs per Engine

Power Range	Cost Types	2008	2009	2010	2011	2012	2013	2014	2015	2020	2030
0 = kW < 19	Variable	$129	$129	$123	$123	$123	$123	$123	$123	$123	$123
	Fixed	$33	$32	$31	$30	$30	$0	$0	$0	$0	$0
	Total	$162	$161	$154	$153	$153	$123	$123	$123	$123	$123
19 = kW < 37	Variable	$147	$147	$139	$139	$139	$849	$849	$645	$645	$645
	Fixed	$49	$48	$47	$46	$45	$74	$73	$71	$0	$0
	Total	$196	$195	$186	$185	$184	$923	$922	$716	$645	$645
37 = kW < 56	Variable	$167	$167	$158	$158	$158	$837	$837	$636	$636	$636
	Fixed	$50	$49	$49	$48	$47	$76	$75	$73	$0	$0
	Total	$217	$216	$207	$206	$205	$913	$912	$709	$636	$636
56 = kW < 75	Variable	$0	$0	$0	$0	$1,133	$1,133	$1,122	$1,122	$1,122	$1,122
	Fixed	$0	$0	$0	$0	$80	$78	$108	$106	$0	$0
	Total	$0	$0	$0	$0	$1,213	$1,211	$1,230	$1,228	$1,122	$1,122
75 = kW < 130	Variable	$0	$0	$0	$0	$1,375	$1,375	$1,351	$1,351	$1,351	$1,351
	Fixed	$0	$0	$0	$0	$78	$77	$106	$105	$0	$0
	Total	$0	$0	$0	$0	$1,453	$1,452	$1,457	$1,456	$1,351	$1,351
130 = kW < 450	Variable	$0	$0	$0	$2,191	$2,190	$1,697	$2,137	$2,136	$2,132	$2,126
	Fixed	$0	$0	$0	$326	$321	$316	$437	$430	$0	$0
	Total	$0	$0	$0	$2,517	$2,511	$2,013	$2,574	$2,566	$2,132	$2,126
kW = 450	Variable	$0	$0	$0	$2,911	$2,910	$2,246	$2,733	$5,153	$5,347	$5,347
	Fixed	$0	$0	$0	$861	$848	$835	$1,083	$1,526	$0	$0
	Total	$0	$0	$0	$3,772	$3,758	$3,081	$3,816	$7,679	$5,347	$5,347

Source: U.S. EPA's Final Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines, May 2004.

Costs are in 2002 dollars.

Table 8.2
Costs per Piece of Equipment

Power Range	Cost Types	2008	2009	2010	2011	2012	2013	2014	2015	2020	2030
0 = kW < 19	Variable	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Fixed	$15	$15	$14	$14	$14	$13	$13	$13	$0	$0
	Total	$15	$15	$14	$14	$14	$13	$13	$13	$0	$0
19 = kW < 37	Variable	$0	$0	$0	$0	$0	$20	$20	$16	$16	$16
	Fixed	$8	$8	$8	$7	$7	$42	$41	$40	$31	$0
	Total	$8	$8	$8	$7	$7	$62	$61	$56	$47	$16
37 = kW < 56	Variable	$0	$0	$0	$0	$0	$21	$21	$17	$17	$17
	Fixed	$8	$8	$8	$8	$8	$44	$43	$42	$32	$0
	Total	$8	$8	$8	$8	$8	$65	$64	$59	$49	$17
56 = kW < 75	Variable	$0	$0	$0	$0	$45	$45	$46	$48	$48	$48
	Fixed	$0	$0	$0	$0	$109	$107	$132	$130	$120	$0
	Total	$0	$0	$0	$0	$154	$152	$180	$178	$168	$48
75 = kW < 130	Variable	$0	$0	$0	$0	$46	$46	$49	$49	$49	$49
	Fixed	$0	$0	$0	$0	$170	$168	$207	$204	$189	$0
	Total	$0	$0	$0	$0	$216	$214	$256	$253	$238	$49
130 = kW < 450	Variable	$0	$0	$0	$75	$75	$60	$80	$80	$79	$79
	Fixed	$0	$0	$0	$378	$372	$366	$453	$446	$415	$0
	Total	$0	$0	$0	$453	$447	$426	$533	$526	$494	$79
kW = 450	Variable	$0	$0	$0	$57	$57	$46	$61	$123	$111	$111
	Fixed	$0	$0	$0	$690	$680	$670	$806	$1,404	$1,310	$0
	Total	$0	$0	$0	$747	$737	$716	$867	$1,527	$1,421	$111

Source: U.S. EPA's Final Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines, May 2004.

Costs are in 2002 dollars.

8.2.2. Potential Impacts on Business

The new federal standards are expected to impose additional costs on engine manufacturers, rebuilders, and equipment manufacturers that utilize these engines in their equipment. A more thorough analysis of these costs is provided in chapter 6 of U.S. EPA's Regulatory Impact Analysis. As shown in Table 8.3, U.S. EPA estimated the prices for seven engine categories using price data compiled from a variety of sources. These prices were sales weighted where appropriate.

Table 8.3
Baseline Engine Prices

Power Range	Estimated Price
kW < 19	$1,500
19 = kW < 37	$2,900
37 = kW < 56	$3,000
56 = kW < 75	$4,000
75 = kW < 130	$5,500
130 = kW < 450	$20,000
kW = 450	$80,500

Source: U.S. EPA Final Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines, May 2004.

The incremental costs of the new standards can be viewed in the context of their fraction of the total purchase price of equipment. As illustrated in Table 8.4, the ratio of variable engine compliance costs to market price ranges from about 29 percent for engines 19 = kW < 37 to roughly three percent for engines equal to and above 450 kW. These different ratios lead to different relative shifts in the supply curves, and different impacts on the change in market price and quantity for each market. As stated earlier, the regulation's market impacts are driven primarily by the per-engine variable costs that remain relatively constant over time, which is why Table 8.4 does not compare total or fixed engine costs. Fixed costs are the unavoidable price of doing business and might give a false sense of the influence that the proposal would have on engine prices if included.

Table 8.4
Ratio of Variable Engine Compliance Costs to Engine Price

Power Range	Variable Engine Compliance Cost / Engine Price
kW < 19	8.2%
19 = kW < 37	29.3%
37 = kW < 56	27.9%
56 = kW < 75	28.3%
75 = kW < 130	25.0%
130 = kW < 450	8.5%
kW = 450	2.8%

Source: U.S. EPA Final Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines, May 2004.

The California adoption of the new federal standards is not going to alter the above costs because these costs already include the cost to California. The harmonization of the standards would actually benefit most engine manufacturers, because they have would not have to comply with different standards for California.

8.2.3. Potential Impact on Business Competitiveness

The proposed amendments would have no significant impact on the ability of California businesses to compete with businesses in other states. The amendments would harmonize the California standards with the federal standards for off-road diesel engines. Thus, California operators of off-road diesel equipment and vehicles would not be disadvantaged relative to operators from other states. The harmonization of the standards should actually benefit engine manufacturers and equipment manufacturers. This is because these manufacturers would not have to deal with different requirements that can result in production inefficiencies.

8.2.4. Potential Impact on Employment

The proposed amendments are not expected to cause a noticeable change in California employment. The adoption of the federal standards in California is expected to benefit manufacturers, who might be faced with production inefficiencies if they had to comply with different California and federal standards. As mentioned above, the harmonization of the standards would reduce production inefficiencies, thereby lowering compliance costs. Since these costs are generally passed on to vehicle operators, they could benefit from lower compliance costs. This would, in turn, moderate any adverse impact the federal standards might have on employment.

8.2.5. Potential Impact on Business Creation, Elimination or Expansion

The proposed amendments would have no noticeable impact on the status of California businesses including small businesses. The proposed emission standards would be the same as the federal standards. Therefore, no additional costs for off-road diesel equipment or vehicle operators in California are expected. The implementation flexibilities proposed would help alleviate the potential impact on businesses including small businesses.

8.2.6. Potential Impact on Small Businesses

Small business entities comprise 68 percent of the off-road diesel private sector nationally based on estimates from the U.S. EPA. However, the sales from these small business entities are only about 11 percent of the total sales from the category. The ten largest engine manufacturers are responsible for 80 percent of the engines sold. The cost to small businesses should be considerable lower than for the rest of the off-road industry as a result of the many compliance facilitating provisions afforded to small business and small volume entities in the regulation.

8.3. Potential Costs to Local and State Agencies

As discussed in section 9 of this report, ARB must either adopt the requirements in this proposal, or other requirements that would result in equivalent or greater air quality benefits in order to comply with the federal Clean Air Act. Staff believes the proposed requirements are the only feasible and cost-effective means of achieving emission reductions of the same magnitude as the federal requirements by 2030. Staff also believes there would be no real incremental cost increase associated with adopting the federal standards as the California standards. Accordingly, the proposed requirements are not expected to result in an overall increase in costs for State and local agencies. The only costs to State government as a result of the proposed amendments would be for administratively implementing the new regulatory requirements. However, the implementation costs may be absorbed with existing ARB resources. ARB is already responsible for verifying the implementation of the existing regulations for off-road diesel engines. Thus, the proposed amendments would not increase the workload to the extent that hiring additional staff would be necessary.

8.4. Potential Costs to Non-Preempt Farm Equipment

As noted previously, the federal Clean Air Act preempts the ARB from regulating new farm equipment with engines rated at less than 175 horsepower (130 kW). This means that new farm equipment at or greater than 175 horsepower would be regulated under the staff's proposal. Under Health and Safety Code, section 43013(c), the ARB is required to hold a public hearing prior to adopting standards and regulations for farm equipment. In the hearing, the ARB shall find and determine that the standards and regulations are necessary, cost-effective, and technologically feasible. The ARB is also required to

consider the technological effects of emission control standards on the cost, fuel consumption, and performance characteristics of mobile farm equipment.

8.4.1. Necessity of Proposal for Non-Preempt Farm Equipment

As discussed above in section 7.1 "Air Quality Impacts," it is clear that the Tier 4 standards are needed to achieve significant reductions in PM (particularly diesel PM), NOx, NMHC, and toxic air contaminants. Without these reductions, the public will continue to be exposed to high levels of these air pollutants. Therefore, the Tier 4 standards and this proposal to harmonize ARB's regulations with the U.S. EPA's Tier 4 regulation are necessary to achieve significant emission reductions and protect public health.

8.4.2. Cost-Effectiveness of Proposal for Non-Preempt Farm Equipment

As discussed above in section 7 "Environmental Impacts and Cost-Effectiveness" and Appendix B, the proposal clearly meets established criteria for cost-effectiveness for farm equipment. We are aware of no specific uniqueness to farm equipment that would make the cost analysis presented in this Staff Report inapplicable to new farm equipment.

The cost-effectiveness for aligning with the federal requirements in California is expected to be similar to the national cost-effectiveness (RIA9 2004), with the exception of the PM benefits attributed solely to the use of ultra low-sulfur diesel fuel. The highest federal fleet-wide cost-effectiveness of the NMHC+NOx standards is about $0.51 to $0.58 per pound of ozone precursors reduced. This compares favorably with other adopted emission control measures in California. The range of cost-effectiveness for the PM standards is expected to be $6.70 to $7.55 per pound of PM reduced after adjusting for the federal inclusion of benefits solely from the ultra low-sulfur diesel fuel, for which California has taken credit in a previous rule. The federal cost-effectiveness for PM including the benefits of ultra low-sulfur diesel fuel is $5.60 to $5.90 per pound.

Based on these reasons, we believe the proposal is cost-effective for new farm engines and equipment.

8.4.3. Technological Feasibility of Proposal for Non-Preempt Farm Equipment

The technological feasibility of the proposal is discussed in section 6 "Technological Feasibility." In summary, the U.S. EPA determined that the Tier 4 standards are technologically feasible for all of the regulated engine classes, including new farm engines and equipment at or above 130 kW. We agree with this determination. The various compliance methods and emission control technologies available to farm equipment manufacturers are discussed in section 6. We are aware of no technical reasons why new farm engines and equipment cannot meet the Tier 4 standards. Therefore, we have determined that the proposal is technologically feasible for new, non-preempt farm engines and equipment.

8.4.4. Technological Effects Of Emission Control Standards On The Cost, Fuel Consumption, And Performance Characteristics Of Mobile Farm Equipment

The effect of the emission control standards on the cost of mobile farm equipment was determined by the U.S. EPA and summarized in Tables 8.1 and 8.2. In summary, the compliance costs ranged from $0 to $2,574 (130 ≤ kW ≤ 450) and $0 to $7,679 (> 450 kW) per engine. This compares to base engine prices of $20,000 (130 ≤ kW ≤ 450) to $80,500 (> 450 kW) per engine. Because the U.S. EPA Tier 4 standards applies nationally, these costs should not adversely affect farming costs in California relative to farming outside of California.

The U.S. EPA's analysis of the standards on fuel consumption and performance characteristics is documented in their Regulatory Impacts Analysis, which is incorporated by reference herein. No significant adverse impacts on fuel consumption and performance characteristics were found as a result of the Tier 4 standards.

9. REGULATORY ALTERNATIVES

The staff evaluated various alternatives to the current proposal. A brief description of the alternatives and staff's rationale for finding them unsuitable follows below.

9.1. Maintain Current California Regulations

The first alternative to this proposal would be to simply maintain the current California off-road diesel engine emission standards. Prior to U.S. EPA's adoption of the Tier 4 standards for off-road diesel engines, current California and federal standards were the same. However, with its passage, current California regulations have become less stringent than the federal program. Pursuant to the federal Clean Air Act (CAA), in order for California to enforce its own emissions reduction program the Board must adopt regulations that are, in the aggregate, at least as protective of public health and welfare as applicable federal standards (CAA Section 209(e)(2)(A)). Therefore, staff rejected this alternative.

9.2. Adopt More Stringent Emission Standards

The degree of emissions control proposed by staff is already technology forcing for most of the engines being regulated, and should result in dramatic emission reductions over time. Staff recognizes that more stringent standards may be necessary in the future, especially for engines rated less than 19 kW. However, data are not yet available to suggest a more cost effective way to achieve greater emission benefits. Therefore, staff is not recommending the adoption of standards more stringent than those already proposed. Harmonization with the federal program will spare the industry unnecessary costs and

administrative burdens, allowing a greater focus on the technical issues of emissions control. Staff rejects this alternative at this time.

9.3. Accelerate Implementation Schedule of Standards

The staff examined the possibility of accelerating the implementation schedule of standards to get cleaner engines into California earlier. While this alternative would provide emission benefits sooner, manufacturers would have less lead time to develop the necessary technologies since standards for many of the power groups would be changing simultaneously, and manufacturers would have fewer years over which to spread out and recoup the development expenses. This would also make the proposal far less cost-effective. Therefore, staff rejected this alternative.

10. REMAINING ISSUES

10.1. Technical Amendments

U.S. EPA intends to make additional improvements to their Tier 4 test procedures in a separate rulemaking titled "Test Procedures for Testing Highway and Nonroad Engines and Omnibus Technical Amendments," which was proposed on August 16, 2004. These changes will primarily be technical in nature, affecting the language in 40 CFR, Part 1065 mostly, and are intended to incorporate the latest measurement technologies. Staff has participated in varying degrees to the development of these technical amendments, and will likely propose that the Board consider incorporating them into California's off-road diesel program in a 15-day notice should U.S. EPA finalize them prior to the October 15, 2004 deadline and after staff has had sufficient opportunity to review them in finalized context.

10.2. Safety Concerns

Staff is unaware of any safety-related issues being raised by the off-road industry regarding this proposal or during the development of U.S. EPA's similar rule. However, with the likely incorporation of catalyzed materials in the exhaust stream to meet the proposed standards, there is the potential for increased heat dissipation. Although such technology could raise exhaust temperatures, staff does not believe it is likely to result in a fire hazard due to the out-of-reach location of the exhaust stack on most off-road diesel equipment and with the anticipated application of proper shielding by the equipment manufacturer. The majority of catalyzed aftertreatment devices are expected to replace mufflers, which should already necessitate sufficient heat resistant designs.

11. CONCLUSIONS AND RECOMMENDATIONS

Staff's objective in recommending the harmonization of ARB's off-road diesel Tier 4

program with federal requirements is to provide the citizens of California with the most effective approach for achieving major air quality improvements in a technologically feasible and cost effective manner. Staff estimates that in 2020, the statewide benefits of the California proposal and the federal rule would be 72.8 tons per day NOx, 6.9 tons per day PM, and 3.0 tons per day NMHC. The estimated California cost-effectiveness with adoption of the staff's proposal would be approximately $0.58 per pound of NMHC+NOx reduced. This cost-effectiveness is well within the range of other control measures adopted by the Board.

There are some differences, however, between the federal program and the California proposal for Tier 4 off-road engines. These are safeguards for ensuring California's continued ability to identify complying engines quickly, and to enforce the regulations. The proposed differences should not be overly burdensome or costly to the manufacturers, but will help to ensure that off-road engines remain in compliance with emissions standards throughout their useful lives.

No alternative considered by the agency would be more effective in carrying out the purpose for which the regulation is proposed, or would be as effective as, or less burdensome, to affected private persons than the proposed regulation. Therefore, staff recommends that the Board adopt staff's proposal as contained in this report and noted in the attached proposed regulations and test procedures.

12. REFERENCES

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ATTACHMENT 1: PROPOSED AMENDMENTS TO THE CALIFORNIA REGULATIONS FOR OFF-ROAD COMPRESSION-IGNITION ENGINES AND EQUIPMENT

ATTACHMENT 2: PROPOSED AMENDMENTS TO THE CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR NEW 2008 AND LATER TIER 4 OFF-ROAD COMPRESSION-IGNITION ENGINES AND EQUIPMENT, PART I-C

ATTACHMENT 3: PROPOSED AMENDMENTS TO THE CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR NEW 2000 AND LATER TIER 1, TIER 2, AND TIER 3 OFF-ROAD COMPRESSION-IGNITION ENGINES AND EQUIPMENT, PART I-B

ATTACHMENT 4: PROPOSED AMENDMENTS TO THE CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR NEW 1996 AND LATER TIER 1, TIER 2, AND TIER 3 OFF-ROAD COMPRESSION-IGNITION ENGINES AND EQUIPMENT, PART II

APPENDIX A: LIST OF PREEMPTED OFF-ROAD APPLICATIONS

(a) Equipment types with engines less than 25 horsepower are presumed not to be construction or farm equipment, with the exception of the following equipment types, which have been determined to be construction or farm equipment:

Aerial devices: vehicle mounted
Asphalt recycler/reclaimer, sealer
Augers: earth
Back-hoe
Backpack Compressors
Baler
Boring machines: portable line
Breakers: pavement and/or rock
Brush cutters/Clearing saws 40 cc and above (blade capable only)
Burners: bituminous equipment
Cable layers
Chainsaws 45 cc and above
Chippers
Cleaners: high pressure, steam, sewer, barn
Compactor: roller/plate
Compressors
Concrete buggy, corer, screed, mixer, finishing equipment
Continuous Digger
Conveyors: portable
Crawler excavators
Crushers: stone
Cultivators: powered
Cutting machine
Debarker
Detassler
Drills
Dumper: small on-site
Dusters
Elevating work platforms
Farm loaders: front end
Feed conveyors
Fertilizer spreader
Forage box/Haulage and loading machine
Forklifts: diesel and/or rough terrain
Harvesters, crop
Jackhammer
Light towers
Mixers: mortar, plaster, grout
Mowing equipment: agricultural
Mud jack

Pavers: asphalt, curb and gutter
Pipe layer
Plows: vibratory
Post hole diggers
Power pack: hydraulic
Pruner: orchard
Pumps 40 cc and above
Rollers: trench
Sawmill: portable
Saws: concrete, masonry, cutoff
Screeners
Shredder/grinder
Signal boards: highway
Silo unloaders
Skidders
Skid-steer loaders
Specialized fruit/nut harvester
Sprayers: bituminous, concrete curing, crop, field
Stump cutters, grinders
Stumpbeater
Surfacing equipment
Swathers
Tampers and rammers
Tractor: compact utility
Trenchers
Troweling machines: concrete
Vibrators: concrete, finisher, roller
Welders
Well driller: portable
Wheel loaders

(b) Equipment types with engines 25 horsepower or greater are presumed to be construction or farm equipment, with the exception of the equipment types listed below, which have been determined not to be construction or farm equipment.

Aircraft Ground Power
Baggage Handling
Forklifts that are neither rough terrain nor powered by diesel engines
Generator Sets
Mining Equipment not otherwise primarily used in the construction industry
Off-Highway Recreational Vehicles
Other Industrial Equipment
Refrigeration Units less than 50 horsepower
Scrubbers/Sweepers

Tow/Push
Turf Care Equipment

APPENDIX B: FEDERAL COST-EFFECTIVENESS OF THE OFF-ROAD COMPRESSION-IGNITION EMISSION STANDARDS

The following tables show the federal cost-effectiveness of the emission standards for diesel engines. The estimated cost of complying with the standards varies depending on the model year under consideration. U.S. EPA calculated the cost per ton of the regulations based on the net present value of all costs incurred and all emission reductions generated over a 30-year time window following implementation of the program. This approach captures all the costs and emission reductions from the regulations, including costs incurred and emission reductions generated by both the new and the existing fleet.

Table B.1
Cost-Effectiveness Estimates ($2002)
30-Year Net Present Value at a 3% and 7% Discount Rate

Pollutant	3% discount rate	7% discount rate
	$/ton ($/lb)	
NMHC+NOx	$1,010 ($0.51)	$1,160 ($0.58)
PM w/Fuel	$11,200 ($5.60)	$11,800 ($5.90)
PM w/o Fuel	$13,400 ($6.70)	$15,100 ($7.55)

U.S. EPA also calculated the cost per ton of emissions reduced in the year 2030 using the annual costs and emission reductions in that year alone. This number, shown in Table B.2, approaches the long-term cost per ton of emissions reduced after all fixed costs of the program have been recovered by industry leaving only the variable costs of control (and maintenance costs), and after most of the pre-control fleet has been retired.

Table B.2
Long-Term Cost-Effectiveness ($2002)
Annual Values w/o Discounting

Pollutant	Long-Term Cost in 2030 $/ton ($/lb)
NMHC+NOx	$680 ($0.34)
PM	$9,300 ($4.65)