State of California
AIR RESOURCES BOARD

Final Statement of Reasons for Rulemaking, Including Summary of Comments and Agency Responses

PUBLIC HEARING TO CONSIDER AMENDMENTS TO ADOPT REDUCED EMISSION STANDARDS FOR 2007 AND SUBSEQUENT MODEL YEAR NEW HEAVY-DUTY DIESEL ENGINES

Public Hearing Date: October 25, 2001
Agenda Item No.: 01-8-1

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List of Acronyms

ABT.....Averaging, banking, and trading
AECD .....Auxiliary emission control device
ALA.....American Lung Association
AMG.....AM General Corporation/Hummer (also referenced as GEP)
ANPRM.....Advanced notice of proposed rulemaking
APBF .....Advanced Petroleum Based Fuels
API.....American Petroleum Institute
ARB .....Air Resources Board
ASTM.....American Society for Testing and Materials
BOTD .....Ball-on-Three-Discs
bsfc.....Brake specific fuel consumption
BSNOx .....Brake specific NOx
BSPM .....Brake specific PM
CAA .....Clean Air Act
CalEPA.....California Environmental Protection Agancy
CASAC .....Clean Air Scientific Advisory Committee
CCR .....California Code of Regulations
CCV.....Closed crankcase ventilation
CDPF .....Catalyzed diesel particulate filter
CETC .....California Electric Transportation Coalition
CF.....Correction factor
CO .....Carbon monoxide
CO_2.....Carbon dioxide
COV.....Coefficient of variance
CRC .....Coordinated Research Council
CVS .....Constant volume sampling
D.C. .....District of Columbia
DDC .....Detroit Diesel Corporation
DECSE.....Diesel Emissions Control Sulfur Effects
DNPR .....Diesel NOx Particulate Reduction
DOC .....Diesel oxidation catalyst
DOE .....Department of Energy (also see U.S. DOE)
DPF .....Diesel particulate filter
EGR.....Exhaust gas recirculation
EMA.....Engine Manufacturers Association
EPA .....Environmental Protection Agency (also see U.S. EPA)
ESC.....European stationary cycle
FEL.....Family emission limit
FR.....Federal Register
FSOR .....Final Statement of Reasons
FTP.....Federal Test Procedure
g/bhp.....grams per brake horsepower
g/bhp-hr .....grams per brake horsepower-hour
GVWR.....Gross vehicle weight rating
H_2S .....Hydrogen Sulfide
HAD .....Health Assessment Document
HD .....Heavy-duty
HDDE .....Heavy-duty diesel engine
HDDV .....Heavy-duty diesel vehicle
HFRR .....High Frequency Reciprocating Rig

List of Acronyms

IARC.....International Agency for Research on Cancer
ISOR.....Initial statement of reasons (staff report)
lb/bhp.....pounds per brake horsepower
LRT.....Load response test
MAEL.....Maximum allowable emission limits
MAF .....Mass air flow
MECA .....Manufacturers of Emission Controls Association
MSTD .....Monterey-Salinas Transit District
MY .....Model year
NCP.....Non-conformance penalty
NIOSH.....National Institute of Occupational Safety and Health
NMHC.....Non-methane hydrocarbon
NMMAPS.....National Morbidity, Mortality, and Air pollution Study
NOx .....Oxides of nitrogen
NO .....Nitrogen oxide
NO_2.....Nitrogen dioxide
NPRM.....Notice of proposed rulemaking
NRDC.....Natural Resources Defense Council
NTE .....Not to Exceed
NVFEL.....National Vehicle and Fuel Emissions Laboratory
OBD .....On-board diagnosis
OEHHA.....Office of Environmental Health Hazard Assessment
OTAQ .....Office of Transportation and Air Quality
PM.....Particulate matter
ppm .....Parts per million
RIA.....Regulatory impact analysis
ROG.....Reactive organic gas
S .....Sulfur
SAE .....Society of Automotive Engineers
SCAQMD.....South Coast Air Quality Management District
SCR.....Selective catalytic reduction
SERT.....Supplemental emission requirement and test
SLBOCLE .....Scuffing Load Ball-on-Cylinder Lubricating Evaluator
SOx .....Oxides of sulfur
SO_2.....Sulfur dioxide
SO_3.....Sulfur trioxide, or sulfur (VI) oxide
SOP.....Statement of Principles
SRP.....Scientific Review Panel
SSS .....Supplemental steady state
TBN .....Total base number
UHC.....Unburned hydrocarbon
U.S. DOE .....United States Department of Energy
U.S. EPA .....United States Environmental Protection Agency
VOC.....Volatile organic compound
ZDDP.....Zinc-dialkyl-dithiophosphate

Note: Acronyms listed above have been used in the abbreviated comments in this Final Statement of Reasons and all other unabbreviated public responses.

I. GENERAL

The Staff Report: Initial Statement of Reasons for Rulemaking ("staff report"), entitled "Public Hearing to Consider Amendments Adopting More Stringent Emission Standards for 2007 and Subsequent Model Year New Heavy-Duty Diesel Engines," released September 7, 2001, is incorporated by reference herein.

Following a public hearing on October 25, 2001, the Air Resources Board (the Board or ARB) by Resolution 01-38 approved more stringent emission standards for 2007 and subsequent model year new heavy-duty diesel engines (HDDEs). Resolution 01-38 is attached and incorporated by reference herein. The Board approved the regulatory language as proposed with non-substantive corrections. The affected sections are title 13, California Code of Regulations (CCR), section 1956.8 (amended) and the incorporated "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" (amended).

Background: HDDEs are used in a variety of applications such as large trucks, school buses, and motor homes. For large trucks in particular, HDDEs have proven to be reliable, durable, and very fuel efficient. Because of this, HDDEs play a vital role in the transportation of goods and material in California, as well as the rest of the nation. Consequently, HDDEs are a key element of a strong economy.

Compared to gasoline-fueled automobiles and light-duty trucks, HDDEs have significantly lagged behind in the use of aftertreatment-based emission control systems. This is primarily because HDDEs emit relatively low levels of hydrocarbons, particulate matter (PM) reductions have been achieved through engine modifications, and aftertreatment systems to reduce oxides of nitrogen (NOx) emissions from HDDEs have been slower to develop. However, in recent years, PM filters have become available to address diesel PM health risk concerns, and NOx aftertreatment devices are rapidly developing. These devices offer the opportunity to achieve substantial reductions in HDDE emissions.

In October of 2000, the United States Environmental Protection Agency (U.S. EPA) adopted a rule that reaffirmed[1] emission standards for 2004 and subsequent model year HDDEs.[2] This rulemaking also included supplemental test procedures required for certification in addition to the existing Federal Test Procedure (FTP). Because aftertreatment technologies for diesel engines have been fully developed for PM and are on the near horizon for NOx, in January of 2001 the U.S. EPA followed the 2004 Final Rule with another rule to reduce emission standards for 2007 and subsequent model year heavy-duty engines,[3] including both Otto-cycle and diesel-cycle engines. These emission standards represent a 90% reduction of NOx emissions, 72% reduction of non-methane hydrocarbon (NMHC) emissions, and 90% reduction of PM emissions compared to the 2004 emission standards. In addition to the more stringent emission standards, in the U.S. EPA's 2007 Final Rule, the U.S. EPA adopted minor changes to the previously adopted supplemental test procedures.

[1] The emission standards were originally promulgated in October 1997.
[2] U.S. EPA's 2004 Final Rule on the Control of Emissions of Air Pollution from 2004 and Later Model Year Heavy-Duty Highway Engines and Vehicles; Revision of Light-Duty On-Board Diagnostics Requirements (65 FR 59896, October 6, 2000). Referred to as the "U.S. EPA's 2004 Final Rule" or "2004 Final Rule."
[3] U.S. EPA's 2007 Final Rule on the Control of Emissions of Air Pollution from 2007 and Later Model Year Heavy-Duty Highway Engines and Vehicles; Revision of Light-Duty On-Board Diagnostics Requirements (66 FR 5002, January 18, 2001). Referred to as the "U.S. EPA's 2007 Final Rule" or "2007 Final Rule." See http://www.epa.gov/otaq/diesel.htm#hd2007.

The U.S. EPA's 2007 Final Rule breaks new ground by setting emission standards that are projected to need aftertreatment-based technologies. The U.S. EPA's 2007 Final Rule is analogous to the regulations that first required the use of aftertreatment devices (i.e., catalytic converters) on gasoline-fueled automobiles and light-duty trucks in the mid 1970s. The U.S. EPA's 2007 Final Rule is also a "systems" approach in that it relies on the use of low sulfur fuel, analogous to the requirement for unleaded gasoline in the mid 1970s.

The California amendments include nearly identical emission standards, test procedures, and other requirements contained in the U.S. EPA's 2007 Final Rule. Although the California amendments include diesel certification test fuel specifications, a major difference with the federal amendments is that there is no proposal to require the production and sale of low sulfur diesel fuel in California. A proposal to require the production of low sulfur diesel fuel in California will be part of a separate rulemaking. In addition to the emission standards and test procedures, other requirements include the elimination of the current exemption that allows turbocharger-equipped engines to vent crankcase emissions to the ambient air. The proposed amendments do not apply to heavy-duty spark-ignited engines and vehicles. Similar emission standard and test procedure requirements for the spark-ignited engines and vehicles are scheduled for consideration before the Board in 2002.

The amendments ensure that the requirements for 2007 and subsequent model year HDDEs are identical to those adopted by the U.S. EPA in January 2001. The Board expects that the adopted, more stringent, emission standards will reduce NOx emissions by 49 tons per day, reactive organic gas (ROG) emissions by 2 tons per day, and PM emissions by 3 tons per day in 2010, statewide, from California and out-of-state registered medium-duty and heavy-duty vehicles. However, by harmonizing the existing ARB medium-duty CO emission standard with the U.S. EPA's 2007 and subsequent model year HDDE emission standard, the amendments will result in an increase in statewide CO emissions of 0.1 tons per day in 2010.

Economic and Fiscal Impacts. The Executive Officer determined, and the Board agreed, that the proposed regulatory action will not create costs or savings, as defined in Government Code section 11346.5(a)(6), to any state agency or in federal funding to the state, costs or mandate to any local agency or school district whether or not reimbursable by the state pursuant to part 7 (commencing with section 17500), division 4, title 2 of the Government Code, or other non-discretionary savings to local agencies.

The Board agreed with the Executive Officer's initial determination that adoption of the regulatory action will not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states. That determination has not changed. While not significant, the ARB has identified the following potential cost impacts that a representative private person or business may necessarily incur in reasonable compliance with the adopted action:

1. The businesses affected by the adopted emission standards and supplemental test procedures are the manufacturers of heavy-duty and medium-duty diesel engines sold in California. Based on previous sales data, there are 21 companies that manufacture these types of engines. Since the adopted emission standards and test procedures harmonize ARB requirements with the U.S. EPA, there may be a net decrease in costs to the engine manufacturers. The cost decrease would be due to reduced manufacturing costs from the manufacturing of one national line of engines rather than two lines of engines. The

decreased costs are expected to be passed on to the consumers or purchasers of heavy-duty vehicles with a gross vehicle weight rating of 8,501 pounds and greater.

2. Any increase in costs to engines and vehicles would be due to adoption of federal requirements. If the entire costs, due to the federal requirements, are passed on to the consumer, heavy-duty vehicle retail prices would increase by approximately $3,400 per heavy heavy-duty vehicle, $2,700 per medium heavy-duty vehicle, and $2,100 per light heavy-duty vehicle after full implementation in the 2010 model year. The U.S. EPA estimates that current average vehicle costs are $108,000 per heavy heavy-duty vehicle, $52,000 per medium heavy-duty vehicle, and $25,000 per light heavy-duty vehicle. Based on the U.S. EPA's estimated vehicle costs, the estimated price increase would represent a 3-8 percent price increase. The potential cost increase could be greater if the proposed ARB requirements and federal requirements are not harmonized. Consequently, the impact to manufacturers and dealers of heavy-duty vehicles due solely to the amendments in this proposal are not expected to be significant. The expected price increase is also not expected to impact California employment, business expansion, creation and elimination, or the ability of California businesses to compete with businesses from other states.

3. Due to the additional emission control technologies that may be required by the U.S. EPA's 2007 Final Rule, manufacturers of those technologies may experience higher sales volume. The higher sales volume may also increase employment for those businesses that supply parts between the related businesses. Compared to overall California employment, this effect is expected to be minor. Additionally, to the extent that manufacturers use contract laboratories located in California for testing or other research and development efforts, there is a potential increase in contract laboratory employment. No other associated businesses are expected to be affected by the proposed regulatory action.

Alternatives. For reasons set forth in the ISOR, in staff's comments and responses at the hearing, and in this Final Statement of Reasons, the Board has determined that no alternative considered by the agency, or that has otherwise been identified and brought to the attention of the agency, would be more effective in carrying out the purpose for which the regulatory action was proposed or would be as effective or less burdensome to affected private persons than the action taken by the Board.

II. SUMMARY OF COMMENTS AND AGENCY RESPONSE

At the October 25, 2001 hearing, oral testimony was received from:

Mr. Jed Mandel, Representative for Engine Manufacturers Association (EMA) *****
Mr. John Duerr, Detroit Diesel Corporation (DDC) *****
Mr. Bob Jorgensen, Cummins Engine Company, Inc. (Cummins) *****
Mr. Richard Burton, Monterey-Salinas Transit District (MSTD)
Mr. Louis Browning, Arthur D. Little, Inc., representing California Electric Transportation Coalition (CETC)
Mr. Paul Wuebben, South Coast Air Quality Management District (SCAQMD)

***** Also submitted written comments. These written submissions were comments on the proposed amendments to the regulations and were received during the 45-day comment period. About half of the oral testimony were in support of the proposal.

Additional written comments were received by the close of the public hearing from:

Mr. Michael L. Kunz, Government Affairs Manager, AM General Corporation/Hummer (AMG)
Ms. Bonnie Holmes-Gen, Assistant Vice President – Government Relations, American Lung Association (ALA)

No comments were submitted by the Office of Small Business Advocate or the Trade and Commerce Agency.

Set forth is a summary of each objection or recommendation made regarding the specific regulatory actions proposed, together with an explanation of how the proposed action was changed to accommodate each objection or recommendation, or the reasons for making no change. The comments have been grouped by topic, wherever possible. Comments not involving objections or recommendations specifically directed towards this rulemaking or to the procedures followed by ARB in this rulemaking are not summarized below. Additionally, any comments on other referenced documents unrelated to the amendments are not summarized below as they are outside the scope of this proposed rulemaking.

Note that the bulk of the comments responded to in this FSOR were comments on the federal 2007 Final Rule that commenters incorporated by reference into this rulemaking. Those comments are responded to here, to the extent that they also apply to this ARB rulemaking. Comments on some 2007 Final Rule issues, including in-use fuels and national oversight, were not relevant to this rulemaking, but in some cases brief responses are provided.

III. GENERAL COMMENTS

1. **Comment:** This is certainly an important milestone in the ARB's air pollution control efforts, and we strongly support the adoption of the proposed standards before you today. (SCAQMD)

   Agency Response: The ARB staff concurs with this comment. The adopted requirements harmonize federal and state requirements for HDDEs beginning in the 2007 model year. Further, the adopted requirements reduce key pollutants that have been found to be harmful, and even carcinogenic, to human health.

2. **Comment:** Heavy-duty truck diesel vehicles do contribute a very disproportionate amount of the emissions in the South Coast air basin and statewide, as you've heard. In the South Coast air basin, we've violated the ozone standard 36 days this year, so the diesel emission reductions of hydrocarbon and NOx are going to be very important in that regard. These vehicles obviously also contribute very significantly to toxic emissions and the particulate matter emissions and that's important to us because we found that 70 percent of the airborne toxic cancer risk in the South Coast air basin is directly associated with exposure to diesel particulate. So we think that that's also an important discussion, because of the environmental justice concerns that relate to inner city neighborhoods having a disproportionate amount of truck traffic in those areas.

   We'd also like to put your consideration in another context, namely that the engine manufacturers, of course, that are affected by this rulemaking have been subject to simply the most extensive and expansive air pollution control related consent decree

ever implemented. So we certainly believe that these standards have to be structured to ensure that that experience that drove those consent decrees is not repeated. I'd like to focus our comments really on four specific areas. Diesel fuel quality, particulate matter standards, the NTE certification criteria that are included in this, and also the transit bus standards which were being discussed. (SCAQMD)

Agency Response: As specified in the staff report, ozone is the result of the photochemical reaction of primarily NOx and HC emissions. A major source of these emissions is from HDDEs. The adopted requirements will reduce future emission standards for NOx by 90 percent and NMHC by 72 percent. By reducing the major precursors to ozone, exceedances of the ozone standard are expected to decrease.

HDDVs travel a disproportionate amount of time in inner city neighborhoods with environmental justice concerns. By reducing emission standards of those engines, the ARB will be reducing the health risk resulting from those vehicles travelling in all areas, including those of environmental justice concern.

In response to violations by numerous engine manufacturers, the U.S. EPA and the ARB included supplemental test procedures in the U.S. EPA's 1999 Heavy Duty Consent Decrees and California Settlement Agreements, the NTE and the ESC tests. Further, these tests were adopted by the ARB in December 2000 and apply to 2005 and subsequent model year HDDEs. Implementation of these test requirements, as amended by this rulemaking, will help ensure that the previous violations do not occur again.

In August 1998, California identified diesel PM as a toxic air contaminant. In addition, diesel PM contains over 40 substances that are individually identified as toxic air contaminants. An assessment of carcinogenic risk found that diesel PM accounts for 70 percent of total ambient cancer risk in the year 2000. All studies cited in the ISOR and in the ARB's Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles,[4] on the hazardous effects of diesel PM, have been peer reviewed. The U.S. EPA references other detailed research regarding the carcinogenic and non-carcinogenic health effects from diesel PM in their Response to Comments.[5]

Further, reductions in PM emissions are necessary for California to attain state air quality standards. ARB staff concurs with these comments and no further changes to the adopted requirements are necessary.

IV. ANALYSIS OF TECHNICAL ISSUES

A. Fuel

1. Need For Low Sulfur Diesel Fuel

3. **Comment:** EMA submitted extensive comments to EPA in response to the ANPRM on diesel fuel quality. In sum, EMA supports reductions in diesel fuel sulfur levels on a nationwide basis for all engine applications in as early a time frame as possible. As

[4] ARB, Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles, October 2000.

[5] Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements: Response to Comments, EPA-420-R-00-027, U.S. EPA, December 2000.

recognized in the Preamble to the Proposed 2007 Rule, current levels of sulfur in commercially available diesel fuel preclude the use of advanced aftertreatment technology that will be necessary to comply with the very stringent NOx and PM levels proposed in this rulemaking.

In order to achieve the emission reductions from diesel engines envisioned by this rulemaking, a systems approach is absolutely essential – advanced engine design, advanced exhaust control technologies, and improved diesel fuel standards all are needed. EPA must adopt a nationwide, ultra-low sulfur diesel fuel standard that recognizes the critical linkage among fuel specifications, engine and aftertreatment system technology, and achievable emission standards.

Reductions in diesel fuel sulfur not only will enable the use of technology necessary to reduce emissions from new engines, but they also will provide emission reduction benefits to the existing engine fleet. This is an important benefit of reducing sulfur in diesel fuel that supports EPA's goals to improve overall air quality. Those benefits should not be overlooked, and they support the establishment of low-sulfur requirements at the earliest possible date.

EPA is well aware that the level of emission reductions it is seeking to achieve from the Proposed 2007 Rule will drive the use of NOx aftertreatment, catalyzed particulate filters, and other advanced aftertreatment technologies. In order to use those technologies effectively, and ensure the durability of engine and aftertreatment systems over the required 435,000-mile useful life, diesel fuel sulfur levels must be near zero. (EMA)

4. **Comment:** Cummins stated earlier in these comments that EPA can only realize the environmental benefits of its proposed regulations by mandating the availability of low sulfur fuel, because without that mandate there is no guarantee that low sulfur fuel will be available when needed. This same result is legally compelled, as well. The comments concluded with the following:

   "It is EPA's obligation to demonstrate the technological feasibility of its standards. Without low sulfur fuel, the standards clearly cannot be met and maintained over the useful lives of heavy-duty engines, and manufacturers will be at risk of enforcement actions and warranty claims. However, the ability to ensure the availability of low sulfur fuel is completely outside the control of engine manufacturers, and rests only with EPA. Without assuring the flow of low sulfur fuel, EPA cannot demonstrate that its proposed standards are technologically feasible over the useful lives of heavy-duty engines. Simply allowing the market place to dictate the possible availability of low sulfur fuel further undercuts the technological feasibility of the proposal." (Cummins)

5. **Comment:** Low sulfur fuel requirements. Without ultra low sulfur diesel fuel, the aftertreatment technology necessary to meet and comply with the extremely stringent NOx and PM standards established for 2007 simply are not feasible. EMA provided extensive comments to EPA on its proposal to adopt low sulfur diesel fuel requirements. (*See, Statement of the Engine Manufacturers Association*, August 14, 2000, pp. 8-31.)

   Until the ARB regulatory requirements for reductions in diesel fuel sulfur are complete, ARB's proposed new standards for 2007 must not be finalized. To underscore the importance of ultra-low sulfur diesel fuel to the feasibility of the standards, ARB should

combine the fuel and emission requirements into one rulemaking package. They simply should not proceed as two distinct programs. Moreover, to the extent possible, ARB should harmonize its fuel requirements with those of EPA in order to provide the greatest overall benefit and cost-effectiveness. (EMA)

Agency Response to Comments 3-5: ARB staff agree with the commenter that a systems approach is necessary to promote and enable the use of aftertreatment technologies. As stated by the commenter, one component necessary to enable the use of aftertreatment systems is the reduction of diesel fuel sulfur content. While this rulemaking adopts emission testing and service accumulation diesel fuel requirements, in-use diesel fuel sulfur requirements have not been adopted yet. California is authorized to propose and adopt separate low sulfur diesel fuel standards. However, the low sulfur diesel fuel requirements in the U.S. EPA's 2007 Final Rule will ensure that low sulfur diesel fuel is available nationwide, regardless of California action. Therefore, no changes to the regulatory text are necessary.

6. **Comment:** A national low-sulfur diesel fuel will provide direct sulfate emissions reductions in pre-2007 diesel vehicles that do not have PM or NOx aftertreatment, helping reduce sulfate particulate matter, acid deposition (due to reduced sulfur dioxide emissions) and other harmful air pollution. (ALA)

7. **Comment:** NRDC firmly rejects the oil's industry's suggestion of a 90 percent sulfur cut (to 50 ppm) because it would render the EPA's proposed PM and NOx targets unachievable.

   Under the oil industry proposal of 50 ppm, PM traps are likely to suffer high failure rates, leaving oxidation catalysts that yield only a 20 percent PM reduction[6] as the most likely PM after-treatment technology. While some PM traps (including the most promising continuously regenerating traps) can operate at 50 ppm, trap clogging and failure is a serious problem at this level, due to the formation of sulfate PM. Fuel economy also suffers, as a result of increased regeneration needs. As a result, it would be difficult—if not impossible—for engine, aftertreatment and/or vehicle manufacturers and/or sellers to warrant such a trap for the full useful life of the vehicle, and fuel economy-sensitive vehicle users might not welcome the technology. Consequently, in the event that EPA adopts a 50 ppm sulfur cap, manufacturers and sellers would be likely to opt for the less effective oxidation catalyst, rendering the proposed 0.01 g/bhp-hr PM standard unachievable.

   Likewise, under the oil industry proposal, engine manufacturers and vehicle sellers would likely opt for selective catalytic reduction (SCR) as their preferred NOx after-treatment because it is less sulfur-sensitive than NOx adsorbers and other NOx aftertreatment technologies that are in development. NOx adsorber efficiencies are dramatically reduced when sulfur contacts the NOx storage bed. Perhaps for this reason, the Manufacturers of Emission Controls Association has testified that industry efforts to develop an effective NOx adsorber would cease if EPA adopts a 50 ppm cap.[7]

[6] Statement by EPA Office of Transportation and Air Quality (OTAQ) Director Margo T. Oge, June 19, 2000, as reported in the transcript of the New York hearing on the Proposal, pp. 53, 55.
[7] Testimony of Bruce Bertelson, June 19, 2000, as reported in the transcript of the New York hearing (hereafter, "Bertelson testimony"), p. 56.

While SCR seems capable of significant emission reductions, it also requires the development of a nationwide urea infrastructure that would cost billions of dollars to install, operate and maintain. As with oxidation catalysts, it seems unlikely that the proposed 0.2 g/bhp-hr NOx standard would be achievable with an SCR-only strategy.[8]

It is worth reiterating that the oil industry's 50 ppm sulfur limit would have a negative effect on the fuel economy of the nation's trucks and buses. For example, NOx adsorbers are expected to consume diesel fuel as they cleanse themselves of stored sulfates. As noted above, PM trap regeneration is inhibited by diesel fuel's sulfur—leading to increased PM loading, increased exhaust backpressure, and decreased fuel economy.[9] In other words, the higher the sulfur cap, the lower the fuel economy. (ALA)

> **Agency Response to Comments 6-7:** ARB staff agree with the commenter that fuel sulfur levels must be much lower than 50 ppm since the fuel sulfur levels have a direct impact on various components of an engine's emissions and combustion process. This has been demonstrated in various programs including the DECSE and APBF programs, both jointly funded by the U.S. Department of Energy. Also see Agency Response to comments #3-#5.

8. **Comment:** EPA estimates that its proposal will force the oil industry to spend, together, between $3 and $4 billion over the next six to ten years to update their refineries to produce low-sulfur diesel fuel. Given that America's largest oil companies reported nearly $12 billion in profits in just the first quarter of 2000 (see Appendix A), this investment in cleaner fuels seems to be an extremely reasonable cost of continuing an extremely profitable business.

   Some oil industry opponents of this Proposal have asserted that a 15 ppm sulfur fuel would create an undue cost on the American consumer. We disagree strongly. EPA has estimated that these rules could add up to four cents to the price of a gallon of diesel fuel over the course of the decade—hardly enough to derail the nation's strong economy. It is worth noting that BP—the nation's largest seller of diesel fuel—has reported that its 15 ppm sulfur fuel will be sold in California next year at an incremental cost of five cents/gallon, even without the economies-of-scale benefits of a nationwide fuel.[10] Tosco—the nation's leading independent refiner and marketer of petroleum products—recently announced its commitment to upgrading its California and Washington refineries to enable it to sell 15 ppm sulfur fuel in 2003—at a better return on capital for its investors than its current, high-sulfur diesel fuel.[11]

   A recent American Lung Association/Clean Air Trust/Environmental Defense poll found that 85 percent of the American public would be willing to pay the incremental costs anticipated by EPA, BP and Tosco.[12] These costs seem especially reasonable once the

[8] EPA OTAQ Director Oge noted that EPA estimated that a 50 ppm sulfur limit would yield NOx reductions of 20 percent, presumably because of the perceived limits of SCR technology. See footnote 10 above.
[9] Memorandum from former EPA Official Michael P. Walsh to Interested Parties, May 17, 2000, p. 10.
[10] http://www.ecdiesel.com/keypoints.html; BP Amoco, press release, June 15, 2000.
[11] News article, "Tosco Corporation Announces Investment Program To Produce Clean Fuels On The West Coast, August 3, 2000.
[12] http://www.cleanupdiesel.org/bulletin.061600.html

benefits of eliminating 2.8 million tons/year of NOx, 305,000 tons/year of non-methane hydrocarbons, and 110,000 tons/year of particulates are factored in.[13] (ALA)

9. **Comment:** The Agency's assumption on the increased cost of low sulfur diesel fuel is understated. (Cummins)

Agency Response to Comments 8-9: Due to potentially irreversible effects of sulfur in diesel fuel to aftertreatment control systems, diesel fuel sulfur content should be limited to the lowest amount feasible in the earliest time frame as possible. In the U.S. EPA's 2007 Final Rule, low sulfur diesel fuel is phased in beginning in 2006. In the effort to harmonize requirements, ARB is currently planning an identical phase-in schedule. However, ARB specific regulations for future diesel fuel requirements will be included in a separate rulemaking. Federal adoption of the low sulfur diesel fuel requirements will ensure that low sulfur diesel fuel is available, regardless of California action. Therefore, no further changes to the regulatory text are necessary.

a. Engine and aftertreatment system technology is integrally linked to diesel fuel sulfur levels.

10. **Comment:** In summary, the commenter provides an overview of the elements that affect diesel engine emissions. The commenter states many emission benefits that have already been realized through engine design optimization (e.g., better air/fuel ratio and engine timing control). The comment goes on to state that greater engine-based emission reductions can be obtained through the use of exhaust gas recirculation and that further emission reductions can be achieved with the use of aftertreatment systems. The commenter emphasizes that sulfur content in both fuel and lubricating oil will have the greatest overall impact on engine and fuel system durability as well as on future emission reduction capabilities. (EMA)

11. **Comment:** NRDC strongly supports EPA's proposed national sulfur cap of 15 ppm in mid-2006. In fact, NRDC has previously testified that EPA should adopt a national sulfur cap of 10 ppm.[14] NRDC would strongly oppose any sulfur level above a cap of 15 ppm because such a sulfur level would disable NOx adsorbers[15] and other promising NOx and PM controls, and would reduce the effectiveness of continuously regenerating PM traps and other promising emission controls.

Our opposition to higher sulfur caps derives from the simple truth, noted above: Just as a small amount of lead in gasoline disables automobile catalytic converters, even a small amount of diesel sulfur will inhibit or disable the most promising NOx emission controls

[13] 65 Federal Register 35430 (June 2, 2000). NRDC also notes EPA's estimated incremental vehicle costs of this proposal: $1,000-1,600 per vehicle over the long run. Given that heavy-duty buses now cost over $300,000 and that heavy-duty trucks can cost over $200,000, we believe that this is a reasonable cost of compliance.

[14] See NRDC Comments on EPA Proposed Rule No. A-98-32, submitted at EPA's hearing in Philadelphia, PA on November 2, 1999.

[15] NOx adsorbers are generally considered to be the most promising advanced NOx emission control technologies in development. They were originally developed for stationary sources and have been used in lean-burning gasoline-fueled direct injection engines. Other than an ultra-low sulfur diesel fuel, no further infrastructure changes are necessary with NOx adsorbers—a distinct advantage over SCR, discussed further below.

and will make PM controls less effective.[16] Because sulfur-sensitive emission controls will be affected more by their interaction with peaks of sulfur than by average sulfur levels, NRDC believes that EPA should focus its sulfur limits on caps, rather than averages.[17]

NRDC believes that a paradigm shift is required to sufficiently clean up diesel emissions. Such a paradigm shift involves a "systems" approach to reducing diesel emissions—evaluating fuel, engine and aftertreatment technologies together as a unified system to maximize the potential emission reductions from the entire "system." Reducing sulfur levels is the key to enabling a systems approach to reducing diesel emissions. Such an approach was critical to the success of last year's Tier 2 emissions and gasoline sulfur standards, and it is appropriately the principle behind today's Proposal. (ALA)

12. **Comment:** In summary, the commenter states that the continued use of diesel fuel with a sulfur level of 500 ppm will preclude or impede the use of the most effective particulate filter and other catalyst based PM control technologies. The higher sulfur levels in the fuel lead to such emission control technical difficulties as limited conversion efficiency of NOx pre-filter catalysts and plugging of PM filters. The commenter states that the use of ultra low sulfur fuel is required to enable the use of more effective catalysts and optimize PM filter technologies. (EMA)

13. **Comment:** As EPA recognizes, current fuel sulfur levels inhibit the performance of the most promising aftertreatment technologies that have the potential to provide significant reductions in NOx emissions. In some cases, diesel fuel with a sulfur content anything other than near-zero levels is a complete barrier to application of those technologies.

    DeNOx ("lean-NOx") catalyst loading is constrained below optimum levels for maximum NOx reduction by the presence of fuel sulfur. The potential for increased sulfate production currently limits NOx reduction capability. Very low sulfur levels are needed to maximize the effectiveness of deNOx catalysts. EPA has already determined, however, that use of lean-NOx catalyst technology will not achieve the levels of reductions it is seeking. As with oxidation catalysts, however, this is a technology that could potentially be retrofitted to existing engines to achieve substantial NOx reductions if ultra low sulfur fuel is available nationwide.

    NOx adsorbers have the potential to attain ultra-low levels of NOx emissions. NOx adsorbers, however, are particularly sensitive to the presence of sulfur in diesel fuel. Sulfur converts to sulfate and the sulfate consumes the storage sites needed for effective NOx adsorption. Because sulfur is a cumulative poison in NOx adsorbers, such technology is not usable with current diesel fuel sulfur levels. Indeed, NOx adsorbers are likely to require near-zero levels of sulfur as their ability to effectively store NOx is extremely sensitive to the presence of any fuel sulfur.

[16] NRDC notes that sulfur controls for engine lubricating oils may also be necessary, to ensure that advanced PM and NOx controls are not compromised by sulfur elsewhere in the system. Today's lubricating oils have sulfur levels up to 8,000 ppm, which is estimated to be equivalent to 2-7 ppm diesel fuel sulfur. If the final rule includes the closing of all crankcases, a less-than-2 ppm diesel fuel sulfur contribution can be maintained. 65 Fed. Reg. at 35477.

[17] However, NRDC does not object to an additional limit on the average level of sulfur, so long as the cap of 15 ppm is not increased.

EMA and other commenters at the public hearings also raised the potential use of selective catalytic reduction ("SCR") technology for meeting the proposed NOx standards. The application of SCR to diesel vehicles will require a systems approach that includes vehicle, engine, very low sulfur fuel, reductant (urea, ammonia) delivery, and catalyst design. Control of the urea/ammonia feed, which is necessary for proper catalyst operation and emissions control, also will be required. Unlike diesel engines in stationary applications which operate over a relatively narrow temperature range, diesel engines in mobile sources operate transiently over a broad range of operating conditions. As a result, they will require precious metal oxidation catalysts to lower the systems' operating temperatures and control ammonia slip. Such catalysts will need low sulfur fuel because of the sulfate conversion issues discussed above and because of sulfur's influence on catalyst operating temperatures. In addition, as with other aftertreatment systems, sulfur poisoning of precious metal oxidation catalysts also will occur. The successful use of SCR requires very low sulfur diesel fuel and the development of an infrastructure for the appropriate production, shipping, handling, and storage of urea.

EMA was a part of the Diesel Emission Control Sulfur Effect ("DECSE") program, sponsored by the Department of Energy, MECA, and EMA, in which EPA staff also participated. The DECSE program was designed to evaluate various sulfur-sensitive technologies and obtain data on the sulfate conversion levels over a broad range of engine operating conditions. The DECSE study evaluated sulfur effects on the performance and short-term durability of diesel oxidation catalysts, lean-NOx catalysts, NOx adsorbers, and particulate traps. What the DECSE program showed is that 1) fuel sulfur affects emissions, 2) there are no sulfur-tolerant aftertreatment technologies capable of meeting future emission standards, and 3) some technologies, such as NOx adsorbers, are so sensitive to fuel sulfur that they are judged to be not feasible without ultra-low sulfur fuel.

Specifically, NOx adsorber testing on 16 ppm and 3 ppm sulfur diesel fuel showed that at 200 hours, NOx adsorber efficiency deteriorates significantly when operating on 16 ppm sulfur diesel fuel. Peak NOx efficiency drops below 30%. On 3 ppm fuel, peak NOx efficiency remained greater than 50% after aging, but did not approach the 90% reduction that EPA is proposing. Moreover, testing with diesel oxidation catalysts, lean-NOx catalysts, and particulate filters demonstrated that sulfate conversion can reach 60% under certain operating conditions – those conditions represented by the NTE zone and the supplemental steady-state test. At 60% conversion with a fuel sulfur level of 15 ppm, sulfate contributes 0.009 g/bhp-hr particulate, representing 90% of the proposed standard.[18]

Sulfur traps also have been considered to protect advanced aftertreatment systems from the deleterious effects of sulfur. Sulfur traps remain in the research stage, however, and are not expected to be commercially viable within the time frame for the Proposed 2007 Standards. Even if they become commercially viable, there remains the question as to how to encourage the customer to "empty" the sulfur trap and how to dispose of the effluent.

Exposure of the engine and aftertreatment system to sulfur also may have an impact on useful life. While engine-out emissions are not expected to deteriorate over time,

[18] Draft Regulatory Impact Analysis, pp. III-10.

tailpipe (post-aftertreatment) deterioration factors have yet to be established for these advanced aftertreatment systems. (EMA)

14. **Comment:** The Natural Resource Defense Council (NRDC)[19] has been working to clean up diesel emissions since the mid-1970s—at about the same time as we were spear-heading the campaign to remove lead from gasoline. The connection between our lead campaign and EPA's current proposal is an important one: Just as lead in gasoline was the barrier to cleaner cars in the 1970s, sulfur in diesel is the barrier to cleaner trucks and buses in this decade.

    The key to the success of EPA's Proposal is the desulfurization of today's high-sulfur diesel fuel: Just as a small amount of lead in gasoline disables automobile catalytic converters, even a small amount of diesel sulfur will disable the most promising emission controls for nitrogen oxides and will make the soot controls less effective. In other words, a smaller, compromised sulfur cut (as suggested by oil interests) would render the EPA's proposed PM and NOx targets unachievable, but EPA's proposed 97 percent sulfur cut would make the air cleaner in every state of the nation.

    Only the near-elimination of sulfur (i.e., capped at 15 ppm) will create a fuel supply that is clean enough to adequately support the most promising PM and NOx emission controls like continuously regenerating PM traps and NOx adsorbers. (ALA)

    Agency Response to Comments 10-14: The ARB agrees with the commenters that fuel sulfur levels have a direct impact on various components of an engine's emissions process, combustion process, and engine durability. Further, the ARB agrees with the commenter that a systems approach is necessary to promote and enable the use of aftertreatment technologies since fuel sulfur levels have a direct impact on the various aftertreatment systems expected to be used to comply with the adopted PM and NOx emission standards. Also see Agency Response to comments #3-#5 and #6-#8.

b. Cap standard for diesel fuel sulfur levels versus average standard.

15. **Comment:** EPA has proposed a 15 ppm cap on sulfur content in diesel fuel, to be effective no later than June 1, 2006 at retail and wholesale fuel outlets, May 1, 2006 at terminal stations, and April 1, 2006 for fuel produced by refiners or imported. EPA also has requested comments on the use of an average fuel sulfur standard. EMA strongly supports EPA's proposal to adopt a cap on fuel sulfur levels, rather than an average requirement.[20]

    Because of the potential for poisoning of engine systems and the irreversible damage that may occur, an average sulfur level for heavy-duty on-highway diesel fuel simply is not appropriate. An average sulfur level provides no assurance that diesel fuel with a specific sulfur content will be available in use for vehicles needing very low sulfur fuel.

[19] The Natural Resources Defense Council (NRDC) is a national, non-profit environmental advocacy organization. Founded in 1970, NRDC has over 400,000 members nationwide, and offices in Washington, DC, New York City, Los Angeles and San Francisco.

[20] See EMA comments below on the appropriate cap level.

Without a cap on diesel fuel sulfur content, aftertreatment technologies will be ineffective or unusable.

A cap-type specification also is required in order to ensure that the appropriate fuel sulfur levels will be available at the points at which the fuel will be delivered to customers' fuel tanks. Heavy-duty trucks typically are fueled with tanker-delivered rack fuel at the truck's site or, secondarily, at truck stops. While it may be of interest to know the quality of the fuel upstream of these locations, upstream quality does not ensure downstream quality. The quality of fuel as it leaves the pump is what will have an effect on vehicle operation, vehicle emissions and the environment. A fuel sulfur average would represent only a refiner's average and, therefore, cannot be monitored – or enforced – at the pump. The aftertreatment devices engine manufacturers will use to meet the standards will be designed to tolerate a known fuel sulfur level. Engine manufacturers, and their customers, must be assured that fuel meeting the required limits will always be available.

A cap also is important in order to assure nationwide availability of uniform low sulfur fuel. Heavy-duty trucks travel across state lines and across the U.S. on a regular basis. Because the fleet is transitory, differing regional requirements– that may nonetheless meet a national average requirement – could have widespread and detrimental impacts on the entire truck fleet.

The potential for irreversible damage to systems such as NOx adsorbers and catalyzed regenerating particulate filters from higher sulfur fuel underscores the need for a capped, not average, diesel fuel sulfur requirement. The recovery of performance of certain aftertreatment systems after higher sulfur fuel exposure is unlikely. Higher fuel sulfur levels result in damage to both new and old aftertreatment systems. And, as discussed elsewhere in these comments, high sulfate particulate matter will be generated when engines are operated on higher sulfur fuel. EPA should not adopt a fuel requirement that could result in degradation of emission performance.

Refinery gate and pipeline specifications are quality control issues that should be left to the refiners and the pipeline companies. They have the responsibility to refine and move the product to the end-user. Engine manufacturers' concern is that the end-user obtains a quality fuel product meeting the required specification. Users must be assured that their equipment is protected throughout the U.S. and at all times. (EMA)

> **Agency Response:** The ARB agrees that due to potentially irreversible effects of sulfur in diesel fuel to aftertreatment control systems, any limitation to diesel fuel sulfur content should be a maximum cap rather than an average. In the U.S. EPA's 2007 Final Rule, diesel fuel sulfur content limitations are maximum caps. At this time, the ARB concurs with such limitations and is not proposing any changes to the U.S. EPA's diesel fuel sulfur content cap. Due to the additional workshops and public content received regarding the proposed diesel fuel specifications, ARB specific regulations for future diesel fuel requirements is included in a separate rulemaking. However, the low sulfur diesel fuel requirements in the U.S. EPA's 2007 Final Rule will ensure that low sulfur diesel fuel is available, regardless of California action. Therefore, no further changes to the regulatory text are necessary.

c. 5 ppm cap on diesel fuel sulfur levels.

16. **Comment:** All evidence suggests that NOx adsorber aftertreatment performs best in the absence of sulfur as demonstrated in the DECSE program. Near-zero sulfur diesel fuel also is needed for the efficient operation of the continuously regenerating PM trap, which EPA has identified as the "most promising" for achieving significant PM reductions. EPA, in the Draft RIA, indicates that 15 ppm sulfur diesel fuel allows catalyzed PM traps to reach levels "ten percent below the proposed standard." (Draft RIA, p. III-9.) Ten percent below the standard means 15 ppm sulfur diesel fuel will allow catalyzed PM traps to be a mere 0.001 g/bhp-hr below the 0.01 g/bhp-hr PM standard. After the contribution of fuel sulfur, this means the non-sulfate particulate emissions must be less than 0.001 g/bhp-hr or, essentially, at the limits of detectability. EPA has proposed to provide no "headroom" for compliance with the standard.

Even more striking is that the proposed closed crankcase requirement will mean an additional sulfur contribution from the engine oil (which, by EPA's own estimate, is equivalent to 2 to 7 ppm sulfur in the fuel). The oil contribution easily will take up that 0.001 g/bhp-hr of "headroom," effectively requiring non-sulfate particulate emissions that are zero or negative. The engines used in the DECSE study, on which EPA relies, were not equipped with closed crankcase controls. Contrary to EPA's assertions, 15 ppm sulfur diesel fuel does not make the standard "feasible." (*Id.*) A 5 ppm cap on sulfur fuel is essential, because there will be an increased engine oil sulfur contribution as a result of the closed breather requirement.

Moreover, EPA has not accounted for the fact that the continuously regenerating trap, on which EPA primarily relies, may not regenerate itself in cold climates at 15 ppm sulfur. The Draft RIA cites the fuel sulfur experience in Sweden, concluding that increased failure rates should be attributed to the higher fuel sulfur levels represented by a 50 ppm cap, rather than a 10 ppm cap diesel fuel. (Draft RIA, p. III-26.) What EPA fails to recognize is that the typical sulfur level of the diesel fuel in Sweden is 3 ppm, with few samples exceeding a 5 ppm level. Thus, EPA admits that 50 ppm does not work in colder climates and has evidence only to show that with a 10 ppm diesel fuel sulfur cap – a level 33% lower than its proposal and which, in Sweden, is less than 3 ppm average sulfur in use – can continuously regenerating traps operate, and only under the operating conditions tested in Sweden. What EPA does not have is evidence that a 15 ppm cap is sufficient for proper operation of continuously regenerating particulate traps in cold ambient conditions.

While EMA recognizes that some refiners would strongly oppose a 5 ppm cap on diesel fuel sulfur content, it should be noted that the technology used to produce single digit ppm diesel fuel sulfur levels is already understood, developed, and in practice. The ARCO ultra low sulfur diesel fuel is produced by a process guaranteed to meet a 15 ppm sulfur diesel fuel limit, designed to achieve 10 ppm sulfur, and delivering diesel fuel at single digit sulfur levels. The Swedish MK1 fuel introduced in 1991 as a city fuel now is used virtually everywhere in Sweden, by virtually everyone. The fuel has a specification of 10 ppm maximum sulfur and a typical sulfur level of 2 to 3 ppm.

While a 5 ppm sulfur cap is not proven technology in the sense that few refineries have, as yet, produced this product on a regular basis, 5 ppm fuel is only a few ppm away from current experience. Furthermore, the MathPro study models 5 ppm sulfur diesel fuel as a feasible technology. As discussed in section 3.1 of their final report, 5 ppm fuel is

within current technology. ("Refining Economics of Diesel Fuel Sulfur Standards," a study performed for the Engine Manufacturers Association, MathPro Inc., October 5, 1999; hereafter "MathPro Study") While the technology to produce single digit sulfur diesel fuel is understood, the ability to reliably and inexpensively measure those levels is in question. EPA must work with industry to develop and codify sulfur test measurement procedures that can be used in both refining and field environments for production and enforcement of ultra low sulfur fuel regulations.

EPA also must recognize that no harm is caused by the use of diesel fuel with a lower sulfur content than may be required by an engine and aftertreatment system. The use of a higher-than-required fuel sulfur level, however, is detrimental to the engine and to the environment. Thus, EPA must adopt the very lowest fuel sulfur level that can be achieved. EPA should finalize a 5 ppm sulfur diesel fuel for heavy-duty on-highway engines and vehicles in this rulemaking. (EMA)

17. **Comment:** We applaud the Agency for acknowledging that the proposed standards are not approachable without advancements in the entire engine "system"– specifically through improved fuel quality coupled with advanced engine and aftertreatment technology. Therefore, we are encouraged by the proposal to mandate drastic reductions in diesel fuel sulfur as an "enabler" of advanced emission control technology. However, sulfur reduction is critical not just to enable these technologies, but also to ensure that their use is not a hindrance to the proper and efficient use of the engine and vehicle. The system design must deliver the needed emissions reduction without compromise to engine performance, fuel economy, and durability. Such a robust design requires near zero sulfur diesel fuel (< 5-ppm S). Cummins strongly supports the Agency's efforts to mandate the use of ultra low sulfur fuel and to require that it be made broadly and exclusively available for use on-highway by both existing and new engines and vehicles.

Sulfur in diesel fuel must be reduced to near zero (< 5-ppm S) to ensure adequate and maintainable performance of the emission control system. As will be discussed here, sulfur derived from the fuel and lubricating oil hinders both the performance and durability of the NOx and PM control technologies that could potentially be utilized to meet the proposed emissions standards. The acute sensitivity of certain technologies will require advanced 'sulfur management' approaches to deal with even trace levels of sulfur from the fuel and lube oil.

Of the potential technologies presently under development for NOx control, NOx adsorber catalysts exhibit the greatest sensitivity to sulfur. NOx adsorber catalysts trap NOx on an adsorbent bed that must be periodically regenerated. Sulfur (SO_2) in the exhaust is also adsorbed, but is not desorbed under the same NOx regeneration conditions. Desulfurization requires higher temperatures and fuel rich exhaust conditions, penalizing fuel economy. As the adsorber bed becomes saturated with sulfur, its ability to trap NOx deteriorates. The rate of deterioration and frequency of required desulfurizations can be minimized by reduction of sulfur in the fuel and by trapping SO_2 upstream of the NOx adsorber. Testing by Cummins and catalyst manufacturers has shown that NOx adsorber catalysts are rapidly poisoned even when exposed to trace levels of sulfur.

Likewise, PM filter/trap performance is compromised by sulfur in the diesel fuel. Most trap technologies employ catalyst material to facilitate the regeneration of the collected

PM at exhaust temperatures reached under typical duty cycles; however, precious metal catalyzes the conversion of SO_2 to SO_3 which condenses as sulfate particulate matter (a.k.a. sulfate make). Depending on the level of sulfur in the fuel, the increase in sulfate PM outweighs the reduction benefits of the trap, resulting in a net-zero reduction efficiency. This sulfur intolerance is not limited to PM filters. Any catalyst technology loaded with precious metal (diesel oxidation catalysts, some SCR catalysts, NOx adsorber catalysts) is vulnerable to sulfate make.

Both NOx and PM aftertreatment devices require ultra low sulfur fuel. The sulfur to sulfate conversion with 15 ppm sulfur fuel contributes too much to PM to make the proposed standard feasible. Fuel capped at 5ppm sulfur is required. The Agency needs to analyze further the impact sulfur has in enabling aftertreatment technologies and on achieving its proposed PM standard. (Cummins)

> **Agency Response to Comments 16-17:** In finalizing the federal rule, the U.S. EPA considered a wide range of diesel fuel sulfur content down to 5 ppm. Information analyzed by the U.S. EPA in their RIA shows that a diesel fuel sulfur limit of 15 ppm is sufficient for the aftertreatment control technologies and compliance with the adopted emission standards. Only marginal benefits can be expected with diesel fuel less than 15 ppm. Also see Agency Response to comments #3-#5.

d. Availability of ultra low sulfur fuel for Tier 2 light-duty engines and vehicles.

18. **Comment:** EPA also must assure that ultra low sulfur diesel fuel is available for Tier 2 light-duty diesel engines and vehicles. Those extremely stringent standards, which were recently promulgated, represent a very significant step in engine technology. Meeting that challenge with diesel engine technology will provide EPA and consumers with a motive power option that has NOx and PM emissions equivalent to a gasoline engine and with substantially better fuel economy, CO_2 emissions, and HC, CO and evaporative emissions.

Critical to assuring that those diesel engines are a viable option in the marketplace, however, is reducing the sulfur content of diesel fuel available for Tier 2 light-duty on-highway vehicles. Diesel fuel with ultra low sulfur levels must be available for certification testing and in-use operation in order for engine manufacturers to comply with the stringent Tier 2 NOx and PM standards that are in place.

Moreover, the adoption of Tier 2 standards that allow a role for vehicles with diesel-fueled engines in the light-duty market – along with substantial improvements in diesel fuel that enable those standards to be met – has significant potential to stimulate, support and speed major research and development in clean diesel engine technology. Such new technology can be transferred to other applications to provide even more extensive benefits.

Without significant sulfur reductions, the Tier 2 standards certainly cannot be achieved with diesel-fueled engines. The Tier 2 standards represent a very significant step in emission control technology. While no manufacturer has yet acknowledged an ability to meet the 0.2 gm/mile NOx and .02 gm/mile PM standards with a diesel engine – the highest Tier 2 certification bin standards – those levels are not even approachable

without substantial reductions in diesel fuel sulfur to ultra-low levels (5 ppm or less). In addition, significant sulfur relief also will be required to reach the least-stringent interim bin standards of 0.6 gm/mile NOx and .08 gm/mile PM for heavy light-duty trucks and 0.9 gm/mile NOx and .12 gm/mile PM for medium-duty passenger vehicles (MDPVs). It is clear that without fuel sulfur reductions, diesel-fueled engines will not be a viable option in the light-duty vehicle marketplace. With 5 ppm sulfur diesel fuel, however, manufacturers of diesel-fueled engines are hopeful that they will be able to meet the challenge posed by the Tier 2 standards. (EMA)

Agency Response: The ARB agrees that lower sulfur diesel fuel is an important part of any effort to reduce emissions from diesel vehicles. Light duty diesel engines and vehicles are not included in this rulemaking. Therefore, no further changes to the regulatory text are necessary.

2. The New Diesel Fuel Sulfur Standard Should Be Effective No Later Than January 1, 2006.

19. **Comment:** EPA has proposed an implementation schedule that would have lower sulfur diesel fuel in the marketplace by June, 2006. In order to support the advanced technologies that are required under EPA's proposal to be offered for model year 2007, it is essential that EPA require implementation of lower sulfur at least by the dates proposed. EPA must assure that lower sulfur diesel fuel is available nationwide prior to the introduction of new model year heavy-duty engines and vehicles.

EPA has proposed that the requirements for 15 ppm sulfur diesel fuel be effective according to the following schedule: (1) for diesel fuel produced by refineries on April 1, 2006; (2) for diesel fuel at the terminal level on May 1, 2006; and (3) for diesel fuel at retail stations and wholesale purchase outlets on June 1, 2006. EMA believes ultra low sulfur fuel must be made available no later than the proposed implementation schedule.

Typically, heavy-duty engine manufacturers begin releasing their new model year engines in September and October. The light heavy-duty vehicle model year traditionally would begin July 1, 2006 for the 2007 model year. But, the 2007 model year could begin as early as January 2, 2006. Clearly, with a January 2, 2006 start of production date, emission control systems could be in serious jeopardy without the required fuel. In fact, in order to make the averaging, banking, and trading program workable for manufacturers, and allow complete field testing necessary for utilization of the AB&T program, EPA should require the availability of ultra low sulfur diesel fuel well before January 2, 2006.

It is essential, therefore, that EPA require the implementation of ultra low sulfur fuel by January 1, 2006, or as soon as possible, but in no event later than the dates proposed. (EMA)

20. **Comment:** As you move forward in adopting 2007 standards for HDDEs, we also urge you to move forward as quickly as possible to adopt requirements for low-sulfur diesel fuel to ensure the maximum possible reduction in on-road diesel emissions. We urge you to adopt low-sulfur diesel standards by 2006 or earlier. (American Lung Association of California)

Agency Response to Comments 19-20: The ARB agrees with the commenter that fuel sulfur levels have a direct impact on various components of an engine's emissions and combustion process. Further, due to potentially irreversible effects of sulfur in diesel fuel to aftertreatment control systems, diesel fuel sulfur content should be limited to the lowest amount feasible in the earliest time frame possible. In the U.S. EPA's Final Rule, low sulfur diesel fuel is phased in beginning in 2006. In the effort to harmonize requirements, ARB is currently proposing an identical phase-in schedule. However, ARB specific regulations for future diesel fuel requirements is included in separate rulemaking. While the ARB adopted emission testing and service accumulation diesel fuel requirements in this rulemaking, in-use diesel fuel sulfur requirements have not been adopted yet. Also see Agency Response to comments #3-#5.

21. **Comment:** Implementing the low-sulfur cap in mid-2006 ensures that the fuel supply of low-sulfur diesel will be adequate to service the first model year 2007 vehicles that are sold (typically, in the summer and fall preceding the calendar year). By requiring that all highway diesel fuel produced by refiners or imported meet the new sulfur standard by April 1, 2006, and that all highway diesel fuel at the terminal level meet the new sulfur standard by May 1, 2006, EPA is providing adequate lead time to ensure that all highway diesel fuel users are buying only the low-sulfur diesel fuel by June 1, 2006 and is providing a clear and useful road map to implementing the sulfur limits in a manner that avoids market disruptions that could occur if only a retail compliance date were provided.[21] (ALA)

22. **Comment:** EPA must implement ultra low sulfur diesel fuel requirements at the earliest possible date in order to enable the use of diesel-fueled technology in the light-duty marketplace. In fact, light-duty engine and vehicle manufacturers' long-range product plans are in flux approximately five years prior to the introduction of a new model. Because of the way such engines are certified and marketed, there is a real possibility that light-duty diesel products for MY 2007 will be introduced early in 2006. For all of those reasons, ultra low sulfur fuel must be available as soon as possible. (EMA)

Agency Response to Comments 21-22: The ARB agrees with the commenter that adequate fuel supply is necessary to prevent misfueling. Further, due to potentially irreversible effects of sulfur in diesel fuel to aftertreatment control systems, diesel fuel sulfur content should limited to the lowest amount feasible in the earliest time frame possible. In the U.S. EPA's Final Rule, low sulfur diesel fuel is phased in beginning in 2006. In a separate rulemaking, ARB intends to propose an identical phase-in schedule. Although, light-duty diesel engines and vehicles would benefit from lower sulfur diesel fuel, these vehicles are not included in this rulemaking. Also see Agency Response to comments #3-#5.

23. **Comment:** EPA should require ultra low sulfur diesel fuel in the marketplace as soon as possible for compliance with the 2004 Standards which become effective for some

[21] NRDC notes that several fuel suppliers (e.g., BP, Tosco) have already signaled their intention to sell low-sulfur diesel fuel in California and elsewhere prior to 2006. In New York, the nation's largest operator of diesel transit buses will be using 30 ppm sulfur fuel by 2001 and has committed to using 15 ppm sulfur fuel as soon as it is available. NRDC assumes that, with proper incentives, other fleets would be early adopters of ultra-low sulfur diesel fuel once it is available, especially those who seek to participate in EPA or state retrofit/rebuild programs.

manufacturers as early as October, 2002. Key to meeting those new and challenging requirements for compliance with current and future standards is the need for significant reductions in diesel fuel sulfur.

To comply with the 2002/2004 requirements, engine manufacturers are expected to employ exhaust gas recirculation (EGR) technology. Engine manufacturers anticipated utilizing a moderate amount of EGR when they committed to the 2004 standards as envisioned in the SOP. With the significant increase in stringency in the 2004 standards resulting from the changes in EPA's compliance program as set forth in the Consent Decree, manufacturers will be forced to use substantially more EGR to comply with EPA's 2002/2004 standards than originally contemplated. Simply stated, the more stringent the standards, the more EGR that will be necessary to meet them, and the more EGR, the greater the likelihood of engine wear and corrosion unless there are reductions in fuel sulfur levels. The introduction of EGR into the engine system, in the absence of fuel sulfur reductions, has an impact on engine components, causing increased corrosion. With lower sulfur fuel, those impacts are lessened.

Lower sulfur fuel also is needed because of the increasing durability demands that are placed on diesel engines. The increased use of EGR, which has a negative impact on durability, is occurring at the same time that customers are demanding greater durability from diesel engines. Complicating those durability challenges even further is the implementation of the new, 435,000-mile useful life requirements that become effective in 2004. Any reductions in the sulfur levels of diesel fuel used in those engines will help to ameliorate the durability concerns raised by the significantly increased 435,000-mile useful life requirement. EPA should implement ultra low sulfur diesel at the earliest possible date and should develop incentive programs to encourage refiners to make ultra low sulfur fuel available prior to the required implementation date. (See further discussion below on fuel incentives.) (EMA)

> **Agency Response:** The 2002/2004 requirements were adopted previously by the ARB in separate rulemaking in April 1998. Though the requirements expected the use of EGR to achieve the emission standards, lower sulfur diesel fuel is not necessary. However, the ARB agrees that any early introduction of low sulfur diesel fuel would benefit all diesel engine users by reducing PM emissions and increasing the durability of EGR systems. Slight PM reduction due to reduced diesel fuel sulfur content is documented in the ARB's Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles – Appendix IV, Fuels Report: Appendix to the Diesel Risk Reduction Plan. Further, reduction of diesel fuel sulfur also reduces the amount of H_2S and other corrosive chemicals that may form in, or go through, the EGR system. However, as addressed in the U.S. EPA's Final Rule and previous rulemaking for pre-2007 model year, technological feasibility of pre-2007 emission standards is not dependent on the introduction of lower sulfur diesel fuel. Therefore, no further changes to the regulatory text are necessary. Also see Agency Response to comments #21-#22.

24. **Comment:** EPA has requested comment on a phase-in of its proposed diesel fuel sulfur content requirements. Uniform, nationwide, ultra-low sulfur fuels levels must be maintained, and phase-in of new, lower-sulfur fuels should not be allowed. Heavy-duty trucks travel across state lines and across the U.S. on a regular basis. Because the fleet is transitory, differing sulfur levels in diesel fuel – based on and resulting from a phase-in

of low sulfur fuel through regional differences or other criteria – could have widespread and detrimental impacts on the entire truck fleet.

A significant and, from engine manufacturers' perspective, unwanted and unnecessary challenge with a phase-in of a lower sulfur diesel fuel supply is the existence of multiple fuel grades in the distribution system. EMA opposes any sulfur phase-in process that would have two on-highway fuels in the marketplace at the same time. The issues associated with enforcing the proper distribution and use of new, lower-sulfur diesel fuels are complex. Such a phase-in would be environmentally unsound as it would likely result in the delayed purchase of new low-emission products and/or the misfueling of those products. Refiners, distributors, and users all must have the right incentives to ensure that appropriate fuels are available and used. (EMA)

25. **Comment:** EMA advocated the adoption of a single fuel stream, if the costs to maintain all diesel fuel at one ultra-low sulfur level proved to be less than the increased costs of multiple distribution. The EMA-sponsored distribution study conducted by Baker and O'Brien indicated elevated cost and distribution complexity for the shipment of small quantities of ultra-low sulfur diesel fuel (5 ppm or less). (See "Very Low Sulfur Diesel Distribution Cost," Baker & O'Brien, Inc., August 1999, sponsored by EMA.) Those complexities are likely to result in an increased possibility of product contamination and fuel runouts or shortages. The petroleum industry also supports this position, as discussed in a report recently issued by the National Petroleum Council in conjunction with the Department of Energy (*See* "U.S. Petroleum Refining: Assuring the Adequacy and Affordability of Cleaner Fuels," National Petroleum Council, June 2000.). (EMA)

26. **Comment:** The benefit of minimizing the number of available fuel streams is reducing the potential for users – both commercial users and consumers – to make short-term economic choices with regard to vehicle or equipment fueling. One aspect of increased distribution costs, leading to higher fuel costs, would be the investments required by refiners and fuel distributors for tankage needed to supply two on-highway fuels. Dual tankage would represent a stranded investment to the refiners and fuel distributors as the capital would have to be recouped over a very short period of time. The elevated cost associated with distributing small quantities of fuel coupled with the stranded investment presumably would result in a more costly product.

    Because profitability in the trucking industry is so sensitive to fuel cost, if two grades of low-sulfur diesel fuel were available for heavy-duty on-highway trucks, commercial operators may simply choose to use the less-expensive, higher-sulfur fuel in their vehicles. The existence of two separate heavy-duty fuel streams also may delay the purchase of newer, lower-emitting, heavy-duty engine technologies if truck owners were able to save the costs of operating on lower fuel sulfur levels by keeping their older trucks longer. (EMA)

27. **Comment:** Significant distribution costs can occur when excessive transmix is generated or when large fuel product downgrading is generated. *The commenter goes on to describe how the flashpoint of the transmix blend would be well below the commercial limit and how the resulting blend product would not meet flashpoint requirements long before sulfur contamination causes a problem*.

    The commenter goes on to describe how the sulfur level of adjacent products will influence the amount of product downgrade at a distillate/distillate interface, in particular

between on- and off-road fuels. These contamination and cost issues provide another reason why EPA must require significant reductions in the sulfur level of nonroad diesel fuel. (EMA)

Agency Response to Comments 24-27: The comments above are directed to the U.S. EPA regarding fuel distribution concerns and, thus, are outside the scope of, and irrelevant, to this rulemaking. However, as discussed in the U.S. EPA's RIA, the U.S. EPA determined that only minor modifications to the current fuel distribution system are necessary to handle low sulfur diesel fuel. For these reasons, no delayed sales of lower emitting engines and vehicles are expected in California.

3. Low Sulfur Nonroad Diesel Fuel.

28. **Comment:** EMA is extremely disappointed that EPA has not moved forward to address the need for low sulfur nonroad diesel fuel. This rulemaking provides a ready opportunity to desulfurize the entire mobile source diesel fuel pool. EPA should take advantage of this opportunity. However, even if EPA should defer immediate action on nonroad diesel fuel quality, it cannot defer such action for very long. It is crucial that EPA understand that the status quo on nonroad diesel fuel quality is unacceptable. As such, EPA cannot simply do nothing. It must take action promptly, whether in this rulemaking or not, to improve substantially the quality of nonroad diesel fuel.

EPA should immediately take action to adopt a much lower fuel sulfur cap for nonroad diesel fuel to ensure, among other benefits, that lower sulfur on-highway fuel is not achieved solely by using the nonroad fuel stream as the dumping ground for high sulfur fuels.

The critical nonroad needs and the real nonroad benefits will come from the linkage between future nonroad engine emission technologies and future nonroad diesel fuel quality.

At present, EPA appears on a path to implement a Tier 3 nonroad regulatory program that will drive 2004-like on-highway engine technologies to the nonroad market.[22] At a minimum, therefore, EPA must assure that nonroad engines operate in-use on the same or better fuel quality as the corresponding on-highway engines with the same or similar technologies. One of the key emission control technologies that will be used in on-highway applications in 2004 (pulled ahead for some manufacturers to October, 2002) is exhaust gas recirculation (EGR). EMA and its members have gone on record in this and previous rulemakings establishing the linkage between fuel sulfur content, sulfuric acid formation, and the resultant impacts on engine wear, maintenance, and durability. The impacts of fuel sulfur on EGR systems and engine wear do not occur from isolated usage, but from long-term exposure to the highly corrosive exhaust gases associated

[22] The key is not whether on-highway and nonroad engines are required to meet the same numeric emission limits. Rather, the key is whether the applicable emission limits require the same or similar technologies. Because there are differences in engine applications, operating conditions, and test cycles between nonroad and on-highway applications, nonroad engine standards generally are numerically higher than on-highway standards of equivalent stringency requiring the same or similar technology. And, in some cases, certain on-highway technologies may not be able to be successfully transferred to nonroad engines or may not achieve the same reductions. Nevertheless, EPA must recognize that the feasibility of any future nonroad emission standards, like their on-highway counterparts, must be determined in conjunction with the fuel that is available for certification and in-use.

with the combustion of fuel with high levels of sulfur. In that regard, EMA has demonstrated that engines with EGR systems must be assured of operating, over their lives, on diesel fuels with sulfur levels that average substantially less than 500 ppm. The same thing will be true for nonroad engines with EGR systems. EGR systems will not meet either EPA's or customers' durability requirements if the current sulfur level of nonroad diesel fuel is maintained. Further, it should be noted that the very stringent PM standards EPA apparently is considering for Tier 3 will not be achievable with current nonroad diesel fuel, may not be achievable with 500 ppm diesel fuel, and, in fact, may, by themselves, drive the need for aftertreatment technology-enabling levels of nonroad diesel fuel.

EPA staff and California Air Resources Board officials have indicated an interest in not just forcing the use of 2004 EGR technology in the nonroad market but, rather, forcing the use of aftertreatment technologies. Indeed, EPA and ARB representatives have indicated an interest in moving directly to aftertreatment-forcing emission limits and skipping the intermediate step of EGR-forcing emission limits. As set forth in detail in these comments, aftertreatment technologies are not enabled without the use of ultra low sulfur diesel. So, EPA must both make decisions now and provide direction now – to engine manufacturers, equipment manufacturers, oil refiners, and the public – as to its future (Tier 3 and beyond) nonroad regulatory program intent. EPA cannot put off these decisions. In fact, engine manufacturers already have made investments and commitments in anticipation of the Tier 3 emission standards and implementation dates adopted on October 23, 1998.

Nevertheless, there is a need and opportunity for EPA to set in place a clear road-map for the future of nonroad engine regulations. And, the key to the ultimate destination on that map is the nonroad diesel fuel sulfur level. EPA cannot do nothing. Nonroad diesel fuel sulfur levels must be improved dramatically for Tier 3. But, Tier 3 may not be the final destination; nor, perhaps, should it be a destination at all.

EPA must immediately assess the benefits associated with Tier 3 emission reductions and also the costs. Not only will engine manufacturers have to invest enormous capital to achieve compliance with Tier 3 standards, but equipment manufacturers also will have to make monumental, unprecedented investments in capital to re-design their entire line of equipment offerings. Clearly, those investments, which follow closely on the heels of similar investments for Tier 2, will require long periods of regulatory stability to allow for the necessary recoupment of such investments.[23] In that regard, a Tier 3 program effectively delays the possibility of aftertreatment for nonroad engines for many, many years and may require oil refiners to make a two-step drop in nonroad diesel fuel sulfur levels, first to a level that supports EGR and then to a level that supports aftertreatment.

As mentioned above, some EPA staff and ARB officials, as well as other interested parties, have advocated skipping the EGR-forcing standards and going directly to an aftertreatment-forcing emission limit while providing engine manufacturers added leadtime to develop aftertreatment technology for nonroad applications and equipment manufacturers added leadtime to re-design equipment, once, to accommodate new engines and new technologies. In considering such an approach, EPA must be mindful of the commitments engine and equipment manufacturers already have made in

[23] The need for stability and time for recouping investment were recognized by EPA and thoroughly documented in the Nonroad Statement of Principles (SOP). See, e.g., Paragraph 4 of the Nonroad SOP.

anticipation of the Tier 3 program scheduled to take effect in 2006 to 2008. EPA should consider implementing the appropriate flexibilities in its future regulatory program to be sure that a manufacturer's current plans for product implementation, AB&T usage, equipment flexibility and the like are not jeopardized by a change in direction. EPA also must be mindful of the commitments to pull ahead certain Tier 3 nonroad standards to 2005 under the provisions of Consent Decrees entered into by some engine manufacturers.[24] EPA must be sure not to jeopardize such commitments. As such, EPA should be sure that the Consent Decrees are not an impediment to a change in direction (or do not create an unlevel playing field).

It is extremely important for engine manufacturers to know the sulfur level of the fuel intended for future nonroad applications to identify the appropriate technology for those engines. From the refinery perspective, such advance knowledge also is important. Refiners should be allowed to plan capital outlays and schedule engineering and construction resources. The pooled sulfur reduction for moving nonroad diesel fuel from over 3500 ppm to below 500 ppm is substantially greater than the reduction of on-highway diesel fuel from 500 to 15 ppm. Reducing sulfur in nonroad and on-highway diesel fuels in two steps is potentially far more costly and disruptive than achieving those reductions at the same time. In fact, the efficiencies and cost synergy of reducing sulfur in nonroad diesel fuel at the same time on-highway diesel fuel is de-sulfurized are far greater than the efficiencies and cost synergy of reducing sulfur in gasoline and on-highway diesel fuel together. In addition, reducing the differences in sulfur levels between on-highway and nonroad diesel fuels lessens the severity and likelihood of contaminating on-highway diesel fuel during the refining process and during transit as part of the distribution process.

Finally, EPA also must be aware of and take into consideration the need for worldwide harmonization which simply is of critical importance to the nonroad industry. EPA's process to establish the appropriate nonroad fuel sulfur levels, emission standards, and implementation dates should be closely coordinated and harmonized with regulatory agencies around the world.

The linked issues of nonroad fuel quality and future nonroad emission regulations are critical and require a timely proposal from EPA. EMA has briefly raised in these comments some of the key issues. We are prepared to meet with EPA to discuss these issues in greater detail. Nevertheless, the conclusion is inescapable: nonroad diesel fuel quality must be substantially improved and must be substantially improved by actions that are taken now. (EMA)

29. **Comment:** One important aspect of minimizing low sulfur diesel fuel distribution and contamination concerns is assuring only a single fuel stream for heavy-duty on-highway engines and vehicles and declining to phase-in the lower sulfur fuel requirements. As EMA also recommends, another way to minimize contamination concerns is to lower the required sulfur content of nonroad diesel fuel to the current on-highway level (500 ppm). Refiners and distributors also have a role to play in minimizing distribution concerns, as do existing interfaces with other fuels. (EMA)

[24] The import of the nonroad Consent Decree requirements is two-fold. One, it drives the need for the introduction of the nonroad fuel sulfur levels required for Tier 3 standards to 2005. Two, it requires some necessary modifications to Consent Decrees if EPA should decide to forego Tier 3 in lieu of the benefits and reduced overall costs associated with skipping Tier 3 and implementing an aftertreatment-forcing standard in a later time frame.

Agency Response to Comments 28-29: The comments are related to off-road diesel fuel and specifically directed to the U.S. EPA. The issue of non-road diesel fuel is outside the scope of, and therefore irrelevant to, this rulemaking. While Tier 3 requirements do not need low sulfur diesel fuel, the ARB agrees that for aftertreatment based NOx and PM emission control systems, low sulfur diesel fuel may be needed. Off-road emissions standards and an associated implementation schedule will be considered in a separate rulemaking. The commenter also recommends a non-road diesel fuel sulfur limit of 500 ppm to minimize contamination concerns. The current off-road diesel fuel sulfur limit in California is 500 ppm, with average in-use levels over 50 percent less than the limit. Therefore, no further changes to the regulatory text are necessary.

4. Diesel Fuel Issues Outside of California.

30. **Comment:** EPA has proposed to extend the temporary exemption from the low sulfur diesel fuel requirements for the areas of Alaska served by the Federal Aid Highway System from January 1, 2004 (the current expiration date) to the proposed effective dates for the proposed 15 ppm sulfur standard (i.e., April 1, May 1, and June 1, 2006). In addition, the Agency is proposing to allow Alaska to submit to EPA a transition plan for implementing the 15 ppm standard, which would be an alternative to the national program and could result in the availability of both 15 ppm and higher sulfur on-highway fuels in Alaska during the transition. In addition, EPA proposes, as it has provided under the current temporary exemption, that it "would not base any vehicle or engine recall on emission exceedences caused by the use of high-sulfur (>500 ppm) fuel in Alaska during the period of the temporary sulfur exemption." Finally, EPA proposes to grant Alaska's request for a permanent exemption from the requirements to dye non-highway fuel throughout the State. 65 Fed. Reg. at 35522.

    EPA also is proposing to exclude American Samoa, Guam and the Commonwealth of Northern Mariana Islands (collectively, the "Territories") from the proposed low sulfur diesel fuel requirements, as well as from the 2007 heavy-duty diesel vehicle and engine emission standards. As a result, the Territories would continue to have access to engines and vehicles meeting the 2004 Standards. The recall and warranty provisions applicable in Alaska during the temporary exemption period would be applicable in the Territories. 65 Fed. Reg. at 35523. (EMA)

31. **Comment:** As EPA is well aware, EMA and its members have repeatedly objected to EPA's prior grants to Alaska of exemption from low sulfur diesel fuel requirements. If the Agency extends its current exemption to 2006 (thereby allowing engines and vehicles to be operated on diesel fuel with a sulfur content greater than 500 ppm), emission control systems used on engines and vehicles introduced into the marketplace beginning as early as 2002 to meet the 2004 Standards not only will likely fail to meet those standards, but also will experience serious operational problems, and in some cases could fail completely. (EMA)

32. **Comment:** The availability of low sulfur diesel fuel is essential to engine manufacturers' ability to meet 2004 and later model year emission standards. As EMA previously explained to the Agency, the emission control systems scheduled for use in engines and vehicles to be introduced to meet the 2004 and later year emission standards are dependent on diesel fuel with a sulfur content of 500 ppm or less. Fuel sulfur contributes to diesel engine emissions in the form of sulfur dioxide (SO_2) and through the further

oxidation of SO_2 to sulfate particulates. Thus, without low sulfur fuel, engines certified to the 2004 Standards simply will not meet those standards in use. For a more detailed discussion, s*ee* EMA Comments on "State of Alaska Petition for Exemption from Diesel Fuel Sulfur Requirement," Docket No. A-96-26 (June 12, 1998).

EPA is well aware that the use of high sulfur diesel fuel results in high PM emissions. Where diesel engines employ an oxidation catalyst technology, the combination of high sulfur diesel fuel and engine aftertreatment devices will result in more PM emissions than those of engines operated without an oxidation catalyst. That phenomenon, well documented by data, is a direct result of the sulfur to sulfate conversion that takes place in the catalyst and was a leading factor in deciding to mandate use of low sulfur diesel fuel. The use of oxidation catalysts is likely to increase to meet the 2004 Standards. Thus, if EPA extends Alaska's temporary exemption from the 500 ppm sulfur fuel requirement beyond January 1, 2004, the adverse emission consequences for the State also are likely to increase.

Moreover, this is not just a local issue, confined solely within Alaska's borders. The 2002/2004 engine technologies that will require low sulfur diesel fuel will be used on all HDDEs, including those used in line-haul operations. Vehicles from the lower 48 States and Canada with technologies requiring low sulfur diesel fuel surely will deliver goods in Alaska. Any exposure to Alaska high sulfur diesel fuel may permanently reduce the effectiveness of the emission control technologies employed on those engines and substantially reduce their overall durability and performance. Not only will the owners of those vehicles suffer damage (for which the engine manufacturer should not be responsible), but as a result, the lower 48 States and Canada also will suffer adverse and excessive emission contributions. (EMA)

33. **Comment:** The use of low sulfur diesel fuel affects not only engine out emissions, but also the functional operation of several emission control technologies scheduled for introduction into the marketplace to meet the 2004 Standards. Specifically, engines with emission control technologies, such as EGR and exhaust catalysts, if not operated on low sulfur diesel fuel, simply will fail to perform as the customer expects and, in some cases, will fail altogether**.**

In EGR systems, exhaust gas is recirculated back into the cylinder to reduce the amount of fresh charge air or oxygen available for combustion during certain operating conditions. Combustion temperatures, and thus NOx formation, are reduced. In order to maximize the effectiveness of the EGR system, the exhaust gas is cooled before it enters the fresh air stream. When the engine is operated on high sulfur diesel fuel, sulfur in the exhaust gas stream is condensed by the EGR cooler and forms sulfuric acid deposits in the cooler and any surfaces through which the cooled exhaust gas passes: valves, rings, cylinder liners, sensors, EGR coolers and turbochargers.

With the significant increase in stringency in the 2004 Standards resulting from the massive changes in EPA's compliance program as set forth in the Consent Decrees and the 2004 Standards, manufacturers will be forced to use substantially more EGR to comply with those standards than originally contemplated. Even with 500 ppm sulfur diesel fuel, the more EGR, the greater the likelihood of engine wear. With diesel fuel of higher sulfur content, those adverse effects would be dramatic.

Lower sulfur diesel fuel also is needed to address the increasing durability demands that are placed on diesel engines. The increased use of EGR, which has a potentially negative impact on durability, is occurring at the same time that customers are demanding greater durability from diesel engines. Exacerbating those durability challenges even more is the implementation of the new 435,000-mile useful life requirements that become effective with the implementation of the 2004 Standards. Taking all of these factors into consideration, there is an overwhelming need to assure that engines operated in Alaska and all areas are not subject to fuel sulfur levels in excess of the current nationwide 500 ppm cap during the 2002-2006 period.

One of the most serious operational consequences associated with the use of high sulfur diesel fuel in heavy-duty on-highway engines is the tendency for plugging of those engines using catalytic aftertreatment devices. This is particularly critical for light-duty applications, which generally operate at lighter loads and lower exhaust temperatures, and for heavy-duty applications that operate extensively at light loads and low speeds. Catalysts respond to high-sulfur fuel with sulfate formation, which increases particulates. Such increase in particulates not only increases emissions, but also plugs the catalyst, inhibiting, and sometimes prohibiting, engine operation. Such plugging is substantially aggravated when the vehicle is operated in extremely cold temperatures. The effect of such plugging can be catastrophic: the engine and vehicle simply will not run.

The performance and dependability of engines equipped with catalytic converters is of critical importance to owners and operators of those engines in all regions of the United States, including Alaska. Manufacturers are concerned that, if EPA extends the temporary exemption and continues to allow the distribution of high sulfur diesel fuel throughout the State, converter plugging could place owners and operators in physical jeopardy due to severe weather conditions in the event the vehicle stops operating in a remote area, stranding the operator. While to date manufacturers have been able to remove catalysts and still meet the emission standards, they will not have that same flexibility with engines designed to meet the 2004 Standards.

In order to avoid what are in all cases serious, and in some cases potentially catastrophic, emission and operational consequences, EPA must not extend Alaska's temporary exemption beyond July, 2002. (EMA)

34. **Comment:** If EPA arbitrarily extends the temporary exemption for Alaska to 2006, it must provide that manufacturers of heavy-duty on-highway engines will not be held liable for any emissions warranty and recall liability for any engine that has, at any time, been operated on fuels that have been exempted from the diesel fuel sulfur requirements. The level of protection provided under the current exemption falls far short of what is reasonable and necessary. Specifically:

Recall Liability. The Agency has taken the following position concerning recall liability:

If EPA determines that the use of exempted diesel fuel is the sole cause why a substantial number of the class or category of heavy-duty engines fails to meet the applicable emission standards, EPA would not seek a recall of the class or category of engines based on these data.
64 Fed. Reg. at 34131.

EPA's position raises serious concerns. Specifically, the Agency is permitted to determine, on a case-by-case basis, whether the use of high-sulfur diesel fuel has caused the engine's failure to comply with the federal emission requirements. Engine manufacturers would not have that burden or expense for any of their engines improperly operated on high sulfur diesel fuel in the other 49 States. The Agency, at a minimum, should take the position that use of high sulfur diesel fuel raises a rebuttable presumption that the fuel has caused the engine failure. And, EPA must have the burden of rebutting that presumption.

Any extension of the temporary exemption from the low sulfur diesel fuel requirements also must grant heavy-duty engine manufacturers an exemption from liability, including fines and recalls, for any engines affected by the fuel exemption (i.e., 1994 and later model year HDDEs used in Alaska). (EMA)

Manufacturers Emissions Warranty. To date, EPA has taken the position that an exemption from the general warranty provisions of Section 207 of the CAA is unnecessary to protect manufacturers from warranty claims based on the use of noncomplying diesel fuel. Instead, according to the Agency:

[W]here the use of noncomplying diesel fuel in fact has an adverse impact on the emissions durability of specific engine parts or systems, such as a catalyst, the manufacturer has a reasonable basis for denying warranty coverage on that part or other related parts.
64 Fed. Reg. at 34131.

The Agency's position on this matter is completely unacceptable. EPA falsely assumes that manufacturers can independently deny emissions warranty claims based on their customers' use of high sulfur diesel fuel. In contrast to a commercial warranty that involves an agreement between a manufacturer and its customers, the emissions warranty is a regulatory requirement. Under Section 207, only EPA has the authority to exclude claims based on the use of high sulfur diesel fuel. The Agency must exercise that authority here to protect manufacturers against a source of potential liability that they did not create in the first place.

Specifically, any extension for Alaska of the temporary exemption from the low sulfur diesel fuel requirements also must grant heavy-duty engine manufacturers an exemption from the requirement that they warrant to the ultimate purchaser that affected engines will conform to applicable emission regulations for their useful lives. Any lesser "remedy" simply is inadequate. (EMA)

35. **Comment:** EPA acknowledges throughout the NPRM that ultra low sulfur diesel fuel is essential to the operation of the advanced emission control technologies – e.g., NOx adsorbers, catalyzed PM traps - expected to be introduced to meet the proposed 2007 Standards. 65 Fed. Reg. at 35480. Those technologies can only be brought to market on light- and heavy-duty diesel applications if ultra low sulfur diesel fuel (i.e., 5 ppm) is available. Such fuel directly affects not only the efficiency with which emission control technologies reduce NOx and PM emissions from heavy-duty engines and vehicles, but also the reliability of the emission control technologies to continue to function as required under all operating conditions for the full useful life of the engine or vehicle. 65 Fed. Reg. at 35480.

Because of the nationwide environmental benefits that can be achieved with cleaner diesel engines and fuel, it is critically important that the proposed nationwide cap on on-highway diesel fuel sulfur content be implemented in Alaska. If it is not, under EPA's proposal, any 2007 or later model year on-highway diesel vehicles fueled in Alaska – whether for operation solely within the State's borders or to haul freight to and from Canada and/or the lower 48 States – will risk serious potential damage to the aftertreatment technologies and to the engines themselves. EPA should not allow such a result. (EMA)

36. **Comment:** EPA proposes to allow Alaska to develop, and submit to EPA for its approval, a transition plan for implementation of new diesel fuel sulfur requirements. The Agency cites several "unique" circumstances operating in the State as its basis for providing the opportunity for such flexibility. According to EPA, "[a]t a minimum, such a transition plan would need to: (1) Ensure an adequate supply (either through production or imports), (2) ensure sufficient retail availability of low sulfur fuel for new vehicles in Alaska, (3) address the growth of supply and availability over time as more new vehicles enter the fleet, (4) include measures to prevent misfueling, and (5) ensure enforceability." 65 Fed. Reg. at 35521.

    Provided that the transition plan truly meets the minimum requirements set forth above, it could be workable. Manufacturers, however, believe that we must have the opportunity to review any plan proposed by Alaska and be assured that it precludes the possibility of any misfueling. (EMA)

37. **Comment:** EPA should not provide any exemption from the ultra low sulfur diesel fuel that EMA recommends EPA adopt nationwide.

    The Territories must import all of the diesel fuel that they use. Ultra low sulfur fuel can be imported as easily as can 500 ppm sulfur diesel fuel. Moreover, the use of ultra low sulfur fuel will ensure the durability and emissions performance of engines used in the Territories. If ultra low sulfur fuel cannot be made reasonably available, EPA must put requirements in place to assure that sulfur in diesel fuel is capped at 500 ppm.

    EPA should be aware, however, that engine manufacturers are concerned that product availability in the Territories is likely to become very limited. As time goes by, manufacturers will phase-out older on-highway engines which can tolerate higher levels of fuel sulfur and will only be producing engines which require ultra low sulfur fuel. In order to assure product availability for the Territories, EPA should allow the local sale of non-certified engines.

    Finally, with regard to the proposed permanent exemption from the fuel dyeing requirement, EMA has recommended above that nonroad diesel fuel sulfur levels be substantially reduced as soon as possible. To the extent EPA adopts that approach, the proposed exemption should not be problematic. However, if EPA does not require nonroad fuels to be at sufficiently low sulfur levels, then EPA should not exempt such fuel from the dye requirements. (EMA)

38. **Comment:** Currently, the U.S., Canada, and Mexico are free to establish their own engine emission standards and fuel requirements. Engine manufacturers will make every effort to ensure that regulators and industry in both Canada and Mexico understand the critical linkage between engine emission standards and fuel standards.

As Canada and Mexico continue to harmonize their engine emission standards with those of the U.S., EMA will stress the need for fuel standards to be harmonized as well.

EPA must recognize that there is a large volume of heavy-duty truck traffic across the borders between the U.S. and Mexico and the U.S. and Canada. For U.S. fleets traveling outside the U.S., the lack of harmonized, ultra low sulfur fuel will cause severe operational problems and damage to emission control systems from operation with high-sulfur fuels in Canada and Mexico. Canadian and Mexican fleets operating locally in the U.S. also will contribute high emissions in border counties. Moreover, a lack of harmonized emission standards may create strong incentives for fleets that travel substantially within the U.S. to locate outside U.S. borders or to purchase less expensive high-sulfur fuel outside the U.S. EPA must take all steps to ensure that that does not happen.

EMA urges EPA to actively seek harmonized fuel and emission standards in Canada and Mexico. If fuel standards are not harmonized, EPA must revisit the implementation dates for the 2007 Rule. (EMA)

39. **Comment:** EPA has failed to grasp the issues associated with the possibility that Canada and/or Mexico do not adopt the same fuel specifications and emission standards at the same time as the United States. Engines designed to be run on ultra low sulfur fuel will be poisoned by high sulfur fuel. Given the expense of engines compliant with these proposed standards, U.S. fleets will be at a significant competitive disadvantage versus their Canadian and Mexican competitors. In addition, multinational fleets will be motivated due to cost consideration to purchase and register these new vehicles in Canada. That this issue is not addressed in the Agency's proposal is another glaring omission. EPA needs to assess the impact of Canada and Mexico not adopting the same fuel specifications and engine emission standards as are finalized in the United States. (Cummins)

40. **Comment:** Proposed Section 86.007-11(g) requires that HDDEs and HDDVs for sale in Guam, American Samoa, or the Commonwealth of the Northern Mariana Islands shall be subject to the same emissions standards and requirements as apply to 2006 model year, and shall bear a permanent affixed label, with special languages prescribed in the regulations. EMA does not support those requirements. Instead, EPA should require compliance with the same emission standards and low-sulfur fuel requirements in the territories as are proposed for the fifty states. (EMA)

Agency Response to Comments 30-40: The comments are directed to the U.S. EPA regarding their policy on fuel sulfur requirements outside of California and are, thus, outside the scope of, and irrelevant, to this rulemaking. However, the ARB agrees that any early introduction of low sulfur diesel fuel would benefit all diesel engine users. California, in particular, would benefit from a nationwide policy for early introduction of low sulfur diesel fuel due to the large number of registered HDDVs and the large amount of HDDV interstate travel to and from California. However, as addressed in the U.S. EPA's Final Rule and previous rulemaking for pre-2007 model year, technological feasibility of pre-2007 emission standards is not dependent on the introduction of lower sulfur diesel fuel. Further, previous feasibility studies and testing have shown that exhaust catalysts are not necessary in order to comply with pre-2007 emission standards.

The ARB also agrees that due to the range of travel of a typical HDDV, a harmonized fuel standard will help prevent operational problems. However, the ARB has no jurisdiction over Mexican and Canadian fuel requirements.

Our regulations prohibit the sale, offer for sale, or supply of non-complying vehicular fuel but there is no prohibition against the use of such non-complying fuel. If the ARB found non-complying diesel in a vehicle's fuel tank, and determined that it was put into the vehicle in Canada or Mexico, there would be no violation. Further, the ARB does not have any jurisdiction over foreign refiners and bulk terminals. However, if an importer brought non-complying fuel into California and sold it, or supplied it here, the ARB could take action throughout the distribution chain, up to the importer. As long as operators are well informed of fuel requirements for the aftertreatment systems, trips and fueling can be planned such that damage to the aftertreatment systems can be avoided. Therefore, no further changes to the regulatory text are necessary.

5. Other Fuel Related Issues.

41. **Comment:** As EPA noted, many distribution concerns can be alleviated by proper attention to processes, practices and procedures. Refiners will have to identify vulnerable areas for potential fuel contamination including piping blinds, leaking valves, incomplete storage tank drainage and other similar problems. Work will be required to design refinery processes to lessen such problems, but the problems are not insurmountable. Likewise, fuel distributors and shippers will have to identify processes and practices that increase the potential for contamination. They likely will need to drain dry and flush storage tanks, backfill storage tank delivery lines, install tank mixers, heart-cut incoming ultra low sulfur fuels and incorporate other good fuel distribution handling practices. (EMA)

Agency Response: The comment is directed to the U.S. EPA regarding the processes, practices, and procedures of refineries. Thus, it is outside the scope of, and irrelevant to this rulemaking. However, the ARB agrees with the commenter that distribution concerns can be addressed with proper attention to processes, practices, and procedures. As discussed in the U.S. EPA's RIA and Response to Comments, the U.S. EPA determined that only minor modifications to the current fuel distribution system are necessary to handle low sulfur diesel fuel. Also see Agency Response to comment #23.

42. **Comment:** De-sulfurization of diesel fuel can be expected to result in changes to other fuel characteristics and properties. These changes have the potential for both positive and negative impacts on fuel quality. (EMA)

43. **Comment:** The processes that remove the sulfur in diesel fuel will result in small but significant quality improvements in other fuel properties, specifically, increased cetane number and index, reduce aromatics and polyaromatics, and a lower gravity fuel. Such improvements are well documented in the EMA MathPro study which shows a cetane level two numbers higher, aromatics level four percent lower, and API fuel gravity 1-1/2 numbers lighter than current on-highway diesel fuel. EMA urges EPA to maintain those average improvements by reflecting them in both the certification fuel and in-use fuel specifications proposed in 86.113-07 and 86.1313-07.

Until the quality of the average fuel in the marketplace can be determined, EPA should establish the following fuel specifications: certification and verification test fuel should have a cetane number and index at 42-52 and minimum aromatic content of 23%; commercial fuel should have a cetane number and index at 42 and a maximum aromatic content of 31%; both testing and commercial fuels should have API gravity range at 33.5-38.5. Those numbers reflect the average change in fuel properties resulting from de-sulfurization of diesel fuel as outlined in the MathPro study. (*See* MathPro Study, Exhibit 7.) Attachment B shows revisions to EPA's fuel tables found in proposed sections 86.1313-07 and 86.113-07 incorporating EMA's recommendations.

Although EMA is not urging EPA to do so in this rulemaking, ultimately, EPA should adopt the diesel fuel specifications of the World Wide Fuel Charter, including a minimum cetane number of 55 and a maximum polyaromatics content of 2%.(EMA)

44. **Comment:** While most of the fuel property changes resulting from de-sulfurization have a positive impact on fuel quality, there is the potential for negative effects on fuel lubricity and elastomer compatibility. Such problems occurred in Sweden and California with the introduction of very low sulfur fuels in those markets. In both cases, however, there were rather extreme reductions of fuel aromatic levels to 10% or less. It is suspected that difficulties with those new fuels were largely a result of the severe aromatic reductions, not necessarily the removal of sulfur from the fuel. EMA also has published its own guideline for superior quality diesel fuel, which includes recommended parameters for lubricity and elastomer compatibility. (See "EMA Consensus Position: Joint EMA/TMC Pump Grade Specification for Premium Diesel Fuel," FQP1-B, Attachment C.)

    For example, lubricity concerns can be mitigated by additization or by blending with higher lubricity components. Two methods (High Frequency Reciprocating Rig, ASTM D6079 ("HFRR") and Scuffing Load Ball-on-Cylinder Lubricating Evaluator, ASMT D6078 ("SLBOCLE")) are commonly used to measure lubricity; however, both methods have been criticized for poor repeatability and their differing response to additives. ASTM is presently developing an additional method (the Ball-on-Three-Discs (BOTD)), as well as modifications to the existing methods in an effort to incorporate a lubricity specification in D-975. EMA has urged ASTM to adopt such a requirement, but continues to be discouraged by the slow rate of progress. Until newer methods prove superior, EMA recommends that fuel lubricity meet 3100 g minimum on the SLBOCLE method or, in the alternative, 450 um maximum on the HFRR method at 60° F.

    EPA should assure that the effects of fuel sulfur reductions on fuel lubricity and elastomer compatibility are properly accounted for. (EMA)

45. **Comment:** EPA has requested comment on "specifying minimum fuel lubricity, and suggestions for the appropriate lubricity standard and test method." (FR 35487)

    Fuel injection equipment, including pumps and injectors, rely on fuel to lubricate close tolerance sliding contact regimes. The performance demands on these systems have been, and will continue to be, greatly magnified as manufacturers continue to increase injection pressures to meet stringent emission and performance requirements.

    Production of deeply desulfurized diesel fuel will require severe hydrotreatment of the distillate pool. In addition to removing the sulfur compounds, this process is known to

remove di-aromatic compounds that have been shown to impart lubricity. Therefore, it is anticipated that fuel produced to a 15-ppm S specification (or lower) will increase the likelihood of lubricity related concerns. The fuel changes necessitated by environmental concerns must not come at the expense of the overall quality of diesel fuel.

Lubricity concerns are easily mitigated through additization or by blending with higher lubricity components. Presently, debate rests in selecting proper methodology to characterize and define lubricity. Two methods (HFRR and SLBOCLE) are commonly used to measure lubricity; however, they are criticized for poor repeatability and their differing response to additives. ASTM is presently developing an additional method (the Ball on Three Discs - BOTD) as well as modifications to the existing methods in an effort to propose a specification in D-975. Cummins has been close to these efforts, but we continue to be discouraged by the rate of progress. Complicating these efforts is the attitude of some fuel suppliers that have publicly stated that lubricity concerns should be addressed by improved engine designs and not through fuel changes.

Diesel lubricity is a critical issue for engine manufacturers and fuel system suppliers and the potential exposure with ultra low sulfur fuels is serious. The European Union has already specified a lubricity requirement in EN-590 utilizing the HFRR (460 µm wear scar max). The cost of additization is minimal (0.2 ¢/gal) and with proper focus the improvements to current methods for evaluating lubricity could be completed. Cummins would support an Agency enforced lubricity requirement. Until newer methods prove superior, the industry standard HFRR and SLBOCLE should be specified. Consistent with our fuel requirements, the applicable limits should be 3100 g (minimum) for SLBOCLE and 450 µm (maximum) for HFRR.

Reducing the sulfur content of diesel fuel is of the utmost importance in reducing emissions from diesel engines beyond current levels and protecting emission control systems. As described above, the process of reducing the sulfur has the unintended consequence of reducing fuel lubricity. Steps must be taken to maintain a minimum lubricity level. The Agency needs to review the issue of fuel lubricity, specify lubricity measurement methods and set reasonable limits. (Cummins)

> **Agency Response to Comments 42-45:** The comments are directed to the U.S. EPA regarding fuel specific properties and, thus, are outside the scope of, and irrelevant to, this proposal. However, the ARB recognizes that sulfur content in the diesel fuel is currently determined to be the only property that affects aftertreatment control systems. The U.S. EPA has recognized that the desulfurization process may result in reduced lubricity. However, due to the lead time available, the U.S. EPA expects refiners to improve this process or add lubricity additive. Costs for this additive have already been included in U.S. EPA fuel cost calculations. Initial studies by the U.S. EPA on cetane improvements have shown only slight improvements in emissions. Further, a study by the U.S. EPA using EGR has only shown a slight increase in NOx emissions due to increased cetane.[25] The U.S. EPA has added that lubricity will be satisfied in the marketplace depending on economics determined by industry and market conditions. The U.S. EPA is continuing studies on effects of fuel properties. At this time, to satisfy the requirements adopted in this rulemaking, only low sulfur

[25] "Gaseous Emissions From A Caterpillar 3176 (with EGR) Using A Matrix of Diesel Fuels (Phase 2)," September 1999, report from Southwest Research Institute under EPA Contract Number 68-C-98-169.

diesel fuel is necessary. No other fuel properties have been determined by the U.S. EPA to affect compliance with the adopted requirements. Further, the ARB is not aware of any other properties that would affect the performance of the aftertreatment systems. ARB specific regulations for future on-road diesel fuel requirements is included in separate rulemaking. Federal adoption of the low sulfur diesel fuel requirements will ensure that low sulfur diesel fuel is available for on-road vehicles, regardless of California action. Therefore, no further changes to the regulatory text are necessary.

46. **Comment:** EPA has asked for comment on exemptions from the requirements for small refiners. EMA believes that it is not in the best interest of a cleaner environment to offer small refiners a blanket exemption from low sulfur requirements. Special provisions, such as delayed fuel sulfur requirements, would have an impact on the performance and durability of emissions control systems. Significant problems with multiple fuel streams also have been outlined above. Because fuel standards are linked to the achievability of engine emission standards, any special provisions for small refiners would limit the ability of diesel engines to achieve their useful life and/or comply with in-use emissions. Any special provision for small refiners must specifically address both the engine useful life and in-use emissions testing provisions.

No small refiner should be allowed to produce a diesel fuel with a sulfur content greater than the maximum allowable cap after 2006. Small refineries tend to have very limited and somewhat well-defined markets. Their fuel is used in a concentrated area and usually not diluted with other refineries' products. Fuel with a 500 ppm sulfur level would have a devastating effect on the aftertreatment systems and operation of engines and vehicles designed to operate on ultra low sulfur fuel as discussed above.

Even small refineries have low-cost options available for reducing sulfur. Those include using the new de-sulfurization catalyst, incremental purchases of hydrogen, elevation of hydrogen partial pressures to the unit's design maximum, and increased residence time. Such approaches could, in many cases, bring a small refiner's product very close to – if not lower than – the proposed standards without jeopardizing the end-users' product and without requiring more costly two- or second- stage processes for de-sulfurization. Those options, combined with low cost government loans, could be a workable solution for small refiners while still helping to ensure the uniform availability of the appropriate fuel for HDDEs and HDDVs. Additionally, EMA urges EPA to investigate the possibility of low-cost loans or other means to minimize the financial burden on small refiners. (EMA)

Agency Response: The comment is directed to the U.S. EPA on their policy regarding small refiner exemptions and, thus, is outside the scope of, and irrelevant to, this rulemaking. While the U.S. EPA is not required to provide small refiners with any special treatment to comply with the federal requirements, they are required to examine options to reduce the economic impact for these small businesses. The U.S. EPA has responded by stating that small refiners do not have the resources necessary to perform the required equipment changes for diesel fuel, in addition to upcoming changes necessary for gasoline fuel requirement. Thus, small refiners are allowed additional time to comply with the reduced diesel fuel sulfur requirements. Further, small refiners are given additional compliance options that will aid those refiners, while not creating any

competitive disadvantages. No other exemptions are granted for these small refiners.

47. **Comment:** EPA has proposed certain requirements with respect to motor oil blended with diesel fuel at any point downstream of the refinery. (Proposed Sections 80.441(a) and 80.448.) The proposed regulatory language is unclear and should be revised.

Proposed Section 80.441(a) appears to mandate that any motor oil blended into diesel fuel with the intent to burn the mixture in an on-highway HDDE be compliant with the requirements of 80.446 (15 ppm sulfur cap, and a minimum cetane index of 40 or a maximum aromatic content cap of 35 volume percent). Such a requirement would be the equivalent of an outright ban on such blending as motor oils cannot meet those specifications and still perform their primary function.

If there is a 15 ppm sulfur cap placed on motor oils intended to be blended with diesel fuel, the clause in proposed Section 80.448 that reads "that is explicitly based on the addition of motor oil having the greatest sulfur content of any motor oil that is commercially available" is not required and simply does not make sense. Further, if proposed Section 80.448 is intended to impose specifications on motor oils that may be blended with diesel fuel, not all motor oils may comply. Producers of motor oil may elect to bring only a portion of motor oils they sell into compliance. Engine manufacturers should not have to certify using a fuel-lube oil blend with lube oils not formulated to be blended.

Even if proposed Section 80.448 does not impose specifications on motor oils, the clause is still inappropriate. First, it will be impractical, if not impossible, to determine which commercially available motor oil has the greatest sulfur content. Second, manufacturers should be allowed to specify which oils can be used in their engines and be able to certify using those specified oils.

EMA recommends that the clause in proposed 80.448(a) which reads "that is explicitly based on the addition of motor oil having the greatest sulfur content of any motor oil that is commercially available" be deleted and replaced with "that is explicitly based on the addition of a motor oil representative of those specified for use in that family of engines as indicated in the manufacturers Operation and Maintenance manual." (EMA)

48. **Comment:** At present, fully formulated HDDE oils contain between 0.3% and 0.8% sulfur (3000-8000 ppm). Assuming typical levels of oil consumption, and considering that at present much of this oil consumption exits the breather, the contribution of sulfur from engine oil is modest in comparison to a 350 ppm sulfur fuel. However, with ultra low sulfur fuel, the lube oil sulfur contribution becomes more significant.

Sulfur in engine oil is derived from both the base oil and additive package. The primary anti-wear component and source of sulfur used in HD engine oils is zinc-dialkyl-dithiophosphate ("ZDDP"). Other sulfur containing additives include sulfonate and phenate detergents. Sulfur free base oils are available in abundance and non-sulfur containing detergents are available; however, sulfur free alternatives to ZDDP have not been identified.

The demands on lubricant formulations for 2007 engines seem to be at odds. Work to date on EGR engine oils has demonstrated a need for higher total base number ("TBN")

(higher ash) content to combat the effects of corrosive wear. This would likely be contrary to the appetite of a catalyst equipped engine which may likely require minimized additive levels to prevent catalyst plugging and minimize the emissions impact (i.e., PM control).

Cummins has taken a lead role in a research endeavor to investigate the impact of lubricating oils on the performance and durability of diesel emission control systems. This work is in collaboration with other engine manufacturers, the Department of Energy, emission control system suppliers, and the petroleum industry. The research will examine the impact of lube derived sulfur and other potential catalyst 'poisons' (phosphorous, ash, etc). The desired outcome of the program is to highlight the need for and accelerate the development of novel additive technologies to meet the apparently conflicting demands of future engines - should the need exist. We encourage the Agency to stay abreast and to participate in DOE's Advanced Petroleum Based Fuels - Diesel Emission Control program and other research in this area.

Lubricant formulation requires delicate balance of components to serve the multiple, and often conflicting, demands of routine engine operation. As a result, we find it difficult at this point to recommend that specific constraints be placed on lubricating oils that could ultimately compromise its performance. Instead, we will continue to cooperate with the petroleum and additive industries to jointly define and develop future specifications.

As described above, lube oil that gets past the valve guides and piston rings contributes to the sulfur and ash loading on the aftertreatment devices. It is essential that low sulfur/low ash lube oil formulation be developed. EPA recognized these issues but hasn't taken any action in this proposal. EPA needs to assess whether the requisite changes to lube oil to reduce the sulfur and ash content will occur voluntarily. Unless EPA can demonstrate that voluntary changes will occur, the Agency must set specifications. Otherwise, EPA has placed all of the risk on the one party – engine manufacturer – that has no control over these conditions. (Cummins)

> **Agency Response to Comments 47-48:** The comment is directed to the U.S. EPA regarding motor oil specifications, and is thus outside the scope of this rulemaking. Because the U.S. EPA did not finalize the requirements that were commented on, in their 2007 Final Rule, and because the ARB has adopted identical requirements to the U.S. EPA's 2007 Final Rule, these comments are not relevant to this rulemaking. Therefore, no further changes to the regulatory text are necessary.

49. **Comment:** EPA should provide incentives to oil refiners for the introduction before January 1, 2006 of ultra low sulfur diesel fuel. Such fuel could be used in centrally-fueled fleets employing sulfur-sensitive emission control systems and would provide emission benefits for any vehicle operated on it. The early introduction of ultra low sulfur diesel fuel also is necessary if engine manufacturers are to have any possibility of generating credits under the averaging, banking and trading program as proposed by EPA.

Such incentives could take the form of refinery emission credits, federal or state tax incentives, or other similar, innovative programs. EPA should include such programs in the final rule and should commit to working with states to incentivize the early introduction of ultra low sulfur fuel on a local level. (EMA)

Agency Response: The comment is directed to the U.S. EPA regarding incentives to oil refiners, and is, thus, outside the scope of, and irrelevant to, this rulemaking. However, similar to the U.S. EPA response, the ARB has no authority to provide tax incentives for the early introduction of low sulfur diesel fuel. In addition, the U.S. EPA did adopt a credit generation program for limited early introduction of low sulfur diesel fuel. ARB specific regulations for future on-road diesel fuel requirements, which will likely adopt this same credit mechanism, are included in a separate, future, rulemaking. However, federal adoption of the low sulfur diesel fuel requirements will ensure that low sulfur diesel fuel is available for on-road vehicles, regardless of California action. Therefore, no further changes to the regulatory text are necessary.

50. **Comment:** The establishment of a 15 ppm cap on on-highway diesel fuel sulfur levels is one of the most critical components of the EPA program. Yet, in that significant aspect, the ARB proposal fails to conform to the EPA final rule. As EMA has emphasized previously, and no one has challenged, ultra low sulfur diesel fuel is essential to enable the use of the aftertreatment technologies necessary to comply with the extremely stringent NOx and PM standards established for 2007. Without such fuel, the standards simply are not feasible. EMA's extensive comments to EPA on fuel sulfur issues are found at pp. 8-31 of its August 14, 2000 Statement. (EMA)

51. **Comment:** As with Mail-Out 01-08, the Staff has provided little discussion and analysis of the need for ultra-low sulfur fuel to meet the proposed standards, nor has it included any requirements for such fuel. Throughout the rulemaking documents, Staff has noted that another completely separate rulemaking is slated to occur in 2002 on the issue of fuel. Separating the fuel component from the standards component fails to underscore the importance of the fuel as a prerequisite to meeting the standards and the systems approach to further reductions from heavy-duty on-highway engines recognized by EPA. Indeed, ARB should act with great speed to adopt ultra-low sulfur diesel fuel requirements to be effective in conjunction with, and prior to, the 2007 standards. At a minimum, ARB should formally recognize in this rulemaking that the engine emission standards proposed are contingent on the availability of ultra-low sulfur diesel fuel. (EMA)

52. **Comment:** One significant area in which the two programs are not currently harmonized is with respect to fuels. While the staff report indicates that new diesel fuel sulfur standards are scheduled for adoption next year, we urge the board to formally recognize that the feasibility of the engine emission standards proposed today are contingent on the adoption of the 15 ppm (parts per million), sulfur diesel fuel standard. It is not possible to overstate the importance of a 15 ppm cap on diesel fuel sulfur levels. Without ultra-low sulfur fuel, the standards simply are not feasible. We urge the board to take all steps necessary to assure that the appropriate fuel is available before 2007 and to recognize that without the fuel the standards are not feasible. (EMA)

53. **Comment:** The Staff has indicated that, in any event, EPA's requirement for a 15 ppm cap on diesel fuel sulfur levels nationwide will act as a "backstop" to assure the in-use availability of fuels for the advanced aftertreatment systems that will be used. (ISOR, pp. 4, 34.) Nevertheless, it is important that engine manufacturers have certainty now with respect to the fuels likely to be available in use in California. And, as noted above,

the adoption of new fuel requirements in combination with new standards will emphasize the absolute interconnectedness of fuel with the feasibility of the standards. (EMA)

Agency Response to Comments 50-53: The ARB recognizes that low sulfur diesel fuel is essential to enable the use of current aftertreatment technologies in 2007. When the U.S. EPA adopted their Final Rule, they included requirements for low sulfur diesel fuel. Although California is authorized to propose and adopt separate low sulfur diesel fuel standards, California has not yet done so for the 2007 model year HDDEs. However, federal adoption of the low sulfur diesel fuel requirements will ensure that low sulfur diesel fuel is available, regardless of California action. Further, the ARB's adopted requirements include emission testing and service accumulation diesel fuel requirements using low sulfur diesel fuel. Finally, the ARB has responded in kind to the extensive comments mentioned, e.g. at responses 3 and 6, among others. Therefore, no further changes to the regulatory text are necessary.

54. **Comment:** Unlike the board's historic low emission vehicle clean fuels program that you adopted initially in 1990 for the light-duty portion of the fleet, the action of course today does not include low sulfur diesel fuel specifications that are in fact needed to ensure the long-term compliance with these standards. Of course, the retail availability of low sulfur diesel fuel is essential to protect the hardware investments which engine operators are going to incur as they purchase new engines. And as you, I'm sure, know, in September of last year the South Coast District board did adopt, as Mr. Kenny mentioned, these fuel standards for the South Coast air basin, the low sulfur diesel fuel. Those take effect, as you may know, initially as early as January 2005 and no later than July 1st, 2006. And, of course, no similar statewide standards are in place, so we would like to suggest that to help address that issue we just simply recommended that you consider adopting diesel fuel specifications, low sulfur diesel specification as soon as possible. (SCAQMD)

Agency Response: The ARB agrees with the commenter that fuel sulfur levels have a direct impact ensuring long term compliance. While the ARB adopted emission testing and service accumulation diesel fuel requirements, in-use diesel fuel sulfur requirements have not been adopted yet. California is authorized to propose and adopt separate low sulfur diesel fuel standards. However, federal adoption of the low sulfur diesel fuel requirements will ensure that low sulfur diesel fuel is available, regardless of California action. To date, no changes to the federally adopted diesel fuel sulfur limits are being proposed. Therefore, no further changes to the regulatory text are necessary.

55. **Comment:** EPA's certification fuel proposal appropriately allows engine manufacturers the option to select a fuel for certification with a sulfur level representative of average diesel fuel available nationwide. EPA should assure that the same fuel used for certification of an engine family is available and used for in-use confirmatory testing of the engine family.

Manufacturers do not control the fuel used for in-use confirmatory testing. Because they do not control the fuel, manufacturers should not be held liable for potential exceedances of the standards in-use based on improper or off-specification fuel. EPA should adopt a 5 ppm diesel fuel sulfur cap standard. In that way, manufacturers could be reasonably assured that the proper fuel would be available for testing an engine family's performance in-use.

If EPA insists on finalizing a 15 ppm diesel fuel sulfur cap standard, at a minimum, EPA must allow in-use testing to be conducted using the average fuel available nationwide (which is estimated by EPA to be at a single-digit sulfur level), not on any fuel sulfur level up to the 15 ppm cap. Moreover, an average approach would give a true picture of the environmental impact of emissions because it would represent nationwide emissions based on the fuel on which engines are operated in-use. (EMA)

Agency Response: The comment is directed to the U.S. EPA regarding their policy on the utilization of test fuel specifications and is, thus, outside the scope of, and irrelevant to, this rulemaking. However, in this rulemaking, the ARB adopted requirements for certification test fuel that are identical to those adopted by the U.S. EPA. Test fuel may be in the range of 7 to 15 ppm sulfur content. As suggested, test fuel may alternatively be representative of the predominant in-use fuel. Therefore, no further changes to the regulatory text are necessary.

B. Emission Standards

1. Heavy-Duty Diesel Engine and Vehicle Standards

56. **Comment:** EPA's Proposed 2007 Standards mark the first time that heavy-duty engine manufacturers have been faced with such a substantial increase in the stringency of the standards. EPA has proposed 90% reductions for both NOx and PM emissions from 2004 levels. This proposal would combine the largest step reductions ever mandated for either NOx or PM emissions into a combined NOx and PM regulation with a single implementation date and complex new test requirements. (EMA)

Agency Response: The comment is directed to the U.S. EPA regarding the substantial increase in stringency of the federally adopted standards and is, thus, outside the scope of, and irrelevant to, this rulemaking. California's adoption of the more stringent standards will only harmonize the already adopted federal requirements with California requirements.

As stated in the ISOR, HDDEs are a substantial source of NOx and PM emissions. For many years, diesel vehicles have operated with very limited emission control systems. Both of the emission byproducts of diesel engines mentioned above has been found to be harmful to human health. Additionally, without further emission reductions from these vehicles, California will not attain state or federal air quality standards. Further, as demonstrated in the ISOR, the technology expected to be used to comply with the adopted requirements have been found to be feasible and cost effective. Therefore, although manufacturers are forced to make substantial reduction in emissions, these reductions are both necessary and feasible.

57. **Comment:** The Proposed 2007 Standards represent an unprecedented step increase in the stringency of the standards for heavy-duty engines. Yet, despite the fact that the new standards would constitute the largest ever step reduction for both NOx and PM emissions, as well as the largest ever simultaneous reduction of NOx and PM emissions, EPA has failed to propose any changes in testing measurement procedures to accommodate this historic change. (EMA)

58. **Comment:** Cummins believes EPA must adopt alternative measurement techniques to achieve a measurement capability that will enable and make feasible lower emissions standards. (Cummins)

59. **Comment:** As EMA has commented to EPA on many previous occasions, technologically feasible standards cannot be properly developed until after the test procedures are in place to measure compliance with those standards. EPA has reversed the proper rulemaking process. Appropriate test procedures must always come first. Once accurate and reliable procedures have been developed, technologically feasible emission standards may be determined. In fact, until the measurement procedures are adequately addressed, EPA cannot finalize the proposed 2007 Rule. (EMA)

60. **Comment:** Substantial reductions in emission standards cannot be set without a review of the capability of the test methods to allow for fair commercial development and effective enforcement. The standards proposed in the 2007 NPRM are an order of magnitude lower than current standards, but there is not commensurate modification of the test methods (as found in 40 CFR 86 Subpart N) or discussion about their capability to measure at these low levels. Without substantial improvement in test methods, the feasibility of the standard may be limited as much or more by the capabilities of the test methods that by engine and aftertreatment technology. (Cummins)

61. **Comment:** While EPA has proposed 90% reductions in the NOx and PM standards from 2004 levels, the Agency has not proposed changes to the methods used to measure these pollutants. The current methods are inadequate to measure PM and NOx at the extremely low levels proposed. The measurement variability using EPA-specified measurement methods is greater than the difference we will need to discern as we attempt to develop engine and aftertreatment systems to meet low NOx and PM. Further, EPA has reversed the order of proper rulemaking process. The defining of appropriate measurement methods needs to come before the setting of standards. Indeed, how else is it possible to assess technological feasibility? This is one of the most glaring omissions in EPA's proposal. The Agency certainly has put the cart before the horse. The Agency must develop new measurement procedures that provide variability less than a fixed percentage of the standards before proposing those standards. (Cummins)

62. **Comment:** The measurement challenges for HC and NMHC include:

    - wider dynamic range of the continuous HC analyzer (lower average concentrations with potentially similar maximum concentrations when aftertreatment devices are inactive)
    - HC hang up being more significant
    - NMHC for natural gas (NG) has much higher precision error than HC because it is the difference of two large numbers (Total HC from FID minus methane from GC)
    - Aftertreatment of NG is not known and very large reductions in NMHC is not expected

    Test method changes that should be considered include: variable flow CVS tunnels to reduce the range of measured concentrations, mixing chambers in the sample line to

attenuate HC spikes to allow low HC ranges, dual continuous analyzers with different ranges, use of initial HC readings for background correction, and for NG determine NMHC from bag sample GC analysis only. EPA should also consider other techniques for measuring NMHC on NG in real time, such as a methane scrubber followed by a FID or an FTIR or other optical analyzer capable of measuring a significant fraction of the NMHC species in NG exhaust. (Cummins)

63. **Comment:** The current test method for NG NMHC will have to change or the standard left unchanged. (Cummins)

64. **Comment:** The measurement challenges for Formaldehyde at these levels include

- long lead time (weeks) for chemical analysis of sample cartridge
- high variability

Similar to NOx and PM, the feasibility of the proposed formaldehyde standard is limited by the measurement precision. (Cummins)

65. **Comment:** EPA should research real time methods for measuring formaldehyde if the standard is set so low that formaldehyde becomes a marginally compliant species. (Cummins)

66. **Comment:** The measurement issues existing on the FTP are only exacerbated by the proposed addition of the Supplemental Emission Requirements where EPA is proposing measurements over a cycle as short as 30 seconds while it has been demonstrated above that it is not yet feasible to obtain accurate measurements over the much longer FTP cycle. (Cummins)

67. **Comment:** EMA recommends that EPA immediately begin a large-scale cooperative effort between Agency and industry experts to reduce test variability and to develop substantial revisions to Subpart N of Title 86 governing certification and auditing test procedures. The goal of such a joint effort must be to reduce the two sigma variability to less than 10% of the standards. EPA must develop appropriate test procedures and correct the significant measurement variability problems now in order to provide manufacturers at least four-years' leadtime to develop, test and produce engines prior to the implementation of the proposed new standards. If that goal cannot be attained in sufficient time, the Proposed 2007 Standards must be adjusted upward to a level wherein testing variability is less than 10% of the standards. (EMA)

Agency Response to Comments 57-67: The commenter provided similar comments to the U.S. EPA during their rulemaking. In response to the comments, the U.S. EPA revised both NOx and PM emission measurement procedures and device specifications to reduce emission measurement variability. The ARB has adopted those same measurement procedures and measurement device specifications. Therefore, no further changes to the adopted requirements are necessary.

a. Technologically feasible demonstration.

68. **Comment:** EPA has proposed extremely stringent new standards for NOx and PM emissions. With prior standards, engine manufacturers have attained impressive

emission reductions primarily through changes in engine design and other in-cylinder modifications. The magnitude of the changes proposed by EPA in this rulemaking will require heavy-duty engine manufacturers – for the first time – to rely primarily on the use of aftertreatment technology to meet the proposed emission reduction goals for both NOx and PM.

EPA itself recognizes that its proposal is "based on the use of high-efficiency catalytic exhaust emission control devices…." (65 Fed. Reg. 35430.) And, as discussed above and in EMA's oral statement, the future of clean, low-emitting trucks and buses rests on a three-legged stool of engine, exhaust aftertreatment, and ultra low sulfur fuel. Without all three legs in place, the stool certainly will fall. With all three legs in place, engine manufacturers will be able to come closer to the emission reduction goals, but reaching the proposed standards with advanced aftertreatment technology and the 15 ppm sulfur diesel fuel EPA has proposed will be extremely difficult and is by no means a certainty.[26]

Moreover, contrary to the mandates of the CAA, EPA has failed to provide any analysis of the technological feasibility of the proposed standards. EPA presumably began its "analysis" by assuming a total amount of emission reductions that would be possible based on a vague assessment of available technology. Based on that assessment, EPA announced the emission levels that it wanted and then sought supporting data for those levels. For example, EPA appears to have selected the NOx and PM emission limits in the Proposed 2007 Rule by looking individually at the FTP reductions obtained through the limited application of one type of advanced aftertreatment technology for each emission constituent (NOx adsorber and catalyzed particulate traps). EPA then apparently extrapolated those reductions to all potential heavy-duty engine applications. EPA's "analysis" did not consider the impacts of having to simultaneously control both NOx and PM emissions nor did it consider the feasibility of meeting the supplemental emission requirements over expanded ambient conditions. Similarly, EPA has not addressed the feasibility of meeting these requirements over the full 435,000-mile useful life period. That approach surely cannot purport to take the place of reasoned and sound analysis of technological feasibility.

More specifically, with respect to NOx reductions, EPA's technology "analysis" shows that of the four potential aftertreatment devices – lean NOx catalyst, NOx adsorber, selective catalytic reduction, and non-thermal plasma – only one, NOx adsorbers, even has the potential to attain levels near the proposed NOx levels over the FTP. And, even with respect to NOx adsorbers, which – EPA believes – show the most promise, EPA has said in its Draft RIA that "we *expect* there will be *great progress* in optimizing the adsorber chemistry *to the specific needs* of the diesel engine." (Draft RIA, May 2000 ("Draft RIA"), p III-16; emphasis added.) Further, EPA is "*optimistic* that these devices can provide the performance necessary" to meet the proposed NOx standard. *Id.* Those statements merely encapsulate the sense of the Draft RIA with respect to aftertreatment technology for meeting the NOx standards: that the technology is not yet known or fully developed, and a manufacturer's ability to meet the standards depends on many uncertain variables. The proposed NOx standard is as much a product of wishful thinking as it is of sound technical feasibility analysis.

[26] EMA's feasibility concerns apply not only to diesel-fueled diesel engines, but also to diesel-cycle engines fueled with compressed natural gas (CNG) and other alternative fuels. In addition to the same measurement variability problems outlined above, substantial development of NOx aftertreatment would be needed to allow natural gas engines to comply with the proposed NOx standard. EPA has failed to analyze or demonstrate the technological feasibility of the proposed standards for CNG and other alternative fueled engines.

EPA has failed to carry out its Congressional mandate to propose standards that achieve the greatest degree of emission reduction achievable through the Application of technology that the Agency "determines will be available for the model year to which such standards apply." CAA Section 202(a)(3)(A). As discussed more fully below, EPA's failures extend not only to the numerical emission limits proposed on the FTP, but also to the numerous and overlapping supplemental test procedures and emission limits and the extreme ambient conditions under which engines would have to be compliant. (EMA)

Agency Response: The commenter contends that the adopted requirements are not technologically feasible. As discussed by the U.S. EPA, and as held by several District of Columbia Circuit Court opinions (see e.g. Husqvarna AB v. EPA, 254 F.3d 195 (D.C. Circuit Court 2001) and National Petrochemical and Refiners Association v. EPA 287 F.3d 1130 at 1136 (D.C. Circuit Court 2002)), CAA requirements do not require the adoption of standards that require technologies that have already matured, or are already in-use. Further, the D.C. Circuit, which California looks to for guidance on technological feasibility requirements, found that the U.S. EPA had not acted arbitrarily and capriciously in setting the technology requirements (e.g. NOx Adsorbers, NOx sensors, crankcase standard, and accuracy of measuring equipment). Current technology with some improvements may be required. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR[27], Section 6, and the U.S. EPA's RIA[28], Chapter 3. Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. In addition, the Board has long argued, and EPA Administrators have long agreed, that CAA Section 209(b) may require U.S. EPA approval of requirements for the California market that force technology faster than the federal government might require. See e.g. Decision Document supporting 58 Federal Register 4166 (January 13, 1993) (waiving federal preemption of California's low-emission vehicle standards for light-duty vehicles) at pp. 63-64. Therefore, no further changes to the adopted requirements are necessary.

69. **Comment:** Given the extraordinary technological reach of these standards, ARB should proceed only if it has made a convincing demonstration that the technology will be available in time. ARB has not made that demonstration; in fact, the only feasibility showing that the Board has made, which is wholly inadequate, is to rely on EPA's extrapolation of steady state performance of preliminary laboratory-only components to make assumptions about mature in-field FTP and SERT compliant full aftertreatment

[27] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[28] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

systems. This does not meet the standards called for in the California Health & Safety Code.

That ARB has a heavy burden in demonstrating feasibility of this Rule is intuitively obvious when one considers the proportional reduction goals that ARB is setting for the industry. Since the beginning of the federal Clean Air Act in 1970 diesels will have reduced emission levels of NOx by about 90% and PM by about 85%. In the 2007 Rule Mailout ARB has proposed additional 90% reductions for both of these exhaust constituents, the largest percentage reductions ever for either NOx or PM emissions, even without considering the need to comply with the additional stringency imposed by the SERTs. (Cummins)

70. **Comment:** The ARB 2007 rule as presented in the Mailout seriously lacks the foundation for technical feasibility. That alone should forestall ARB from proceeding with this rule at this time. Furthermore, Cummins supports harmonization of requirements for engines and fuels nationwide. Until the significant policy and technical issues with the EPA final 2007 rule are resolved, however, the ARB should delay the adoption of its own 2007 standards. Therefore, if ARB believes it should proceed to adopt 2007 standards now, then explicit and appropriate language should be included in the rule that commits ARB to harmonize its requirements with those finally approved and made effective federally. (EMA, Cummins)

Agency Response to Comments 69-70: The ARB does not know what the commenter means by the "heavy burden" they think ARB has to make and a "convincing demonstration" of the feasibility of the adopted standards. As stated in response to comment #68 and elsewhere, the ARB has in this rulemaking adopted cost-effective, technologically feasible standards, pursuant to its Health & Safety Code and California Administrative Procedures Act requirements. In doing so, the ARB looked to past rulemakings, past federal waiver decisions, and D.C. Circuit Court opinions (see e.g. Husqvarna AB v. EPA, 254 F.3d 195 (D.C. Circuit Court 2001) and National Petrochemical and Refiners Association v. EPA 287 F.3d 1130 at 1136 (D.C. Circuit Court 2002)) for guidance regarding the limits of forcing technology into the California market. None of those sources indicate the kinds of showings that the commenter suggests. Rather, the ARB generally forecasts potential technologies (while not precluding others), identifies major hurdles toward implementing those technologies, and identifies plausible steps that could be taken to overcome those hurdles. The ARB had done this here, just as it has for other engine types (e.g. light-duty vehicles, marine engines, and small off-road engines) that at some point required such high proportionate reductions that ARB projected the need for improved aftertreatment technologies and fuels -- in conjunction with engine improvements -- to reach the standards.

At this time, the adopted requirements harmonize federal and state requirements for HDDEs beginning in the 2007 model year. The adopted requirements are identical to those adopted by the U.S. EPA in January 2001. Should there be a change to the federal requirements, the ARB will consider each change with respect to the effects on the California environment and its residents. Also see Agency Response to comment #68 regarding technical feasibility and Agency Response to comments #3-#5 and #6-#8 regarding diesel fuel harmonization. Therefore, no further changes to the adopted requirements are necessary.

71. **Comment:** Cummins and some other opponents of the Proposal are asking EPA to "slow down" the rule-making process, i.e., that EPA should not rush to finalize these rules this year.[29] These opponents claim that the PM and NOx technology has not been demonstrated, so EPA shouldn't act.

Already, MECA has testified in support of the proposed PM and NOx standards and has stated that it believes that its members will able to meet the requirements of this proposal in a cost-effective manner.[30] Given that MECA members are quite likely to develop and commercialize the PM and NOx aftertreatment controls, MECA's position should be given great weight by EPA and this Subcommittee. Further, it is worth noting that the past three decades of environmental regulation are filled with examples of regulations that were opposed by regulated entities who said it couldn't be done, only to thereafter prove that it could be done—and usually at a lower cost than initially estimated.

Cummins' position is troubling for another reason. There is evidence in the rulemaking docket that suggests strongly that Cummins' presumptive emission targets are as low as EPA's proposed PM and NOx levels, and that it already believes that NOx adsorbers will work, that there are several approaches to sulfur management, and that a sulfur level of 50 ppm is deleterious to EGR systems.[31] (ALA)

72. **Comment:** Technologies that require low-sulfur diesel are being commercialized and used in Europe and elsewhere, and are providing the health benefits of reduced diesel emissions in those places. Americans deserve the health benefits of these technologies. Every year of delay on industry's part means more avoidable asthma emergencies and more avoidable cancers. (ALA)

Agency Response to Comments 71-72: As stated in Agency Response to comment #68 and elsewhere, the U.S. EPA mentions that CAA requirements do not require the adoption of standards that require technologies that have already matured, or are already in-use. Current technology with some improvements may be required, as long as supporting information for the future technologies is provided. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR[32], Section 6, and the U.S. EPA's RIA[33], Chapter 3. Both discussions specify NOx adsorbers as a promising NOx reduction technology, and PM traps as a promising PM reduction technology. Since there is no difference between the California and federal requirements that would warrant a different technological feasibility demonstration, technologies cited in the U.S. EPA's RIA can expected to be used to comply with the adopted California requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted

[29] Statement of Cummins Engine Company, June 19, 2000.
[30] See, e.g., Bertelson testimony, p. 48.
[31] Presentation of John Wall, Cummins Vice President, to EPA and the White House Office of Management and Budget, May 1, 2000. EPA Docket No. A-99-06, Document No. 2E-25, pp. 1, 2, 4, 8, 12.
[32] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[33] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

levels, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

73. **Comment:** EPA has considered only the results of separate tests on emission control technologies (NOx adsorbers, PM traps, combustion technology, etc.) used individually or independently of one another. To meet the proposed emission levels, engine manufacturers will need to combine several technologies into one emissions control system. The Advanced Petroleum-Based Fuel Program, which is just getting underway in 2000, is designed to address combinations of technologies at standard laboratory ambient conditions. EMA is not aware of any publicly available study that is underway which combines the technologies to reach the proposed 2007 emissions levels as well as expanded ambient conditions. Therefore, EPA has not given adequate consideration to the impact of combining those technologies into one emissions control system at FTP conditions, nor especially with the new SERTs at expanded ambient conditions. (EMA)

Agency Response: Technological feasibility for the supplemental test procedures is discussed in detail in the ARB's ISOR[34], Section 6, and the U.S. EPA's RIA[35], Chapter 3. Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. While those tests demonstrate reductions that satisfy the test requirements, further testing is expected to demonstrate an additional compliance buffer. As explained in the U.S. EPA's Response to Comments, testing on a CDPF/NOx Adsorber system was completed at the NVFEL. This system is comprised of both NOx and PM emission control. Testing of this system demonstrated sufficient reductions necessary to comply with the adopted requirements. Additionally, the Toyota Motor Corporation has expressed interest in marketing a similar system under the trade name of DNPR.[36] Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

74. **Comment:** Among the significant issues EMA continues to have with the final 2007 Rule are whether EPA has the underlying authority to adopt the NTE standards. The feasibility of the NTE requirements also is a significant issue. The NTE requirements were developed in the context of EPA's 2004 rule and, therefore, were based on exhaust gas recirculation technology. When applied in the context of the final EPA 2007 standards, however, where emission levels can be reached only with the use of advanced aftertreatment systems, the NTE requirements have not been shown to be feasible or cost-effective. (EMA)

Agency Response: The commenter contends that the adopted requirements are not technologically feasible or cost-effective. As discussed by the U.S. EPA,

[34] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[35] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.
[36] Revolutionary Diesel Aftertreatment System Simultaneously Reduces Diesel Particulate Matter and Nitrogen Oxides, Toyota Motor Corporation press release, July 25, 2000.

CAA requirements do not require the adoption of standards that require technologies that have already matured, or are already in-use. Current technology with some improvements may be required. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR[37], Section 6, and the U.S. EPA's RIA[38], Chapter 3. Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected.

Cost effectiveness for the proposed requirements is summarized in the ARB's ISOR[39], Section 9, and the U.S. EPA's RIA[40], Chapter 5. Cost effectiveness is based on costs from a study conducted by ICF Consulting in 1999, and the minimum reductions necessary to comply with the adopted requirements. The calculated costs effectiveness for NOx plus NMHC is $0.42 per pound reduced and $3.42 per pound of PM reduced. These cost effectiveness values are within the range of previous ARB actions for NOx plus NMHC which has ranged from $0.29 to $0.63 per pound reduced and for PM which has ranged from $3.03 to $6.65 per pound reduced. Therefore, the adopted requirements are cost effective.

(i) NOx and PM Standard

75. **Comment:** Any discussion of the technological feasibility of the proposed standards must assume at least a 15 ppm cap on fuel sulfur levels. A 15 ppm cap is not adequate, however, and EPA should adopt a 5 ppm diesel fuel sulfur cap for all the reasons set forth above. Nevertheless, even with 15 ppm sulfur fuel, a feasible combination of combustion and aftertreatment system technology has not been identified that can achieve 0.20 g/bhp-hr NOx in the 2007 timeframe. The proposed NOx standard will require the development and use of an aftertreatment system with more than 90% effectiveness over an extremely broad range of engine operating conditions for a useful life of up to 435,000 miles.

Such systems must not only be able to demonstrate such a high level of effectiveness within the laboratory, but they must be production-feasible and capable of assuring compliance with the standard over the full 435,000-mile useful life of the vehicle, with minimal deterioration of the engine and aftertreatment technology. No known NOx aftertreatment system has demonstrated, or can be reasonably projected to achieve, the necessary levels of reductions that will be necessary to comply with the NOx standard over the range of exhaust temperature encountered by a diesel engine during normal operation and use, let alone at 435,000 miles useful life. Nor has any known NOx

[37] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[38] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.
[39] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[40] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

aftertreatment system demonstrated the necessary reductions under those conditions in combination with the PM emission limit, at expanded ambient conditions, and with the proposed supplemental emission requirements.

Despite EPA's claims and some claims of aftertreatment suppliers to the contrary, the new, advanced aftertreatment technologies that will be required must be developed, tested and successfully applied to engines. In turn, those engine-aftertreatment systems must be tested, refined, re-tested and adequately proven in terms of reliability, durability and, of course, emissions performance. Aftertreatment suppliers and engine manufacturers will need to undertake substantial research efforts regarding engine and NOx aftertreatment strategies and will need to determine, with reasonable assurance, which are most durable, reliable, and cost-effective, and provide the greatest assurance of being able to meet the proposed standards in use.

Moreover, unlike the case with prior heavy-duty engine standards, engine manufacturers will be forced to work with third-party suppliers in order to attain the types of emission reductions required by the Proposed 2007 Standards. The addition of third parties to engine manufacturers' processes for development, testing, and certification of compliant engine-aftertreatment systems will further complicate those processes and add significant costs. In addition, engine manufacturers will need substantial additional time to work with suppliers to fully integrate engine and aftertreatment systems, leading to increased costs and likely delays in the process.

Even if there were "known" technologies for which the expected probability of their successful application were relatively high, significant design and development work would be necessary to adapt such technologies to engine manufacturers' products. The full integration of advanced NOx aftertreatment devices with HDDEs to produce a cost-effective, compliant product is a significant undertaking and, itself, fraught with many unknown obstacles.

EMA is aware that aftertreatment suppliers have told EPA that the proposed standards can be met within the leadtime provided. However, aftertreatment suppliers acknowledge that they can be no more than "optimistic" that the "technology will be commercialized in the 2007 timeframe for diesel engines," provided that sufficiently low sulfur fuel is available. (Hearing Statement of the Manufacturers of Emission Controls Association, June 2000.) Moreover, those projections do not account for the development and implementation by engine manufacturers of a complete line of cost-effective, production-feasible and production-ready heavy-duty engine families that can fully comply with the proposed standards, including the supplemental emission tests and standards EPA is proposing to apply, across the full range of engine operating and expanded ambient conditions. And, those projections do not account for the willingness of customers to accept a dramatically different and more costly product.

With aftertreatment, engine manufacturers will have to develop engine technology to meet emission levels well below the proposed standards in order to assure compliance with those standards in actual production and use. With the use of aftertreatment technology in addition to optimized engine design, manufacturers will have to account for a wide set of variables in meeting the proposed standards. Variability in, and potential effects on, the engine exhaust aftertreatment system, engine control system(s), tests, emissions deterioration of aftertreatment systems, and potential prohibitions on traditional control technologies (such as altitude compensation) have as yet unknown

ultimate effects. And, while EPA has proposed a 90% reduction in numerical emission limits from the 2004 Standards to the Proposed 2007 Standards, the real emission reductions which engine manufacturers must be able to attain are far greater.

Engine manufacturers will have other new challenges to face in complying with the standards. As noted above, the deterioration of aftertreatment systems is a variable that must be accounted for. As EPA is well aware, engine-out NOx emissions from a diesel-fueled engine do not deteriorate over time and, in fact, may improve. Engine manufacturers previously designed engines with that fact in mind, and were able to comply with little or no deterioration factor.

With the addition of an aftertreatment system such as a NOx adsorber, NOx emissions may be expected to deteriorate over time. Such deterioration could have a significant impact on emissions. For example, a 37% drop in efficiency (say, from 80% to 50%) over the useful life of an engine would increase the NOx emissions by 0.6 g/bhp-hr if the engine-out NOx level remained constant at 2.0 g/bhp-hr. There is no data available to quantify the in-use deterioration of NOx aftertreatment systems, but few experts believe it will be negligible even with 15 ppm sulfur fuel.

In general, EMA recognizes that it is appropriate for EPA to adopt technology-forcing standards, and engine manufacturers have supported such standards in the past. In this rulemaking, however, EPA has failed to propose a NOx emission standard for HDDEs in 2007 and later model years that it has demonstrated is technologically feasible. EPA must fully analyze all the technological, cost and other appropriate factors in connection with its proposal. When this is done, EMA believes that EPA must conclude that it cannot justify the proposed NOx standard and that a less-stringent standard is more appropriate. (EMA)

76. **Comment:** Unlike NOx emissions, a feasible combination of combustion and aftertreatment system technology has been identified that may achieve 0.01 g/bhp-hr PM on the FTP at FTP conditions, using ultra low sulfur fuel, where the PM trap is operating at peak efficiency. To be sure, this does not include operation of the system at expanded ambient conditions and with the addition of the proposed supplemental emission requirements. Indeed, much development work must be done to ensure that particulate filters cannot only meet the FTP standard but can also meet the Supplemental Emission Requirements over the full 435,000-mile useful life period. Integrating PM filters with EGR and NOx aftertreatment systems also will be a significant challenge.

EPA has focused on the particulate trap as the only means capable of providing the level of emission control sought by the proposed PM standards. (Draft RIA, p. III-5.) While particulate traps have demonstrated such levels of performance during laboratory tests, they, like NOx aftertreatment, must be production-feasible and capable of assuring compliance with the standard over the full 435,000-mile useful life of the vehicle, with minimal deterioration of the engine and aftertreatment technology. The Agency itself acknowledges that catalyzed particulate trap technology is not a certain means to achieve compliance with the proposed PM standard: "In the past, …regeneration of the collected PM has been a serious challenge." (*Id.*) Yet, continuously regenerating traps "are the most promising for enabling very low PM emissions." (Draft RIA, p. III-6.)

EPA focuses, in part, on results from demonstration field tests done in Europe to support its belief that continuously regenerating traps hold the most promise for meeting the proposed PM standard. It is significant, however, that the data from those successful field tests were obtained from non-EGR engines meeting EURO 0, EURO I or EURO II NOx levels four to five times greater than the proposed 2007 NOx standard. The much lower engine-out NOx levels of 2007 engines as proposed by EPA clearly will have an impact on trap regeneration, as NO_2 is used as an oxidant in the regeneration process. Thus, while EPA relies on the availability of NOx for PM regeneration, the extremely low-NOx 2007 and later engines will not have available the same levels of NO_2 necessary for PM regeneration.

EPA correctly recognized that PM traps are "…unable to oxidize, or regenerate, the trapped PM" without NO_2. The DECSE study cites sulfur poisoning as a key reason why PM filters are only potentially successful even with ultra low sulfur fuel. What EPA failed to recognize is that the low-NOx engines proposed for 2007 will reduce NO_2 in a way that would be analogous to a severely sulfur-poisoned trap. Such a result will leave industry with no choice but to employ active regenerating systems which the EPA recognized as having "complicated the system design" without providing "the durability and dependability required for HD diesel applications." (Draft RIA, p. III-5.)

In addition, the engine-aftertreatment units tested in the European field tests were specifically chosen by aftertreatment suppliers for their favorable duty cycles. Engine suppliers will not have this flexibility in developing all engine families to comply with the PM standard.

Despite EPA's view of the success of PM traps, no known PM aftertreatment system has demonstrated the level of reductions that will be necessary to comply with the PM standard over the range of exhaust temperatures encountered by a diesel engine during normal operation and use, and at 435,000 miles useful life. Nor has any known PM aftertreatment system demonstrated the necessary reductions under those conditions in combination with the NOx emission limit, at expanded ambient conditions, and with the proposed supplemental emission tests and standards. Moreover, the efficiency of PM traps in a particular instance will largely depend on the specific engine family and engine application. In other words, particulate trap technology is not expected to have the same effectiveness across all engine applications and all engine families. As a result, manufacturers may be extremely limited in the products they have available for customers.

Despite such significant obstacles, engine manufacturers believe that, with ultra low sulfur fuel (*i.e.*, 5 ppm) and proper attention to PM emission measurement methods as outlined above, the 0.01 g/bhp-hr PM standard could be feasible on the FTP. The addition of the supplemental emission requirements and the expansion of ambient conditions over which compliance is required, however, brings the attainment of the PM standard for production engines over their full useful life substantially into question. EMA discusses those requirements further below. (EMA)

77. **Comment:** EPA is required by statute to propose emissions standards that are feasible for the timeframe in which they will be applied. The Agency has failed to provide any credible support in the NPRM that the multifaceted technology to implement these stringent standards exists or can be invented in time for the industry to meet them. The task of developing or inventing most of the individual components (catalysts, sensors,

and control valves) for candidate technical solutions is daunting. In addition, the engine manufacturers must integrate each of these components into an aftertreatment system that will work for three classes of heavy-duty engines, each having multiple applications with their respective duty cycles. Finally, the systems must survive up to 435,000 miles and, as proposed, meet two sets of testing protocols (FTP and SERTs) over a wide range of environmental conditions.

Given the extraordinary technological reach of these standards, EPA should proceed only if it has made a convincing demonstration that the technology will be available in time. EPA has not made that demonstration; in fact, the only feasibility showing that the Agency has made, which is wholly inadequate, is to extrapolate steady state performance of preliminary laboratory-only components to make assumptions about mature in-field FTP and SERT compliant full aftertreatment systems. This does not meet the standards called for in the CAA.

Section 202(a)(3)(A)(i) of the CAA sets out the criteria the Agency must follow when it promulgates new emission standards for heavy-duty vehicles:

> "…Regulations…applicable to emissions…of heavy-duty vehicles or engines…shall contain standards which reflect the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the model year to which such standards apply, giving appropriate consideration to cost, energy, and safety factors associated with the application of such technology." [Emphasis added]

Section 307(d)(3) of the Act sets out the required procedure for giving the public, including the regulated industry, adequate notice of the Administrator's determination:

> "[Notice of proposed rulemaking shall be published in the Federal Register…shall be accompanied by a statement of its basis and purpose and shall specify the period available for public comment…. The statement of basis and purpose shall include a summary of—
>
> (A) the factual data on which the proposed rule is based;
> (B) the methodology used in obtaining the data and in analyzing the data; and
> (C) the major legal interpretations and policy considerations underlying the proposed rule."

That EPA has a heavy burden in demonstrating feasibility of this Rule is intuitively obvious when one considers the proportional reduction goals that EPA is setting for the industry. Since the beginning of the CAA in 1970 (some 34 years when measured until the date of the 2004 emission standards) diesels will have reduced emission levels of NOx by about 90% and PM by about 85%. In the 2007 NPRM, EPA has proposed additional 90% reductions for both NOx and PM emissions from these 2004 levels. This proposal thus constitutes the largest step reductions ever for either NOx or PM emissions, even without considering the need to comply with the additional stringency imposed by the SERTs.

Clearly, EPA has proposed extremely stringent new standards for NOx and PM emissions. However, the reality is that while the singular obligation to demonstrate

compliance with these standards falls on the engine manufacturers, they cannot hope to achieve compliance without aggressive technological advances by third parties. With prior standards, engine manufacturers have attained impressive emission reductions primarily through changes in engine design and in-cylinder modifications. However, for the first time, engine manufacturers will be forced to rely primarily on third-party-supplied aftertreatment technology to meet the proposed emission reduction goals. EPA has not addressed, in the NPRM, the uncertainty associated with whether independent aftertreatment device manufacturers, who in the end are component suppliers and not aftertreatment system suppliers, will make sufficient investments in a timely manner to permit the integration of a complete aftertreatment system onto engine and vehicle systems. Plus, the engine manufacturers must certify the system's conformance to promulgated standards for up to 435,000 miles.

Moreover, EPA concluded that the proper efficiencies and regeneration of these systems is practicable through up to 435,000 miles. They did this without ever having tested this conclusion even at a prototype level.

Confronted by the statutory obligations and this complex technical situation, the only analysis presented by EPA is to extrapolate current reductions claimed by catalyst manufacturers. Specifically, EPA appears to have selected the NOx and PM emission limits in the Proposed 2007 Rule by looking individually at the steady state reductions obtained through the limited application of one type of advanced aftertreatment technology for each emission constituent (NOx adsorber and catalyzed particulate traps). EPA then apparently extrapolated those reductions to all potential heavy-duty engine applications. This "analysis" did not consider the impacts of having to meet the supplemental test requirements over expanded ambient conditions. That approach surely cannot purport to be a reasonable and sound analysis of technological feasibility.

In its Draft RIA, EPA states with regard to the NOx adsorber technology, the one of four technologies that it believes has the most promise: "[W]e *expect* there will be *great progress* in optimizing the adsorber chemistry *to the specific needs* of the diesel engine." (Draft RIA, May 2000 ("Draft RIA"), p III-16; emphasis added.) Further, EPA is "*optimistic* that these devices can provide the performance necessary" to meet the proposed NOx standard. *Id. (emphasis added).* But no where does EPA provide any credible analytical support for its optimistic expectations. Rather, with regard to the feasibility of the candidate NOx reduction technologies, the proposed 2007 NOx standard is based less on a sound analysis of technical feasibility analysis and more on faith.

It is likely that the Agency will reply to the foregoing that in lieu of providing a roadmap to compliance with the 2007 standards, it has provided the manufacturers an excessively long development period in which to comply. If so, this is an abdication of EPA's statutory obligation to demonstrate that technology will be available to meet the proposed standards. To repeat a final time here: The Administrator must have a reasonable belief that these technologies "will be available for the model year to which such standards apply." CAA Section 202(a)(3)(A). As discussed more fully below, that has not happened here. (Cummins)

> **Agency Response to Comments 75-77:** The ARB agrees that, due to potentially irreversible effects of sulfur in diesel fuel to aftertreatment control systems, diesel fuel sulfur content should be limited to the lowest amount

feasible. In the U.S. EPA's Final Rule, diesel fuel sulfur content is limited to 15 ppm. In the effort to harmonize requirements, the ARB is proposing a diesel fuel sulfur content limit of 15 ppm in a separate rulemaking. Federal adoption of the low sulfur diesel fuel requirements will ensure that low sulfur diesel fuel is available, regardless of California action.

While this may be the first time that this industry will rely on third-party suppliers, the ARB's experience with such suppliers in other sectors (light-duty, passenger car, and others) is reassuring, as manufacturers from those other sectors have stepped forward to meet the demand. Further, the ability of third-party aftertreatment suppliers to work with engine manufacturers to meet the requirements is discussed in the U.S. EPA's RIA,[41] Chapter 3, where extensive testing and data have already demonstrated that the necessary technologies are expected to be available for the 2007 MY.

As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured or are already in-use. Current technology with some improvements may be required, as long as supporting information for the future technologies is provided. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR,[42] Section 6, and the U.S. EPA's RIA,[43] Chapter 3. Both discussions specify particulate traps as promising PM reduction technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate compliance over the useful life of the engines. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

78. **Comment:** Regarding the particulate matter standards, we think that there is an issue there about the degree of stringency that on a per-mile basis heavy-duty trucks are the single highest vehicular source of toxic emissions that operate in urban environments, and we do think that all technologically feasible measures should be pursued to reduce toxic emission risks. And in that regard we would therefore recommend that the board establish a stretch goal or a target, if you will, that would essentially establish an equivalency or a target that would be set originally on a PM comparison basis to what's achievable on natural gas engines. That level is .005 grams per brake horsepower hour PM, and we think that that type of long-term target could be established, not necessarily as particularly as a standard, but as a target, and then perhaps 12 to 18 months later there could be a formal consideration, a formalizing that type of a standard based on any fuel coming forward and being able to achieve such levels. (SCAQMD)

[41] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.
[42] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[43] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

Agency Response: Technological feasibility for the proposed requirements is summarized in the ARB's ISOR,[44] Section 6, and the U.S. EPA's RIA,[45] Chapter 3. Both discussions specify particulate traps as promising PM reduction technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate a compliance over the useful life of the engines. At this time, no testing has been completed to show compliance with PM emissions of 0.005 grams per brake horsepower-hour. Such a PM emission limit is not considered technologically feasible for HDDEs at this time. Further experience is still needed with current generation particulate traps. In addition, more accurate PM measurement techniques will also need to be developed. Due to the significant lead time, compliance with the adopted requirements is expected. However, if additional information supports a more stringent PM emission standard, the Board can reconsider that standard at any time. Therefore, no further changes to the adopted requirements are necessary.

(ii) Optional combined NMHC+NOx standard.

79. **Comment:** EPA has proposed separate standards for NOx and NMHC emissions. As discussed above, the proposed NOx standard is 0.20 g/bhp-hr and the proposed NMHC standard is 0.14 g/bhp-hr. As also discussed above, engine manufacturers have significant concerns about the feasibility of the emission limits proposed by EPA. Those concerns include the 0.14 g/bhp-hr NMHC standard. One of the ways that EPA has addressed the trade-offs in controlling both NOx and NMHC in diesel engines, recognized the need to provide a level playing field for both diesel and gasoline-fueled heavy-duty engines, and, in general, provided engine manufacturers with flexibility is to adopt combined NMHC+NOx standards. Indeed, EPA's proposal represents a significant departure from the 2004 Standards, wherein a combined NMHC+NOx standard was adopted. A combined standard not only provides flexibility, but it also recognizes that NMHC and NOx both contribute essentially equally to ozone formation. EPA should follow previous precedents and allow manufacturers the option of meeting a combined NMHC+NOx standard in the 2007 Rule.

As with prior rules, a primary objective of EPA's proposal is to reduce ozone, and NMHC and NOx both contribute to the formation of ozone in the atmosphere. Thus, EPA will not lose air quality benefits from its proposed standards by allowing manufacturers the option of a combined NMHC+NOx standard.

A combined standard also is reasonable because it allows manufacturers to adjust the control of emissions constituents relative to one another, providing greater compliance flexibility. Such an approach also allows each engine manufacturer to design for the most cost-effective solution. For example, on diesel engines it may be easier and less costly to control NMHC than NOx, while the reverse may be true with gasoline engines. And, it should be noted that, even for diesel engines, EPA's proposed NMHC limit

[44] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[45] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

should not be presumed to be readily achievable due to the addition of diesel fuel to the exhaust, which is needed as a reductant in some aftertreatment systems. A combined standard provides the greatest degree of ozone control for the least cost, and provides a level playing field for diesel and gasoline engines attempting to meet the proposed standards. With the significant reductions that are proposed to be achieved, as much flexibility as is reasonably possible, and the ability to adapt to achieve the most cost-effective solutions, are paramount to successful compliance with the standards.

By allowing a combined standard option, EPA also minimizes any problems with converting averaging, banking and trading credits that were generated on engine families meeting the combined NMHC+NOx standard. If, as EMA recommends, EPA allows credit exchanges between pre- and post-Interim engine families (as defined below), engine manufacturers would not have the added cost and burden of re-calculating pre-Interim credits in order to determine the separate NOx and NMHC components for use in post-Interim engine families. While that can be done, manufacturers should have the option of simply certifying to a combined NMHC+NOx standard for 2007 and later model year engine families.

EMA recommends that EPA adopt an optional combined NMHC+NOx standard. The ultimate numerical limit of such a standard must be technologically feasible and cost-effective, and could reflect a modest reduction from the numerical limits of the separate NMHC and NOx standards which are finally determined to be feasible. EMA also recommends that EPA, as it did with the combined standards for 2004, adopt a second optional combined standard at somewhat higher emission limit, with a cap on NMHC emissions. EMA is willing to work with EPA to determine the appropriate, technologically feasible, and cost-effective combined NMHC+NOx limits. (EMA)

> **Agency Response:** In the past, the U.S. EPA and the ARB focused more on reducing NMHC emissions than NOx emissions. However, due to health concerns from NOx emissions and ozone concerns, summarized in the ARB's ISOR[46], Section 3, and the U.S. EPA's RIA[47], Chapter 2, the ARB is once again separating NOx and NMHC emission standards. This is expected to result in a more effective program to reduce emissions of both air contaminants. Therefore, no further changes to the adopted requirements are necessary.

(iii) Formaldehyde standard.

80. **Comment:** EPA has proposed a formaldehyde standard of 0.016 g/bhp-hr, with a certification requirement that is waivable by the Administrator. In other words, in lieu of providing certification data on formaldehyde emissions, the manufacturer may, upon request to the Administrator, demonstrate compliance with the standards on the basis of previous emission tests, development tests, or other data.

EPA should withdraw the proposed formaldehyde standard entirely, as it has failed to demonstrate either the need for, or the technological feasibility of, the proposed standard. EPA's "analysis" amounts to claims that the formaldehyde standard will not be an issue for diesel-fueled engines equipped with catalysts. Engine manufacturers do not

[46] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[47] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

have sufficient data on formaldehyde emissions either to support or dispute EPA's conclusion. EPA's 2007 Rule would require the use of new technologies from which engine manufacturers have had no opportunity to obtain data. As a result, the impact of these technologies on formaldehyde emissions is totally unknown. Further, the addition of supplemental tests and emissions limits, including the steady-state supplemental limits, MAEL requirements, and NTE zone test and limits, add additional uncertainty about the need for and appropriate limits of a possible formaldehyde standard.

Moreover, engine manufacturers typically do not have the emissions testing capability to measure formaldehyde emissions within their laboratories. Adding such measurement capability will be extremely expensive. Furthermore, the additional costs involved in obtaining a sufficient database of emissions information to ensure engine families' compliance with the standard, even with the certification flexibility that EPA has proposed, will be significant.

EPA indicates that diesel engines are not considered to be a substantial source of formaldehyde emissions. (65 Fed. Reg. at 35451.) With the new emission controls anticipated to be used to meet the other new emission standards, it is expected that formaldehyde emissions would only improve. In that regard, the proposed formaldehyde appears to be completely unnecessary not only for diesel-fueled engines, but also for heavy-duty natural gas and heavy-duty gasoline engines. EPA should defer finalization of such a standard for all heavy-duty engines, regardless of fuel, until such time as sufficient data is gathered to evaluate need and feasibility.

As an alternative to the proposed standard, EMA recommends that EPA consider a one-time cooperative industry test demonstration (for example, a CRC-sponsored effort) with respect to the formaldehyde emissions from heavy-duty engines. Emissions from a representative engine or engines with aftertreatment could be measured to show that the new aftertreatment technology does not cause an increase in formaldehyde emissions. (EMA)

If the addition of new procedures made applicable over the expanded ambients weren't enough, EPA adds formaldehyde to the list of regulated pollutants. EPA has not adequately demonstrated the need to control formaldehyde emissions from heavy-duty engines nor has the Agency shown that controlling formaldehyde emissions to the proposed levels is feasible.

Our own experience tells us the DOC which will be required to reduce the hydrocarbon slip from the NOx adsorber can likely reduce formaldehyde from either 'engine out' or generated from the partial oxidation of the hydrocarbon reductant.

However, Cummins knows of no data on formaldehyde levels from EGR equipped engines or from engines with SCR or an adsorber aftertreatment systems. Cummins has little data on formaldehyde emissions from its engines.

EPA has not demonstrated that it is technologically feasible to control formaldehyde emissions to the proposed standards for current engines over the transient test at standard laboratory conditions, much less for engines utilizing the technologies required to comply with the proposed 2007 standards over the new test procedures and over the expanded ambient conditions. EPA needs to perform this analysis. (Cummins)

81. **Comment:** EMA's concerns with the formaldehyde standards are only exacerbated by the application of the SERTs. As discussed above, the SERTs only add additional uncertainty about the need for and appropriate limits of a possible formaldehyde standard. EPA has failed to analyze the impacts of the SERTs on the formaldehyde standard, and should not finalize such a standard until it has undertaken an appropriate technological feasibility analysis. (EMA)

82. **Comment:** ARB's proposed formaldehyde standards must be eliminated. In the summary of emission standards, ARB proposes to adopt a 0.01 g/bhp-hr formaldehyde standard. The EPA final 2007 Rule eliminated the proposed formaldehyde standard for all engines tested on an engine dynamometer, which standard was originally proposed at 0.016 g/bhp-hr, not 0.01 g/bhp-hr as stated in the ARB summary. In any event, ARB must eliminate the proposed formaldehyde standard from its proposal. (*See*, *Statement of the Engine Manufacturers Association*, pp.41-42 for more specific comments.) (EMA)

Agency Response to Comments 80-82: At this time, the ARB does not have sufficient data to support a formaldehyde emission standard for HDDEs. Further, formaldehyde emissions are expected to decrease with the associated reduction to the NMHC emission standard. Therefore, the ARB has not adopted any additional formaldehyde standards and no further changes to the adopted requirements are necessary.

(iv) Issues with Major Systems Components

(a) Diesel Particulate Filter (DPF)

83. **Comment:** The DPF regeneration will have the following known hurdles to overcome, there will be many other hurdles that can be anticipated, but not identified:
    - an active regeneration system will be required for instances where exhaust temperature is below 675 degrees F for significant periods of time
    - a durable delta-pressure sensor is not available
    - an exhaust mass air flow sensor (MAF) is not available
    - a reliable variable position exhaust valve system is not available
    - a wide range NOx/Oxygen sensor is not available
    - EGR systems capable of compensating for high backpressure swings is not available
    - a reliable and feasible heat addition source (e.g. electric, burner, microwave) is not available
    - robust and comprehensive controls algorithms have not been developed

    EPA has failed to appreciate the need for a failsafe active DPF regeneration system. Without active regeneration, catastrophic failure will inevitably occur. The addition of an active regeneration system requires the use of redundant filters with a method to switch between them. It greatly increases the DPF system complexity. The time to develop such a DPF system with active regeneration increases. Our own experience in the early 1990s with dual trap active regeneration systems demonstrates the immensity of this task and shows that even with a significant expenditure of both human and financial resources, success is not guaranteed.

    The Agency needs to spend the time to perform a thorough analysis of the issues related to the active regeneration of DPFs. (Cummins)

84. **Comment:** Attached as Exhibit E are some real world results of attempted application of this aftertreatment technology. The bar graph shows maximum exhaust gas temperatures produced by a typical diesel engine over a variety of operating bus routes in New York City. The buses were equipped with data loggers and thermocouples to measure the exhaust temperature on buses operated on 7 different routes. Cummins experience shows that in order for a filter to regenerate, the exhaust temperature must be above 350C for about 10% of the time. The routes were named M2, M3 etc. and show that only one route (M60) produced temperatures above the 350C requirement for the required 10% of the time. (Cummins)

Agency Response to Comments 83-84: The commenter contends that the adopted requirements are not technologically feasible and technical issues remain outstanding. As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured, or are already in-use. Current technology with some improvements may be required, as long as supporting information for the future technologies is provided. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR,[48] Section 6, and the U.S. EPA's RIA, [49] Chapter 3. Both discussions specify particulate filters as a promising technology that is expected to be used to comply with the adopted PM requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. The U.S. EPA has even tested a NOx adsorber/particulate trap system in the laboratory that involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Particulate traps using passive regeneration systems have also been used in many demonstration programs in the U.S. and throughout the world. Results from these demonstration programs have demonstrated PM reductions in excess of 90 percent.

The comments also refer to specific concerns regarding improvements necessary for various sensors, controls, valves, and other systems. The specific concerns identify engineering challenges that will require further refinement and development to improve the expected technologies. The original analysis in the U.S. EPA's RIA concludes that these engineering improvements are expected to be completed prior to the 2007 model year.

While fleets with combined PM and NOx aftertreatment do not yet exist, there are numerous test fleets using CDPFs. Further, the U.S. EPA's RIA also discusses reasoning why NOx adsorbers will be useful and durable in combined aftertreatment systems. Toyota has already demonstrated that a combined aftertreatment system will be ready prior to the 2007 time frame with their DNPR system.[50] Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary

[48] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[49] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.
[50] Revolutionary Diesel Aftertreatment System Simultaneously Reduces Diesel Particulate Matter and Nitrogen Oxides, Toyota Motor Corporation press release, July 25, 2000.

(b) NOx Adsorber

85. **Comment:** NOx absorbers are very sensitive to any amount of sulfur in the exhaust stream. Thus, the next major hurdle for a system containing an adsorber is sulfur management. Even at 5 ppm sulfur content, efficiency degradation is intolerable.

The simple fact is that there has been no successful demonstration of a NOx adsorber which can be desulfurized periodically and maintain sufficient activity to meet the NOx emission reduction requirements for the full useful life of a heavy-duty engine. In fact, as will be pointed out in the next section, there has not yet been demonstrated a regenerable sulfur trap that can survive to full useful life. Regardless, for the sake of this analysis, the presumptive system will incorporate a sulfur trap, because even with its critical shortcomings, no better alternative has been identified. (Cummins)

86. **Comment:** The NOx adsorber system will have the following known hurdles to overcome:
- Durability of a reductant delivery system has not been proven
- A reductant delivery system with the required atomization capabilities in the limited space available remains a significant system integration problem
- A low range NOx sensor is not available
- A durable regenerable sulfur trap does not exist
- A durable regenerable NOx adsorber does not exist
- Robust and comprehensive controls algorithms have not been developed

In looking at the totality of the system under consideration, several other issues must be highlighted:
- The required system will impose nearly impossible space claim requirements that many OEMs will simply not be able to accommodate
- The cost of this system is clearly significantly higher than the system cost as proposed by the Agency in the NPRM
- The weight of the system will be considerable requiring sophisticated bracketry and vibration controls on the vehicle
- The durability requirements of such a system are entirely beyond the current state of the art.

NOx absorbers have shown the ability at isolated conditions to significantly reduce NOx emissions. The Agency needs to perform additional analysis to show that NOx adsorbers will be able to achieve an average of 90% effectiveness over the transient cycle and over the SERTs over the extended ambient condition. (Cummins)

87. **Comment:** EPA has failed to demonstrate that the proposed 0.20 g/bhp-hr NOx standard can be achieved with production-ready engines in 2007. The issues discussed above, which suggest that the 0.20-gram standard will not be feasible, apply just as well for 25% of engines as for 100%. There is little likelihood that most manufacturers would have even 25% of available engines for sale that can comply in production and use with the proposed NOx standard by 2007.

The aftertreatment technologies that have been identified as potentially allowing the required reductions – NOx adsorbers and selective catalytic reduction – have significant

development ahead of them before they can be expected to achieve the high level of conversion efficiency needed to meet the proposed NOx standard. When combined with the other complicating factors outlined below, the lack of production-ready engines in 2007 makes EPA's proposal unworkable for engine manufacturers. (EMA)

88. **Comment:** Attached a brief note on the state of development and the significant hurdles associates with development of aftertreatment systems needed to meet the low emissions standards of the ARB 2007 Rule. This work clearly demonstrates that ARB's reliance of the hopeful predictions by potential aftertreatment systems suppliers of 90% efficiency is up against some impossible hurdles. (Cummins)

Agency Response to Comments 85-88: The ARB agrees that due to potentially irreversible effects of sulfur in diesel fuel to aftertreatment control systems, diesel fuel sulfur content should limited to the lowest amount feasible. In the U.S. EPA's Final Rule, diesel fuel sulfur content is limited to 15 ppm. In the effort to harmonize requirements, ARB is currently proposing a diesel fuel sulfur content limit of 15 ppm in a separate rulemaking. Federal adoption of the low sulfur diesel fuel requirements will ensure that low sulfur diesel fuel is available, regardless of California action. With the low sulfur diesel fuel, the U.S. EPA' technical analysis of NOx adsorbers in their RIA concludes that no sulfur trap is needed in the aftertreatment control system.

As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured, or are already in-use. Current technology with some improvements may be required. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR[51], Section 6, and the U.S. EPA's RIA[52], Chapter 3. Both discussions specify NOx adsorbers as promising NOx reduction technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer.

The comments also refer to specific concerns regarding improvements necessary for various sensors, controls, valves, and other systems. The specific concerns identify engineering challenges that will require further refinement and development to improve the expected technologies. The original analysis in the U.S. EPA's RIA concludes that these engineering improvements are expected to be completed prior to the 2007 model year.

While fleets with combined PM and NOx aftertreatment do not yet exist, there are numerous test fleets using CDPFs. Further, the U.S. EPA's RIA also discusses reasoning why NOx adsorbers will be useful and durable in combined aftertreatment systems. Toyota has already demonstrated that a combined aftertreatment system will be ready prior to the 2007 time frame with their DNPR

[51] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[52] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

system.[53] Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Also see Agency Response to comment #68. Therefore, no further changes to the adopted requirements are necessary

(c) H2S System

89. **Comment:** An H_2S catalyst will be required in order to convert the H_2S in the exhaust downstream of the NOx, SOx and DPF components to prevent odor associated with H_2S. These devices are used extensively in the light duty automotive industry for a similar purpose, but at much lower sulfur quantities. The technology is well understood and can be applied to heavy-duty diesel exhaust. However, it does add cost, space needs, weight and complexity to an already overburdened system. (Cummins)

Agency Response: H_2S would result from the cycling of the engine from fuel lean operation to fuel rich operation during NOx adsorber regeneration. As addressed by the U.S. EPA, several methods to reduce the H_2S formation are as follows: reduce the amount of ceria used in the catalyst, thermally treat the ceria to reduce the amount of oxides of sulfur adsorbed in the catalyst,[54] use a metallic scavenger (nickel, copper, or manganese) to reduce the H_2S formation,[55] or use a diesel oxidation catalyst to reduce H_2S and HC.[56] As reported by the U.S. EPA, nickel scavenging is the most common technique used to reduce H_2S emissions from gasoline engines. This is a well understood process and is not expected to overburden or complicate the system. Cost estimates were based on a HC/H_2S clean-up catalyst. The clean-up catalyst is also not expected to complicate the system. Therefore, no further changes to the adopted requirements are necessary.

(d) Diesel Oxidation Catalyst

90. **Comment:** Application of DOCs in a trap/NOx adsorber system presents numerous challenges. During the regeneration of one of the two NOx adsorbers, the effluent from the regenerating adsorber is oxygen free. DOCs cannot oxidize in an oxygen free environment. Therefore, the streams from both paths are joined upstream of the DOC. The stream from the non adsorber regeneration side provides the oxygen to oxidize the products of the regeneration of the opposite stream. Adequate mixing of the two streams is essential. Without such proper mixing, the proposed NMHC standard will not be achievable.

DOCs require high exhaust gas inlet temperatures in order to function properly. When used in conjunction with other aftertreatment devices, the exhaust gas temperature entering the DOC will be at their lowest values since DOC must be placed at the end of the system components. The DOC's ability to function is jeopardized under low ambient conditions. (Cummins)

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[53] Revolutionary Diesel Aftertreatment System Simultaneously Reduces Diesel Particulate Matter and Nitrogen Oxides, Toyota Motor Corporation press release, July 25, 2000.
[54] Lox, E., Engler, B., Koberstein, E., "Development of Scavenger-Free Three-Way Automotive Emission Control Catalysts with Reduced Hydrogen Sulfide Formation," SAE Technical Paper Series, No. 890795, 1989.
[55] Golunski, S., Roth, S., "Identifying the Functions of Nickel in the Attenuation of H2S Emissions from Three-Way Catalysts," 1991 Catalysis Today 9:105-112.
[56] Chapter 3, Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

Agency Response: The commenter presents a dual line system with separate PM traps, NOx adsorbers, and catalysts. The commenter assumes each part of the system cannot be integrated into one complete system to conserve space and retain heat. As demonstrated by Toyota in their DNPR system, the required functions can be combined into a single unit, while also providing flow switching to allow for regeneration. Thus, the functionality of the DOC is not jeopardized and no further changes to the adopted requirements are necessary.

(e) Trap/SCR System

91. **Comment:** Following the main urea-SCR catalyst will be a NOx sensor to monitor NOx slip. This downstream NOx sensor will be of very low range and will be critical in the control of the dosing algorithm in the controller. This sensor has yet to be invented. (Cummins)

92. **Comment:** The NOx conversion efficiency of SCR systems is dependent on exhaust temperature and drops off quickly at lower exhaust temperatures (less than 25% load). Therefore engine management will be required to achieve the necessary efficiencies under FTP and other light duty cycle conditions. Cummins' experience with SCR has been limited to engines producing NOx at the 8.0 g/hp-hr level so it is difficult for us to predict the SCR performance at the 2.0 g/hp-hr engine out level.

Several truck demonstrations using SCR technology have been conducted in Europe. However, all of these exercises were undertaken with the objective of reducing a 7 to 8 g/hp-hr NOx engine to a 2 g/hp-hr NOx engine. They were accomplished with a single technology device designed to reduce NOx only. The task is much more complex when attempting to reduce a 2 g/bhp-hr NOx engine to a 0.2 g/bhp-hr engine, especially when combined with a large reduction in particulate matter.

One large concern is overall thermal lag of the system and the effect on SCR operation. Catalysts and soot filters take a finite time to heat up in the exhaust to reach light-off temperature. For SCR catalysts, this occurs both at cold start and every time the catalyst transitions from a light load condition to a high load condition. This lag can add a significant time delay before full NOx reduction is available. There is about a 50 second lag for NOx reduction when coming off an extended period of idle.

This time lag is largely due to the large size of catalysts required for HDDE exhaust emission control (in this case, 25 liters of catalyst for a 5.9 liter engine). This time lag will get worse when additional emissions control devices are added upstream of the SCR catalyst, due to the increased thermal capacity of such devices.

There is also a chemical time lag in these systems brought about by the adsorption/desorption phenomena with these large catalysts. Both the thermal time lag and chemical time lag make the transient control problem for SCR more difficult, since the urea must be metered to exactly match the NOx output of the engine and the capability of the catalyst to reduce NOx (based on temperature, flow rate, and past history).

The extended temperature range NOx catalysts are designed using precious metal pre-SCR catalysts designed to convert NO to NO2 for enhanced catalyst reactivity at light

loads/low temperatures. We do not know how they will work when the total NOx in the exhaust stream has been reduced to 2 gram/hp-hr by EGR compared to 7 to 8 grams/hp-hr for which most of the current work has been done.

SCRs, like NOx absorbers, have a limited temperature window over which they are able to operate effectively. Given the wide range of temperatures seen during the transient test, and the significant amount of operating time spent outside the range of efficient NOx conversion, it is unclear if SCRs can achieve the 90% reduction posited in the Agency's proposal. EPA has not provided any answers to this fundamental question about SCRs , and must conduct that analysis before it can show that technology will be available.

SCRs have demonstrated significant reductions under certain steady state conditions where control systems have adequate time to home in on the correct amount of urea solution injection to get maximum NOx control while avoiding slip. With heavy-duty engines in on-highway applications, there are rapid and wide swings in both speed and load. It is unclear that under varying conditions that the significant reduction needed to comply can be achieved with available sensor, actuators and control technologies. EPA needs to ensure that urea SCR systems can achieve the requisite NOx reductions over these wide swings in speed and load. (Cummins)

93. **Comment:** In achieving 90% NOx reduction the matching of urea and NOx flow rate will have to be controlled very precisely. Excess injection will result in ammonia slip and excess urea consumption, under injection will result in not meeting the desired NOx targets. This process is made more complex because the engine NOx output is changing at each operating condition and also from the external environmental conditions the engine is being subjected to. At this point in time, we do not know how to represent this NOx output of the engine except with look-up tables and adjustment coefficients. Exhaust NOx can be measured with a NOx sensor, but the current sensor accuracy is only about ± 5% (about half the proposed NOx standard) and the sensors are not expected to be durable beyond 125,000 miles. The existing NOx sensor does not meet our need for either accuracy or durability.

Aqueous urea solutions have a freezing point at about 11 °F that will require the use of a heater system to prevent freezing in winter operation. This problem will need to be solved for the onboard storage tank, the lines required to transport the urea from the onboard tank to the injection equipment and the infrastructure that will be required to assure widespread availability. Solute alternatives to water have not been found to circumvent the freezing problems which do not also damage the SCR process.

The use of SCR will require the establishment of an infrastructure to support the technology and measures to ensure use of the product. We understand that the American Petroleum Institute has only recently engaged a consultant to determine the practicality of such a distribution system. Results from that study will be extremely useful to our understanding of the commercial feasibility of SCR. However, due to EPA's timeline and rush to rulemaking, we are required to submit comments prior to knowing the results of this important study.

Significant durability testing will be necessary to determine if the urea injection control system and catalyst can meet up to the 435,000 mile useful life requirements. No systems to date have even anticipated such a long useful life.

EPA has provided little analysis of SCRs much less aftertreatment systems which include SCRs. As shown, urea solutions are subject to freezing so heating systems will be required for urea storage and delivery systems. EPA needs to analyze trap/urea SCR systems and determine if they are a viable alternative.

The urea solution distribution infrastructure is a major unknown. EPA has not yet, but must determine if a urea solution distribution system can be developed. If it can, the Agency needs to determine if this system represents the lowest cost solution. (Cummins)

Agency Response to Comments 91-93: Selective catalytic reduction is an effective method to reduce NOx emissions from diesel engines. However, both the U.S. EPA and the ARB are concerned over possible hurdles that are currently inherent in the system and acknowledge concerns presented by the commenters. These hurdles include ensuring a sufficient distribution system for the urea and ensuring proper levels of urea stored in the trucks. Currently, there are no distribution facilities available for the urea. Both distribution and refueling facilities would need additional storage for the urea. Further, it would be ideal to have the urea storage next to existing diesel storage tanks such that urea refueling can be ensured. Once the urea is available, there is the other hurdle of ensuring proper levels of urea in the trucks. Current truck drivers are not accustomed to checking urea levels. While restricting engine operation with adequate urea levels is a possible answer to this problem, this would create unsafe highway conditions may be created by such an association. Therefore, at this time, the ARB does not expect SCR to be used to comply with the adopted requirements. However, the ARB-adopted requirements are not dependent on the successful implementation of SCR systems. Also see Agency Response to comment #68 regarding technical feasibility. Therefore, no further changes to the adopted requirements are necessary.

(f) Various System Components

94. **Comment:** Based on the current level of understanding, the integrated system that will need to be in place to control NOx and particulates for heavy duty on-highway diesels is a combined NOx and PM aftertreatment system in which the sulfur is trapped and later regenerated. Other systems can be conceived in which the sulfur is stored in a replaceable trap. This system consists of two primary circuits. The components in each circuit are identical. The flow of exhaust gases through the system is split between the circuits and is regulated by a variable position valve. This valve will have a full range, i.e., it can effectively divert the entire flow to either circuit or any ratio in between. A temperature sensor will be required in front of this valve to monitor the exhaust gas temperature entering the system. In addition, a NOx sensor with inherent oxygen sensing capabilities will also be necessary.

During normal operation two strategies may be employed. Either the flow can be equally diverted between the two circuits or flow can be fully diverted into one circuit. If the flow is equally diverted and a regeneration event is required, then the flow would be regulated in such a way as to optimize the flow into the regenerating circuit (see next section for details). The other approach would entail operating through a single circuit until a regeneration event is encountered at which time the second circuit is employed.

Most likely, thermal capacitance issues will drive the system to operate in the split flow mode. This would maintain the system at the proper operating temperatures more effectively.

As the exhaust flow enters a given circuit. the first device encountered is a mass air flow sensor (MAF). This sensor will be critical to several aspects of the system operation. For example, it will be used to control the oxygen flow rates to the circuit (in conjunction with the upstream NOx sensor previously referenced) and will, therefore, be one of the primary sensors used in the closed loop feedback of the variable position valve regulating the flows through the circuits.

The diesel particulate filter ("DPF") will be the next device encountered. This trap will filter the particulates from the gas and its operation will be monitored by a pressure sensor. Given the mass flow measured through the circuit as well as the relative pressure drop, the state of the particulate filter can be monitored. The particulate trap will have some device configured within it to add supplemental heat to aid regeneration during harsh ambient conditions. The device for addition of heat could include electrical grids, fuel addition, burners or microwaves. However, none of these systems has yet been shown to be effective and their reliability and durability remain in question.

A temperature sensor and a reductant injector will follow the DPF. The temperature sensor will serve a dual role. It will monitor the regeneration event in the particulate trap to prevent uncontrolled regeneration and it will indicate the inlet conditions to the sulfur trap. The reductant delivery system is, at this time, an unknown device. Diesel fuel is a poor reductant for sulfur traps and NOx adsorbers. Optimally, the diesel fuel would have to be partially reformed by some device not yet invented.

After the reductant delivery system, the flow enters a sulfur trap. This device will be mandatory as the NOx adsorber can tolerate absolutely no sulfur from either the fuel or engine lube oil. A diverter valve will be placed downstream of the sulfur trap. This valve will divert the flow around the NOx adsorber during sulfur regeneration. This will be required so that the sulfur given off during the sulfur regeneration does not poison the NOx adsorber. This valve may be a two-position valve so that either the flow is entirely diverted or none of the flow is diverted.

After the diverter valve is the NOx adsorber itself. This device will have a temperature sensor in front of it to monitor the inlet conditions. It will also have a NOx sensor at the outlet to monitor NOx slip. This downstream NOx sensor will be of very low range and will be critical in the determination of the timing of a NOx desorption event. This sensor, too, has yet to be invented.

Finally, the flow from the two circuits is recombined and enters the first of two final catalysts. The function of the first catalyst will be to convert any H_2S in the exhaust to H_2O and SO_2. H_2S is a foul smelling gas that results from the rich desorption of the sulfur trap. The second catalyst will be an oxidation catalyst which is intended to clean up any slip of CO or hydrocarbons during a NOx adsorber regeneration event.

The system described herein is intended to be capable of handling all three of the required regeneration events; particulate trap, sulfur trap, and NOx trap. How these three events are handled individually, or in combination, remains an open and extremely challenging technical development issue. Based on our current level of knowledge, the

temperatures and conditions for successful regeneration of NOx adsorbers are very different than those of PM traps. Furthermore, the rejuvenation of a sulfur trap may also require cleaning or replacement by the operator. None of these technical issues have been addressed by EPA. Without an actual system in place, it is difficult even to comment on all the unknown hurdles that will be encountered. (Cummins)

Agency Response: The commenter contends that the adopted requirements are not technologically feasible and technical issues remain outstanding. As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured or are already in-use. Current technology with some improvements may be required. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR,[57] Section 6, and the U.S. EPA's RIA, [58] Chapter 3. Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. The U.S. EPA has even tested a NOx adsorber/particulate trap system in the laboratory that involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

(v) Trap/Adsorber System Issues

95. **Comment:** The regeneration event for adsorbers (both NOx and SOx) has conflicting requirements to the regeneration event of particulate filtration. Adsorber regenerations require low (zero) oxygen partial pressures, a supplement of reductant (for NOx adsorbers), low space velocities, and moderated temperatures. On the other hand, regeneration of particulate filters and DOCs require high temperatures, high oxygen partial pressures, high NO_2 concentrations and moderate space velocities. It is not practical to combine the regeneration of particulate filters with the regeneration of sulfur traps. Nor is it practical to combine the regeneration of NOx absorbers with the regeneration of sulfur traps. For these reasons, a very flexible dual bypass system is required.

In the case of sulfur trap regeneration, the low oxygen partial pressure requirement will require a precise control over the bypass system and the reductant delivery system. If the vehicle is undergoing transient operations, great care will have to be employed to control the flow rate in the bypass circuit undergoing regeneration while simultaneously dosing the proper amount of reductant. If too little reductant is dosed, the desulfation event will not be effective. If too much reductant is dosed, there could be a problem with hydrocarbon slip. This level of transient control has never been demonstrated. In fact, neither the control system capable of this type of control, nor the sensors, nor the actuators exist at this time to effectively demonstrate capability of such a complex system, even in the laboratory.

[57] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[58] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

A further complicating matter is the total size of the system. The DPF will need to be in front of the NOx control system due to the requirement for sufficient NO2. This issue has been addressed earlier in this document. However, it is impractical to place the reductant system in front of the DPF. Doing so would have unacceptably high risks of filter plugging. In addition, the transient lag of the reductant traveling through a DPF would be unacceptable at any non-steady condition. Given these constraints, the room available to achieve adequate atomization and distribution of the reductant is prohibitive. Poor delivery of reductant will make efficiency and hydrocarbon slip issues problematic.

During a desulfation event, the sulfur within the trap will be released primarily as SO_2, H_2S, and COS. The release of the sulfur cannot be allowed to travel through the NOx adsorber. If this were allowed to occur, the NOx adsorber would be poisoned. Therefore, a second bypass valve will be needed to bypass the products of regeneration around the NOx adsorber. This will entail a short period of exhaust being released into the atmosphere which did not undergo NOx treatment. This event would put in jeopardy the requirements within the NPRM of low emissions during the regeneration events. In addition, the H_2S, COS and HC slip emissions will require an H_2S and DOC catalyst to be placed downstream of the point where the two circuits of the system rejoin.

The NOx adsorber desorption event will have many of the same issues as the sulfur desorption event. It will also drive the need for sophisticated flow and temperature controls. It will drive the need for complex reductant delivery systems as well as a DOC to capture any HC slip. In addition, the NOx desorption event will require a low range NOx sensor which currently does not exist. At the proposed levels of NOx emissions, NOx concentration in the exhaust is expected to be in the 15-25 ppm range. This sensor will have to have not only single digit NOx ppm accuracy but will also have to be able to survive high NOx ppm spikes which are associated with the regeneration event. NOx sensors able to measure these small concentrations have not yet been developed.

As explained previously, aftertreatment systems to meet the proposed emission standards will require both two way and variable position valves in the exhaust stream. These valves must last to full useful life of the engine (435,000 miles). Valves that can reliably meet these requirements have not yet been developed.

The Mass Air Flow Sensor as described earlier will be a key component critical to several aspects of the system. However, no such device exists at the present time.

Delta pressure sensors will be another critical component of a successful system helping determine when regeneration needs to occur. A reliable delta pressure sensor that will likely be required for this type of application has not yet been developed.

As shown above, the system of aftertreatment devices required to simultaneously reduce particulate, remove the remaining sulfur, reduce NOx and prevent slip is more complex than envisioned by the Agency. It requires the use of components not yet commercially viable such as NOx sensors. Each of the major components of this system has issues in their own right that must be resolved. Even if these can be resolved, getting them to function as a system will be a challenging task. EPA has failed to address these trap/adsorber systems issues in its own analysis. The Agency needs to take the time to do so. (Cummins)

Agency Response: As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured, or are already in-use. Current technology with some improvements may be required. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR[59], Section 6, and the U.S. EPA's RIA[60], Chapter 3. Both discussions specify particulate traps with NOx adsorbers as promising reduction technologies that are expected to be used together to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While tests at the NVFEL have demonstrated reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Additionally, those tests using low sulfur diesel fuel have shown that SOx adsorbers/sulfur traps are not necessary.

The comments also refer to specific concerns regarding improvements necessary for various sensors, controls, valves, and other systems. The specific concerns identify engineering challenges that will require further refinement and development to improve the expected technologies. The original analysis in the U.S. EPA's RIA concludes that these engineering improvements are expected to be completed prior to the 2007 model year.

While fleets with combined PM and NOx aftertreatment do not yet exist, there are numerous test fleets using CDPFs. Further, the U.S. EPA's RIA also discusses reasoning why NOx adsorbers will be useful and durable in combined aftertreatment systems.

The comments also refer to a dual bypass system. While a dual bypass system has been tested at the NVFEL (see the U.S. EPA's RIA), Toyota has already demonstrated that a combined aftertreatment system will be ready prior to the 2007 time frame with their DNPR system.[61] Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Additionally, past experience has shown that engineering and manufacturing improvements can be expected to continually decrease the size of the system. Therefore, no further changes to the adopted requirements are necessary

(vi) Technological Feasibility of Proposed NOx and NMHC Standards for Alternative-fueled Engines

96. **Comment:** EPA has provided little analysis of the technological feasibility of its proposed standards for alternative-fueled engines. There are many varieties of alternative-fueled engines; Cummins offers both natural gas and propane versions of certain of its heavy-duty engines. In general, the concerns about the technological feasibility of NOx aftertreatment to achieve the proposed standards with diesel-fueled engines holds for these engines as well. In fact, each of these types of alternative-fueled engines presents unique issues of technological feasibility, and general

[59] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[60] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.
[61] Revolutionary Diesel Aftertreatment System Simultaneously Reduces Diesel Particulate Matter and Nitrogen Oxides, Toyota Motor Corporation press release, July 25, 2000.

conclusions reached with regard to diesel engines cannot be extrapolated to alternative-fueled engines without specific analysis. This is particularly true for NOx adsorbers as natural gas and propane may not be effective reductants. The proposed NMHC level would also be difficult to achieve, as well as to even demonstrate, for natural gas and propane engines. EPA must specifically analyze the feasibility of achieving its proposed NOx and NMHC emission standards for alternative-fueled engines, including natural gas and propane engines. (Cummins)

Agency Response: The adopted requirements are intended to be fuel neutral and not advocate one fuel over another. The purpose of this rulemaking is to demonstrate technical feasibility and cost effectiveness. Identical to the U.S. EPA, the ARB is not required to demonstrate technical feasibility for alternative fuels. Since the more widely used heavy-duty diesel-cycle engines are diesel fueled, technological feasibility has been demonstrated using technologies that would be applied to HDDEs (also see Agency Response to comment #68). The ARB agrees with the U.S. EPA in that alternative-fuel engines already achieve very low emissions. Therefore, attaining the adopted emission standards with lower control efficiency aftertreatment systems, already determined to be technologically feasible for HDDEs, is expected with "cleaner" alternate fuel technology. Therefore, no further changes to the adopted requirements are necessary.

(vii) Natural Physical Limitations of Emission Control Systems

97. **Comment:** Based on research undertaken at Cummins, from interactions with suppliers of emission controls equipment, and from careful reading of the open technical literature on the subject, we do not know of any single technology, or combination of technologies, capable of meeting an emissions level remotely near the proposed NOx and PM standards when combined with the onerous SERTs and Extended Ambient Conditions. It is no surprise we come to that conclusion given there are no systems of control (aftertreatment) technologies with sensors to test against the SERTs. This is true even at a laboratory level of development.

Any emission control system will be subject to physical limits of effective operation, determined by such factors as:

- Catalyst reaction rate limits as a function of exhaust gas temperature and space velocity
- Diesel combustion reaction rate limits as a function of end-of-compression temperatures
- Mechanical stress or thermal limits of the materials from which the systems are constructed
- EGR condensation limits based on local gas temperature and pressure
- EGR fouling due to deposition of soot and other substances as a function of coolant temperature and EGR flow rate

When a number of emission control technologies are combined to achieve low emissions, it is important to recognize that the physical limitations of the new (combined) system will be a composite of the physical limitations of the sub-systems. Such physical limits will prevent effective operation of the emission control system at the extremes of ambient temperature, pressure and humidity.

The same physical behavior also contributes to natural variations in achievable NOx and PM emissions throughout the engine's operating range, and range of ambient conditions. In fact the capacity to control NOx and PM will vary continuously throughout the engine's load and speed range, and with changes in ambient temperature, pressure and humidity.

Since such fundamental physical limitations are immutable, it is essential that they be recognized at the outset, and used effectively to establish achievable emission standards and test procedures, and the range of extended ambient conditions over which they apply.

As will be discussed further, it is apparent that EPA has not considered the stringency of compliance with the SERTs over extended ambient conditions, in the light of the fundamental physical limits of the available technologies. Standards have been proposed based only on testing of prototype aftertreatment hardware at standard laboratory conditions. (Cummins)

Agency Response: Toyota Corporation has already announced the planned production of an emission control system similar to the system tested at the NVFEL.[62] The DNPR system, developed by Toyota, consists of a combined CDPF and a NOx adsorber system and is planned to be produced in 2003, which is several years prior to the introduction of 2007 compliant HDDEs. This indicates that the required sensors and associated controls have been developed, apparently overcoming the described physical limitations, or will be fully developed by 2003. Therefore, no further changes to the adopted requirements are necessary.

b. Period of stability for introduction of the new standards.

98. **Comment:** In the SOP and in the preamble to the 2004 Rule finalized prior to the 1999 Feasibility Review, EPA committed to providing engine manufacturers with more than the minimum three years' period of stability required by the CAA. EPA's commitment was based, in part, on its recognition that the emission standards established in the SOP and finalized in the 2004 Rule would require an enormous and unprecedented investment in research, development and tooling. As the SOP made clear, industry's commitment to, and investment in, those proposed standards required all of the leadtime afforded by the SOP and required EPA to establish a period of stability for the 2004 Standards greater than the three-year minimum set forth in the CAA. 60 Fed. Reg. at 45604. EPA should provide more than three years' stability in the implementation of standards as stringent as those finalized for 2004 and proposed for 2007. (EMA)

Agency Response: The ARB agreed to the Statement of Principles (SOP), along with the U.S. EPA. The SOP committed to a three-year lead time for any reduction in HDDE emission standards. Since the adopted emission standards are phased-in beginning in 2007 and the previous emission standards were implemented beginning in 2004, the three-year lead time agreement is satisfied.

[62] Revolutionary Diesel Aftertreatment System Simultaneously Reduces Diesel Particulate Matter and Nitrogen Oxides, Toyota Motor Corporation press release, July 25, 2000.

Further, as detailed in the ARB's ISOR,[63] Section 6, and the U.S. EPA's RIA,[64] Chapter 3, technology required to satisfy the adopted requirements is technologically feasible within the lead time and adopted phase-in schedule. Therefore, no further changes to the adopted requirements are necessary.

c. Phase-in of NOx, NMHC and formaldehyde standards.

99. **Comment:** EPA has proposed an optional phase-in program for meeting the HDDE standards. Under the proposal, the 2007 standards would be fully effective in 2007, but manufacturers of diesel engines could elect to phase in engines meeting the NOx, NMHC, and formaldehyde standards over the 2007 to 2010 time period. The proposed percentage of manufacturer's engine sales that must comply with the new NOx, NMHC, and formaldehyde standards would increase from 25% in 2007, to 50% in 2008, to 75% in 2009, and to 100% in 2010. Percent-of-sales requirements are based on U.S.-directed production of heavy-duty engines for the applicable model year. EPA's proposed phase-in is not feasible or practical for heavy-duty engines for a number of important reasons. (EMA)

100. **Comment:** The NPRM proposes a phase-in schedule for the NOx and NMHC standards between 2007 and 2010. The rationale for this is that "the manufacturer would have to redesign only that 25 percent of its engines during the 2007 model year." 65 Fed. Reg. 35466. This statement further demonstrates EPA's lack of understanding of the technology needed to meet these stringent standards. In order to meet this standard, the companies will need EGR and aftertreatment devices. In the case of the bulk of the industry that is currently under consent decrees, cooled EGR will be a well-developed technology. The critical milestones with regard to making aftertreatment devices work is the catalyst and regeneration issue within the aftertreatment device, not the application of the aftertreatment device to a specific model engine.

The proposed phase-in does nothing to lighten manufacturers' burdens, and in fact compounds them. With new supplemental test procedures effective in 2007, the first year of the proposed phase-in, engine manufacturers will have to re-certify engines that meet the 2004 standards in order to meet the supplemental test requirements. All engine families, not just that percent required to meet the new NOx standard, must be re-certified. The problem will compound every year as a new set of engine families must be re-certified as the phase-in continues.

Moreover, EPA is required by statute to promulgate one set of standards that applies equally to every manufacturer within a segment of the industry – in this case, the manufacturers of HDDEs. The CAA allows EPA to categorize engines for purposes of standard-setting based on weight, horsepower, fuel, or other appropriate factors. CAA § 202(a)(3)(A)(ii). Nowhere does the statutory language suggest, however, that EPA can abdicate its obligation to draw up appropriate categories and set up a system allowing the application of different standards to competing engines. By proposing to phase in standards over three years, each manufacturer will be subject to a different set of standards within its product line. This only invites engine and vehicle manufacturers to "game" the system competitively, seeking to lock up one corner of the market by

[63] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[64] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

allocating to that corner its engines that are subject to less stringent standards and, therefore, enjoy potential cost advantages. EPA may not use its rules to tamper with the marketplace in this fashion.

Further, the proposed phase-in program violates the lead-time and stability requirements of the CAA. As noted, heavy-duty standards must stay in effect for a minimum of three years. EPA's scheme contemplates an annual tightening of standards that is inconsistent with that statutory requirement. (Cummins)

101. **Comment:** Cummins views this (25%/50%/75%/100% phase-in approach for NOx, NMHC, and formaldehyde emission standards based upon percentages of U.S.-destined volume) approach as being impractical to implement. The cost and fuel economy impact of engines meeting the lower standards are yet to be determined; therefore, it is difficult to predict the future make-up of the marketplace. Plus, there are changing alliances that could dictate who gets which engines. It is unlikely that OEMs would offer two different vehicles to accommodate two different engine designs as there would probably be substantial physical and cost differences. This approach is completely arbitrary.

    EPA has rightfully determined that compliance flexibility is required. However, the proposal phase-in is impractical. EPA needs to develop a better alternative. (Cummins)

    Agency Response to Comments 99-101: The phase-in schedule that was finalized by the U.S. EPA, and subsequently adopted by the ARB, is 50% in 2007, 2008, and 2009, and 100% in 2010. As detailed in the ARB's ISOR[65], Section 6, and the U.S. EPA's RIA[66], Chapter 3, technology required to satisfy the adopted requirements is technologically feasible within the adopted phase-in schedule. Since the adopted standards begin the phase-in with the 2007 MY, the CAA lead time requirement of 4 years is satisfied, and since the phase-in remains at 50 percent for 3 consecutive years, the 3 year stability requirement is satisfied. In addition, California is not bound by federal lead time requirements.

    The adopted phase-in schedule is intended to provide manufacturers a period to gain experience with aftertreatment systems. Although some "gaming" of emissions may occur, engine manufacturers are not expected to manipulate the markets since all engines are required to comply with the adopted requirements in the 2010 model year. The three-year phase-in only provides additional flexibility and additional lead time for the more problematic engine designs. Therefore, no further changes to the adopted phase-in schedule requirements are necessary.

    At this time, the ARB does not have sufficient data to support a formaldehyde emission standard for HDDEs. Further, formaldehyde emissions are expected to decrease with the associated reduction to the NMHC emission standard. Therefore, the ARB has not adopted any additional formaldehyde standards and no further changes to the adopted requirements are necessary.

[65] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[66] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

102. **Comment:** EPA's proposal allows a compliance phase-in only for NOx, NMHC and formaldehyde standards. Engine manufacturers would be required to certify all engine families to meet the proposed 0.01 g/bhp-hr PM standard in 2007.[67] Yet, with the proposed phase-in, engine families that were previously certified in 2007 to the PM standard will be required to be redeveloped, re-tested, and re-certified for one of the three remaining years of the phase-in.

In fact, the 25% phase-in of the NOx, NMHC and formaldehyde standards during the first year is misleading, because the "phase-in" actually will require re-development of *all* engine families for NOx compliance with the supplemental emission requirements that will be effective in 2007.

Moreover, the continued "phase-in" of greater percentages of engine families to the NOx, NMHC and formaldehyde standards means that in each year, additional engine families comprising 25% of production volume must be re-certified to the new NOx, NMHC and formaldehyde standards. There would be no carry-over from the first year of the new standards for 75% of the engines that were certified to the PM standard and the supplemental emission requirements.

EPA's proposed phase-in adds enormous additional, unnecessary burdens to manufacturers in terms of the human and financial resources required to redevelop, re-test and re-certify already certified engines. More important, EPA's proposed phase-in fails to provide the minimum period of stability that is required for the implementation of new standards. Congress has mandated that EPA provide at least three years' period of stability for the imposition of new heavy-duty engine and vehicle standards. Under the proposed phase-in, engine manufacturers would not receive the benefits of any stability for 75% of a manufacturer's production volume, as engine families must be re-certified to new standards every year for three years.

The lack of mandated stability is true even though EPA has couched its proposal as an "optional" phase-in. As a practical matter, and for the reasons outlined in these comments, engine manufacturers could not hope to meet the extremely stringent emission limits proposed by EPA across the board in the proposed first effective year of the standards. In that regard, EPA's proposed phase-in is actually a mandatory standard – one that fails to meet the requirements of the CAA for the minimum period of stability. As a result, some type of workable phase-in or two-step standard, as EMA proposes below, is the only "option" for compliance. (EMA)

103. **Comment:** EPA's phase-in proposal is unworkable because it does not account for the realities of the marketplace. Engine manufacturers' customers are influenced in large part by new engine costs. If customers choose to purchase 2006-compliant engines over 2007 model year engines, engine manufacturers would have significant difficulty in managing engine sales to achieve the required volumes of 2007-compliant engines during the phase-in period.

Managing engine sales over the phase-in period is complicated by the fact that the heavy-duty engine and vehicle industry, unlike the light-duty engine and vehicle industry,

[67] Engine manufacturers also will have to re-develop and re-certify all of their pre-2007 engine families for NOx and NMHC compliance because of the implementation of the new Supplemental Emission Requirements for 2007 which significantly increase the stringency of EPA's previous emission standards.

is not vertically integrated. With few exceptions, heavy-duty engine manufacturers sell engines to heavy-duty truck manufacturers. Thus, for both engine and truck manufacturers, the control of new product mix becomes even more complicated, and creates the potential for significant difficulties between engine manufacturers and their truck manufacturer customers. EPA's proposed phase-in creates significant difficulties and must not be finalized. (EMA)

104. **Comment:** Most heavy-duty engine manufacturers produce and sell engines from a relatively small number of certified engine families. The small number of engine families available to manufacturers will make it extremely difficult for many manufacturers to subdivide their product lines into discrete 25% increments in order to conform with the proposed phase-in. (EMA)

Agency Response to Comments 102-104: The commenter is concerned about being able to control the proper percentage of sales over the phase-in period due to the small number of engine families and due to customer preferences. The commenter made comments based on the U.S. EPA's preliminary phase-in schedule of 25% / 50% / 75% / 100%. Similar to the U.S. EPA, the ARB does not expect problems for manufacturers to achieve the level of sales necessary to comply with the adopted requirements. Rather than a 25% phase-in for the first year, the U.S. EPA's 2007 Final Rule and ARB-adopted phase-in requirement is 50% for the first three years. This provides several years of stability for engine manufacturers and reduces the amount of redevelopment necessary to incorporate NOx reduction technology. The first three years are intended to allow manufacturers experience in incorporating NOx reduction technology.

Further, a modified averaging, banking, and trading program was also adopted that allows engine manufacturers greater flexibility in complying with the adopted emission standards. The provisions allow the transfer of credits between phased-in and non-phased-in engines. The provisions also allow the transfer of credits between engine families. Consequently, engine manufacturers do not need to totally rely on customer preference to achieve the level of sales necessary to comply with the adopted requirements.

As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured, or are already in-use. Current technology with some improvements may be required. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR,[68] Section 6, and the U.S. EPA's RIA, [69] Chapter 3. Both discussions specify particulate traps as promising PM reduction technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate compliance over the useful life of the engines. Due to the significant lead time for compliance with the adopted requirements,

[68] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[69] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

105. **Comment:** EPA's proposed phase-in creates a significant potential for competitive issues among engine and vehicle manufacturers. Assuming the Proposed 2007 Standards were technologically feasible and some engine families could be production-ready as early as 2007, manufacturers offering 2007-compliant engines in a certain market segment early in the phase-in period would be at a competitive disadvantage to other manufacturers electing to introduce their 2007-compliant engines into the same market segment later in the phase-in period. The inability to know with certainty – or even to gauge – the phase-in and marketing plans of competing engine manufacturers would make it exceedingly difficult for manufacturers to manage their own product mix to meet the phase-in schedules. EPA's proposed phase-in makes the introduction of new technology into the marketplace an extremely complicated and burdensome undertaking, with potential deleterious effects on competition. (EMA)

Agency Response: The commenter is concerned of potential free market effects due to the adopted requirements. In any free market system, companies will make marketing and business decisions that may help or hurt their sales. These decisions are made on a daily basis. Adoption of the requirements will not create unequal effects because all manufacturers will be meeting the same requirements. Based on the manufacturer's previous experience with more stringent standards that have been adopted through the years, manufacturers are expected to make appropriate decisions regarding compliance with the adopted requirements. Since it is not ARB's duty to force manufacturers on any path to compliance, engine manufacturers must use their experience to make such decisions. Therefore, no further changes to the adopted requirements are necessary.

106. **Comment:** EPA has no way even to assure that the air quality benefit goals of the phase-in will be assured. Manufacturers may choose – or may have no choice but – to delay the introduction of some higher power or higher usage engine families until later years of the phase-in schedule. Since these engines account for a disproportionate share of the emission inventory, the air quality benefits sought by EPA, therefore, may not be attained during the early years of the phase-in. (EMA)

Agency Response: The ARB does not believe that engine manufacturers will delay compliance, or exit the marketplace, to avoid compliance with the adopted requirements. If such an event occurred, the engine manufacturer may risk losing potential sales for that engine family due to the competitive marketplace. Such loss in sales may even be permanent. Further, as the cost effectiveness analysis in both the ARB's ISOR,[70] Section 9, and the U.S. EPA's RIA[71] shows, the increase in cost for each engine is not expected to be significant. Anticipated air quality benefits are expected to be realized since consumers are not expected to alter their purchasing habits to avoid purchasing new, compliant engines. Although higher power engines, with aftertreatment systems, may be delayed until the end of the phase-in period, the modified averaging, banking, and trading

[70] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[71] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

program allows engine manufacturers greater flexibility in complying with the adopted emission standards. The provisions allow the transfer of credits between phased-in and non-phased-in engines. The provisions also allow the transfer of credits between engine families. Thus, the adopted flexibilities will allow for delay of some engine families while ensuring the emission benefits. Therefore, no further changes to the adopted requirements are necessary.

107. **Comment:** Because of the difficulties in managing sales under the proposed phase-in, manufacturers may need to resort to dual product offerings in order to continue to compete in the marketplace. Under such a scenario, engine manufacturers would offer customers full line-ups of both 2007-compliant and 2006-compliant engines and would attempt to manage sales through pricing. Such approaches are inefficient, will serve only to add costs, will create severe financial strain for engine manufacturers, and will cause ill-will between engine manufacturers and their customers.

    Heavy-duty truck manufacturers also may need to provide dual truck model offerings in order to manage their sales consistent with restricted engine availability during the phase-in period. Again, this will merely add costs and create financial difficulties for vehicle manufacturers. (EMA)

    Agency Response: Included in the adopted requirements are additional flexibilities such that dual product offerings are not necessary. These flexibilities include additional averaging, banking, and trading provisions that allow the use of credits between engine families and engine weight classes. Further, as the cost effectiveness analysis in both the ARB's ISOR[72], Section 9, and the U.S. EPA's RIA[73] shows, the increase in cost for each engine is not expected to be significant. Therefore, no further changes to the adopted requirements are necessary.

108. **Comment:** EMA is pleased that EPA has recognized that engine manufacturers need compliance flexibility in meeting the Proposed 2007 Standards. As detailed above, however, EPA's proposed phase-in is not a workable, cost-effective alternative to meeting the extremely stringent standards proposed and does not, therefore, provide the compliance flexibility intended by EPA and sorely needed by engine manufacturers. As another option, EMA recommends that EPA adopt a two-step process for implementing the standards that would be designed to achieve the same air quality benefits that EPA would achieve from a four-part phase-in program. EPA's proposed phase-in option may be beneficial for a segment of product offerings below 14,000 lbs. GVWR and should be retained, therefore, but only for those limited instances. (EMA)

    Agency Response: At the time the commenter made this comment, the U.S. EPA had proposed a four-year phase-in schedule of 25%, 50%, 75%, and 100%. However, the U.S. EPA adopted a two-step phase-in schedule of 50% for the first 3 years, and 100% for the final year. The two-step phase-in provides some stability in the requirements, allowing engine manufacturers to make proper manufacturing decisions and also allows engine manufacturers to gain working

[72] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[73] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

experience with the new technologies. Therefore, no further changes to the adopted requirements are necessary.

(i) NOx standard implementation.

109. **Comment:** As an alternative to its proposed phase-in, EPA should adopt an initial set of standards for both NOx and the NMHC+NOx option that would be set at reasonable yet still technology-forcing levels (the "Interim Standards").[74] A second set of standards would be effective later that clearly contemplates the use of advanced NOx aftertreatment technologies (the "Final Standards"). The standards would apply across the board to all HDDE families. The two sets of standards would be set at levels that provided the same general emission benefits as the same, technologically feasible NOx (or comparable NMHC+NOx) standard phased in 25% per year over four years.

EMA's proposal addresses a number of concerns engine manufacturers have with EPA's proposed standards and phase-in. The first and most serious concern is the technological infeasibility of EPA's Proposed 2007 Standards and the likelihood that manufacturers will not have production-ready engine families available to meet the Proposed 2007 Standards in 2007. By adopting Interim Standards that are less stringent than the Final Standards (without losing air quality benefits, as discussed below), manufacturers gain much needed time to ensure that their engine families will be able to fully comply with the new, very-stringent standards and be production-ready for the marketplace. Moreover, any concerns with the maturity and readiness of NOx adsorber devices as an appropriate aftertreatment technology would be alleviated, as illustrated more fully below.

Engine manufacturers will not have the time or resources to investigate fully new potential technologies in aftertreatment that may be developed for the 2010 time frame. With EMA's proposal, early efforts will focus on compliance with the Interim Standards and preparation of production-ready engines, using the technology expected to be available. Those technologies can then be improved, refined and optimized to meet the Final Standards.

EMA's proposal also addresses the very important competitive obstacles that EPA's proposed four-year phase-in raises. Under EMA's proposal, all manufacturers would be required to meet the same standards for all of their engine families. Engine manufacturers would not have to expend time and resources attempting – and most likely failing – to accurately predict how the marketplace will act or react. Market disruptions would be minimized to the extent possible, and manufacturers would not unnecessarily risk suffering substantial financial harm.

EMA's proposal also would alleviate problems with market disruptions arising from the relationships between engine and truck manufacturers and between truck manufacturers and truckers, the ultimate customer. While engine manufacturers may attempt to control and manage product availability from their perspective, truck manufacturers and truck owners and operators may have differing interests and thereby complicate the marketing and availability of products even further. EMA's proposal simply eliminates those

[74] As discussed elsewhere in EMA's comments, EMA does not support the adoption of formaldehyde standards for heavy-duty diesel engines, as they are unnecessary and would greatly increase engine manufacturers' certification costs without any demonstrated benefit.

problems. It also eliminates any need for either engine manufacturers or vehicle manufacturers to maintain dual product offerings throughout the four-year phase-in period.

EMA's proposal also would minimize development, testing, and certification costs. As discussed above, EPA's proposed phase-in would require redevelopment, re-testing, and re-certification of engine families each year throughout the phase-in. Under EMA's proposal, all engines would be required to be certified to a technologically feasible PM standard, once determined, and the applicable NOx and NMHC standards in two discrete steps. The standards should be implemented such that manufacturers would be afforded at least three years of stability in the intervening years.

EMA's proposal also eliminates the issue of whether EPA's phase-in complies with the 3-year period of stability requirement established by the CAA. EPA's proposed phase-in schedule would require manufacturers to redevelop and re-certify new engine families able to meet the percent-of-sales requirements in each of four subsequent years. With new changes required every year, the proposed phase-in would violate the three-year period of stability requirement for new standards established by Congress in the CAA. Although EPA may argue that its proposal is "optional," and, therefore, not subject to the period of stability requirement established in the CAA, engine manufacturers, as a realistic matter, would have no other option than to comply with the phase-in provisions because of technology limitations and competitive pressures. It is uncontroverted that engine manufacturers cannot comply with the 0.20 g/bhp-hr NOx standard across the board in 2007. EMA's proposal would eliminate any stability questions, as the Interim Standards would be effective for at least a three-year period, and the Final Standards would be effective thereafter. (EMA)

> **Agency Response:** In the past, the U.S. EPA and the ARB focused more on reducing NMHC emissions than NOx emissions. However, due to health concerns from NOx emissions and ozone concerns, the ARB is once again separating NOx and NMHC emission standards. This is expected to result in a more effective program to reduce emissions of both air contaminants. Therefore, no further changes to the adopted requirements are necessary.
>
> The commenter also notes that "engine manufacturers will not have the time or resources to investigate fully new potential technologies in aftertreatment that may be developed for the 2010 time frame." By adopting one NOx emission standard that applies to 50% of heavy-duty engine production for three years, engine manufacturers are provided with the requested stability in emission standards. Further, engine manufacturers are only required to research control technologies to achieve one emission level, rather than two. Therefore, no further changes to the adopted requirements are necessary.
>
> As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured or are already in-use. Current technology with some improvements may be required. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR,[75] Section 6, and the U.S. EPA's RIA,[76] Chapter 3. Both discussions

[75] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[76] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control

specify NOx adsorbers as promising NOx reduction technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

(ii) Emission standards level and emission benefits.

110. **Comment:** EMA proposes that the Interim and Final Standards can – and should – be set at levels that provide the same general emission benefits that EPA determines to be otherwise technologically feasible for the standards phased in 25% per year over four years.

EPA has failed to justify the extremely low emission limits of the Proposed 2007 Standards. Before finalizing any aspect of this rulemaking, EPA must re-examine the emission limits it has proposed not only in the context of FTP compliance, but especially taking into consideration the measurement issues that have not yet been addressed and the new Supplemental Emission Requirements that were made available only days before the comment period on this proposed rule closed. Nowhere in the rulemaking record is there any evidence that EPA considered the feasibility of its proposed emission limits under the increased stringency of the new Supplemental Emission Requirements or with any recognition for the margin of error associated with EPA's current measurement procedures. EMA believes EPA will find that the proposed standards cannot be justified in 2007 (or 2010) and that, in fact, the most technologically feasible, cost-effective standard will be found at a level higher than what EPA has proposed.

EMA recommends that EPA adopt Interim and Final Standards for NOx (and NMHC+NOx) at levels determined to be technologically feasible. As discussed above, and as recognized by EPA in the Draft RIA, NOx aftertreatment technology is at an early stage of development. While some technologies – specifically NOx adsorbers – have been demonstrated to be effective at significantly reducing NOx on some engines, the path to full application of NOx adsorber technology to the complete range of HDDEs, and the integration of that technology into production-ready, durable, and reliable engine product, is a long and arduous one.

EMA anticipates that its recommendations for a two-step implementation of NOx reductions may engender responses from some in the oil industry that low sulfur diesel fuel would not be needed in 2006. To the contrary, EPA's proposed 0.01 g/bhp-hr PM standard by itself requires the nationwide availability and use of ultra-low sulfur diesel fuel. As discussed above, PM aftertreatment devices will be needed to meet the proposed 0.01 g/bhp-hr standard. And, ultra low sulfur fuel is necessary for the effective use of PM aftertreatment and to prevent the severe damage that can occur to engine and aftertreatment systems with the use of higher sulfur fuel. Ultra-low sulfur fuel also is necessary for engines employing cooled EGR, which will be used even prior to 2007.

Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

EMA recognizes, however, that NOx aftertreatment also is a key driver for ultra low sulfur fuel. Under EMA's proposal, there is a likelihood that both PM and NOx aftertreatment, independently, would justify the need for ultra low sulfur fuel. In contrast, under EPA's proposed phase-in, by definition, 75% of all engines would not immediately require ultra low sulfur fuel to achieve NOx reductions.

Once EPA has determined the appropriate, technologically feasible emission levels, then the alternative program can be designed with numerical limits (Interim Standards and Final Standards) that will attain the same general environmental benefits to be attained by EPA's proposal for standards phased in 25% increments over four years.

As part of EMA's proposed alternative and as discussed elsewhere in EMA's comments, EPA also should adopt an optional combined NMHC+NOx standard and should revise the proposed averaging, banking and trading program to make it fully usable and effective for engine manufacturers.

EMA's proposal will match the air quality benefits that would be achieved with EPA's phase-in plan, but would do so in a more logical and cost-effective manner.[77] EMA's proposal demonstrates that significant emission reduction goals can be reached in a cost-effective and logical manner without causing undue damage to engine manufacturers, vehicle manufacturers, and the marketplace. (EMA)

> **Agency Response:** As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured or are already in-use. Current technology with some improvements may be required. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR,[78] Section 6, and the U.S. EPA's RIA, [79] Chapter 3. Both discussions specify NOx adsorbers as promising NOx reduction technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.
>
> The emission standards and phase-in were adopted by the U.S. EPA in consideration of the emission benefits. The ARB has adopted the same emission standards and phase-in period that were adopted by the U.S. EPA. Since there are no changes to the requirements, there is no detrimental effect to net emission benefits. Emission benefits are summarized in the ARB's ISOR[80], Section 10. Further emission benefits may be obtained if engine manufacturers

[77] In fact, EMA's proposal would improve on EPA's proposal because EMA's proposal provides more benefits in the early years.
[78] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[79] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.
[80] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.

utilize the adopted averaging, banking, and trading provisions. Also see Agency Response to comments #99-#101 and #102-#104. Therefore, no further changes to the adopted requirements are necessary.

(iii) Phase-in.

111. **Comment:** The ARB is proposing to implement the new emissions standards and test procedure for HDDEs by phasing them in at the rate of 25% in 2007, 50% in 2008, 75% in 2009 and 100% in 2010 with no consideration given to small volume manufacturers. Clearly, with only a single product and very low sales, we have no ability to phase-in compliance over several multiple years. Traditionally, the ARB has recognized the special problems faced by small volume manufacturers in developing and implementing new control strategies and has in turn provided additional flexibility by allowing small volume manufacturers to come into compliance at the 100% level in the final year of the phase-in. This policy of allowing small volume manufacturers to come into compliance in the final year of the phase-in has and will continue to be critical to the survival of small companies like GEP. ARB needs to recognize that those companies developing new emissions control technologies capable of meeting 2007 emissions standards will focus on the needs of the large engine manufacturers in the early years of the phase-in. Without question, it will be very difficult for us to obtain the services of technology providers for such low production runs in the 2007/2008 timeframe. We simply don't have the clout with the suppliers to gain their attention.

Because of this, we respectfully request that CARB consider amending its proposal so that small volume manufacturers have the option of complying at the 100% level beginning with the 2010 model year without having to meet the compliance requirements for the early years of the phase-in. Alternatively, we ask that CARB allow manufacturers selling fewer than 1,000 units per year in California to come into compliance starting in 2010 at the 100% level. (AMG)

Agency Response: The commenter proposed a compliance requirement that delays compliance until the final year of the phase-in. The comments are similar to those submitted to the U.S. EPA. Similar to the U.S. EPA (response to comment 3.1.4(J)), the ARB believes that existing flexibilities for compliance, as well as adopted ABT provisions, will not hinder the survival of these small manufacturers. Further, a delay in implementing the requirements would hinder the ARB's efforts to attain the State and federal air quality standards since HDDEs are in-use for long periods of time. Aligning California requirements with federal requirements will ensure that consistent products will be produced on a national basis. This will also allow increased production runs and, thus, increased clout for the smaller manufacturers during the phase-in period. Therefore, no change to the regulatory text is necessary.

112. **Comment:** NRDC Strongly Supports the Proposed Emission Standards for PM, NOx and Other Emissions from Diesel Vehicles and Engines in 2007—But With No NOx Phase-In.

NRDC strongly supports EPA's proposed new standards for particulate matter and nitrogen oxides (0.01 grams-per-brake-horsepower-hour (g/bhp-hr) for PM and 0.2 g/bhp-hr for NOx, respectively). However, NRDC has strongly urged EPA to eliminate the four-year phase-in of the NOx standard. NRDC also supports and applauds EPA's

other proposed emissions standards (e.g., non-methane hydrocarbons, formaldehyde, complete vehicle standards, gasoline standards), as well as EPA's decision to include turbocharged diesels in the existing crankcase emissions prohibition.[81]

First, by 2007, low-sulfur diesel fuel will be available nationwide, so there will be no fuel barrier to the national use of the most advanced PM and NOx controls. Second, implementing all of the new standards at the same time will minimize the cost and burdens of compliance. With one national, industry-wide compliance date, these companies will not have to maintain multiple production and record-keeping operations, nor will EPA have to investigate the sales records of every truck and bus seller in the nation. Third, other low-emission heavy-duty activities around the world—from the ARB's urban bus standards to various upcoming European national and European Community low-sulfur diesel requirements[82]—will have created momentum for the commercialization of advanced emission control technologies elsewhere that will be applied to meeting EPA's requirements. Fourth, states around the nation will be relying on the new NOx standards to meet ozone attainment and maintenance deadlines over the course of the decade. Public health imperatives in these states, combined with these states' legal obligation to meet their attainment and maintenance deadlines, require the implementation of the proposed NOx standard as expeditiously as practicable. (ALA)

> **Agency Response:** The adopted requirements harmonize federal and state requirements for HDDEs beginning in the 2007 model year. The adopted requirements are identical to those adopted by the U.S. EPA in January 2001.
>
> As discussed in the U.S. EPA's Response to Comments, the phase-in allows engine manufacturers the flexibility to introduce NOx emission control technology on only half of their engines. This is expected to increase the resources directed at those particular engine families and ensure the effectiveness of the emission control systems. Further, the phase-in will allow the new technology to be equipped on engines that are most compatible with the new emission control systems, allowing additional in-field experience and testing for development of the remaining engines. This provision should be more cost effective than without a phase-in.
>
> The ARB agrees with the commenter that the ARB's urban bus requirements are expected to create momentum for manufacturers of aftertreatment based emission control systems. The urban bus requirements will allow manufacturer's to test aftertreatment systems in-use and further develop the systems during the phase-in period.
>
> The ARB also agrees that States, including California, will rely on these reduced emission standards to attain and maintain ozone standards. As stated in the staff report, NOx and HC are both precursors to the formation of ozone. By

[81] NRDC notes that EPA should not take any actions in this rule-making that would preclude further reductions from diesel engines and vehicles that may be necessary under EPA's mobile source air toxics program.

[82] Sweden's Class I diesel is capped at 10 ppm sulfur; tax incentives are quickly reducing the sulfur in the diesel fuel supplies of the United Kingdom and Germany to a cap of 10 ppm; and the European Community is considering moving to a 10 ppm cap in the 2007-2008 time frame.

reducing NOx by 90 percent and NMHC by 72 percent, these requirements will help in California's efforts to reduce ozone. Therefore, no further changes to the regulatory text are necessary at this time.

(iv) Alternative technologies.

113. **Comment:** The California Electric Transportation Coalition of California applauds the ARB for adopting more stringent emission standards for HDDEs. However, very -- several very low or zero emission technologies which are in existence today, as well as some that are close to commercialization, are excluded from this regulation, as well as the averaging, banking and trading portion of the regulation. Battery electric heavy-duty vehicles, fuel cells and hybrid electric vehicles could easily meet these new stringent emission standards. Since they do not represent engine families, but rather the vehicle power trains, they've not been considered as part of the technology to meet these standards. (ADL / CETC)

114. **Comment:** In addition, they (battery electric heavy-duty vehicles, fuel cells and hybrid electric vehicles) are not eligible to receive credits from either of the early adoption or the reduced family emission levels. Obviously, several issues arise for technologies for these electro technologies, such as what test cycle to use, and who should receive the credit. Cal ETC believes that these issues will take time to resolve, but they are not insurmountable, and they can provide incentives to commercialize these electro technologies. (ADL / CETC)

115. **Comment:** Cal ETC suggests that the proposed emission standards be adopted as is, but in the future that ARB staff include electro technologies as an option to meet these standards, and to work on mechanisms to provide credits for those electro technologies. Although we are raising this issue today with the 2007 heavy-duty diesel emission regulations, we believe ARB should include electro technologies as an additional option to meeting other regulations based on engine families. Cal ETC is pleased to provide any support needed to have ARB include these technologies and the average banking and trading portion of the 2007 emission standards, as well as any other emission-based regulations. (ADL / CETC)

116. **Comment:** We urge you to not loose sight of the important role for fuel cells, batteries and other advanced technologies in the heavy duty market. We urge you to accompany this rule with programs to encourage the development and commercialization of advanced technology, ultra-low and zero emission heavy-duty vehicles. (American Lung Association of California)

117. **Comment:** Emissions test data demonstrates a gap between certification and in-use emissions for HDDEs. This gap does not appear to exist for engines powered by alternative fuels, such as natural gas.[83] For example, the staff of the ARB concludes that diesel transit buses currently have in-use particulate emissions of approximately 0.23 g/mi, over ten times the 0.02 g/mi for natural gas buses[84]—even though the diesel

[83] Based on data from the Alternative Fuels Data Center. www.afdc.doe.gov and Engine, Fuel, and Emissions Engineering, Inc. *The Cleaner Choice: Natural Gas as a Substitute for Diesel*, September 1999.

[84] CARB. Proposed Regulation for a Public Transit Bus Fleet Rule and Emission Standards for New Urban Buses, Staff Report: Initial Statement of Reasons, December 1999.

buses certify to PM levels only two to three times higher than their natural gas counterparts.

Zero-emission technologies, such as the fuel cell buses expected to be commercial by the time EPA's rule goes into effect, offer substantial, guaranteed air pollution benefits while also eliminating toxic emissions from the tailpipe, substantially cutting emissions of greenhouse gases over the total fuel cycle, and reducing reliance on foreign oil. Other advanced technologies, such as hybrid-electric vehicles, may also offer in-use emissions benefits if they are designed to reduce engine operating characteristics that lead to high emissions rates. (ALA)

118. **Comment:** These intrinsically cleaner options are currently being demonstrated throughout the country in applications such as medium duty delivery vehicles, school buses, transit buses and waste haulers, and wider applications are expected within the next few years. We have urged EPA to ensure that its rule does everything it can to encourage these technologies and fuels by (a) revising to its averaging, banking and trading ("ABT") program (a program that permits engines that beat EPA's standards to generate marketable credits); (b) creating a separate, more stringent emissions standard for fleet vehicles (historically, transit buses have met more stringent emissions standards than other heavy duty vehicles, thereby providing greater health protection from diesel emissions in high-population urban centers); and/or (c) creating optional low-pollution standards (following California's lead, EPA should adopt optional low-pollution standards for diesel engines that would encourage the development of even lower-polluting engines, taking toxic and greenhouse gas emissions into account). (ALA)

119. **Comment:** NRDC believes strongly that the Proposal—and EPA's overall program to reduce diesel emissions—can be improved by adding a series of incentives for the increased use of advanced technology and alternative fuel vehicles in urban fleets, especially transit buses, sanitation trucks and delivery vehicles. (ALA)

Agency Response to Comments 113-119: The adopted requirements harmonize federal and state requirements for HDDEs beginning in the 2007 model year. At this time, the U.S. EPA has also excluded battery electric, fuel cells and hybrid electric vehicle technologies from incentives in the adopted requirements, such as the averaging, banking and trading program. Since there are other programs that offer monetary incentives for these technologies, there is no need to further duplicate the incentives and credits available for such vehicles. Further, since there still exist technical barriers for the alternative technologies, it is still too early to include such options in the averaging, banking and trading program. The ARB may consider these advanced technologies in the development of future HDD rulemaking proposals. However, the focus of the adopted requirements is to ensure that the prevalent diesel technology runs as clean as possible in the 2007 and subsequent model years.

Similar to the federal requirements, the adopted requirements also include incentives to introduce lower emitting engines earlier than required. This includes an early introduction credit program and a "Blue Sky Series" engine program. Both give incentives to introduce complying engines earlier than required. Therefore, no further changes to the regulatory text are necessary at this time.

2. Heavy-Duty Gasoline Engine And Vehicle Standards

120. **Comment:** EPA has proposed a set of standards to be effective for heavy-duty gasoline engines and vehicles in model year 2007. There are a number of issues surrounding EPA's proposal for heavy-duty gasoline engines and vehicles, some of which differ from those for HDDEs and HDDVs. (EMA)

121. **Comment:** EPA has proposed new standards to be effective for heavy-duty gasoline engines and vehicles in 2007. (Section 86.007-10.) EPA previously proposed new heavy-duty gasoline engine and vehicle standards to be effective for 2004. Finally, eight months after the rule was to be finalized, EPA has finalized the 2004 heavy-duty gasoline engine and vehicle standards ("2004 HDG Standards"). As a result, EPA cannot make the 2004 HDG Standards effective for the 2004 model year without violating the four full years' leadtime required by the CAA. The first time it would be mandatory for those standards to be effective would be for the 2005 model year.

    The CAA further requires that EPA provide a three-year period of stability for all new mandatory heavy-duty engine and vehicle standards. If the 2004 HDG Standards are finalized in time to have a mandatory effective date for the 2005 model year, the absolute first time that the Proposed 2007 Standards could be effective for heavy-duty gasoline engines and vehicles ("2007 HDG Standards") would be the 2008 model year. EPA must be certain that the 2007 HDG Standards are effective no sooner than the 2008 model year. And, if the 2004 HDG Standards are not finalized in time for the 2005 model year, then EPA has no other choice but to push back the 2007 HDG Standards even farther to assure the necessary three-year period of stability. (EMA)

122. **Comment:** EPA has proposed a 0.20 g/bhp-hr NOx standard for heavy-duty gasoline engines. EPA has provided little basis or analysis for the technological feasibility of such an extremely stringent NOx standard for HDG engines. EMA believes the proposed standard simply is not feasible.

    EPA has stated its belief that the technology that engine manufacturers are developing in order to meet the Tier 2 gasoline engine standards will automatically be sufficient to meet the 2007 HDG standards for heavy-duty engines. Even if manufacturers were certain they could achieve the Tier 2 light-duty standards, the technology cannot be assumed to be sufficient to achieve the levels of reductions sought for heavy-duty gasoline engines in 2007.

    Furthermore, EPA cannot simply assume that the same standard is appropriate for heavy-duty gasoline engines as may be appropriate for HDDEs. Even if gasoline and diesel engines could achieve the same levels, EMA has already detailed elsewhere in its comments the significant concerns it has with the technological feasibility of the proposed NOx standard for 2007 and later diesel engines.

    Gasoline engine aftertreatment technology that will be required to meet the proposed standards is subjected to emissions deterioration over the useful life of the engine/vehicle. Because of the deterioration realities, engine manufacturers must design gasoline engine and aftertreatment systems to achieve emissions performance at least 50% below the standard, in order to provide the necessary assurance that in-use engines will comply with the standard for their full useful life. The proposed standards would require NOx catalyst efficiencies to be maintained above 98% over the useful life,

thus essentially requiring catalysts that are indestructible and do not deteriorate. EMA is not aware of any catalyst technology that can meet this requirement.

The burdens imposed on heavy-duty gasoline engines to attempt compliance with those standards also are significant. Heavy-duty gasoline engines represent only a very small portion of the heavy-duty market. In 1998, for example, heavy-duty gasoline engines accounted for approximately only eleven percent (11%) of the market for vehicles greater than 14,000 lbs. GVWR, with HDDEs comprising the remainder of the market (45,757 vs. 351,509 units[85]).

EMA recommends that EPA adopt a combined NMHC+NOx standard of 1.0 g/bhp-hr. Such a standard would represent a 33% reduction from current voluntary standards under discussion with EPA for the pre-2005 time frame. Moreover, a combined standard should be adopted for heavy-duty gasoline engines for the same reasons set forth for HDDEs above. (EMA)

123. **Comment:** EPA has proposed the same emission standards across the board for all 2007 HDG engines certified on the engine dynamometer. EPA's proposal does not recognize the inherent differences in technology that are required to meet the standards in vehicles over 14,000 lbs. GVWR with heavier weights and at higher loads.

Heavy-duty gasoline (Otto-cycle) vehicles, with their wide and varied usage in the field, can experience a wide range of load duty cycles from light to very heavy. Otto-cycle engines used in vehicles over 14,000 lbs. GVWR have vastly different operating conditions than those used in engines $\leq$ 14,000 lbs. GVWR. Moreover, the higher load duty cycles of vehicles over 14,000 lbs. cause differences in engine operating characteristics and emissions. The technology used to control emissions in HDG engines is not likely to be the same for engines in vehicles less than versus greater than 14,000 lbs. EPA has not provided any analysis or justification for requiring the same set of standards across the board for all heavy-duty gasoline engines.

Moreover, EPA also has not justified its proposal to require emissions from incomplete vehicles to meet the same or similar standards as those for complete vehicles across the board. EPA indicates its belief that the engine technology the Agency expects manufacturers to use for incomplete vehicles would be similar to that used for complete vehicles. EPA has not provided any justification for that statement or for the technological feasibility of the emission levels proposed for incomplete vehicles.

There are many differences between incomplete vehicle and complete vehicle technology, and further differences between technology for less than and greater than 14,000 lbs.-GVWR vehicles which EPA must take into account. Those include catalyst configuration, higher in-use temperatures for vehicles over 14,000 lbs. GVWR, air pump characteristics, the use of exhaust gas recirculation, and basic calibration differences. EPA must recognize and account for those differences, and finalize two sets of standards for HDG engines used in vehicles less than and greater than 14,000 lbs. GVWR, based on an appropriate analysis of the technological feasibility and cost-effectiveness of those standards. EPA must conduct a similar analysis for the differences between incomplete and complete vehicles to arrive at appropriate standards for each category of heavy-duty gasoline engine and vehicle. If EPA adopts a 1.0 g/bhp-

[85] Numbers taken from *Ward's Motor Vehicle Facts & Figures 1999*.

hr NMHC+NOx standard, as recommended earlier, EMA concludes that a single standard for above and below 14,000 lbs. GVWR will be feasible for manufacturers to meet. However, if EPA adopts standards below 1.0 g/bhp-hr, then EPA will need to adopt higher engine standards for vehicles over 14,000 lbs. GVWR to account for the issues described above. (EMA)

124. **Comment:** EPA has proposed to continue a completely unnecessary idle CO emissions standard for heavy-duty gasoline engines and vehicles. EPA has proposed no justification for continuing such a requirement. Continuing such a requirement would be completely unnecessary and a waste of precious resources. (EMA)

125. **Comment:** ARB's proposal appears to apply only to heavy-duty diesel engines. The Staff summary indicates that only heavy-duty diesel engines are subject to the new 2007 emission standards. The summary does not contain any reference to the regulation of heavy-duty Otto-cycle and alternative-fuel engines. Indeed, the title of Mail Out #MSC-01-08 and the section on emission standards reference only heavy-duty diesel engines. EPA's proposed and final 2007 Rule, however, includes new standards and other provisions for heavy-duty Otto-cycle and alternative-fuel engines as well.

    If it is not ARB's intent to provide new regulations for Otto-cycle and alternative fuel engines identical to those of EPA, then that intent should be made clear. If, however, ARB does intend to regulate Otto-cycle and alternative fuel engines in alignment with the EPA final 2007 Rule, then ARB should clearly so indicate. If engine manufacturers and other interested parties had been given the opportunity to review proposed regulatory text, perhaps ARB's intent would have been more clear. As it is, without reviewing the text, EMA cannot provide additional comment on the proposal. (EMA)

    Agency Response to Comments 120-125: No alternative fuel or any heavy-duty gasoline engine and vehicle requirements were proposed or adopted as part of this rulemaking. These comments are outside the cope of, and therefore irrelevant to, this rulemaking. Therefore, no further changes to the adopted requirements are necessary.

    a. Nationwide availability and use of California Phase III reformulated gasoline, with a 30-ppm sulfur cap, to meet the proposed 2007 HDG Standards.

126. **Comment:** EPA has proposed standards for heavy-duty gasoline engines and vehicles in 2007 that are similar to, and in some cases more stringent than, the standards adopted by California under the LEV II program. A significant difference, however, is that California provides for the use of Phase III reformulated gasoline with a 30 ppm sulfur cap, and an average sulfur level of 20 ppm (beginning in 2004). Under EPA's Tier 2 light-duty proposal finalized last year, gasoline fuel sulfur will be capped at a higher level of 80 ppm, with an average of 30 ppm (beginning January 1, 2006).

    EPA has not assured in this rulemaking that the appropriate low sulfur fuel will be available to meet the proposed 2007 HDG Standards. The availability only of 80 ppm sulfur gasoline causes the proposed 2007 HDG Standards to be significantly more stringent than the California LEV II standards. Moreover, the higher sulfur gasoline will cause substantial difficulties with emission control technologies that will be needed to

meet the standards. EPA has not shown that the 2007 HDG Standards will be feasible with 80 ppm sulfur gasoline.

EMA recommends that EPA adopt the California Phase III reformulated gasoline fuel standard nationwide, with a sulfur cap of 30 ppm, to be effective no later than mid-2006 in order to comply with the proposed 2007 HDG Standards. In the alternative, if EPA does not adopt a change in the gasoline sulfur level for 2006, EPA must, at a minimum, allow all emission testing to be conducted on California Phase III reformulated gasoline, along with allowing vehicles to undergo additional preconditioning to burn off sulfur from emissions components. In the alternative, the standards must be adjusted upwards to account for reduced emissions component performance. (EMA)

Agency Response: The comments above are directed to the U.S. EPA regarding reformulated gasoline and, thus, are outside the scope of, and irrelevant to, this rulemaking. No reformulated gasoline requirements were proposed or adopted as part of this rulemaking. Therefore, no further changes to the adopted requirements are necessary.

3. Closed Crankcase Requirement.

127. **Comment:** EPA's proposed crankcase requirement has a potentially deleterious effect on the ability of heavy-duty engines and vehicles to meet the Proposed 2007 Standards for the full useful life. It is clear that the vast majority of the emissions are in the form of lube oil vapor and, thus, do not represent an air quality problem. Recirculating this effluent to the engine intake will, on the other hand, have a number of deleterious effects which will degrade engine performance and emission control.

Moreover, the regulatory language is unclear. If crankcase emissions are routed to the intake manifold, and if any of the crankcase emissions survive the combustion process and are emitted into the atmosphere along with the combustion exhaust products, it is not clear whether such an approach would violate the proposed requirement. Similarly, it is not clear whether routing crankcase gases to the exhaust manifold and then emitting them into the atmosphere with the combustion exhaust products also would violate the proposed requirement. EMA has serious concerns, however, even with such an approach; EMA does not believe routing crankcase emissions to the exhaust system would be technologically feasible because exhaust back pressure is higher than crankcase pressure, thereby prohibiting crankcase emissions from entering the exhaust.

At a minimum, the closed crankcase requirement would require improved engine lubricating oils. Engine manufacturers have initiated a research program in cooperation with the Department of Energy, the petroleum industry, and catalyst suppliers. The Advanced Petroleum Based Fuels – Diesel Emission Control program is studying catalyst-compatible lubricants. EPA should become familiar with and participate in this study to the extent possible, in order to help ensure that necessary advances are made in lubricating oils to keep up with advancing engine technology.

Engine manufacturers do not believe it is technologically feasible to achieve the proposed NOx and PM emission standards for the full useful life of a heavy-duty engine in the face of a requirement to recirculate crankcase emissions. EMA recommends that the Agency eliminate this element of the proposal until a demonstration of feasibility is completed. Such a demonstration should be done on a heavy HDDE which, due to the

435,000-mile useful life requirement, would represent the most difficult case in which to meet such a requirement.

If EPA proceeds with provisions which require controls in crankcase emissions, EMA recommends that EPA simply require manufacturers to combine crankcase emissions with exhaust emissions for test purposes and for demonstrating compliance with applicable emission standards during certification and verification testing. This would provide manufacturers needed flexibility while still controlling both crankcase and exhaust emissions. A manufacturer would have the option of routing crankcase emissions to the intake, routing crankcase emissions to the exhaust or emitting the crankcase emissions directly into the atmosphere as long as when these gases are combined with the exhaust the applicable standards are met. If this approach is taken, the standards which EPA finally promulgates must be shown to be feasible when crankcase emissions are accounted for in this way. (EMA)

128. **Comment:** EPA's proposed method for controlling crankcase emissions is to simply prohibit their discharge into the ambient atmosphere. This is confusing and impractical – simply commanding a result falls far short of EPA's statutory obligation to explain how it can be achieved. Methods for the control of crankcase emissions involve trapping such emissions and/or redirecting them into the intake or exhaust so that some are eventually emitted via the exhaust pipe. A properly developed requirement should allow the emission of crankcase gases provided they are measured and controlled in conjunction with the engine's exhaust emissions. As worded, EPA's proposal would lead to confusion over whether crankcase emissions could or could not reach the atmosphere by way of the engine's exhaust system.

    EPA has neither justified the need for, nor analyzed the technological feasibility of, any type of crankcase emissions control. EPA envisions Closed Crankcase Ventilation (CCV) systems with 90% removal efficiency with the remaining gases being redirected back to the engine intake or exhaust. In our own laboratory analysis, when utilizing an absolute filter as a means of determining the system oil removal efficiency, the system's performance did not meet the claims of 90% efficiency.

    Even more important than overall system efficiency is the mass of oil that is not removed from the crankcase vent stream and is carried into either the inlet of the turbocharger or into the exhaust system as identified by EPA. It would be much more difficult to achieve the proposed levels of control throughout the engine's useful life due to the loss of engine efficiency. Both phenomena lead to higher engine out NOx levels. Introduction of crankcase emissions to the exhaust system ahead of aftertreatment devices would have a similar fouling effect but as a result of sulfur and ash content in the lube oil. This would be of particular concern during long periods of light load.

    Cummins recommends that EPA better develop a proposal for the control of crankcase emissions addressing justification, practicality, and feasibility. (Cummins)

129. **Comment:** ARB's proposal inaccurately describes crankcase emissions provisions. In discussing requirements for crankcase emissions, the Staff summary of the proposal does not fully describe the crankcase emissions provisions as finalized by EPA and, thus, appears to be different from the EPA requirement. Under the EPA final 2007 Rule, crankcase emissions may be discharged into the atmosphere (*i.e.*, downstream of the exhaust aftertreatment device, not just upstream) in certain circumstances, provided

those emissions are accounted for in the exhaust emissions measurement, either physically or mathematically. The Staff summary only references the return of crankcase emissions to the engine inlet or upstream of the emission control device, implying that such emissions are not allowed downstream of aftertreatment. That approach is inconsistent with the EPA final 2007 Rule and must be revised. (EMA)

Agency Response to Comments 127-129: As stated in the ARB's ISOR,[86] Section 10, crankcase emissions do present an air quality concern. As stated in the staff report, a single diesel engine can emit up to 100 pounds of NOx, NMHC, and PM from the engine's crankcase over its lifetime. Further, testing by the U.S. EPA for their RIA[87] shows crankcase emissions of 0.01 grams per brake horsepower-hour for NOx, NMHC, and PM.

The U.S. EPA considered the commenter's recommendation to allow crankcase emissions to be vented to the engine's exhaust. Engines with aftertreatment systems may vent the crankcase emissions upstream or downstream of the aftertreatment device. However, engines will still need to comply with the adopted emission standards and test procedures. Due to the low emission standards that have been adopted, the ARB does not expect engine manufacturers to vent crankcase emissions downstream of the aftertreatment device.

Consequently, the ARB does consider the regulatory language to be clear by allowing engine manufacturers to vent crankcase emissions to the engine compartment, route the emissions to the exhaust stream, or route the emissions to the air intake of the engine. In either case, crankcase emissions will be added to total exhaust emissions and will likely need some method of control detailed in the ARB's ISOR and the U.S. EPA's RIA. Additionally, there are systems available for crankcase ventilation that do not affect durability and others that can remove almost all lube oil vapor from the crankcase exhaust. These systems route the filtered crankcase exhaust back into the air intake without damaging the turbo compressor or charge air cooler. Further, requirements for lubricating oils is outside the scope of this rulemaking. Therefore, no further changes to the adopted requirements are necessary.

4. Technology Review.

130. **Comment:** EPA should not incorporate a technology review into the final 2007 Standards. EPA should not use a future technology review as a substitute for a thorough analysis now of the technological feasibility of the proposed standards. Moreover, a technological feasibility review would only create more uncertainty for engine manufacturers than already exists. Such a review would effectively prevent engine manufacturers from fully developing and investing resources toward achieving the standards finally adopted, because those standards may change in the future. EPA should not conduct a technology review. (EMA)

[86] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[87] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

Agency Response: Although the ARB has not committed to an official Technology Review, the ARB will examine any findings from the U.S. EPA's Technology Review. As a result, on a case-by-case basis, the ARB may propose changes to the adopted requirements. Regardless of any results from the Technology Review, engine manufacturers should expect and develop technologies necessary to comply with the adopted requirements. Therefore, no further changes to the adopted requirements are necessary.

5. Non-Conformance Penalties.

131. **Comment:** EPA also should establish non-conformance penalties ("NCPs") now, as part of this rulemaking. With the unprecedented percent reduction in NOx and PM emission limits for heavy-duty engines and vehicles sought by EPA's proposal, fundamental changes in engine technology and the integration of new and untested aftertreatment systems with engine technology will be required. EPA's proposed new standards and requirements will be technology-forcing and almost certainly will result in the inability of some engine manufacturers and/or some engine families to comply with the standards.

At the extremely stringent emission levels proposed, even under EMA's two-step standard proposal, NCPs are essential to assure that manufacturers are able to participate in the market and meet customer needs. In addition, the amount of the penalty and the degree to which the non-conforming engine family may not exceed the applicable standard must be established well in advance of the implementation date of the standards if manufacturers are to effectively factor in the availability of such penalties in their engine development programs. The size of the penalties must be established using the same cost estimates used to establish the cost of the proposed regulation. (EMA)

Agency Response: The requirements that have been adopted by the ARB are identical to those that were adopted by the U.S. EPA to ensure conformity of requirements throughout the U.S. Non-conformance penalty requirements for 2004 and subsequent MY engines have just been adopted by the U.S. EPA and may be considered by the ARB. At this time, there are no plans by the U.S. EPA or the ARB to adopt NCPs for 2007 and subsequent MY engines. There still remains sufficient time for engine manufacturers to further refine the expected aftertreatment based emission control technologies. Further, no evidence is provided to show that engine manufacturers will exceed the standards to gain a competitive advantage over other engine manufacturers. At this time, no further changes to the adopted requirements are necessary.

C. Supplemental Emission Tests

132. **Comment:** In its NPRM, EPA proposes that the 2007 emission standards will be subject to a whole set of new, complex SERTs. EPA explains that those new concepts, key to the cost and feasibility of the Proposed 2007 Rule, have not yet been finalized, are likely to be changed, but still will be made a part of this rule. EPA apparently believes it is a perfectly sound approach to rulemaking to propose in one set of proposed rules (the 2007 NPRM) a still-moving target from another set of proposed rules (the 2004 NPRM). It goes without saying that proposing a proposal from somewhere else, which EPA acknowledges it will change and, then, finalize, does not provide interested parties the

kind of notice, opportunity for comment, and fundamental due process that is required by law.

Of course, EPA at once both acknowledges its due process failure and the need for notice and opportunity for comment when it states:

While the details of the final provisions are not yet available, we will provide the necessary information in the docket for this rule as soon as it becomes available in order to allow for comment. 65 Fed. Reg. at 35463.

EPA has done no such thing. The "Final Emission Standards for 2004 and Later Model Year Highway Heavy-Duty Vehicles and Engines" (the "2004 Final Rule") was signed on July 31, 2000, and posted on EPA's Web site on August 1, 2000. According to the Web site, the posted versions "are not the official Agency versions of the documents. The official versions will be published in the Federal Register, and the documents posted here may be slightly different from the Federal Register documents." Thus, EPA has warned that its Web site version should not be relied upon because it is not "official" and acknowledged that the Web site version not only is unofficial, but could still be changed. EPA did publish a Federal Register notice about the availability of the 2004 Final Rule – which presumably contains the detailed test procedures applicable for the proposed new emission standards which EPA failed to include with its NPRM – but only on August 3, 2000, leaving insufficient time to review and assess approximately a thousand pages of preamble, regulatory text, response to comments and regulatory support documents before the close of comments on this rulemaking. (65 Fed. Reg. 47706; Aug. 3, 2000.)

This is a monumental due process failure. EPA has failed to provide interested parties any meaningful opportunity to review the specifics of EPA's supplemental emission requirements, to assess them in the context of the proposed new emission standards and emission control technologies to which they will apply, and to comment on them. And, what is equally bad, if not worse, EPA has not done any of the necessary review and analysis itself.

The rulemaking record is devoid of any review and analysis by EPA or any of its contractors of the impact of the SERTs on the proposed new emission limits and control technologies or vice-versa (i.e., the impact of the limits and technologies on the supplemental requirements has not been reviewed or measured). That, too, is a fundamental failure on EPA's part. We are not simply stating that EPA could have done more. We are stating that EPA utterly failed to meet its responsibilities under section 307(d)(9) of the CAA.

In its NPRM, EPA indicated an intent to apply new supplemental emission requirements to EPA's proposed 2007 emission limits. But, it did not indicate with specificity what those requirements were or how they would apply or function in the context of new emission limits and new control technologies. In fact, EPA indicated that the supplemental emission requirement concepts that it referenced would be changed, then finalized, and then made available for comment as part of the 2007 NPRM. Based on a quick review of EPA's Web site, EPA certainly followed through on its promise to make changes. There are plenty of changes, although EMA and its members have not had sufficient time to assess those changes (or those elements that remain unchanged in the context of the new standards and technologies to which they will apply). And, so far, EPA has not yet followed through on its promise to officially publish the changes in the

Federal Register (although we have no reason to think EPA will not eventually get around to doing so). But, what now is obvious is that EPA has absolutely no intent of making the Final Rule available "in order to allow for comment."

On August 2, 2000, EMA representatives met with EPA Office of Transportation and Air Quality staff to discuss issues concerning the 2007 NPRM. At that meeting, EMA representatives expressed concern and raised objections about the inability of engine manufacturers to review, assess, analyze, and comment on the final supplemental emission requirements in the context of the Proposed 2007 Rule. Also at that meeting, we specifically asked for additional time to comment since the period for public comment on the NPRM was set to close on August 14, 2000. EPA refused to grant such additional time and, in fact, discouraged any further requests for additional time.

But, EPA must provide additional time. It simply is obligated to do so under basic principles of due process and fundamental fairness. EMA hereby officially requests that the rulemaking record on the proposed emission limits and the proposed supplemental emission requirements be re-opened for at least an additional 90 days to provide interested parties an opportunity to comment on the supplemental emission requirements in the context of the new emission limits and control technologies, and vice versa. Despite the inability to fully review and comment on the supplemental emission requirements, EMA will provide as many preliminary, incomplete comments as it can. (EMA)

133. **Comment:** The regulatory language that EPA has proposed regarding the supplemental standards contains numerous references to the proposed, but not yet finalized 2004 Rule. As discussed above, however, the 2004 Final Rule was not available for review until a mere *eight* (8) working days before the close of the comment period on this rulemaking, and then only in "unofficial" form on EPA's Web site. Because EPA has failed to provide engine manufacturers or other interested parties with any meaningful opportunity to review and comment, EMA's comments cannot be complete, as they are based on a broad brush look at the finalized Supplemental Emission Requirements. In addition to the very limited comments that EMA has been able to compile below, EMA also incorporates herein by reference its comments to EPA on the 1999 Feasibility Review. (*See* Statement of the Engine Manufacturers Association in response to "Control of Emissions of Air Pollution From 2004 and Later Model Year Heavy-Duty Highway Engines and Vehicles; Revision of Light-Duty Truck Definition, Proposed Rule," Docket No. A-98-32, December 2, 1999; hereafter "EMA Comments on 1999 Feasibility Review".)

Further, it is impossible to comment meaningfully on the remainder of the 2007 NPRM with the availability of the applicable test procedures and requirements only eight working days before the close of the comment period. For the time period from publication in the Federal Register of the 2007 NPRM on June 2, 2000 until two months later, when the Supplemental Emission Requirements were finalized, EMA and other interested parties have had only an incomplete proposal to review. For two entire months – or, for two-and-a-half months counting publication on the EPA Web site in mid-May, 2000 – engine manufacturers have engaged in an exercise in near-futility, attempting to comment on standards that are based on test procedures and other add-on requirements that were not available for review until the last possible minute. While EMA has attempted to provide comment on all aspects of the NPRM, EPA's last-minute publication makes EMA's comments, unfortunately, of limited scope.

What engine manufacturers have been able to discern of the SERTs to date, however, is that they are technologically infeasible and create numerous unnecessary and redundant requirements. The SERTs are not mere add-on tests to assure compliance with the Proposed 2007 Standards, but constitute separate and more-stringent emission control standards in and of themselves. EPA has provided no justification for the technological feasibility of the proposed SERTs. Indeed, EPA has failed to demonstrate the technological feasibility, cost-effectiveness or overall efficacy of the SERTs. (EMA)

Agency Response to Comments 132-133: These comments concern matters regarding comment periods for the U.S. EPA's 2007 Final Rule, which occurred almost a year before this ARB rulemaking. The supplemental emission test procedures were introduced to the engine manufacturers and the public when the U.S. EPA's 2004 Heavy-Duty Rule was noticed (October 1999) and finalized (October 6, 2000). Virtually identical test procedures were also released for public comment (October 20, 2000) during the ARB's 2005 NTE and Euro III ESC rulemaking process.

Revisions to the supplemental test procedures that have been adopted by the ARB in this rulemaking are identical to the changes that have been finalized by the U.S. EPA in their 2007 Final Rule (January 18, 2001). ARB's Regulatory requirements for public notice of the proposed revisions were satisfied with a 45-day public notice that ended with a public board hearing (October 25, 2001). Technological feasibility for both the emission standards and the supplemental test procedures is discussed in both staff reports (Initial Statement of Reasons). Further, responses to comments regarding technological feasibility of the supplemental test procedures are included in Section IV.C. Therefore, no further changes to the adopted requirements are necessary.

134. **Comment:** NRDC believes strongly that the Proposal—and EPA's overall program to reduce diesel emissions—can be improved by ensuring that the NTE limits and other compliance mechanisms of the 1999 Consent Decrees do not expire in 2004. (ALA)

Agency Response: The adopted requirements harmonize federal and state requirements for HDDEs beginning in the 2007 model year. The adopted requirements are identical to those adopted by the U.S. EPA in January 2001. Further, the NTE test and other requirements that are part of the U.S. EPA's 1999 Heavy Duty Consent Decrees and California Settlement Agreements were adopted in previous ARB rulemaking on December 7, 2000. Those requirements extend the consent decree and settlement agreement requirements through the 2005 through 2006 model years, as the commenter requests. Therefore, no further changes to the regulatory text are necessary at this time.

135. **Comment:** NRDC notes approvingly that EPA recently finalized a rule (the "2004 Rule") that will require diesel engines to meet the NTE limits in last year's Consent Decrees, new OBD requirements, a steady-state emissions test and other compliance and enforcement mechanisms (collectively, the "compliance mechanisms"), beginning in 2007.[88] However, NRDC is deeply concerned that the final 2004 Rule may leave a

[88] EPA, Regulatory Announcement, Final Emission Standards for 2004 and Later Model Year Highway Heavy-Duty Vehicles and Engines, July 2000. See http://www.epa.gov/oms/regs/hd-

three-year gap between the termination of the Consent Decrees in 2004 and the industry-wide implementation of the NTE limits and other compliance mechanisms in 2007 under the 2004 Rule's implementation schedule. Thus, we have urged EPA to take steps to extend the Consent Decrees until the codification of the NTE limits and other compliance mechanisms are fully implemented in 2007. (ALA)

136. **Comment:** Even though the 2004 Rule is now final, NRDC stresses the importance of these points because of the interaction between the Consent Decrees, the 2004 Rule and this 2007 Proposal. It has been widely reported that at least some of the engine companies wish to weaken the NTE limits and perhaps other compliance mechanisms. NRDC continues to urge EPA to maintain a rigorous commitment to these mechanisms because they are the public's best protection against the kind of emissions "cheating" practiced throughout the 1990s and because they will help assure the public that real world, in-use emissions are being reduced as a result of the Proposal's new emissions standards and other provisions. To the extent that competitive issues underlie the companies' request for relief from the Consent Decree's NTE limits and other compliance mechanisms, NRDC feels strongly that the only acceptable resolution of these competitive issues is an industry-wide adherence to the NTE limits and the other compliance mechanisms, rather than carve-outs and exceptions that favor one company over another—especially if such carve-outs result in competitive advantages for companies that have failed to remove the auxiliary emission control devices that were at the heart of the defeat device problem.

    To summarize, NRDC strongly opposes any change to the NTE limits contained in the Consent Decrees, strongly opposes any weakening of the NTE limits or any of the compliance mechanisms in the 2004 Rule, and strongly urges EPA to apply the NTE limits and other compliance mechanisms to all heavy-duty engines and vehicles, regardless of the fuel used.[89] Further, NRDC strongly encourages EPA to take all necessary steps to extend last year's Consent Decrees until the NTE limits and other compliance mechanisms are implemented on a codified, industry-wide basis in 2007, including a strict enforcement of EPA's defeat device policy and returning to court if necessary. (ALA)

Agency Response to Comments 135-136: The adopted requirements harmonize federal and state requirements for HDDEs beginning in the 2007 model year. The adopted requirements are identical to those adopted by the U.S. EPA in January 2001. Further, the NTE test and other requirements that are part of U.S. EPA's 1999 Heavy Duty Consent Decrees and California Settlement Agreements were adopted in previous ARB rulemaking on December 7, 2000. Those requirements extend the consent decree and settlement agreement supplemental test requirements through the 2005 through 2006 model years and utilize the current fuel requirements during testing. The adopted requirements in this rulemaking will utilize future California low sulfur fuel that is being proposed in separate rulemaking. However, the U.S. EPA's

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hwy/2000frm/f00026.pdf (the "2004 Rule").

[89] NRDC also encourages EPA to adopt supplemental federal test procedures (SFTP) standards for heavy-duty vehicles that would further enable EPA to limit off-cycle emissions from these vehicles. One element of such a SFTP adoption would be to consider SFTP standards for emerging hybrid-electric vehicles.

adoption of low sulfur diesel fuel will ensure the needed fuel requirements, regardless of California action.

Deficiency allowances are provided to engine manufacturers as compliance flexibility in the case that engine manufacturers need additional time to comply with the adopted requirements. The allowances are phased out after 2012, due to the lead time provided to manufacturers to make technological improvements. Deficiencies for phased-out engines are reviewed on a case-by-case basis, while a maximum of three deficiencies per engine family is allowed for phased-in engines. All deficiencies are reviewed on an annual basis. The deficiency allowance is a result of meetings with engine manufacturers that expressed concern with compliance over specific operating conditions. Both the U.S. EPA and the ARB believe those concerns can be addressed with the additional time provided by the deficiency allowances.

In addition, deficiency allowances are equally available to all engine manufacturers. However, the limitations in the allowances prevent engine manufacturers from using the allowances to avoid or delay compliance. Thus, with the limitations and time constraints, the ARB does not believe any competitive advantages/disadvantages will occur within the marketplace. Therefore, no further changes to the adopted requirements are necessary.

1. Technologically Feasibility of the Proposed Supplemental Emission Requirements and Tests.

137. **Comment:** EPA did not provide sufficient data of technological feasibility to show the SERTs can be complied with on the 2.5-gram per horsepower-hour NMHC+NOx standard. EMA provided extensive comments to EPA on the Agency's lack of analysis in EMA's comments in response to the 1999 Feasibility Review. (See EMA Comments on the 1999 Feasibility Review, pp. 14-40.)

Indeed, EPA initially developed the concept of the NTE zone and other supplemental requirements and conditions based on engine technology that primarily relied on the use of retarded injection timing as an emission control strategy, prior to the use of technologies necessary to meet a standard on the order of 2.0-gram NOx. After engine manufacturers' agreement in the SOP to meet a 2.5 g/bhp-hr NOx+NMHC standard in 2004, EPA changed the roadmap by choosing to apply multiple, complex requirements represented in the NTE zone and limits, supplemental steady-state tests, maximum allowable emission limits, load response test, and expanded ambient conditions. The technology to meet the standards on the FTP alone was anticipated to be EGR, a technology which represents a significant step beyond retarded injection timing in its ability to control emissions. Despite such a significant technology change, EPA failed to demonstrate the technological feasibility of the proposed supplemental emission tests and requirements on the proposed (now-final) 2004 standards.

EPA has now moved a huge technology leap beyond the 2004 standards – a leap reflecting a 90% reduction in emissions from the 2004 standards, and which require not only engine emission controls but also aftertreatment controls for both NOx and PM. As EMA has detailed above, the development, testing and integration of engine-aftertreatment systems on the FTP alone represents a significant technological hurdle, and one which manufacturers are certain cannot be overcome without significant

changes to EPA's proposal. Yet, EPA has failed to provide any analysis that the now-finalized SERTs, which were developed on the basis of retarded timing, finalized to apply to EGR, and, now, proposed for implementation with aftertreatment, are technologically feasible with respect to the proposed 0.20-gram NOx, 0.14-gram NMHC, 0.01-gram PM, and 0.016-gram formaldehyde standards. EPA has failed to meet its statutory mandate. (EMA)

138. **Comment:** The NTE was originally proposed at emission levels of 2.5 g/hp-hr NOx+HC (3.125 g/hp-hr NTE) and higher levels, during the Consent Decree process. Table Two shows the emission levels and NTE requirements for the standards contained in the Consent Decrees. At the standards proposed in the 2007 NPRM, the difference between the NTE NOx level and the NOx standard would be only 0.05 g/hp-hr. The difference between the NTE PM level and the PM standard would be only zero ("0") when EPA's rounding convention is applied.

Proposed emission limits in the NTE zone are 1.25 times the standard. While that may make sense as applied to the 2004 standards, it makes no sense at the levels of the proposed 2007 standards. As a result, any relief that EPA intends to be provided by the 1.25 multiplier does not exist. Compliance with NTE emission limits is determined through undefined in-use drive-cycles, over unbounded ambient operating conditions. The unbounded scope of the NTE in terms of both operating conditions and ambient conditions, combined with the lack of margin between certification conditions and all-conditions, renders the NTE infeasible.

Given that the NTE is essentially an in-use standard, to which an engine is required to comply under a very broad range of conditions – both ambient and operational – the NTE as proposed would become the *de facto* standard – essentially rendering the FTP Transient Test redundant and ineffectual.

EPA has simply superimposed, without analysis, the NTE as set out in the 2004 Rule to the significantly more stringent limits in the 2007 proposal. That is unworkable. Consequently, EPA should drop the NTE requirements from the proposal. (Cummins)

139. **Comment:** The NTE represents an additional layer of requirements that are so stringent as to overwhelm the effectiveness and value of the FTP transient test. The original NTE requirements were devised for considerably higher emission standards than are proposed in the 2007 NPRM. When associated with the emission standards proposed here, the NTE becomes the overwhelmingly dominant requirement – it effectively becomes the standard. The NTE requirements should be dropped from the proposal, and reliance instead placed where it belongs – on the certification test procedure. (Cummins)

Agency Response to Comments 137-139: The U.S. EPA and the ARB adopted changes to the test procedure requirements in response to such comments. The NTE cap of 1.25 times the applicable emission standard applies to engines with a NOx family emission limit of 1.50 grams per brake-horsepower-hour and greater. For engines with a NOx family emission limit less than 1.50 grams per brake-horsepower-hour, the NTE cap is 1.50 times the applicable emission standard. With the 0.20 grams per brake-horsepower-hour emission standard, the NTE cap would be 0.30 grams per brake-horsepower-hour. Further, the U.S. EPA revised both NOx and PM emission measurement procedures and device specifications

to reduce emission measurement variability. The ARB has adopted those same measurement procedures and measurement device specifications.

The supplemental emission test procedures were introduced to the engine manufacturers and the public when the U.S. EPA's 2004 Heavy-Duty Rule was noticed (October 1999) and finalized (October 6, 2000). Virtually identical test procedures were also released for public comment (October 20, 2000) during the ARB's 2005 NTE and Euro III ESC rulemaking process.

Revisions to the supplemental test procedures, that have been adopted by the ARB in this rulemaking, are identical to the changes that have been finalized by the U.S. EPA in their 2007 Final Rule (January 18, 2001). ARB's Regulatory requirements for public notice of the proposed revisions were satisfied with a 45-day public notice that ended with a public board hearing (October 25, 2001). Technological feasibility for both the adopted emission standards and the supplemental test procedures is discussed in detail in the ARB's ISOR[90], Section 6, and the U.S. EPA's RIA[91], Chapter 3. In particular, the NTE test was found feasible at the 2007 emission standard levels because the NTE test was found to be adaptable to the change in technologies, from retarded timing to aftertreatment. Further, responses to comments regarding technological feasibility of the supplemental test procedures are included in Section IV.C. Therefore, no further changes to the adopted requirements are necessary.

140. **Comment:** Even if EPA had demonstrated the technological feasibility of the SERTs on the 2004 Standards (which it most certainly has not), EPA clearly has failed to account for the technological feasibility impacts of the SERTs on the addition of NOx and PM aftertreatment as emission control devices (and vice versa).

EPA's lack of analysis cannot be denied. The Agency's only mention of the SERTs in the 2007 NPRM was to state that they would be based on – at the time – to-be-finalized regulations. Now those regulations are in (somewhat) final form, having appeared on EPA's Web site in the context of the 2004 Rule. Those regulations presumably will appear in the Code of Federal Regulations, the various subparts of which provide the basis for engine manufacturers' compliance with emission standards and other regulatory requirements. But, EPA has not taken "step one" of analyzing the impacts of the use of aftertreatment technology necessary for meeting the Proposed 2007 Standards on engine manufacturers' ability to comply with the now-finalized SERTs.

The impacts on the efficiency of NOx adsorbers – EPA's "technology of choice" – provide one illustration of the point. As discussed above, there are many obstacles to making NOx adsorbers a workable technology for meeting the proposed standards over the FTP cycle. Further, there is no assurance that these devices will operate at the necessary level of effectiveness over the broader range of conditions represented by the SERTs and expanded ambient conditions within EPA's proposed time frame. For maximum conversion efficiency using a NOx adsorber, engine exhaust temperature must be maintained within a relatively narrow temperature window. At the extreme ranges of exhaust temperatures *over the FTP alone*, various NOx adsorber catalyst

[90] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[91] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

formulations show significant drops in efficiency. At sufficient extremes over the FTP, catalyst efficiency may drop to 0%. Current catalyst formulations simply do not have the capability to provide sufficient NOx conversion over the entire range of engine operating conditions.

Not only has EPA failed to analyze the aftertreatment impact on the FTP, EPA has failed completely to address the issue in the context of the Supplemental Emission Requirements. For example, EPA has finalized an NTE limit which allows a factor of 1.25 over the NOx standard. However, a decrease in catalyst efficiency from 90% to 87.5% -- a mere 2.5 percent decrease in catalyst efficiency – will result in an exceedance of the 1.25 NTE limit. In another example, conversion efficiency of NOx adsorbers over the various modes of the EURO test cycle – the basis for EPA's supplemental steady-state test requirement – can range from just over 50% to over 90% for individual modes, with a weighted cycle average of 80%.

EPA simply has failed to take into account the impact of aftertreatment on the technological feasibility of meeting the proposed SERTs and has failed to demonstrate that the SERTs as finalized in the 2004 Rule are feasible or appropriate for the Proposed 2007 Rule. (EMA)

141. **Comment:** In addition to the examples noted above, it is significant that the aftertreatment test results that have been reported publicly (for example, the DECSE study) have all been completed at standard, or FTP, laboratory conditions. There have been no publicly reported data at extreme ambient conditions – temperature, altitude or humidity. While EPA has proposed the emissions levels based upon the publicly reported aftertreatment test results, EPA has failed to give adequate consideration to aftertreatment performance at the expanded ambient conditions. EPA has no basis, therefore, to propose that the emissions standards are technologically feasible on the Supplemental Emission Requirements, including at expanded ambient conditions. (EMA)

EPA has not made any assessment of the performance capability of available emission control systems under any ambient conditions other than standard laboratory conditions. It is well known that catalysts operate at peak efficiency only within certain exhaust gas temperature ranges. Since, for a given operating condition, the exhaust gas temperature at the catalyst is approximately proportional to the ambient temperature, issues of poor performance will arise at both low and high ambient temperatures. Such issues would represent non-compliance with the NTE as currently defined. This non-compliance would result from the standard being set below levels that are feasible over the broad range of ambient conditions associated with the NTE.

EPA must carry out a detailed analysis of the performance of available emission control technologies, over the range of ambient conditions that the Agency proposes to regulate. Standards should be set such that compliance over the broad range of conditions is feasible. (Cummins)

Agency Response to Comments 140-141: As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured or are already in-use. Current technology with some improvements may be required. Technological feasibility for both the adopted emission standards and the supplemental test procedures is discussed in detail

in the ARB's ISOR,[92] Section 6, and the U.S. EPA's RIA, [93] Chapter 3. Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions that satisfy the NTE test requirements, further testing is expected to demonstrate an additional compliance buffer. The hurdles specific to the NTE test, and the process to overcome them, are discussed in the U.S. EPA's RIA cited above. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

142. **Comment:** EMA has detailed above the significant variability problems of the existing FTP test measurement methods for measuring compliance with the Proposed 2007 Standards. Until those problems are resolved in an acceptable manner, EPA cannot finalize its Proposed 2007 Rule. As part of its undertaking to resolve those measurement problems, EPA must include the issue of testing accuracy for the Supplemental Emission Requirements as well. While emission measurement methods obviously must be highly accurate to appropriately measure compliance on the FTP, the need for highly accurate measurement capability is exacerbated by the Supplemental Emission Requirements. (EMA)

143. **Comment:** Comparing the COVs at the current levels and at the proposed NOx and PM standards shows an alarming increase in the amount of testing that would be required of manufacturers. EPA has failed to consider the impacts of these additional tests, in terms of time constraints (the pre-certification test schedule is already demanding) and cost (costs of additional test, new test cells, and additional personnel to run tests.) Table Three summarizes increased testing due to projected increases in COV from current levels to the proposed standards as described below.

    Cummins' internal baseline program shows that the short term COV for repeat hot cycles using the current test methods is 0.37% and 2.5% for BSNOx and BSPM, respectively. Thus, to detect a 2% difference in BSPM between two engine conditions, 6 hot cycles need to be run at each condition with no significant delay in testing between the two conditions.

    Cummins has conducted tests to make an optimistic estimate of the short term precision error of the current test methods at the future levels. Repeat hot cycles were run with the exhaust disconnected from the CVS tunnel. The resulting standard deviations (SD) were 0.0078 g/bhp-hr for BSNOx (3.9% of the proposed 0.2 standard) and 0.0009 g/bhp-hr for BSPM (9% of the 0.01 standard). The CVS was essentially sampling background dilution air. These estimates of short term precision only include variability in the CVS and dynamometer systems; they do not include variability of the engine or variability in the CVS system induced by temperature and pressure fluctuations during normal testing. To continue with a conservative approach in estimating the short term COV,

[92] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[93] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

assume the mean level is at the proposed standard. This results in estimated short term COVs of 3.9 and 9.0%, for BSNOx and BSPM, respectively. Thus, for short term development tests, the number of repeat tests to detect a 2% difference, increases from 2 to 13 for BSNOx and from 6 to 55 for BSPM. Thus, development costs and time would roughly scale up by an order of magnitude.

As the time frame for changing engine conditions increases, such as hardware changes, long term precision errors become important. Because long term precision errors are larger, the quality of the decision is worse.

Cummins' internal baseline program shows that the long term COV for hot cycles only in multiple cells in the same test facility using the current test methods is 2.3% and 5.7% for BSNOx and BSPM, respectively. At these COVs, the number of tests required to detect a 2% difference is 5 and 28 for BSNOx and BSPM, respectively. In practice, fewer tests are run resulting in a lower quality development decision. The number of tests required to detect a 5% difference is 2 and 6 for BSNOx and BSPM, respectively.

These values of long term COV are 6.2 and 2.3 times their corresponding short term COVs. Assuming the same ratio between short and long term COV at the future levels, gives long term COVs of 24.2 and 20.7% for BSNOx, and BSPM, respectively. Thus, for long term development tests, the number of repeat tests even to detect a 5% difference, increases from 2 to more than 70 for BSNOx and from 6 to 55 for BSPM. (Cummins)

Agency Response to Comments 142-143: The commenter provided similar comments to the U.S. EPA during their rulemaking. In response to the comments, the U.S. EPA revised both NOx and PM emission measurement procedures and device specifications to reduce emission measurement variability. At this time, the U.S. EPA believes such changes will improve the accuracy over the previous requirements, and that the improvements will yield results sufficiently accurate to determine compliance. However, the U.S. EPA will continue to review and improve the measurement procedures and specifications. Further, the ARB has adopted the same measurement procedures and measurement device specifications and will likewise review and improve them as warranted. Therefore, no further changes to the adopted requirements are necessary.

a. NTE caps.

144. **Comment:** The proposed NTE zone establishes a 1.25 factor over the base standard. A 1.25 factor on a 0.20 g/bhp-hr standard is much more stringent than a 1.25 NTE factor on a 2.0 g/bhp-hr standard. In fact, with a 0.20 g/bhp-hr standard, the 0.05-gram "headroom" allowed with the 1.25 factor is meaningless because it is beyond the measurement resolution. A 0.25 g/bhp-hr standard that must be met over all points of the engine operating map simply is not technologically feasible. (EMA)

145. **Comment:** For the proposed PM standard, a 1.25 factor NTE limit over the base standard is even more meaningless, if that is possible. At the proposed 0.01 g/bhp-hr PM standard, the NTE limit and the standard on the FTP are the same. The 1.25 factor applied to the 0.01 standard results in an NTE limit of 0.0125 g/bhp-hr which, when rounded, results in a 0.01 g/bhp-hr NTE limit. Such a requirement makes no sense.

More important, EPA has failed to meet its burden of demonstrating that such an NTE standard is technologically feasible. (EMA)

Agency Response to Comments 144-145: The U.S. EPA and the ARB adopted changes to the test procedure requirements in response to such comments. The NTE cap of 1.25 times the applicable emission standard applies to engines with a NOx family emission limit of 1.50 grams per brake-horsepower-hour and greater. For engines with a NOx family emission limit less than 1.50 grams per brake-horsepower-hour, the NTE cap is 1.50 times the applicable emission standard. With the 0.20 grams per brake-horsepower-hour emission standard, the NTE cap would be 0.30 grams per brake-horsepower-hour. Further, the U.S. EPA revised both NOx and PM emission measurement procedures and device specifications to reduce emission measurement variability. The ARB has adopted those same measurement procedures and measurement device specifications.

As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured, or are already in-use. Current technology with some improvements may be required. Technological feasibility for both the adopted emission standards and the supplemental test procedures is discussed in detail in the ARB's ISOR[94], Section 6, and the U.S. EPA's RIA[95], Chapter 3. Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

146. **Comment:** Staff are proposing that the NTE cap be increased, and we'd like to suggest that it be kept at a minimum 1.25. I appreciate, in terms of your ability to perhaps adjust that record or that NTE value today, but we would just generally urge that you consider maintaining at the minimum point possible that value because maintaining that level is critical to ensuring the durability and compliance with your standards. (SCAQMD)

Agency Response: The NTE cap of 1.25 times the applicable emission standard applies to engines with a NOx family emission limit of 1.50 grams per brake-horsepower-hour and greater. For engines with a NOx family emission limit less than 1.50 grams per brake-horsepower-hour, the NTE cap is 1.50 times the applicable emission standard. Due to more stringent emission standards, this is not expected to have an adverse impact on the overall effectiveness of the adopted requirements. With the 0.20 grams per brake-horsepower-hour emission standard, the NTE cap would be 0.30 grams per brake-horsepower-hour.

[94] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[95] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

In addition, the increased cap for lower emitting engines provides more meaningful flexibility. If the cap remained at 1.25 for an engine with a 0.01 grams per brake-horsepower-hour emission standard, the resulting emission cap would still be 0.01 grams per brake-horsepower-hour. With a cap of 1.50, that same engine would have an emission cap of 0.02 grams per brake-horsepower-hour.

The U.S. EPA also revised both NOx and PM emission measurement procedures and device specifications to reduce emission measurement variability. The ARB has adopted those same measurement procedures and measurement device specifications. Therefore, no further changes to the adopted requirements are necessary.

147. **Comment:** In the 2004 Rule, EPA adopted a compliance scheme for meeting applicable standards based on "NTE deficiencies." Under such a structure, manufacturers could apply to the Agency for NTE deficiencies for a manufacturer's anticipated failure to meet the NTE requirements in the first three years during which the new standards were effective.[96] The Agency notes that the provision is to provide "additional lead time to resolve technical compliance issues" and will be granted only if compliance would be infeasible. (Section 86.007-11(a)(iv).) Deficiencies would not be carried over from year to year. Finally, deficiency allowances apparently would only be granted for "minor" deviations from the NTE requirements, although that term is not fully defined. See "unofficial" Preamble to the 2004 Final Rule at p. 85.

EPA's proposed NTE deficiency provisions would give little help to engine manufacturers in attempting to comply with the NTE limits alone, and no help with the other Supplemental Emission Requirements. The time frame in which manufacturers would be allowed to apply for and obtain deficiencies is very limiting. Once an engine manufacturer reached the point of needing to request one or more deficiency allowances, the manufacturer likely would be far along in the engine-aftertreatment system development process. At such a late date, the manufacturer, further, would face significant uncertainty: the manufacturer would not know whether the Agency would grant the deficiencies and, if granted, whether they would be granted in time to make them of any help to the manufacturer in producing certified engine families under the proposed new standards. And, of course, if the request for a deficiency were not granted, engine manufacturers might not have sufficient time to develop alternative product plans.

Another significant issue with the proposed NTE deficiency allowances is the potential for an uneven playing-field in the granting of such allowances. Engine manufacturers have significant concerns that the Agency will not be able to assure a level playing-field in the review, evaluation and granting of requests for deficiency allowances.

Of even greater concern, however, than the impracticality and limited usefulness of the NTE deficiency allowances, and the lack of a level playing-field, is the fact that the Agency apparently is using NTE deficiencies as a substitute for conducting a thorough analysis of the technological feasibility of the NTE zone and limits. EPA cannot shirk its

[96] It should be noted that the concept of "NTE deficiencies" was never proposed or subject to comments, but merely was made up by EPA from whole cloth and then finalized. As such, it not only has not been made available for comment in the context of the 2007 NPRM, but it was not even made available for comment in the 2004 NPRM. It also should be noted that "NTE" deficiencies are strictly that. They are not applicable to meeting the supplemental steady-state emission limits, MAELs, or other supplemental requirements.

statutory obligations simply by creating more administrative procedures, which are yet undefined, and by using a process that provides no certainty for manufacturers. By adding the deficiency option and by noting that there is no limit on the number of NTE deficiencies that the Agency may grant to a manufacturer, EPA appears to be anticipating that manufacturers will not be able to meet the NTE requirements. NTE deficiency allowances, which purportedly allow manufacturers some flexibility in meeting the NTE requirements, appear to be little more than a crutch for EPA to use to avoid a thorough analysis of technological feasibility. (EMA)

148. **Comment:** This provision would allow EPA to approve exceedances of the NTE for undefined technical reasons – on a case-by-case basis. Such a provision will in general not be helpful – since it is subject to negotiation, it carries considerable uncertainty for both the regulator and the manufacturer, and is likely to cause lead-time issues if a deficiency is refused late in an engine development program.

EPA should not propose standards and SERTs that anticipate technical issues that have to be handled by such means. EPA should not use this mechanism to circumvent their responsibility to fully evaluate the feasibility of meeting future standards and to provide some measure of certainty to the regulated community. Standards should be set at levels that are appropriate for the available technologies at the time the standard is introduced – not for two to three years later.

EPA should, however, recognize that future engine designs will require the current provisions for AECDs - for example, for the purposes of engine starting, and engine / vehicle protection. (Cummins)

Agency Response to Comments 147-148: As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured, or are already in-use. Current technology with some improvements may be required. Technological feasibility for both the adopted emission standards and the supplemental test procedures is discussed in detail in the ARB's ISOR,[97] Section 6, and the U.S. EPA's RIA, [98] Chapter 3. Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions that satisfy the test requirements, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected.

While the ARB recognizes and allows certain specific AECDs, deficiency allowances are provided to engine manufacturers as compliance flexibility in the case that engine manufacturers need additional time to comply with the adopted requirements. Deficiencies for phased out engines are reviewed on a case-by-case basis and, contrary to the comment, a maximum of three deficiencies per

[97] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[98] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

engine family is allowed for phased-in engines. All deficiencies are reviewed on an annual basis after the certification process, where the ARB often meets with or contacts the engine manufacturers to request more information or get further clarification on the submittals.

The deficiency allowances are a result of meetings with engine manufacturers that expressed concern with compliance over specific operating conditions. Both the U.S. EPA and the ARB believe those concerns can be addressed with the additional time provided by the deficiency allowances. Further, both the U.S. EPA and the ARB expect engine manufacturers to make reasonable efforts to eliminate the need for AECDs and deficiency allowances. Thus, the AECDs and deficiency allowances are compliance flexibilities that do not relieve engine manufacturers from complying with the other requirements included in this rulemaking.

Deficiency allowances are not expected to result in an uneven playing field since potential modes of operation that may be of concern have already been discussed with the U.S. EPA. Such discussions resulted in a mailout by the U.S. EPA that outlines potential AECDs (see U.S. EPA Advisory Circular 24-3). Consequently, engines from one manufacturer are not expected to be any dirtier than engines from other engine manufacturers. Also see Agency Response to comments #135-#136 regarding the impracticality, limited usefulness, and lack of level playing field from the deficiency allowance provisions. Further, the U.S. EPA and the ARB has already conducted a thorough technological feasibility analysis (see Agency Response to comment #68) that includes compliance with the supplemental test requirements.

Requests for AECDs and deficiencies are typically submitted with applications to certify engines. Engine manufacturers are expected to submit such applications with sufficient time to allow review of the AECDs and deficiencies. AECD requirements are not new and do not change in this rulemaking. Consequently, most engine manufacturers are aware of the limitations regarding various types of AECD requests. Therefore, no further changes to the adopted requirements are necessary.

149. **Comment:** The NTE provisions were originally developed based on manufacturer data and experience from “old” engine technology. EPA has failed to provide any analysis of the technological feasibility of the proposed shape, size and limitations of the NTE zone, as well as the “carve-out” area of the zone, as applied to aftertreatment technology. EPA cannot finalize the NTE provisions for the Proposed 2007 Standards without a complete analysis of all those issues. (EMA)

150. **Comment:** The shape and size of the NTE zone (in engine speed and load) was originally defined for engines using retarded injection timing as the primary emission control. Additional carve-outs were defined that recognized the natural behavior of engines using that technology. EPA has transferred the NTE shape and size definitions directly from injection-controlled technology to systems that will rely on both engine controls and aftertreatment controls – without due consideration of the behavior of NOx and PM aftertreatment systems.

The shape and size of the NTE zone should be evaluated in the context of engine emission controls and advanced aftertreatment systems. (Cummins)

Agency Response to Comments 149-150: The NTE provisions have been agreed upon by several major engine manufacturers in the U.S. EPA's 1999 Heavy Duty Consent Decrees and California Settlement Agreements. Additionally, the NTE provisions were adopted with previous rulemaking in December 2000; after numerous meetings with engine manufacturers, sufficient public notice, and a public hearing.

Technological feasibility for both the adopted emission standards and the supplemental test procedures is discussed in detail in the ARB's ISOR[99], Section 6, and the U.S. EPA's RIA[100], Chapter 3. Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady-state testing includes testing within the NTE control zone. While those tests demonstrate reductions that satisfy the NTE test requirements, further testing is expected to demonstrate an additional compliance buffer. The hurdles specific to the NTE test, and the process to overcome them, are discussed in the U.S. EPA's RIA cited above. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

151. **Comment:** Upon brief review of the 2004 Final Rule, EPA appears to be indicating an intent to enforce the new NTE requirements just as they have enforced previous regulatory programs. (Preamble at p. 75.) Yet, in the regulatory provisions there is specific language including some elements of the SERTs in selective enforcement audit testing. And, adding further confusion, EPA indicates its interest in proceeding with a separate rulemaking to develop an in-use program, only at which point would NTEs appear to be truly applicable and relevant.

Needless to say, EPA should provide greater clarity on how and when the NTE requirements will apply. Obviously, depending on where and how they apply, the NTE requirements will have differing, yet significant impacts on stringency. Further, the stringency of the NTE requirements is impacted by the definition of defeat device, which definition is different in the current rules, in the 2004 NPRM, in the 2004 Final Rule, and in the Consent Decrees. Engine manufacturers have not yet had the opportunity to assess the differing impacts on stringency of those different definitions. The fact is, however, that the NTE requirements appear to have no basis, provide no benefit, and, thus, are not needed until EPA establishes an in-use program. As such, EPA should withdraw the NTE requirements and not now make them part of any final rule. In addition, EPA should retain the current definition of defeat device. (EMA)

Agency Response: This comment seems to be directed solely to the U.S. EPA. The ARB adopted NTE provisions were adopted with previous rulemaking in

[99] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[100] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

December 2000 after numerous meetings with engine manufacturers, sufficient public notice, and a public hearing. Like any other test procedures, the supplemental test procedures should be expected to be used at any point to determine compliance. This includes certification, selective enforcement auditing, and in-use compliance. There is no reason to expect the NTE test requirements to be used differently than previous test requirements. Further, the NTE provisions have been agreed upon by several major engine manufacturers in the U.S. EPA's 1999 Heavy Duty Consent Decrees and California Settlement Agreements. Therefore, no further changes to the adopted requirements are necessary.

b. SSS (Euro III)

152. **Comment:** EPA has proposed to require manufacturers to comply with a weighted average emissions limit based on the supplemental steady-state ("SSS") test cycle, specified in the just-finalized 2004 Standards. Under the proposal, EPA would require that weighted average emissions not exceed 1.0 times the applicable FTP emission standards or FEL. If an engine failed to meet the weighted average emission limits, it would not be certified. Thus, while cast by EPA as an addition only of "test procedures," the SSS emission requirements proposed by EPA would create a new and unnecessary standard for HDDEs.

Based on what engine manufacturers have seen of the regulations proposed in the 1999 Feasibility Review on the supplemental steady-state requirements, and the just-finalized 2004 Standards, the SSS requirements are technologically infeasible in the context of the proposed 2007 Standards. EPA should refer to EMA's Comments on the 1999 Feasibility Review for more discussion of these issues (pp. 30-35). (EMA)

153. **Comment:** The SSS test proposed covers a very wide range of speeds and load – with a correspondingly wide range of exhaust gas temperatures and space velocities. Because of the temperature dependence of exhaust aftertreatment conversion efficiency, it is highly improbable that very high conversion rates (such as EPA proposed 90%) can be achieved over the range represented by the SSS test. When the SSS modal emission results are additionally constrained by the NTE, the SSS becomes infeasible. EPA should drop the SSS requirement from the proposal. (Cummins)

Agency Response to Comments 152-153: The Euro III test provisions (referred to as the SSS test by the commenter) have been agreed upon by several major engine manufacturers in the U.S. EPA's Heavy Duty Consent Decrees and California Settlement Agreements. Additionally, the Euro III provisions were adopted with previous rulemaking in December 2000; after numerous meetings with engine manufacturers, sufficient public notice, and a public hearing. The Euro III is only a test procedure used to verify an engine's compliance with the adopted emission standards. The Euro III only includes emission caps associated with the test and does not include separate emission standards.

Technological feasibility for the supplemental test procedures is discussed in detail in the ARB's ISOR,[101] Section 6, and the U.S. EPA's RIA,[102] Chapter 3.

[101] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[102] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control

Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. While those tests demonstrate reductions that satisfy the test requirements, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

154. **Comment:** In an engine with multiple control parameters, which might include: EGR rates, injection timing, fuel system pressure, NOx reductant dose rates etc, it is unreasonable and meaningless to require an engine to be in a maximum NOx producing state during the SSS test. That logic was originally proposed for engines with injection timing control as the emissions controlling input. In that case, timings could be easily identified during the SSS test, and held in the controller as 'maximum NOx timing values'.

With multiple technologies present in the emission control system, it is reasonable to assume that at different times, under different conditions control variables will be varied to achieve the required compliant emission levels. This requirement should be dropped, as it is overly restrictive, and will ultimately reduce the performance envelope of the emission control systems envisioned. (Cummins)

Agency Response: These comments concern matters regarding comment periods for the U.S. EPA's 2007 Final Rule, which occurred almost a year before this ARB rulemaking. This comment is in reference to the ARB-adopted test procedures that incorporate 40 Code of Federal Regulations 86-1360-2007(e)(4) by reference. These provisions ensure that testing is conducted on engines that have been calibrated to the highest emitting NOx conditions. Engines should always be tested at the maximum NOx producing state to prevent engine manufacturers from certifying their engines with emissions that are not conservative with respect to actual, in-use emissions.

Further, These comments concern matters regarding comment periods for the U.S. EPA's 2007 Final Rule, which occurred almost a year before this ARB rulemaking. The supplemental emission test procedures were introduced to the engine manufacturers and the public when the U.S. EPA's 2004 Heavy-Duty Rule was noticed (October 1999) and finalized (October 6, 2000). Virtually identical test procedures were also released for public comment (October 20, 2000) during the ARB's 2005 NTE and Euro III ESC rulemaking process.

Revisions to the supplemental test procedures, that have been adopted by the ARB in this rulemaking, are identical to the changes that have been finalized by the U.S. EPA in their 2007 Final Rule (January 18, 2001). The U.S. EPA's 2007 Final Rule also includes the adopted emission standards. There have been no proposed changes to this section by the U.S. EPA and the ARB. Therefore, no further changes to the adopted requirements are necessary.

Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

c. Mystery Points/MAELs

155. **Comment:** In addition to meeting the proposed standards on the FTP and throughout the NTE zone, and proposed compliance with supplemental steady-state emission requirements, EPA has proposed that exhaust emissions cannot exceed Maximum Allowable Emission Limits ("MAELs"), as determined under the just-finalized 2004 Standards, when operated in the steady-state control area, also as specified regulations. As EMA commented previously to EPA, the MAELs are costly and add no discernible value to EPA's regulatory program. (See EMA's Comments on the 1999 Feasibility Review, pp. 35-38.) (EMA)

Agency Response: In response to this comment, the U.S. EPA eliminated the MAEL test requirements for engines that certify to reduced NOx emission standards less than 1.5 grams per brakehorsepower-hour. Identical to the U.S. EPA, the ARB also eliminated this test requirement for engines that certify to reduced NOx emission standards. Therefore, no further changes to the adopted requirements are necessary.

d. Load response test

156. **Comment:** The load response test ("LRT") has no correlation to any real world heavy-duty truck operation. Moreover, the FTP, federal smoke cycle and J1667 roadside test procedures already measure highly transient behavior. The LRT is a completely useless and unnecessary, yet burdensome requirement.

The Agency's proposal is not required for and is unrelated to certification of engine families. EPA states that LRT requirements are for data-gathering only. Indeed, it appears that the only reason for requiring manufacturers to undertake such testing is to provide EPA with research data which it may find useful. EPA does not have authority to require manufacturers to undertake the work of the Agency in such a manner.

EPA's representations as to what the LRT provisions require, however, are not accurate. Inasmuch as the LRT lies entirely within the NTE zone, and that the LRT is longer than 30 seconds in duration, the NTE limits would apply. Once again, EPA has proposed another unnecessary test on top of other unnecessary tests, complicating manufacturers' compliance burden even further. (EMA)

157. **Comment:** The Load Response Test is a redundant and burdensome requirement. The goal of the test appears to be to provide EPA with research data – which could be gathered through non-regulatory activities. The current FTP transient test, Federal smoke test and road-side tests adequately demonstrate the transient emissions performance of the engine. This requirement should be dropped from the 2007 rule. (Cummins)

Agency Response to Comments 156-157: Although the U.S. EPA adopted the Load Response Test in the 2004 Final Rule, the ARB has not adopted the data gathering test. Therefore, no further changes to the adopted requirements are necessary.

e. Expanded ambient conditions

158. **Comment:** EPA does not specifically address expanded ambient conditions in the 2007 NPRM. Based on EPA's statements that just-finalized SERTs also would be applicable to heavy-duty engines under the Proposed 2007 Rule, however, EMA's understanding is that the SERTs include requirements for expanded ambient conditions. (EMA)

159. **Comment:** The ambient conditions over which the NTE requirements apply are essentially unbounded, which is a major deficiency in the formulation of the Rule. For example, in proposal Option 1,the ambient temperature requirements state that outside of the range 55 °F to 95 °F (undefined) Correction Factors may be used to adjust the NOx and Particulate standards back to 55 °F if the temperature is below 55 °F, or to 95 °F if the temperature is above 95 °F.

    These undefined correction factors are intended to take account of the natural effects of ambient temperature on the mechanisms of NOx and Particulate production inside the engine. The Correction Factors are not intended to account for the changing performance, or physical limits to operation, of engine emission control systems such as cooled EGR, or exhaust aftertreatment. Yet it is inevitable that such systems will experience changes in performance capability, or encounter physical limits, at some level of ambient temperature, pressure or humidity – especially since such conditions could apply simultaneously.

    EPA has an obligation under the CAA to promulgate test procedures that serve as the basis for issuance of certificates of conformity, and that provide a measure of certainty to a manufacturer that if it can demonstrate compliance under the prescribed conditions, it is entitled to market engines under that certificate. By proposing unbounded test conditions, EPA is not proposing any test at all, but instead is attempting to shift all risk to the manufacturer so that even if it can demonstrate compliance and receive a certificate of conformity, it is at risk of noncompliance under other undefined conditions. (Cummins)

160. **Comment:** The NTE Extended Ambient Conditions options presented in the 2004 Final Rule allow Correction Factors ("CFs") to be applied outside of certain ambient temperature and humidity ranges. Individual manufacturers – using 'good engineering judgment', may determine such CFs.

    The original intent of CFs was to allow the natural effects of temperature and humidity to be compensated for when an engine was tested at non-standard ambient conditions. This was relatively straightforward when engines had mechanical controls – changes in ambient temperature and humidity were transmitted almost directly to the combustion event, and consequently had a more or less direct link with emissions production. A relatively simple CF scheme could be agreed upon, and used by all manufacturers.

    With future low emission technologies, no such simple relationship exists between the ambient conditions, and the emissions output of the engine. For example, a decrease in ambient temperature could reduce combustion temperatures and therefore reduce NOx emissions, while the conversion efficiency of a NOx aftertreatment device may be falling – tending to increase NOx. The precise rate of change of NOx with ambient temperature would be a complex function of ALL components of the emission control system.

    Two issues are raised by the 2007 NPRM:

First, on what basis are CFs defined for engines having complex emission control systems? Should CFs so defined take account of the natural effects of ambient temperature and humidity on the emissions output of such a complex system? If so, what is the process by which such CFs are determined? If not, on what basis are CFs defined ?

Second, relying on manufacturers to use 'good engineering judgment' is too vague, and allows a variety of interpretations of the regulations by manufacturers creating a "level playing field" issue. (Cummins)

161. **Comment:** The expanded conditions significantly increase the stringency of the emission standards. All of the technical feasibility studies on aftertreatment (for example, the DECSE Study) have been completed at standard laboratory conditions, or the nominal FTP conditions. There have been no publicly reported test results on aftertreatment systems at extreme ambient conditions. Therefore, EPA does not have a technical basis to extend the test results at standard lab conditions to expanded ambient conditions. If the aftertreatment systems perform less efficiently at expanded ambient conditions, then the direct effect of the expanded ambient conditions is to increase stringency. (EMA)

Agency Response to Comments 158-161: The supplemental test procedures, including the ambient condition requirements, were adopted in previous rulemaking. The previous rulemaking went through a 45-day public notice period that began on October 20, 2000. During the public notice period, engine manufacturers and other interested parties commented on the proposed requirements. All comments were considered and the requirements were adopted at a public hearing on December 8, 2000. In this rulemaking, there are no changes to the ambient condition requirements that were adopted at the December 8, 2000 hearing.

In the adopted requirements, there are two ambient operating areas where the NTE requirements apply. Each has a defined set of ambient temperature and altitude zones. Provisions for humidity and temperature are optional with no requirement for manufacturers to use CFs. The U.S. EPA and the ARB also believe an industry-wide set of correction factors would server to restrict the abilities of engine manufacturers to design combinations of hardware for control strategies.

Technological feasibility for the supplemental test procedures is discussed in detail in the ARB's ISOR[103], Section 6, and the U.S. EPA's RIA[104], Chapter 3. Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. While those tests demonstrate reductions that satisfy the test requirements, further testing is expected to demonstrate an additional

[103] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[104] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected.

Further, deficiency allowances are provided to engine manufacturers as compliance flexibility in the case that engine manufacturers need additional time to comply with the adopted requirements. Deficiencies for phased-out engines are reviewed on a case-by-case basis, while a maximum of three deficiencies per engine family is allowed for phased-in engines. All deficiencies are reviewed on an annual basis. The deficiency allowance is a result of meetings with engine manufacturers that expressed concern with compliance over specific operating conditions. Both the U.S. EPA and the ARB believe those concerns can be addressed with the additional time provided by the deficiency allowances. Therefore, no further changes to the adopted requirements are necessary.

162. **Comment:** Aftertreatment performance is dependent upon the exhaust temperature entering the aftertreatment system. It is well known that many years after the first introduction of aftertreatment systems, automotive manufacturers are adding technology to assure minimum exhaust temperatures under expanded ambient conditions. The proposed 2007 engine standards are emissions forcing for diesel exhaust aftertreatment (which must operate under lean conditions). Therefore, it is unreasonable for EPA to expect the concurrent development of the basic aftertreatment system along with the additional technology required for the aftertreatment system to operate efficiently at low ambient temperatures. (EMA)

163. **Comment:** Aftertreatment devices reduce emissions as a percentage of the engine-out emissions. As engines (vehicles) travel to higher altitudes, the engine-out PM emissions will increase. As air density decreases with higher altitude, the reduced oxygen content increases the fuel-to-air ratio, causing smoke and PM emissions to increase.

    Data show that engine-out PM emissions increased at high altitude by 1.64 times for electronic engines and 1.67 times for mechanical engines. Clearly, PM emissions increase at altitude and, even where efforts are made to reduce PM by advancing timing, PM still has increased well above the 1.25 times limit required within the NTE zone. Advanced emission control strategies may have some ameliorative effect on increased PM emissions at altitude, but the extent of such impact, if any, is unknown and unproven at this time. In the meantime, EPA must account for the effects of high altitude on PM with or without aftertreatment. (EMA)

164. **Comment:** The exhaust gas temperature from a diesel engine increases at high ambient temperature and/or high altitude. Aftertreatment systems can be damaged by high exhaust gas temperatures. Current regulations allow for the use of auxiliary emission control devices ("AECDs") to protect the engine from damage under such conditions; however, the 2004 Rule and the 2007 NPRM are silent on EPA's regulatory intent with regard to AECDs. The current AECD provisions must be continued for 2007 and later model year engines to address the engine and aftertreatment system protection issues. (EMA)

Agency Response to Comments 162-164: The expanded ambient (temperature and altitude) conditions are part of the supplemental test procedures and were adopted in previous rulemaking. The previous rulemaking went through a 45-day public notice period that began on October 20, 2000.

During the public notice period, engine manufacturers and other interested parties commented on the proposed requirements. All comments were considered and the requirements were adopted at a public hearing on December 8, 2000. In this rulemaking, there are no changes to the ambient condition requirements that were adopted at the December 8, 2000 hearing. This comment also does not mention supplemental means of aftertreatment regeneration such as insulation of exhaust piping and external heating devices. Both methods can be used to ensure proper exhaust temperature.

Use of AECDs is not precluded. Further, the adopted requirements include deficiency allowances that may be granted on a case-by-case basis.

Technological feasibility for the supplemental test procedures is discussed in detail in the ARB's ISOR,[105] Section 6, and the U.S. EPA's RIA,[106] Chapter 3. Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. While those tests demonstrate reductions that satisfy the test requirements, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

f. Stringency impact of the new defeat device definition

165. **Comment:** In the 2004 Rulemaking, EMA urged EPA to retain the current definition of defeat device. (See EMA Comments on 1999 Feasibility Review, pp. 17-18.) In the Preamble to the 2004 Final Rule, EPA purports to agree with EMA's recommendation that the definition should not be changed: "[w]e have decided in this final rule to retain the existing definition of defeat device contained in § 86.094-2, *with only a minor change* to clarify that the applicable heavy-duty federal emissions test procedure includes the supplemental steady-state and NTE test procedures beginning in model year 2007." (Draft Preamble to 2004 Final Rule, p. 106 (emphasis added).) But, obviously, as EPA acknowledges, it *has* changed the definition. Moreover, the change is not "minor." In fact, EPA takes several pages in the Preamble to the 2004 Final Rule to attempt to explain the impact and import of its "minor" change. The net result is continued confusion, continued uncertainty, and, it appears, further restrictions on the use of AECDs.

If EPA does not retain its existing definition, then, at a minimum, it must provide clearly understandable direction to manufacturers and must be sure not to prohibit the appropriate and necessary use of AECDs. For example, in the definition of defeat device applicable to light-duty vehicles, EPA specifically allows for the use of AECDs unless they *unnecessarily* reduce emission control effectiveness. But, EPA appears to be far more limiting in its heavy-duty definition of defeat device. Any strategy that would reduce emission control effectiveness, no matter how insignificant, would constitute a

[105] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[106] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

defeat device and be prohibited unless it fell into one of the three narrow exceptions set forth in the revised definition.

EPA states in the Preamble to the 2004 Final Rule that it will continue to interpret the defeat device definition as it has in the past "focusing on changes to the emissions control system that cause emissions to increase above what they would be without the change." (Preamble, p. 107.) But, that is not how EPA has interpreted the definition in the past, nor is it the basis for how they previously determined whether a strategy is an acceptable AECD or an illegal defeat device. As a result, EPA's revised defeat device definition, and the confusing discussion in the Preamble to the 2004 Final Rule, appear to make the proposed 2007 emission standards even more stringent.

For example, our best understanding of EPA's intent with respect to defeat device definition leads us to conclude that engine manufacturers would not be permitted to modulate engine control parameters to account for and manage the trade-off that naturally occurs between NOx and PM emissions. As discussed elsewhere in these comments, PM emissions increase at higher altitudes. One way to address that potential problem is to use electronic controls to trade-off between NOx and PM emissions while keeping both NOx and PM below regulatory limits. EPA's analysis of its new defeat device definition appears to prohibit such modulation even where no emission limit is exceeded. That has the direct effect of limiting manufacturers' ability to comply with the proposed standards, of forcing manufacturers to develop larger compliance margins and to design to lower design targets, and, generally, to increase the stringency and, possibly, the feasibility of the proposed standards.

EPA must not limit manufacturers' ability to modulate engine control parameters (while remaining in compliance with the emission standard) and must not unnecessarily limit manufacturers' ability to address cold weather, engine warm-up and a variety of other engine operating conditions. For all of these reasons, EPA must revise its definition of defeat device. (EMA)

166. **Comment:** The defeat device language has been changed in a so-called 'minor' way, apparently intended to clarify and further restrict the availability of AECDs. The sophisticated technology needed for compliance with future emission standards will require more or less continuous modulation to meet the goals of emission control, engine performance and reliability. Subtle system optimizations will be required between engine emission controls and aftertreatment systems if peak performance is to be maintained over a wide range of ambient conditions and duty-cycles. Emission control systems will typically be operated differently outside of the standard certification test conditions – a reflection of the need to make adjustments as emission control efficiency varies among the sub-systems employed. EPA will need to fully recognize that continuous modulation of the emission control system is absolutely required for compliance, and does not automatically represent a defeat device. (Cummins)

Agency Response to Comments 165-166: These comments concern matters regarding comment periods for the U.S. EPA's 2007 Final Rule, which occurred almost a year before this ARB rulemaking. At this time, there has been no change to the defeat device definition. Engine manufacturers still must not reduce the effectiveness of their control devices "under conditions which may reasonably be expected to be encountered in normal vehicle operation and use." Since the supplemental test procedures include most normal operating

conditions, defeat devices may not be utilized in conditions represented by those tests. This is not intended to prohibit a modulation necessary to comply with normal high altitude type operation. Additionally, cold weather and warm-up conditions are only temporary and may only require AECDs to comply with the NTE requirements. With this clarification, no further changes to the adopted requirements are necessary.

g. Cost-effectiveness of the SERTs.

167. **Comment:** EPA has failed to provide any analysis of the cost-effectiveness of the SERTs in the context of the Proposed 2007 Rule. Engine manufacturers anticipate significant costs associated with the imposition of the numerous and complex new requirements represented by the SERTs.

EMA understands that EPA, in its analysis of the costs of the SERTs in the context of the 2004 Standards, only considered half the costs of the product increases to be due to the increased use of EGR. To the extent EPA intends to follow the same cost "analysis" template, such an approach is inadequate.

Moreover, EPA cannot assume that there will be no costs associated with the SERTs for 2007. Even if EPA has attributed certain costs of the SERTs in connection with the 2004 Standards, EPA has failed to address the impact of aftertreatment on the costs of the SERTs proposed for 2007. (EMA)

Agency Response: The supplemental test procedures (referred to as SERTs by the commenter) were adopted in previous rulemaking. The previous rulemaking went through a 45 day public notice period that began on October 20, 2000. Included in the staff report was a cost effectiveness analysis for the supplemental test procedures. During the public notice, engine manufacturers and other interested parties provided comments on the requirements. All comments were considered and the requirements were adopted at a public hearing on December 8, 2000. The changes to the test procedures, adopted in this rulemaking, only provide additional flexibility. Costs to comply with all of the adopted requirements, including the test procedures, are included in the ARB's ISOR,[107] Sections 9 and 10, and the U.S. EPA's RIA, [108] Chapters 5 and 6. There are no additional costs associated with the proposed changes to the test procedures. Therefore, no further changes to the adopted requirements are necessary.

2. SERTs for 2007 and Later Model Year Engines.

168. **Comment:** As detailed above, the proposed SERTs are fraught with issues of technological infeasibility. EPA has fully and completely failed to demonstrate the technological feasibility of the tests, the limits and standards established in connection with those requirements, and the expanded ambient conditions over which the FTP and the SERTs are required to be run. EPA has no authority to adopt such requirements until it has conducted a thorough and reasoned analysis of the technological feasibility issues associated with the proposed tests and limits.

[107] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[108] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

Moreover, EPA has failed to provide fundamental due process by proposing emission standards in the 2007 NPRM based on test procedures that were not available with adequate time for review. All the references in the Proposed 2007 Rule to "guidance" in the 2004 regulations are, therefore, meaningless. Engine manufacturers and other interested parties have had no opportunity to review and meaningfully comment on those SERTs in the context of the 2007 rulemaking or to comment on the Proposed 2007 Standards in the context of the test procedures under which they will apply. Foreclosing such an opportunity completely undermines the administrative rulemaking process. (EMA)

169. **Comment:** The 2007 NPRM represents an attempt by EPA to regulate the industry through Supplemental Emission Requirements and Tests that are considerably more stringent than the certification tests, at the same standards. EPA must take the time to revisit SERTs to address:
    - The feasibility of meeting the emissions requirements over the extended ambient conditions associated with the NTE.
    - The redundancy and infeasibility of SERTs, combined with the proposed emission standards.

    (Cummins)

Agency Response to Comments 168-169: As discussed previously, technological feasibility for the supplemental test procedures (also referred to as SERTs by the commenter) is discussed in detail in the ARB's ISOR[109], Section 6, and the U.S. EPA's RIA[110], Chapter 3. Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. While those tests demonstrate reductions that satisfy the test requirements, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected.

Further, the supplemental test procedures were adopted in previous rulemaking. The previous rulemaking went through a 45 day public notice period that began on October 20, 2000. During the public notice, engine manufacturers and other interested parties provided comments on the requirements. All comments were considered and the requirements were adopted at a public hearing on December 8, 2000. The only changes to the test procedures provide additional flexibility during the phase-in period. Therefore, no further changes to the adopted requirements are necessary.

D. Compliance And Other Issues

1. Averaging, Banking & Trading Program.

170. **Comment:** EPA's proposed changes to the averaging, banking and trading (AB&T) program and new provisions in new subparagraph (l) of section 86.007-15 render the

[109] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[110] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

proposed AB&T program utterly unworkable and of little value to engine manufacturers. Among those provisions are severe restrictions on the generation and use of credits and credit life, as well as restrictive NOx and PM family emission levels (FEL). (EMA, Cummins)

171. **Comment:** EPA's proposal to prohibit the use of credits generated by engines meeting the 2006 standards for use on engines certified to the 2007 standards completely eviscerates the founding principle of the ABT program to ease the transition of new, more-stringent standards. This is because there will be no possibility for manufacturers to generate credits by producing engines meeting the 2007 standards prior to 2007 as a result of the unavailability of ultra low sulfur fuel. Ultra low sulfur fuel is required for engines certified to the 2007 standards. Furthermore, the proposal removes any incentive for manufacturers to introduce new emission control technology prior to 2007 and provides incentive for manufacturers to sell higher-emitting engines in order to use up any credits generated that, under the proposal, will expire after 2006.

    Of utmost concern to the engine manufacturers, the proposal reneges on EPA's guarantee, provided in the existing regulatory language, which states that NOx plus NMHC and particulate credits do not expire. Unlimited-life credits were a key element for the manufacturers' support of the SOP and have been recognized by EPA and ARB to provide emission benefits and to eliminate incentive to use credits unnecessarily. By eliminating the use of non-2007-compliant credits from the proposed AB&T program, EPA has violated its prior commitment as embodied in existing regulations. (EMA, Cummins)

172. **Comment:** While federal agencies have some ability to change positions for well-articulated policy reasons, EPA has not offered any cogent explanation for its reversal of its position to not expire NOx plus NMHC and particulate credits. Moreover, the right to accrue these credits confers a property right on a manufacturer. By changing the rules of the game retroactively, EPA would deprive the manufacturer of that property without due process. (Cummins)

173. **Comment:** EPA's proposed requirement to prohibit credit exchanges between phase-in and phase-out families removes flexibility without providing any environmental benefits. EPA's concerns that this flexibility would delay the introduction of NOx aftertreatment technology are completely unfounded and unsupported by any data or analysis. Even if EPA's concerns were a possibility, they are irrelevant. EPA's focus should be on achieving the greatest emission reductions possible, not on forcing a particular technology. Moreover, even if EPA's focus was on such technology to justify the move to ultra low sulfur fuel, EPA should not be concerned because the 2007 PM standard and 2007 NOx limits with the use of pre-2007 credits would still require ultra low sulfur fuel. (EMA, Cummins)

174. **Comment:** EMA does not support EPA's proposed percent-of-sales phase-in. As part of EMA's proposal to adopt a two-step implementation of the NOx standard, EPA should craft a workable and reasonable AB&T program that allows full credit exchange among engine families meeting pre-Interim, Interim, and Final standards. (EMA)

175. **Comment:** Credits earned by reducing emissions from pre-Interim standard engines by any amount should be fully applicable to Interim and later compliant engines. Likewise, under EMA's proposed two-step standard approach, credits earned by early reduction of

emissions from engines meeting the Interim Standards should be fully applicable to engines meeting the Final Standards.

Setting thresholds and applying the deep discounts that a threshold approach involves discourages the early application of emission control technology – especially technology that cannot achieve the threshold level. AB&T programs are intended to provide compliance flexibility and encourage the early use of emission control technology – not to provide a direct emission benefit through discounting or credit expiration schemes. (EMA)

176. **Comment:** Credits earned by reducing emissions from pre-Interim standard engines by any amount should be fully applicable to Interim and later compliant engines.

    Setting thresholds and applying the deep discounts that a threshold approach involves discourages the early application of emission control technology – especially technology that cannot achieve the threshold level. AB&T programs are intended to provide compliance flexibility and encourage the early use of emission control technology – not to provide a direct emission benefit through discounting or credit expiration schemes. (Cummins)

177. **Comment:** Supports EPA's proposal to retain the existing practice of not discounting credits and placing no limits on credit life. Retention of these provisions increases the flexibility and utility of the AB&T program. It encourages the development and use of low-emission technology earlier than would otherwise be required and does so in a way that is environmentally neutral.

    This specific aspect of EPA's proposal, however, is more than disingenuous. EPA, by disallowing the use of credits generated prior to 2007, has not done what it committed to in prior rulemakings and in this very rulemaking. EPA should not discount credits and should not limit credit life. To that end, EPA should start by not disallowing the use of credits generated prior to 2007. (EMA, Cummins)

178. **Comment:** The proposal's severe restrictions on the generation and use of credits render the AB&T program utterly unworkable. The stringency of the proposed standards necessitates a flexible AB&T program. Even a flexible AB&T program is a zero sum proposition and, inasmuch as credits are generated early and used later, the environment is benefited. EPA needs to remove the constraints that were added to the existing AB&T program by the NPRM. (Cummins)

179. **Comment:** EMA urges the Board and Staff to draft regulatory language concerning the averaging, banking and trading program that will minimize the need for engine manufacturers to track separately engines for sale in the U.S. and California. (EMA)

> **Agency Response to Comments 170-179:** In response to these comments, the U.S. EPA revised their 2007 Final Rule to incorporate additional flexibility to the ABT program. One is to allow unlimited use of banked PM credits. Since the FEL is 0.02 grams per brake horsepower-hour, use of PM credits is not expected to be abused. Second, NOx plus NMHC credits banked prior to 2007 may be exchanged for NOx credits that may be used in the 2007 and subsequent model years. In addition to the NOx FEL of 0.50 grams per brake horsepower-hour, these converted credits must be discounted by 20 percent to account for the

NMHC portion. This effectively allows full credit exchange for the NOx portion of the credits. Further, only 10 percent of total sales of engines certifying above the NOx FEL of 0.50 grams per brake horsepower-hour may use these converted credits.

Additionally, the ARB adopted identical provisions as those adopted in the U.S. EPA's 2007 Final Rule. Consequently, engine manufacturers are not required to separately track engines for sale in the U.S. and California. Given the additional flexibility, no further changes to the ARB adopted requirements are necessary. Also see Agency Response to comments #99-#101 and #102-#104.

a. NOx and PM credits rounded to 0.01 megagram.

180. **Comment:** Commenter supports rounding NOx and PM credits to 0.01 megagram. That change allows a greater degree of precision and is consistent with the order of magnitude reduction in the emission standards. (EMA, Cummins)

Agency Response: The adopted provisions require credits to be rounded to the nearest one-hundredth of a Megagram. Therefore, no further changes to the adopted requirements are necessary.

b. AB&T emission caps levels.

181. **Comment:** EPA should establish the previous emission standards as the upper limit cap for the use of credits in transitioning to new emission standards. By so doing, EPA will allow credits to be used for small-volume, specialty engine applications which manufacturers could not otherwise easily or cost-effectively re-engineer for the first year of the program. This upper limit FEL cap would allow certain engine families to be carried over and would not cause an overall delay in the introduction of NOx or PM aftertreatment technology. These ABT flexibilities would allow manufacturers additional time to refine technology for optimum emission control, but, in doing so, will not be able to delay introduction of such technology. Most important, there is absolutely no detriment to the environment from allowing such flexibilities. (EMA, Cummins)

182. **Comment:** The AB&T emission caps should be set at the level of the previous standards. Such a requirement is consistent with EPA's previous AB&T programs and will allow manufacturers to carry over a very limited number of engines that otherwise could not be certified at the new standards or could only be done so at excessive costs. An FEL cap at the previous standards assures that there are no excessively emitting engines sold while at the same time providing engine manufacturers maximum flexibility.

Of course, ultimately the FEL cap is self-limiting. The higher the credit using FEL and the larger the number of engines using credits, the more credits an engine manufacturer will be required to have banked. As EPA recognizes, the 2004 emission standards are very stringent and, absent the widespread availability of ultra-low sulfur fuel, represent the near limits of emission reductions that engine manufacturers will be capable of achieving. As such, there are very real limitations on the number of emission credits that can be generated which, as a practical matter, will limit the usage of credits under the new program irrespective of FEL caps.

As such, EPA should set a cap which provides the greatest flexibility possible and allows for the limited carryover of low volume engines. (EMA, Cummins)

Agency Response to Comments 181-182: The U.S EPA and the ARB have not always set FEL caps at the maximum levels allowed by the previous emission standards. The purpose of the significantly lower FEL caps is to ensure sufficient installation of newer technology engines and aftertreatment based emission control systems. Further, since these FEL caps do not have a termination date, the U.S. EPA and the ARB do not want engines produced that emit over ten times the current (2004-2006) emission standards. Also see Agency Response to comments 78 and 83 regarding technological feasibility. Therefore, no further changes to the adopted requirements are necessary.

2. Requirements for Allowable Maintenance Procedures.

183. **Comment:** EPA has proposed in Section 86.007-25(b)(4)(iii) that only adjustment and cleaning of the filter element of a particulate trap or trap oxidizer system, and the catalyst beds of a catalytic converter, may be conducted under current maintenance schedules. The proposed section would prohibit repairs or replacement of those components throughout an engine's useful life.

Such an approach is a significant departure from current allowable maintenance procedures. Current regulations allow the adjustment, cleaning, repair, or replacement of critical emissions-related components, such as fuel injectors, turbochargers, electronic control unit and its associated sensors and actuators, particulate trap or oxidizer system (including related components), exhaust gas recirculation system (including all related control valves and tubing), catalytic converter, and any other add-on emissions-related components to occur at 100,000 miles (or 3,000 hours) of use and at 100,000 miles (or 3,000 hours) intervals thereafter for light HD diesel engines, or at 150,000 miles (or 4,500 hours) intervals thereafter for medium and heavy HD diesel engines.

EPA's arguments for removing the current repair/replacement provisions for particulate traps or catalytic converters elements from the 2007 rule apparently are based on two assumptions. Those assumptions are that ultra-low sulfur diesel fuel will now be available, thereby increasing the durability of engine systems, and that manufacturers may otherwise "underdesign the adsorbers and traps compared to the level of durability that is achievable." (65 Fed. Reg. at 35524.) The Agency, however, has neglected to account for a number of facts.

Manufacturers do not have any incentive to underdesign or to procure any "underdesigned" components in a very competitive market, where customer satisfaction is of ultimate importance. Underdesigned components would mean lost time and lost revenue for repairs, and manufacturers would lose customers.

Aftertreatment suppliers' technology, or production ability may not enable them to produce zero failure rate or 0% AQL products. European field test results on particulate traps with low sulfur diesel fuels, from 10 ppm to 50 ppm, show that trap plugging due to metallic ash from the lube oils is a serious problem, requiring trap removal and mechanical blowoff, at an interval of every 100,000 to 150,000 miles of operation, depending on applications. This problem also is known to contribute to many premature

catastrophic failures or meltdowns of the trap, when the ash blowoff schedule is not adhered to, or in combination with insufficient regeneration of the trap.

There is little long-term in-use experience with the technologies expected to be used to meet the proposed standards. The service and maintenance needed to maintain the equipment operating at its intended high efficiency in order to meet the proposed standards in-use are yet to be determined. EPA must understand that engine manufacturers already have strong commercial incentives to minimize the amount of required maintenance. The only impact of prematurely placing restrictions on allowable maintenance will be restricting the use of promising emission control technology that may not be able to meet the allowable maintenance requirements.

In summary, EPA should not restrict emission control technology by limiting maintenance that can be performed. Instead, EPA should adopt final allowable maintenance provisions that allow for repair or replacement of the applicable components throughout the useful life of the engine. (EMA)

Agency Response: Both the U.S. EPA and the ARB believe that the expected aftertreatment control technologies will be durable for the full useful lives of HDDEs with the use of the available low sulfur diesel fuel. Further, by requiring aftertreatment emission control devices, such as particulate traps and NOx adsorbers, to be durable for the useful life of the engine, the ARB is ensured that those manufacturers will give the effort to design the most durable control systems. This is expected to result in improved emission control system technologies, rather than creating wide scale problems. Therefore, no further changes to the adopted requirements are necessary.

3. OBD Requirements

184. **Comment:** EPA has proposed extensive on-board diagnostic (OBD) requirements for Otto-cycle and diesel heavy-duty vehicles and engines up to 14,000 lbs. GVWR but have not conducted the technological feasibility and cost-effectiveness of these requirements. Engine manufacturers would be required to accurately measure a 0.1 g/bhp-hr NOx limit, a 0.005 g/bhp-hr PM limit, and 0.65 NMHC limit during engine operation under any condition. Today, there are no known commercial, real-time sensors that could reliably and accurately measure such extremely small changes in emissions. It is a significant unknown whether such sensors will be able to accurately and reliably measure the required emission changes under all the required conditions. The commentors recommend that EPA convene public workshops to evaluate the technological feasibility and that no OBD requirements be finalized until EPA has completed the necessary work to establish technological feasibility and cost-effective requirements. (EMA, Cummins)

185. **Comment:** The existing regulations are not specific about the system-monitoring requirements for new exhaust emission technologies. Clear system requirements should be included for OBD. In addition, once monitoring strategies are developed for low sulfur fuel engines, the OBD monitors will be sensitive to an operator misfueling with a higher sulfur fuel, causing MIL activation and higher warranty claims, and catalyst damage. (Cummins)

Agency Response to Comments 184-185: OBD requirements were not included as part of this rulemaking and have not been adopted. Therefore, no further changes to the adopted requirements are necessary.

4. Voluntary Retrofit Program

186. **Comment:** EPA's proposal recognizes that the nationwide availability of ultra low sulfur diesel fuel could provide the basis for making retrofit technologies available. (65 Fed. Reg. At 35438.) In pursuing retrofit opportunities, EPA should take into consideration the following:

- EPA should encourage the implementation of voluntary, incentivized retrofit programs and should prohibit or strongly discourage the development of separate and different such programs among the states.
- EPA must properly define what qualifies as a retrofit including the use of add-on aftertreatment technology, replacement engines, engine upgrades, and cleaner fuels or fuel additives.
- EPA must develop a uniform testing and certification protocol that does not impose an impediment to retrofits while at the same time assures that retrofits will provide real and lasting emission reductions.
- EPA should develop uniform baseline emission rates for determining SIP credits associated with retrofits and should not allow states to develop their own baseline emission rates.
- EPA should establish how SIP credits for voluntary retrofit programs are calculated.
- Credits that are generated as a result of a voluntary retrofit program should only be used once (e.g. for manufacturers' AB&T programs, for state SIP reductions, but not for both). In addition, EPA should not establish a minimum emission level as a credit trigger. Any real emission reduction should be creditable. However, reductions resulting from test variability, for example, should not count.
- EPA should establish a program that assures that the ultra low sulfur fuels that enable retrofits are available and used.
- EPA must address issues related to warranty and liability to assure that the party or parties responsible for a potential failure are liable. Said another way, the manufacturers of the original engine should not be responsible for changes made to that engine as a result of the use of a retrofit system developed and certified by another party.

These are just a few of the important issues that EPA will need to address in order to implement a successful, cost-effective and practical voluntary retrofit program. EMA is willing to work with EPA on these important issues. (EMA)

Agency Response: Due to the durability of HDDEs, the ARB recognizes the importance of a retrofit program to attain state air quality goals. However, voluntary retrofit requirements were not included as part of this ARB rulemaking and have not been adopted. Therefore, no further changes to the adopted requirements are necessary.

5. Labeling Requirements for Vehicle Manufacturers.

187. **Comment:** EMA shares EPA's concerns regarding the effects that possible misfueling with high sulfur diesel fuels may have on the environment and the functioning of aftertreatment devices which are required to enable engine systems to meet the 2007 emission standards. In fact, EMA believes that all necessary steps should be taken to prevent misfueling, including a requirement to use different fueling nozzles. The difficulty with EPA's proposal is that a great majority of HDDE manufacturers are not vertically integrated manufacturers, and they do not undertake either vehicle or evaporative emissions certification.

EPA should clarify that it is not the Agency's intent to require HDDE manufacturers to comply with labeling requirements when certifying engines to the Interim and Final emission standards. As the Agency knows, most HDDE manufacturers supply certified engines to vehicle manufacturers. Engine manufacturers do not have any control of the vehicle dashboard, instrument panel, or fuel inlet. The Agency should impose such requirements only on the ultimate heavy-duty truck and bus manufacturers. (EMA)

Agency Response: The adopted requirements include specifications that manufacturers must install "low sulfur diesel fuel" labels on the dashboard and near the refueling inlet. Since not all engine manufacturers are vehicle manufacturers, the requirement provides flexibility to both manufacturers by allowing either manufacturer to install the label. Those engine and vehicle manufacturers may use other arrangements that they find more convenient or cost effective. However, engine manufacturers would be expected to provide the fuel labels to the vehicle manufacturer. Therefore, no further changes to the adopted requirements are necessary.

6. Special Provisions For Intermittently Regenerating Aftertreatment Devices.

188. **Comment:** EPA has proposed in section 86.1337-07(d) special provisions for aftertreatment devices that are intermittently regenerated. EPA's proposal is unclear, unworkable, and not representative of emissions from such devices. First, EPA must adopt an appropriate definition of "intermittently regenerating aftertreatment device," which should exclude the NOx adsorber that has desulfation events. Second, the proposed language is unclear as to whether the engine must be shut off and then restarted during repeat hot cycles, and how long the soak period should be between engine starts. Furthermore, it would be inappropriate to use the highest emission levels among the numerous repeat hot cycles performed before a regeneration event occurs. If the highest emissions occur during the "regeneration event," but the regeneration event happens only once in numerous hot cycles, it would be inappropriate to weight such emissions on a 6/7 basis.

EMA recommends that the Agency eliminate the proposed special provisions for intermittently regenerated aftertreatment devices and adopt a single procedure for engines with aftertreatment devices, as follows: If a regeneration event occurs during the cold and/or first hot cycle, the emissions test is concluded and the calculation to determine the composite emission level is performed according to section 86.1342. If a regeneration event does not occur during either the cold or first hot cycles, then repeat hot cycles are to be run until regeneration occurs, with a minimum of soak time in between. Emissions would be measured only during the first and last hot cycles. The emissions under the proposed approach would be calculated as follows: 1/7 (cold) + 6/7

((number of hot cycles before regeneration event occurred ÷ total number of hot cycles run) (first hot) + (1 ÷ total number of hot cycles run) (last hot)). Such a procedure would provide a more realistic picture of emissions from such devices.

Finally, EPA should make clear that the proposed supplemental emission test and limit requirements – including NTEs and MAELs – do not apply during regeneration. Further, if regeneration occurs during a steady-state test mode, the test mode would be re-run and the emissions recorded during the re-run test point (without regeneration) would be used in the calculation of the composite cycle emissions, provided the manufacturer can show that regeneration frequency is no greater than once every two hours of operation at rated load and speed. If regeneration frequency is greater than once every two hours, then test modes run with regeneration would not be re-run and would count toward the composite emissions. (EMA)

189. **Comment:** EPA's proposal for addressing regeneration emissions is unacceptable. First, it over-simplifies the variety of regeneration processes that might occur and does not provide procedural details. Second, EPA's approach overstates the real impact of any regeneration events that would occur under these conditions. Using the highest emission levels among the numerous repeat hot cycles would not provide representative results. Third, EPA's proposal would add significant cost to every emissions test as a result of the multiple cycles required before a regeneration event occurs and would increase variability in the test results. Based upon current understanding of the regeneration processes of potential aftertreatment systems, their emissions impacts are not significant enough to warrant the excessive test cost to measure them during each test. Cummins recommends that EPA carefully reassess how to properly measure and account for regeneration emissions from intermittently regenerated aftertreatment devices. (Cummins)

Agency Response to Comments 188-189: Both comments refer to U.S. EPA proposed language to conduct multiple FTP test such that regeneration events are included in emission testing. Regeneration events can potentially result in an increase emissions during those events. However, the U.S. EPA and the ARB agree that it is unpractical to require multiple heavy-duty FTP test cycles until a regeneration event occurs. As a result, this provision was not included in the adopted requirements. However, there are provisions in the NTE test to incorporate regeneration events. When a discrete regeneration event occurs during a NTE test, the averaging period increases proportionately to the number of regeneration events. The U.S. EPA and ARB expect that the regeneration events should be predictable, making for a simple regeneration factor, and thus no significant burden to the engine manufacturers.

For phased-in engines with NOx FELs less than 1.5 g/bhp-hr, MAEL requirements do not apply. In addition, comments regarding impracticality and excessive test costs are based on the U.S. EPA's proposed inclusion of regeneration event in FTP testing. Since those provisions were neither proposed nor adopted in this rulemaking, those comments are not relevant to this rulemaking. Therefore, no further changes to the adopted requirements are necessary.

7. Urban transit bus standards.

190. **Comment:** By revising the proposed rule to include urban bus engines and rescinding the 2007 provisions in the existing urban bus rule, the Board will greatly increase the probability that compliant low emission urban bus engines will be available for purchase by California transit operators during the 2007 to 2009 phase-in period. (DDC)

Agency Response: The adopted requirements are only applicable to the 2007 and subsequent model year new HDDEs, and exclude urban bus engines. Separate requirements for urban bus engines were previously adopted by the Board in December of 2000. Since the adopted urban bus engine emission standards are lower, and the phase-in schedule is more aggressive compared to those adopted for HDDEs, there is a potentially significant adverse health impact that may result from a relaxation of urban bus engine standards. This is particularly important since a majority or urban buses operate in highly populated areas. Further, there is sufficient lead time for the ARB and engine manufacturers to review technology developments to ensure successful introduction of these urban bus engines. Therefore, no change to the regulatory text is necessary.

191. **Comment:** The final ARB rule requires transit buses to meet a NOx standard of 0.20 g/bhp-hr across the board in 2007. The EPA final 2007 Rule, however, adopted a phased-in approach to compliance for HDDEs. Under the EPA rule (and the rules proposed to be adopted by ARB for non-transit buses), manufacturers have the option to certify to an "average" compliance level of approximately 1.2 g/bhp-hr NOx in 2007, 2008 and 2009. That approach recognizes that NOx aftertreatment technology initially will be approximately 40% efficient. The phase-in will require NOx aftertreatment on all heavy-duty on-highway engines in 2007, but will allow three additional years for the technology to mature until a very high level of efficiency is required. Not until 2010 are 90%-efficient NOx aftertreatment technologies expected to be available and it is not until 2010 that engines must be certified to the 0.20-gram NOx standard.

Despite the Staff's indication that its proposal "ensures that the requirements for 2007 and subsequent model year HDDEs are identical to those adopted by the U.S. EPA in January 2001," ARB is proposing to maintain the more-stringent urban transit bus standards that the Board adopted last year. ARB must re-examine its decision not to harmonize those recently-adopted urban transit bus standards with the requirements of the EPA final 2007 rule. In order to fully harmonize with EPA's final 2007 Rule, and to follow through on the representations ARB Staff made to engine manufacturers during the transit bus rulemaking process, ARB must revise the final transit bus fleet rule. (EMA)

192. **Comment:** The ARB must revise the transit bus NOx standard to harmonize with EPA by allowing for the same NOx phase-in provisions as provided in the EPA 2007 Rule. Indeed, in numerous discussions among EMA and the ARB Staff concerning the new transit bus rule, the understanding and intent was that the 2007 provisions of the transit bus rule would be aligned with the EPA 2007 Rule once it was finalized. At the time ARB was developing its transit bus proposal, EPA was working on its proposal for emission standards applicable to 2007 and later model year heavy-duty on-highway engines used in trucks and buses. Engine manufacturers repeatedly stressed the need for ARB's transit bus proposal to harmonize with EPA's 2007 standards. If not, ARB would end up requiring a unique product in California which likely would not be economically or technically feasible for engine manufacturers to produce.

In fact, Staff explicitly acknowledged throughout the transit bus rulemaking process the importance of harmonization and the expectation that the standards would be aligned with EPA's. "If the [ARB's] proposed levels are not the emission levels ultimately adopted by the U.S. EPA, staff would consider modifications to the proposed long-term emission standards." (ARB Staff Report: ISOR, "Proposed Regulation for a Public Transit Bus Fleet Rule and Emission Standards for New Urban Buses," p. 36, December 10, 1999.) ARB's Informative Digest of Proposed Action on the rule also explicitly stated the ARB's expectation that the standards would be harmonized: "The U.S. EPA is expected to adopt equivalent emission standards for heavy-duty engines and vehicles, including urban buses, for the 2007 model year." (Mail-Out #MSC-99-35, p. 7.) And, ARB's Final Statement of Reasons and response to comments included the same acknowledgement: "Once the U.S. EPA's [2007] rulemaking is finalized, the ARB staff will consider modifications to California's 2007 standards for urban bus engines, if necessary." (Final Statement of Reasons for Rulemaking, Including Summary of Comments and Agency Responses, p. 17.) (EMA)

193. **Comment:** Another significant disharmony between the ARB and EPA requirements for 2007 are in the standards applicable to engines used in urban buses. The ARB rule requires all urban bus engines to meet a NOx standard of 0.2 g/bhp-hr in 2007 while the EPA rule phases in the new NOx standard over a period of four years, with full implementation in 2010. As has been recognized by EPA, and as ARB is recognizing in today's proposal, 90 percent efficient NOx aftertreatment is not technologically feasible until 2010. If ARB holds to the 2007 new NOx standard for urban buses, California will simply not have engines, either diesel or CNG, for urban buses available to meet the diesel fuel or alternative fuel path of the California program. About 800 urban buses are sold annually in California, with half in diesel and half in natural gas. Manufacturers will not invest substantial resources to develop 90 percent efficient NOx aftertreatment for this very small market. In addition, given the transit agency's only option for 2007 through 2010 will be to rebuy engines or to defer purchases, it is likely that ARB's failure to harmonize will actually have an adverse air quality impact. It is in the interest of the stakeholders that harmonization with the federal urban bus requirements occur.

We raised this issue with staff on numerous occasions during the regulatory development of the urban bus rule. In fact, during the urban bus rulemaking, staff committed to look at the issue of harmonization of the ARB urban bus standards with EPA's heavy-duty engine standards once EPA finalized its rule. Engine manufacturers want to work with you and your staff to achieve reasonable, cost-effective and attainable regulatory solutions. To that end, we urge the board to harmonize its urban bus standards with the balance of the EPA and ARB heavy-duty on-highway program for 2007 through 2010, and to harmonize its entire heavy-duty on-highway program with that ultimately implemented by EPA for all heavy-duty engines. (EMA, DDC)

DDC cannot financially justify, and therefore, is not planning, any developmental programs aimed at meeting the unique California bus requirements. Transit bus engines in California are only about one percent of the sales volume of on-road engines. It does not make good business sense or environmental sense for us to divert substantial resources to meet unique California bus requirements at the expense of the program aimed at meeting the 50 state requirements for truck engines and the federal bus engine standards. (DDC)

194. **Comment:** There are distinctions/problems with rural and small systems trying to assemble the funding and assemble the funding in the time frame that's being required by your board. It's certainly been hammered home, I think the time needs to occur as well for the technology to develop. (MSTD)

195. **Comment:** We think it makes sense as well to harmonize the CARB with the EPA (urban transit bus) requirements. At our level it makes it easier to implement. It allows more time to plan and execute and assemble the funding. And funding is the real issue for smaller transit systems. (MSTD)

196. **Comment:** Cummins' second issue pertains to certain provisions where the staff's proposal does not harmonize with the EPA 2007 rule. Despite the staff's indication that its proposal, in quotes, ensures that the requirements for 2007 and subsequent model year HDDEs are identical to those adopted by the US EPA in January 2001, end quotes, they're proposing to maintain the more stringent urban transit bus standards that the board adopted last year. This rule requires transit buses to meet a 0.20 NOx standard per brake horsepower hour in 2007. The EPA final rule adopted a phase-in approach and, along with that average, under the EPA rule, manufacturers have the option to certify to an average compliance level of approximately 1.2 in these three years, 2007, '8 and '9. The ARB should revise the transit bus NOx standard to harmonize with EPA by allowing the same phase-in for these engines. If not, ARB would end up requiring unique products in California, which likely will not be feasible for Cummins to produce. (Cummins)

Agency Response to Comments 191-196: ARB's previously adopted NMHC and CO emission standards for urban transit buses are currently lower than those that were just adopted for on-road HDDEs. In addition, the phase-in schedule for the urban transit bus emission standards is more aggressive. While the ARB has made every effort to harmonize the requirements, the ARB also knows that most urban transit buses operate in highly populated and lower income areas. The ARB has considered revisions to the previously adopted emission standards and phase-in schedule. However, relaxation of the previously adopted emission standards and/or phase-in schedule would be detrimental to such "environmental justice" communities. Further, there is enough lead time to allow engine manufacturers to adjust the technologies necessary for compliance. Therefore, no further changes to the regulatory text are necessary at this time.

More importantly, the ARB rulemaking is "identical" to the U.S. EPA's 2007 Final Rule only for those provisions within the scope of the 45-day Notice. Commenters are attempting to argue that to be identical, ARB must amend California's previously adopted urban bus standards to conform to the U.S. EPA's 2007 Final Rule. The Notice clearly excluded urban bus engines from consideration in this rulemaking. The proper forum for considering amendments to the urban bus standards is during amendment of those standards, or by separate petition under Government Code section 11340.6.

197. **Comment:** Staff has dismissed EMA's concerns, and the acknowledgements made to engine manufacturers, by claiming that "there is sufficient lead time to review technology development for urban bus engines at a later date." (ISOR, p 34.) But brushing off the urban bus standard harmonization issue in this manner does not assure timely resolution

of the issue. Engine manufacturers need certainty with regard to the requirements for all heavy-duty engine applications in order to plan and produce engines that can comply with the standards and meet customer needs. As it stands now, what engine manufacturers know with near certainty is that there simply will not be urban transit bus engines available – whether diesel or natural gas-fueled – that can meet the 0.20 g/bhp-hr NOx standard and meet the demands of the transit market in 2007. ARB should accept this reality and take steps now to harmonize California's urban bus engine requirements for 2007 with EPA's 2007 requirements. Unless this is done, there will be considerable confusion and unnecessary disruption of the urban bus market. (EMA)

198. **Comment:** EMA again urges the Staff to follow through on the understandings and acknowledgements made to engine manufacturers throughout the urban transit bus rulemaking. Now that the new EPA 2007 standards are in place, ARB has the opportunity and a clear road map for adjusting the implementation of the final NOx standard for urban buses. The ARB should take such a step without delay. (EMA)

Agency Response to Comments 197-198: The ARB is not attempting to dismiss EMA concerns. Due to the disproportionate amount of urban transit buses that operate in highly populated areas, the ARB believes that it is critical that engine manufacturers utilize their time to improve their emission control technologies to comply with the previously adopted emission standards for urban transit buses. There is sufficient time for development and, if necessary, a review of those technologies at a later date such that we can minimize the resulting health risk due to urban transit bus emissions.

199. **Comment:** The fact is that when the staff first developed their proposals for urban buses, and as they were thinking about all of the heavy-duty on-highway program, the direction, the intent for 2007 was to harmonize with the federal program. The federal program at that time it was developed along with the concept of the taking the two-tenths gram per brake horsepower hour standard and implementing it on a sales unit basis, 25 percent per year over a four-year period, so that in 2007 under the EPA proposal there would be two-tenths gram engines. Ultimately, EPA realized that that was not technologically feasible, and that was not the rule that they finalized. They finalized the rule that assumed the same emissions benefits as would have been achieved through a 25 percent per year phase-in of the two-tenth gram standard, but recognized that aftertreatment technologies of that efficiency would not be available in 2007, would be available by 2010. And what EPA allowed and what the staff is recommending to you as a board to adopt today for all other heavy-duty on-highway products is to have an averaging program that allows the emission equivalent of a 25 percent per year phase-in the two-tenth gram standard, but which will in fact be implemented by NOx aftertreatment in 2007 at about a 40 percent efficient basis, and in 2010 with a 90 percent efficient aftertreatment technology, and this is for all engines. We're not talking about diesel-fueled engines. All we are talking about is compressed natural gas engines. The idea of somehow being able to accelerate the development of the 90 percent efficient aftertreatment technologies for urban buses in California is simply not realistic or factual in terms of the development programs.

I need to remind you that there are about 800 urban buses sold in California every year. Half of those sales go to Detroit Diesel and about half of those sales go to Cummins. Of each of those approximately 400 sales they have, about half of them are compressed natural gas and about half of them are diesel. So we're talking about two different

development programs for the compressed natural gas engines, for the diesel engines for about 200 sales volume each that those companies would have to try to develop to accelerate 90 percent efficient traps to 2007. And I think you'll hear from me and you'll certainly hear from them that it's not going to happen. So again this is not a diesel issue. It's an urban bus issue.

I had conversations just recently as yesterday with Nancy Steele to try to find a way to implement the demonstration programs that the board adopted as part of the alternative NOx option. That option was adopted by the board again as with my urging, the urging of engine manufacturers, and I thought with the creative efforts of both your staff and yourselves to come up with that option, because we told you then that the half gram NOx standard that was to otherwise to be implemented in 2004 also was not technologically feasible, also could not be supported by a very small market, but we committed to find another way to get the same emission reductions.

We have been somewhat almost single messaged on this point since we began working with you to find a way to get reductions from urban buses used in the state. We are continued to be committed to do that. We're on a path to do that. And we will do that working with the staff, with you, with the transit agencies, with the aftertreatment device manufacturers. It will happen, but it will not happen necessarily under the base program, which is why you developed, and I think made available to others, the alternative program. And I think it would be prudent for the board today to also recognize that come 2007 we have a potential problem, one that we would like to work with you now to address by recognizing that the kinds of NOx aftertreatment efficiencies that are anticipated for the urban bus market will not be there until 2010. There will be NOx aftertreatment in 2007. It will be applicable to urban buses, both CNG and diesel, and it can be sold and used in the state. And if there isn't that option made available, our grave fear is that people will not buy buses during that three-year period because there won't be any to buy, and that hurts air quality.

In the ISOR for the urban bus rule, this was as the original package on the urban bus rule, the ISOR under section H says if the proposed levels are not the emission levels ultimately adopted by the US EPA, staff will consider modifications to the proposed long-term emission standards. In the mail-out, mail-out 99.35 for the urban bus rule, it stays US EPA is expected to adopt equivalent emission standards for heavy-duty engines in vehicles including urban buses for the 2007 model year. That was the intent. In the final statement of reasons, in comment B-10, it says in the agency response, once the US EPA's rulemaking is finalized, the ARB staff will consider modifications to California's 2007 standards for urban bus engines if necessary. (EMA)

> **Agency Response:** ARB's previously adopted NMHC and CO emission standards for urban transit buses are currently lower than those that were just adopted for on-road HDDEs. In addition, the phase-in schedule for the urban transit bus emission standards is more aggressive. While the ARB has made every effort to harmonize the requirements, the ARB also knows that most urban transit buses operate in highly populated and lower income areas. The ARB has considered revisions to the previously adopted emission standards and phase-in schedule. However, relaxation of the previously adopted emission standards and/or phase-in schedule would be detrimental to such "environmental justice" communities. Further, there is enough lead time to allow engine manufacturers to adjust the technologies necessary for compliance. The control technology

expected to be used for obtaining the necessary reductions of NOx emissions is the NOx adsorber. However, for transit buses, SCR may be an ideal emission control system since buses are maintained and fueled at central facilities. Therefore, no further changes to the regulatory text are necessary at this time.

200. **Comment:** Transit systems are not staffed, financed or equipped to be R and D activities. Our (transit districts) mission is to put reliable, safe, affordable service on the street. And we have been operating natural-gas-powered buses now for five and a half years. We have real-world experience with them. We find that they are not proven technology. They break down more frequently than diesel buses and they are more expensive, specifically 18 percent higher to operate. So I would encourage you to consider to continue to allow, and consider the dual fuel path and be fuel neutral as we implement the rules. (MSTD)

Agency Response: The adopted requirements are fuel neutral and only set emission standards rather than require any alternative fuels. Further, requirements for urban transit buses is outside the scope of this rulemaking. Therefore, no further changes to the regulatory text are necessary at this time.

201. **Comment:** It was envisioned (natural gas) to be a unlimited supply. We're finding that's not necessarily the case. It appears to be that all the electrical generating stations that being are built to meet California's energy needs are going to be fired by natural gas. So the issue of supply and demand will drive the costs and have a direct impact on us. (MSTD)

Agency Response: As with any fuel supply, supply and demand will have an affect on prices. Since the requirements are fuel neutral and only emphasize the emission standards, fuel costs for alternative fuels are not expected to be affected by this rulemaking. Further, a thorough cost effectiveness analysis was performed by the U.S. EPA in their RIA,[111] Chapter 5. Those costs were used in the ARB's analysis in the ISOR,[112] Section 10. The cost effectiveness for the adopted requirements was determined to be within the range of previous rulemaking. Therefore, the adopted requirements are cost effective and no further changes to the regulatory text are necessary at this time. Also see Agency Response to comment #74.

202. **Comment:** We strongly agree with your staff that there is ample time to consider this whole question in the future if that's necessary. It is not appropriate, in our judgment, to relax the transit standards or their timetable. So I think simply stated there really is no justification to impede the market momentum of natural gas buses in order and in some sense to give diesel engines more time. So we would urge that you, as suggested by your staff, hold that issue at abeyance. (SCAQMD)

Agency Response: The ARB agrees with the commenter. The ARB has considered revisions to the previously adopted emission standards and phase-in schedule. However, relaxation of the previously adopted emission standards and/or phase-in schedule would be detrimental to such "environmental justice"

[111] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.
[112] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.

communities. Further, there is enough lead time to allow engine manufacturers to adjust the technologies necessary for compliance. Therefore, no further changes to the regulatory text are necessary at this time.

8. In-use compliance program.

203. **Comment:** NRDC believes strongly that the Proposal—and EPA's overall program to reduce diesel emissions—can be improved in the following way: improve the in-use compliance and enforcement program, to ensure that engine and vehicle certification emissions more accurately reflect in-use, real-world emissions levels. (ALA)

204. **Comment:** Setting more stringent tailpipe standards alone will not be sufficient to assure Americans that diesels are getting cleaner, so NRDC has urged EPA to ensure the strongest possible in-use compliance and enforcement program for the nation's trucks and buses.

In summary, the commenter sites various studies estimating the cost to the public health and economy as a result of engine manufacturers' decade-long use of defeat devices resulting in significant excessive NOx emissions.

The commenter goes on to site studies that show in-use emissions significantly higher than certification standards, indicating that realworld engine deterioration is much higher than demonstrated by the manufacturers during certification, resulting in a gross underestimation in the establishment of heavy duty diesel emission inventories, even to the point of overwhelming any benefits associated with the increase in standard stringency over the past decade.

The commenter closes by emphasizing that in-use compliance testing will become even more important beginning in 2007 and beyond, when newly develop aftertreatment systems are used. This will necessitate in-use testing to confirm the in-use durability of these systems is consistent with estimates made during certification and ensure that the emission benefits are obtained throughout an engines useful life. (ALA)

Agency Response to Comments 203-204: The ARB agrees that an improved in-use compliance and enforcement program is necessary to improve overall emissions. At this time, the adopted requirements harmonize federal and state requirements for HDDEs beginning in the 2007 model year. The adopted requirements are identical to those adopted by the U.S. EPA in January 2001. Therefore, no in-use requirements are included in this rulemaking proposal. However, the ARB is currently working with engine manufacturers to develop an in-use compliance and enforcement program that is expected to be implemented in 2005. This program will help ensure "real world" emissions more closely reflect certification emissions. Therefore, no further changes to the regulatory text are necessary at this time.

V. HEALTH EFFECTS ANALYSIS

205. **Comment:** The reasons for our concern about diesel emissions are clear. In our view, diesel's excessive quantities of particulate matter (PM), NOx and toxic emissions are probably the most serious air pollution threat facing many Americans, particularly in many urban areas.

More than fifty studies show links between particulate matter generally and a wide range of health impacts, including increased asthma attacks and emergencies, endocrine disruption,[113] numerous cardiopulmonary ailments, cancer and premature death.[114] Nitrogen oxides contribute to ground-level ozone formation, acid deposition, nutrient pollution of waterways, and secondary (i.e., atmospheric) formation of particulate matter.

While numerous studies have concluded that the particulate matter and nitrogen oxide emissions in diesel exhaust are harmful to human health, NRDC is increasingly concerned about the growing evidence that diesel particulates are associated with increased cancer risk. Diesel exhaust has long been considered to be at least a probable human carcinogen by the National Institute of Occupational Safety and Health (NIOSH) and the World Health Organization's International Agency for Research on Cancer (IARC).

Diesel's link to cancer results in thousands of avoidable cancers nationwide. The association of the nation's state, territorial and local air pollution officials estimates that current levels of diesel pollution result in over 125,000 potential lifetime cancers nationwide, based on their extrapolation of the MATES-II study.[115]

NRDC is also especially concerned about the growing incidence of asthma in our nation, as well as the association between diesel particulate matter and asthma attacks. A recent study estimated that asthma cases will double by 2020, hitting one out of every five American families.[116] Nobody knows what causes asthma, but numerous studies have found associations between pollution (i.e., both ozone and particulate levels) and acute respiratory symptoms, including asthma attacks and hospitalizations.[117] (ALA)

> **Agency Response:** The ARB agrees with the comments on the adverse health impacts of diesel emissions and the link those emissions have in carcinogenic risk. The U.S. EPA references other detailed research regarding the carcinogenic and non-carcinogenic health effects from diesel PM in their Response to Comments[118]. In August 1998, diesel PM was identified by California as a toxic air contaminant. In addition, diesel PM contains over 40 substances that are individually identified as toxic air contaminants. An assessment of carcinogenic risk found that diesel PM accounts for 70 percent of

[113] Endocrine/Estrogen Letter, June 2, 2000, p. 6. Researchers at the Science University of Tokyo found testicular abnormalities in male mice that inhaled diesel exhaust.
[114] NRDC, Exhausted by Diesel, Third edition, May 1999, pp. 5, 8.
[115] State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO), Cancer Risk from Diesel Particulate: National and Metropolitan Area Estimates for the United States, March 2000. This report was based on calculations of cancer risk first published in South Coast Air Quality Management District, Multiple Air Toxics Exposure Study (MATES-II), Draft Final Report, November 1999.
[116] Pew Environmental Health Commission, Attack Asthma: Why America Needs a Public Health Defense System to Battle Environmental Threats, May 2000.
[117] Regarding ozone associations, see, e.g., Gilmour MI, "Interaction of air pollutants and pulmonary allergic responses in experimental animals," Toxicology 1995 Dec 28; 105(2-3): 335-42; regarding PM associations, see, e.g., Nel AE, Diaz-Sanchez D, Ng D, Hiura T, Saxon A, "Enhancement of allergic inflammation by the interaction of diesel exhaust particles and the immune system," J Allergy Clin Immunol 1998 Oct; 102 (4 Pt 1): 539-54.
[118] Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements: Response to Comments, EPA-420-R-00-027, U.S. EPA, December 2000.

total ambient cancer risk in the year 2000. All studies used in this rulemaking process, on the hazardous effects of diesel PM, have been peer reviewed.

Further, reductions in PM emissions are necessary for California to attain state air quality standards. Therefore, no further changes to the adopted requirements are necessary.

A. Health Effects Of Ambient PM And Diesel PM

206. **Comment:** In summary, the commenter questions the U.S. EPA's interpretations, in the NPRM, of health effect studies associating PM and, specifically, diesel PM to mortality rates. Although there are some studies that demonstrate an association between PM concentration and mortality, the commenter contends that there is no conclusive evidence showing that diesel PM posses a greater health risk. The commenter cites two recent studies[127,128] on this subject to emphasize that more studies need to be completed in order to determine the causality of PM on mortality rates. Specifically, the commenter contends that there are no studies that show diesel PM is any different that ambient PM, as EPA states in their NPRM. (EMA)

207. **Comment:** NRDC strongly supports EPA's proposal for a very simple reason—EPA's proposal means cleaner air and better health for all Americans. These emission reductions will bring critical relief to the more than 120 million Americans live in areas that don't meet EPA's health standards for ozone and/or particulate matter.

EPA and the administration should continue to hold firm because it is on the verge of a historic environmental victory. When it happens, removing sulfur from diesel fuel will be the biggest vehicle news since the removal of lead from gasoline. By cleaning up every truck and bus in the nation, this should mean longer, healthier lives for asthmatics, and many other Americans, who currently hold their breath when a diesel truck or bus blows by and who fear the summer's first ozone alerts far more than they should. (ALA)

Agency Response to Comments 206-207: The U.S. EPA references other detailed research regarding the carcinogenic and non-carcinogenic health effects from diesel PM in their Response to Comments.[119] Even if the health effects studies that the U.S. EPA cited had been found insufficient to support their 2007 Final Rule, California has additional data to support the need for more stringent California standards. Despite comments that "many issues continue to be unresolved," in August 1998, diesel PM was identified by California as a toxic air contaminant. In addition, diesel PM contains over 40 substances that are individually identified as toxic air contaminants. An assessment of carcinogenic risk found that diesel PM accounts for 70 percent of total ambient cancer risk in the year 2000. All studies on hazardous effects of diesel PM used to make this determination have been peer reviewed. Diesel PM aside, this rulemaking will substantially reduce NOx, an ozone precursor. Several California areas will need further NOx reductions to attain and maintain state and federal ozone standards.

[119] Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements: Response to Comments, EPA-420-R-00-027, U.S. EPA, December 2000.

Further, reductions in PM emissions are necessary for California to attain state air quality standards. Therefore, no further changes to the adopted requirements are necessary.

B. Cancer Effects Associated With Diesel Exhaust

208. **Comment:** The NPRM indicates that the HAD is currently being revised to address additional concerns by CASAC. The NPRM then indicates that EPA believes that diesel exhaust[120] is a likely human carcinogen at both the occupational and environmental levels. Additional comments are made concerning some of the purported evidence used to make such an assessment as well as quantitative risk ranges.

The NPRM provides an unbalanced view of the scientific evidence, or lack thereof, linking diesel exhaust and lung cancer and relies on statements from a revised HAD that has not passed independent review by CASAC. The document should not presuppose the acceptance or validity of such revisions, particularly since CASAC has not approved previous versions of the HAD due to the fact that its conclusions were not backed up by scientific evidence. Previous HAD revisions had included a characterization of diesel exhaust as supposedly "highly likely" to cause cancer, and also had included a quantitative risk assessment. Both of those elements of the HAD for diesel exhaust have since been retracted by EPA in response to CASAC's careful review and critique of EPA's methodologies and conclusions. Similar critiques of the findings in EPA's current draft HAD are likely, which is why the NPRM should not cite or quote the HAD.

That issue aside, there are two primary errors or issues in the NPRM's health effects discussion that need revision: the incorrect assumption that diesel exhaust is carcinogenic and the quantification of a range of risk. Both of these issues are discussed below. (EMA)

209. **Comment:** In summary, the commenter questions the U.S. EPA's interpretations, in the NPRM, of the health effect studies associating exposure to diesel PM and lung cancer, especially exposure from ambient air PM. Although there are some studies that show a slight increase in cancer risk associated with higher than normal diesel PM exposure, the commenter contends that these studies are flawed because they did not account for the possible effect of other suspect sources, such as cigarette smoke and other know toxic exposure. The commenter cites two recent studies[137,138] on this subject to emphasize that more controlled studies are needed before determining any association between diesel PM exposure and lung cancer. The commenter concludes by stating the following:

Therefore, there is no clear scientific evidence demonstrating that a causal association exists between exposure to diesel exhaust and incidence of lung cancer at occupational levels, let alone ambient environmental levels. The animal data are not relevant to

[120] EPA is proposing to list "diesel exhaust" as an air toxic in its proposed 202(l) rule. EMA believes that "diesel exhaust" is an inappropriate "substance" to reference as an air toxic since it is a generic term that applies to all combustion products from a compression-ignition engine. Including the broad category of diesel exhaust as an air toxic is problematic for the industry because it is impossible for manufacturers to develop a compression-ignition engine using diesel fuel that does not produce "diesel exhaust." It is possible for manufacturers to remove or control specifically identified toxic components present in diesel exhaust. However, using the approach proposed by EPA, even if the exhaust is composed entirely of carbon dioxide and water and contains zero toxic components, by definition the exhaust would continue to be an air toxic.

human exposures and the epidemiology evidence shows only a weak association by a relative risk of 1.2 - 1.5. Both the World Health Organization and the National Cancer Institute indicate that relative risks of less than 2.0 may be due to chance, statistical bias, or confounding factors.[121] (EMA)

210. **Comment:** In summary, EMA believes that the health risk range should be removed from the NPRM and RIA documents because current epidemiology studies as well as other scientific data does not provide a quantitative relationship between exposure to diesel exhaust and a risk of cancer. EMA cites several specific reasons for removal of the risk range including lack of real exposure data, public misinformation, and the fact that neither EPA or the National Institute of Environmental Health Services[141] has listed diesel exhaust as a known human carcinogen. EMA recommends that if a risk range is to be included in the NRPM and RIA, then a discussion should be included indicating that the risk may be as low as zero. (EMA)

211. **Comment:** Neither the California EPA (CalEPA) nor the Scientific Review Panel (SRP) have stated that diesel PM causes cancer in humans. In the final report examining the health effects of diesel exhaust as approved by the SRP on April 22, 1998, CalEPA's Office of Environmental Health Hazard Assessment (OEHHA) concludes that "epidemiological studies provide evidence consistent with a causal relationship between occupational diesel exhaust exposure and lung cancer." The report further states that "The strength of association reported is typically within the range considered 'weak' in epidemiology" and a "reasonable and likely explanation for the increased risk of lung cancer observed in epidemiological studies is a causal association between diesel exhaust exposure and lung cancer." There is no statement that diesel PM causes lung cancer.

    Similarly, the SRP did not conclude that diesel exhaust causes lung cancer in humans. As indicated in the report entitled Findings of the Scientific Review Panel on the Report on Diesel Exhaust as adopted at the Panel's April 22, 1998 Meeting, the strongest statement regarding cancer and diesel exhaust is that "lung cancer findings are consistent and the association is unlikely due to chance. These epidemiological studies strongly suggest a causal relationship between occupational diesel exhaust exposure and lung cancer."

    At most, both OEHHA and the SRP only indicate that epidemiology studies suggest a causal relationship at occupational levels of exposure and do not conclude that diesel PM causes lung cancer in humans. Similarly, after extensive and thorough reviews of all the evidence and literature examining the relationship between exposure to diesel exhaust and incidence of lung cancer, both EPA in 2000 and the U.S. Department of Health National Toxicology Program in 1999 failed to find sufficient evidence that diesel exhaust causes lung cancer. Neither organization lists diesel exhaust or PM as a known carcinogen and have only classified diesel exhaust as a "probable" or "likely" carcinogen.

    ARB's statement is untrue and should be eliminated from the document. ARB Staff must avoid mischaracterizing, and misleading the general public regarding, the scientific

[121] World Health Organization 1966. Diesel Fuel and Exhaust Emissions. Environmental Health Criteria 171, Geneva, WHO; National Cancer Institute. 1994. Press Release on Abortion and possible risks of breast cancer: Analysis and Inconsistencies. National Institutes of Health, Bethesda, MD. October 26, 1994.

conclusions concerning the health effects of diesel PM in all of its current and future publications. (EMA)

Agency Response to Comments 208-211: The U.S. EPA references other detailed research regarding the carcinogenic health effects from diesel PM in their Response to Comments.[122] Similar to the U.S. EPA, the ARB does not agree with the provided comments. The data provided by the U.S. EPA was a balanced view of scientific literature. The Health Assessment for Diesel Exhaust evaluated 22 of 30 studies that showed increases in lung cancer risk and were most relevant for risk assessment. Review of those studies found increased occurrences of lung cancer across workers from different occupations. In addition, interpretation of the data is consistent with research experts in the field. While the data did not measure exposure to diesel exhaust, surrogate estimates were used to determine relative risk in the occupational groups. However, this did not significantly limit the U.S. EPA's ability to calculate the risk from exposure. Additional supporting evidence includes observation of tumors when applying diesel particles to animal skin and respiratory tissue.

Further, in August 1998, diesel PM was identified by California as a toxic air contaminant. This followed a 10-year scientific assessment process, including peer review and public comment. Diesel PM also contains over 40 substances that are individually identified as toxic air contaminants. An assessment of carcinogenic risk found that diesel PM accounts for 70 percent of total ambient cancer risk in the year 2000. Therefore, even if the health effects studies that the U.S. EPA cited had been found insufficient to support their 2007 Final Rule, California has additional data to support the need for more stringent California standards.

Further, reductions in PM emissions are necessary for California to attain state air quality standards. Therefore, no further changes to the adopted requirements are necessary.

C. Non-Cancer Effects Of Diesel Exhaust

212. **Comment:** The NPRM indicates that chronic exposure to diesel exhaust increases the risk of respiratory tract inflammation and changes in lung function and that noncaner health effects are a concern to the Agency. The document then alludes to the HAD and EPA's development of a Reference Concentration (RfC).

The discussion of non-cancer health effects is misleading in that it neglects to report on the findings and conclusion of the HAD. In the Draft 1999 document, EPA concludes, in Chapter 5 on Noncancer Health Effects, that "the primary acute (high concentration, short term) effects of diesel emissions in humans include irritation, mild airway inflammation and indicators of mild inflammation in lung lavage fluids." Discussion in the text indicates that human studies assessing lung function have found no changes. With regard to long term effects, the document states "noncancer effects in humans from long term chronic exposure to DPM are not evident."

[122] Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements: Response to Comments, EPA-420-R-00-027, U.S. EPA, December 2000.

In addition, the calculation of a RfC for diesel exhaust lower than that of other particulate matter was questioned by CASAC. In its comments on the Reference Concentration, CASAC expressed concern that EPA had not provided a sufficient rationale for selecting a different RfC for diesel exhaust as compared to ambient PM. Similarly, CASAC concluded that there was inadequate assurance that the RfC presented in the document was appropriate, and, so, certainly was not convinced in the "high level of confidence" for the RfC value reported by EPA.

Accordingly, the discussion of non-cancer health effects needs to be revised and expanded to describe the current state of knowledge. The absence of information in the NPRM from the HAD indicating that there appears to be little if any long term health effects from diesel emissions is misleading and needs correction. (EMA)

> **Agency Response:** The ARB's ISOR[123] provides a summary of non-cancer health effects from diesel PM. The U.S. EPA also references other detailed research regarding the non-cancer health effects from diesel PM in their Response to Comments.[124] As explained by the U.S. EPA, the reference concentrations are appropriate and has received concurrence with CASAC for the reference concentration. Further, reductions in PM emissions are necessary for California to attain state air quality standards. Therefore, no further changes to the adopted requirements are necessary.

VI. COST ANALYSIS

213. **Comment:** In order to comply with its Congressional mandate, EPA is obligated to review and evaluate the costs of its proposed standards and requirements. EPA has failed to provide an adequate and accurate analysis of the costs and benefits of its proposal for heavy-duty engines and vehicles. Among other cost concerns, the cost impacts of imposing supplemental emission requirements and tests, at both FTP and expanded ambient conditions, will be enormous. EPA has not met its statutory burden. (EMA)

> **Agency Response:** A thorough cost effectiveness analysis was performed by the U.S. EPA in their RIA,[125] Chapter 5. Those costs were used in the ARB's analysis in the ISOR,[126] Section 10. The cost effectiveness for the adopted requirements was determined to be within the range of previous rulemaking. Therefore, the adopted requirements are cost effective.
>
> The supplemental test procedures were adopted in previous rulemaking. The previous rulemaking went through a 45-day public notice period that began on October 20, 2000. Included in the staff report was a cost effectiveness analysis for the supplemental test procedures. During the public notice, engine manufacturers and other interested parties provided comments on the requirements. All comments were considered and the requirements were adopted at a public hearing on December 8, 2000. The only changes to the test

[123] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[124] Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements: Response to Comments, EPA-420-R-00-027, U.S. EPA, December 2000.
[125] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.
[126] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.

procedures, provide additional flexibility. Consequently, there are no additional costs associated with the proposed changes to the test procedures. Therefore, no further changes to the adopted requirements are necessary.

214. **Comment:** Undoubtedly, the oil industry and its allies will continue their fight until the end of the year, hoping to push this Proposal into the next Administration. They are fighting against cleaner air and improved public health—even though the oil industry earns more profits in a single quarter of a single year than its own estimated costs of compliance for the entire 10-year roll-out of the Proposal, and even though the past three decades of environmental regulations are filled with examples of air pollution regulations that did not cost nearly as much as industry advocates had previously estimated. (ALA)

Agency Response: A thorough cost effectiveness analysis was performed by the U.S. EPA in their RIA,[127] Chapter 5. Those costs were used in the ARB's analysis in the ISOR,[128] Section 10. The cost effectiveness for the adopted requirements was determined to be within the range of previous rulemaking. Also see Agency Response to comment #74. Therefore, the adopted requirements are cost effective.

A. Economic Impact and Cost Effectiveness Analysis

215. **Comment:** In promulgating new emissions regulations, EPA has the obligation to take into account the cost of developing technologies to meet these standards and the operation costs to the public using products which meet these standards. This analysis is particularly important with respect to heavy-duty engines because, as pointed out in these comments, high product costs could cause a would-be purchaser of a new engine to decide to rebuild an existing engine instead, which completely undermines the environmental benefits of the rule.

While the EPA did provide an economic analysis of the impact of the proposed 2007 Rule, no commenter was given access to the cost methodology that EPA used to construct this estimate. In order to prepare these Comments, therefore, Cummins used the EPA assumptions that are set out in the NPRM, and employed Cummins' standard cost estimating methodology along with its own current estimates for the cost of implementing the NPRM. The resulting calculations indicate a wide disparity between the Agency's estimates and Cummins' estimates.

A key consideration related to the high cost of the NPRM compliant technology is the reality that diesel engines are designed to run for a long time and the fact that the market has ample rebuild capability. Furthermore, the difference in fuel economy alone, without taking into consideration increased acquisition costs, will incent a truck owner to continue to operate an existing higher emitting, better fuel economy truck rather than buying new. And at the increased cost that Cummins estimates for total lifetime cost, a heavy heavy-duty truck owner could pay for several out-of-frame rebuilds of their engine.

[127] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.
[128] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.

The EPA must withdraw this NPRM until it can provide credible and well founded estimates of the cost of this technology. Cummins is very interested in working with EPA's own economists in comparing methodologies and providing a credible estimate of the cost of the proposed new technologies. Otherwise, no environmental benefits will be achieved if this Rule is implemented. (Cummins)

Agency Response: The first part of this comment refers to a misunderstanding between the commenter and the U.S. EPA. Details of the cost estimates were made available by the U.S. EPA to all interested parties. Both the U.S. EPA's RIA and the cost analysis[129,130] were also referenced in the ARB's ISOR. Any misunderstandings have been cleared up.

The commenter also attempts to simplify the decision to rebuild or purchase a new HDDE by cost alone. The estimated increase in cost of a heavy-duty diesel vehicle is expected to increase between 3 percent and 8 percent. Despite this increase, review of the effects of previous reductions in emission standards by the U.S. EPA have shown no significant effects to the rebuilding industry. Therefore, no significant delay to purchase newer engines is expected as a result of the adopted requirements and no further changes to the adopted requirements are necessary.

1. Development Cost Analysis

216. **Comment:** The Agency states that it expects manufacturers to adapt various technologies 'fine tuned to each application' to meet the demands of each market segment they serve. The Agency then proceeds under the assumption of one totally impractical simplified combination of technologies (a PM trap combined with a NOx adsorber) to formulate their development cost estimate. The Agency also ignored the costs to develop other competing/potential technologies to the point of a) viable comparison or, b) deployment as the 'fine tuned' solution for specific markets segments. The Agency has therefore neglected to account for the development cost of any and all alternative technologies in their assumptions while deriving their fixed cost estimates.

We believe a more rational estimate of the development cost for the system required to meet the Agency's proposed levels can be found in the development cost for the EGR systems required for MY2002/2004. Both the EGR system being developed for MY2002/2004 and the likely system combinations required to meet the Agency's proposed 2007 and beyond emission levels represent derivative development of hardware purchased from suppliers applied to a base engine product, including control system development. Cummins used EGR development costs as the model. We believe, given the complexity and timing involved in the Agency's proposal, that this cost is very optimistic. (Cummins)

Agency Response: Cost estimates are based on technologies that are expected to be used to comply with the adopted requirements. The costs include all

[129] ICF Consulting, 1999. "Economic Analysis of Vehicle and Engine Changes Made Possible by the Reduction of Diesel Fuel Sulfur Content, Task 2 – Benefits for Durability and Reduced Maintenance," prepared by ICF Consulting for the U.S. EPA, December 9, 1999.
[130] Engine, Fuel, and Emissions Engineering, 1999. "Economic Analysis of Vehicle and Engine Changes Made Possible by the Reduction of Diesel Fuel Sulfur Content," prepared by Engine, Fuel, and Emissions Engineering for the U.S. EPA, December 15, 1999.

auxiliary sensors and equipment and are based on systems used during testing of technical feasibility of the adopted requirements. Since the tested system has been determined to be technologically feasible, comparison to more expensive alternatives is not necessary. Further, 'fine tuning' of solutions only refers to minor calibration adjustments and possibly alternative equipment which would not result in a significant increase in costs. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

217. **Comment:** The Agency makes repeated comments to the benefits of the 'learning curve' in projecting reduced costs with time. The Agency appears to neglect the cost of development of these improvements and is also apparently assuming that this will be the last round of emission reductions ever imposed. (Cummins)

Agency Response: Research and development of the expected components are included in the cost calculations. Cost estimates are included in both the U.S. EPA's RIA and the referenced cost analyses[131,132], both of which are referenced in the ARB's Staff Report. However, cost effectiveness is only calculated in terms of the adopted requirements. Future regulations are not included in cost estimates since hypothetical regulations and costs have no effect on the required technology. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

218. **Comment:** The Agency has not adequately accounted for the requirement that these systems operate for 435,000 miles. (Cummins)

Agency Response: The cost analysis included in the ARB's Staff Report, Section 9, does account for the expected lifetime of HDDEs, 20 years. This is demonstrated in both annual operating costs and net present value of operating and equipment costs. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

219. **Comment:** The Agency attempts to account for the cost of certification in their cost analysis. EPA neglected to include the added deterioration factor ("DF") testing cost and complexity in dealing with these new technologies required for the propose standards been included in this cost estimate. (Cummins)

Agency Response: As responded by the U.S. EPA, DF testing costs are not included in the presented certification costs. DF testing costs are included in the presented research and development costs since manufacturers determine the DFs during research and not certification.

220. **Comment:** The Agency's proposal will require the engine manufacturers to greatly improve their emission test measurement capability and accuracy for both development and certification purposes. The Agency's proposal does not appear to address the costs involved to develop these additional test resources and capabilities. The Agency's

[131] ICF Consulting, 1999. "Economic Analysis of Vehicle and Engine Changes Made Possible by the Reduction of Diesel Fuel Sulfur Content, Task 2 – Benefits for Durability and Reduced Maintenance," prepared by ICF Consulting for the U.S. EPA, December 9, 1999.
[132] Engine, Fuel, and Emissions Engineering, 1999. "Economic Analysis of Vehicle and Engine Changes Made Possible by the Reduction of Diesel Fuel Sulfur Content," prepared by Engine, Fuel, and Emissions Engineering for the U.S. EPA, December 15, 1999.

emission measurement development plans and cost estimates have not been articulated. (Cummins)

Agency Response: Similar to the U.S. EPA, costs to improve emission test measurement capability are included in research and development costs. Research and development estimates of the expected components are included in both the U.S. EPA's RIA and the referenced cost analyses,[133,134] both of which are referenced in the ARB's Staff Report. Further, the U.S. EPA and the ARB believe the equipment will be upgraded during normal equipment replacement and turnover. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

221. **Comment:** EPA has failed to account for the costs of increased numbers of tests that result from increased test-to-test variability. This includes the costs of additional tests, the costs of procuring new test cells, and the costs of employing additional personnel to conduct multiple tests. (Cummins)

Agency Response: Similar to the U.S. EPA, we do not agree that additional testing will be necessary. The U.S. EPA had revised the measurement procedures such that test to test variability decreases. These costs to improve emission test measurement capability are included in research and development costs. Research and development estimates of the expected components are included in both the U.S. EPA's RIA and the referenced cost analyses,[135,136] both of which are referenced in the ARB's Staff Report. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

222. **Comment:** The Agency has not accounted for the impact of the continuing development and system integration costs that will be incurred by the engine manufacturers. The Agency repeatedly remarks that the engine manufacturers will 'develop', 'optimize', 'refine', etc. but the Agency's analysis only includes a recovery for inventory carrying cost. The Agency apparently assumes that the engine manufacturers can continue to expend unrecovered resources with no ill effect on their financial viability, which is an erroneous assumption. The costs of evaluation of the various alternative control systems and the required product durability testing (beyond deterioration factor determination testing) are also not included in the Agency's analysis. (Cummins)

Agency Response: Cost estimates are based on technologies that are expected to be used to comply with the adopted requirements. The costs include all auxiliary sensors and equipment and are based on systems used during testing of technical feasibility of the adopted requirements. Since the tested system has

[133] ICF Consulting, 1999. "Economic Analysis of Vehicle and Engine Changes Made Possible by the Reduction of Diesel Fuel Sulfur Content, Task 2 – Benefits for Durability and Reduced Maintenance," prepared by ICF Consulting for the U.S. EPA, December 9, 1999.
[134] Engine, Fuel, and Emissions Engineering, 1999. "Economic Analysis of Vehicle and Engine Changes Made Possible by the Reduction of Diesel Fuel Sulfur Content," prepared by Engine, Fuel, and Emissions Engineering for the U.S. EPA, December 15, 1999.
[135] ICF Consulting, 1999. "Economic Analysis of Vehicle and Engine Changes Made Possible by the Reduction of Diesel Fuel Sulfur Content, Task 2 – Benefits for Durability and Reduced Maintenance," prepared by ICF Consulting for the U.S. EPA, December 9, 1999.
[136] Engine, Fuel, and Emissions Engineering, 1999. "Economic Analysis of Vehicle and Engine Changes Made Possible by the Reduction of Diesel Fuel Sulfur Content," prepared by Engine, Fuel, and Emissions Engineering for the U.S. EPA, December 15, 1999.

been determined to be technologically feasible, comparison to more expensive alternatives is not necessary. Further, 'fine tuning' of solutions only refers to minor calibration adjustments and possibly alternative equipment which would not result in a significant increase in costs.

As responded by the U.S. EPA, durability testing costs are not included in the presented certification costs. Durability testing costs are included in the presented research and development costs since manufacturers determine durability during research, not during certification. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

223. **Comment:** In its description of the learning curve/cost reduction process (the 'p' analysis), the Agency describes the impact of learning on cost reduction but states that this observed trend does not seem to be followed in the chemical industry. The emission control technologies and development processes required to achieve the proposed emission levels are more reminiscent of a chemical plant than a manufacturing process. (Cummins)

Agency Response: Similar to the U.S. EPA, the ARB disagrees with the comment since the learning curve/cost reduction process is a well-documented occurrence. Further, industry experience has demonstrated that manufacturer's do reduce variable costs for components, as the manufacturer gains experience in producing the parts and reducing the steps for assembly. While there may be some similarities between the aftertreatment control systems and chemical factories, this is irrelevant to the application of a learning curve. The aftertreatment control systems will still need to be manufactured. The process of doing so can continue to be improved. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

2. Hardware Costs Analysis

224. **Comment:** The Agency has allowed for the exhaust aftertreatment hardware suppliers to recoup their development costs by allowing for a 29% markup from their direct costs to their selling price to the engine manufacturer. The Agency has not accounted for realistic recovery by the engine manufacturers of their system development and integration costs nor the markup of the OEM vehicle manufacturer to the end customer. The Agency has instead treated this economic chain as would be appropriate for a vertically integrated vehicle manufacturer like the passenger car industry. The Agency clearly does not understand the economic realities of the heavy-duty engine industry that it has been charged to develop regulations for. The Agency has grossly underestimated the initial cost impact to the end user of these proposed standards. (Cummins)

Agency Response: Since cost estimates are developed several years prior to implementation of the requirements, there is an uncertainty associated with the estimates. However, actual costs may ultimately be higher or lower than the estimates. Past rulemaking by the U.S. EPA has demonstrated that, in general, those estimates are higher than the actual costs to the end users, when the requirements become effective.

Further, similar to the U.S. EPA, the ARB does not believe engine manufacturers will incur significant costs to integrate the aftertreatment control systems.

Depending on development agreements with aftertreatment control system manufacturers, those manufacturers will likely incur integration costs as part of their research and development. Any other markups to costs in the marketplace would be the result of supply and demand problems, or efforts to increase profits by the vehicle manufacturers. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

225. **Comment:** The Agency, in stating that it expects manufacturers to adapt various technologies to meet the demands of each market segment, has ignored the impact of the low volumes for each technology on the variable hardware costs. Low volumes typically result in higher costs per unit as the development costs are amortized over a smaller volume of product. (Cummins)

Agency Response: Similar to the U.S. EPA, the ARB agrees with the statement that low volumes will typically result in higher costs per unit with fixed development costs. However, manufacturers will typically develop technology solutions for a wide range of engines that include a wide range of production volume. Consequently, development costs can be spread across the range of all engine classes. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

226. **Comment:** The Agency has assumed a 1% warranty rate for the emission control system it has proposed. The Agency's warranty rate assumptions are not representative of our expectations for such complex emission control systems that will be required to meet the Agency's proposed emission levels and useful life criteria. This rate is completely arbitrary. (Cummins)

Agency Response: Similar to the U.S. EPA, the ARB disagrees with the commenter and believes that a one percent warranty rate for any one component of an engine is reasonable. Warranty and repair rate goals for engine and vehicle components are actually less than one percent. Further, the emission control system is not any more complex compared to other systems in the vehicle; such as the fueling system, air conditioning system, and braking system. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

227. **Comment:** It appears the Agency has made no allowance for the potential fluctuations in the cost of the precious metals required for the emission control hardware being considered. (Cummins)

Agency Response: The basis for cost estimates with relation to precious metals is likened to previous rulemaking for light duty gasoline vehicles. Following the gasoline vehicle regulations, there was a sharp increase in precious metal prices due to speculation. However, prices soon dropped down to the normal levels. To estimate a much higher price would be speculation. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

228. **Comment:** The Agency states that PM/HC control technologies have "already shown good robustness in retrofit applications with low-sulfur fuel". If this were the case, the "learning curve" for PM control should be well underway and very little further reduction in the cost of the PM control system should be projected. In fact, however, the

application of PM exhaust aftertreatment systems has been done to fleets operating in rather limited geographic domains and are not in vehicles subject to the extremes in temperature, altitude, and duty cycle requirements typical of most segments of the heavy duty engine fleet. Further, the applications cited in the Agency's comments are generally not subject to enforcement requirements if the devices fail to operate as designed. The Agency's logic is not consistent in this matter and the assumptions that this technology is proven to be robust is speculative at best. (Cummins)

Agency Response: The commenter implies that, due to the range in temperature, altitude, and duty cycle requirements, other options may be used, such as active particulate filter systems. As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured or are already in-use. Current technology with some improvements may be required. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR,[137] Section 6, and the U.S. EPA's RIA,[138] Chapter 3. Both discussions specify passive particulate filters as a promising technology that is expected to be used to comply with the adopted PM requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. The U.S. EPA has even tested a NOx adsorber/particulate trap system in the laboratory that involved both transient and steady-state test cycles. Further, some steady-state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Particulate traps using passive regeneration systems have been used in many demonstration programs in the U.S. and throughout the world. Results from these demonstration programs have demonstrated PM reductions in excess of 90 percent. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

229. **Comment:** The Agency's economic impact analysis does not take into account the engine manufacturer's financial liability nor their accrual of financial responsibility for any emission control system failures, possible recalls, or enforcement actions that may occur due to the failure to either successfully achieve the proposed standards, to accurately measure the emissions, or to satisfy the requirements of the standards over the useful life of the products. (Cummins)

Agency Response: As discussed by the U.S. EPA, no additional liability is expected as a result of the adopted requirements. Therefore, no costs for recalls and enforcement actions are included in the cost analysis. Therefore, no further changes to the adopted requirements are necessary.

230. **Comment:** The Agency's analysis is based on the use of speculative technologies, and the design assumed for the cost analysis does not reflect the minimum system we believe necessary to achieve all the requirements set forth in the Agency's proposal during certification and in use. Specifically, even the Agency appears to assume that the after-treatment system can be by-passed during it's regeneration and does not include,

[137] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[138] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

among other costs, the cost of the second PM trap, the second NOx catalysts, the second sulfur trap, the associated control valves, required sensors for the NOx after-treatment system, other sensor required for the PM trap regeneration system, the cost of added complexity and capability for the onboard engine control module, and the cost of the regeneration systems for the sulfur traps.

In its assumption that no by-pass system is required, the Agency is ignoring the potential and very likely probability that the duration between regeneration for the PM, sulfur, and NOx control systems are different. These differences are expected to have profound impacts on the system design, development costs, certification process, and operating costs.

The Agency states its assumption that the same electronic control system hardware developed for the 2004 engines will be applied to the 2007 products. This may be true for the engine control processes, but the complex exhaust after-treatment systems required for the Agency's proposal will require much more electronic control capability than is/will be embodied in the 2002/2004 engine products. (Cummins)

> **Agency Response:** The ARB disagrees with the commenter that the cost analysis does not reflect the minimum system necessary to achieve the adopted requirements. The commenter mentions the need for a dual line system with separate PM traps, NOx adsorbers, and catalysts. This assumes each part of the system cannot be integrated into one complete system to conserve space and retain heat. As demonstrated by Toyota in their DNPR system, the required functions can be combined into a single unit, while also providing flow switching to allow for regeneration. Thus, the functionality of the DOC is not jeopardized and no further changes to the adopted requirements are necessary.

231. **Comment:** The Agency assumes that an oxidation catalyst would be required to meet the 2002/2004 emission levels for urban buses and that this catalyst could be removed as a cost saving for the MY 2007 urban bus engines. The Agency projects a $500 per engine cost reduction for this removal. This is assumption is in error. As described in an earlier section, an oxidation catalyst downstream of the NOx aftertreatment system will be required to deal with HC or CO 'slip' that will occur during the regeneration process for all 2007 urban bus engines.

The Agency assumes that no oxidation catalyst would be required to meet the proposed 2007 emission levels for all markets. This is an erroneous assumption in that an oxidation catalyst downstream of the NOx after-treatment system will be required to deal with HC or CO 'slip' that will occur during the regeneration process for all 2007 engines. The addition of this catalyst will add several hundred dollars of direct cost per engine, depending on rating. In general, the Agency's direct cost hardware estimates appear to be less than half of what is expected to achieve the proposed standards. (Cummins)

> **Agency Response:** Similar to the U.S. EPA, the ARB has applied changes to the both the cost effectiveness analysis and technical review of the expected technologies. Since an oxidation catalyst is expected to be necessary to further reduce HC emissions and clean-up any remaining H_2S emissions that result from desulfation events, costs for this catalyst are already included in the analysis. However, the adopted requirements do not apply to urban buses. Consequently,

there were no cost savings for any catalyst removal. Therefore, no further changes to the adopted requirements are necessary.

3. Operating Cost Analysis

232. **Comment:** The Agency comments that lower fuel sulfur content will extend the oil life by reducing the depletion of the total base number ("TBN") and thereby reducing the frequency and life cycle cost of oil change. While we agree that reducing fuel sulfur content is both beneficial for the environment and required to achieve any hope of employing the viable after-treatment systems, we must point out that TBN depletion is only one cause of oil degradation. Another likely cause of oil degradation leading to oil change is the contamination of the oil by soot. This path is likely to dominate the oil drain interval requirements and the Agency's speculation that low fuel sulfur content will extend oil drain interval and therefore reduce maintenance cost is tenuous at best. (Cummins)

Agency Response: Similar to the U.S. EPA, the oil change interval was estimated to increase by 10 percent. The estimate was a result of a survey and analysis of industry. While there may be other factors that affect the oil change frequency, no further analysis was provided to more accurately reflect oil change frequency. Therefore, no further changes to the adopted requirements are necessary.

233. **Comment:** In estimating the impact of the proposed standard on fuel use and cost, the Agency assumed that NOx and PM aftertreatment will be added to engines using EGR as the technology to achieve 2.0 g/hp-hr of NOx and 0.1 g/hp-hr of PM engine out emission levels. The Agency states its assumption that in 2002/2004, manufacturers will take advantage of the improved NOx/bsfc trade-off with EGR (compared to timing retard) to achieve this engine out NOx with no degradation in fuel consumption compared to today's products. In reality, achieving these engine out emission targets will result in a 5% increase in fuel consumption with respect to today's (MY2000) heavy heavy-duty engines. This fuel economy penalty will continue with the Agency's proposed standards in addition to fuel consumption increases caused by the regeneration requirements of the NOx and PM after-treatment systems. Our current estimates of the total fuel economy impact, compared to today's engine (same context as the Agency's statement) is 4-6% for the dual path system we believe required and 9-11% for single systems as described by the Agency when fuel used for regeneration requirements is included. (Note our fuel economy penalty) (Cummins)

Agency Response: Similar to the U.S. EPA, the ARB disagrees with the comment. The expectation that fuel consumption will increase is based on the assumption that NOx adsorbers will increase fuel consumption up to 10%. Based on testing at the NVFEL, actual fuel consumption is approximately 2% with engine out emissions meeting 2004 emission standards. Further, NOx adsorbers are expected to have a better NOx to fuel economy trade-off as compared to the use of exhaust gas recirculation and injection timing retard. The 2004 emission standards require a balance of exhaust gas recirculation and injection timing retard with a limited fuel economy impact. Since NOx adsorbers are expected to be used with exhaust gas recirculation, the effect to fuel economy is expected to be minimal. Further, it is not unreasonable to expect improvements in fuel economy, as manufacturers gain experience with NOx

adsorbers while eliminating technologies that may be detrimental to fuel economy. Therefore, no further changes to the adopted requirements are necessary.

234. **Comment:** The engine will weigh more which reduces payload and diminishes operators' revenue. The Agency's grossly underestimated impact on the operating cost is 2% for the user. Our operating cost estimates are at least 3-4 times higher. The profit margin goal for the line haul trucking industry is typically 5%. Given a realistic cost impact of the proposed standard many small (and some large) line-haul firms will no longer be able to stay solvent. How does the Agency propose to manage the economic impact of these business failures? (Cummins)

Agency Response: Any change in engine weight due to the adopted requirements is expected to be small as compared to the gross vehicle weight of the vehicles. Consequently, no significant effect is expected as a result of the small increase in weight.

The expectation that fuel consumption will increase is based on the assumption that NOx adsorbers will increase fuel consumption up to 10%. Based on testing at the NVFEL, actual fuel consumption is approximately 2% with engine out emissions meeting 2004 emission standards. Further, NOx adsorbers are expected to have a better NOx to fuel economy trade-off as compared to the use of exhaust gas recirculation and injection timing retard. The 2004 emission standards require a balance of exhaust gas recirculation and injection timing retard with a limited fuel economy impact. Since NOx adsorbers are expected to be used with exhaust gas recirculation, the effect to fuel economy is expected to be minimal. Further, it is not unreasonable to expect improvements in fuel economy, as manufacturers gain experience with NOx adsorbers while eliminating technologies that may be detrimental to fuel economy. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

235. **Comment:** The engine will have more reliability and durability issues, which will add to operating costs. (Cummins)

Agency Response: The commenter provided no justification why reliability and durability would decrease with the new engines. Since both the U.S. EPA and the ARB believe that a one percent warranty rate for any one component of an engine is reasonable, reliability and durability should be no different than current models. Further, the emission control system is not any more complex compared to other systems in the vehicle; such as the fueling system, air conditioning system, and braking system. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

236. **Comment:** The Agency chose to ignore the analysis of the consulting organization (EF&EE) it retained to ascertain the fuel use impact and likely available NOx reduction capability. The Agency choose in a seemingly arbitrary fashion to use much more optimistic assumptions for the impact of the technologies on fuel use and the ultimate emission reduction capability of the NOx after-treatment system(s). It is not clear how the Agency arrived at its assumptions or what facts were involved in this determination. The basis on which the Agency chose the fuel economy and efficiency values it used in formulating the proposal is very unclear. (Cummins)

Agency Response: The commenter provided no other alternative assumptions or methods to determine cost impacts of fuel economy and efficiency. Cost estimates provided by the U.S. EPA are based on current information and expected future costs. Differences between the costs presented by the U.S. EPA and the contractor only reflect changes to the assumptions and methods used to calculate estimated costs for compliance. The ARB agrees with the U.S. EPA in that the methods used result in estimates that best reflect expected future costs. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

4. Cost Effectiveness Analysis

237. **Comment:** The Agency made a deliberate choice to represent its cost effectiveness analysis on an 'average' basis instead of an incremental basis. Using an incremental basis may have resulted in the identification of a lower total cost and much more cost effective proposed emission standard than what is contained in the Agency's current proposal. No assessment of cost vs. NOx burden impact was considered other than for the standards EPA proposed. (Cummins)

Agency Response: Based on the CAA, the adopted standards must only be determined to be technologically feasible. Cost effectiveness is not required to be used to determine the appropriateness of the adopted standards. However, costs should be considered in applying the expected technologies. Therefore, cost effectiveness has been included to demonstrate that a thorough evaluation, including technology and costs has been considered in evaluating the adopted requirements. Utilizing an incremental basis is not consistent with previous rulemaking, or the CAA, which requires only technological feasibility determinations. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

238. **Comment:** Comparing the cost effectiveness of the proposal to that of 2002/204 is premature. No engine manufacturer has entered a viable 2002/2004 capable engine into commerce. We have not yet demonstrated 2002/2004 levels. (Cummins)

Agency Response: The commenter is referring to the previously adopted 2004 emission standards and those standards that will be required two years earlier for consent decree/settlement agreement engine manufacturers. On April 2002, the ARB has issued an executive order for an engine family satisfying the 2002/2004 requirements. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

239. **Comment:** The Agency is using emission factors from MOBIL6 to estimate the impact of its proposal on air burden. The Agency's web site states this model is not scheduled for release until January of 2001. EPA is unfairly using results (or portions) of an air burden model in the Agency's proposal using a tool that is not widely available nor peer reviewed. (Cummins)

Agency Response: The ARB has used emission impact estimates based on the emission model EMFAC 2000 version 2.02. This emission model was adopted by the Board on May 2000 and has been reviewed and commented upon by the

public. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

240. **Comment:** EPA should forecast for effect of 'pre-buy' on the cost and effectiveness of the proposed standards. (Cummins)

Agency Response: The purchaser's decision regarding 'pre-buying' of vehicles and engines is not based on cost alone. The newer engines often offer additional benefits compared to older models. The estimated increase in cost of a heavy-duty diesel vehicle is expected to increase between 3 percent and 8 percent. Despite this increase, review of the effects of previous reductions in emission standards by the U.S. EPA has shown no significant effects to consumer purchasing patterns. Therefore, no significant delay to purchase newer engines, nor effort to 'pre-buy', is expected as a result of the adopted requirements. Therefore, no further changes to the adopted requirements are necessary.

241. **Comment:** EPA should share the economic model it used to determine the impact of the proposed standards on the owner operator, the small fleet owner, and the large fleet owner. (Cummins)

Agency Response: Cost estimates of the expected components are included in both the U.S. EPA's RIA and the referenced cost analyses,[139,140] both of which are referenced in the ARB's Staff Report. The economic impacts apply to all owners and operators of heavy-duty diesel vehicles, regardless of fleet size. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

VII. INVENTORY/MODELING ANALYSIS

242. **Comment:** It is critical that EPA use accurate emissions inventory projections as a basis for the development of appropriate and cost effective regulatory policy. In order to help assure the most accurate inventory possible, EMA has worked extensively with EPA, as well as other regulatory agencies and stakeholders such as ARB, NESCAUM and OTAG, to develop robust, peer-reviewed inventory models. Such models exist, are generally well accepted, and provide accurate results because of their having been peer-reviewed. Unfortunately, EPA did not use any of those existing models, nor did it have its model peer-reviewed. Instead, EPA has used a largely undocumented model that has had little, if any peer-review. Using such a model diminishes the accuracy of the emission inventory projections used in this rulemaking.

As part of the emissions inventory determination process for this rulemaking, EPA relied on HD emission factors from a spreadsheet-type model, not previously used elsewhere. While elements of this model were incorporated within a report that was published as part of the MOBILE6 process, EPA did not subsequently address the comments it

[139] ICF Consulting, 1999. "Economic Analysis of Vehicle and Engine Changes Made Possible by the Reduction of Diesel Fuel Sulfur Content, Task 2 – Benefits for Durability and Reduced Maintenance," prepared by ICF Consulting for the U.S. EPA, December 9, 1999.
[140] Engine, Fuel, and Emissions Engineering, 1999. "Economic Analysis of Vehicle and Engine Changes Made Possible by the Reduction of Diesel Fuel Sulfur Content," prepared by Engine, Fuel, and Emissions Engineering for the U.S. EPA, December 15, 1999.

received on that report, nor did it evaluate the impact of those comments on the inventory. As a result, stakeholders cannot with certainty determine the underlying assumptions and/or modeling techniques used by the Agency. But, we do know that EPA's new, unproven model is a dramatic change from previously accepted inventory models. (EMA)

243. **Comment:** It is critical that EPA use the best inventories possible. Subjecting its models and modeling assumptions to peer review helps to achieve that result. EPA should allow interested parties a full opportunity to comment on the spreadsheet model used in this inventory and, based on that input, EPA should revise its inventory projections and, as necessary, its inventory assumptions. (EMA)

Agency Response to Comments 242-243: The commenter provides comments on the U.S. EPA's emission modelling program MOBILE6. Emissions estimates and calculated reductions within California were calculated based on differences between the existing emission standards and the adopted emission standards. Inventory emissions were determined based on the ARB's emission modelling program EMFAC 2000 Version 2.02. At the time of the rulemaking, this model was the most current version available that had been publicly reviewed and approved for use by the ARB. The adopted requirements are not proposing any changes to the previously adopted emissions model. Therefore, no further changes to the adopted requirements are necessary.

244. **Comment:** There is a growing body of evidence indicating that on weekends ozone levels increase while NOx *decreases*. Heavy-duty truck activity is dramatically lower on weekends than weekdays, with corresponding reduced NOx emissions, yet ozone levels increase. To better understand the science behind these ozone increases, the ARB has undertaken a significant data analysis and research program in cooperation with industry and other interested parties. While still ongoing, the data that are available underscore other observations that reduced NOx emissions are a likely primary cause of higher ozone on weekends. There is considerable concern on the part of industry, regulators, health experts and environmentalists alike that NOx reduction strategies may *increase* ground-level ozone, causing more harm than good. As part of its inventory development program, EPA should actively participate in this cooperative effort. EPA should work with other interested stakeholders to better understand the mechanisms that cause higher ozone as an apparent by-product of NOx reductions. (EMA)

Agency Response: This comment towards the U.S. EPA, regarding participation in the ARB's cooperative research program on weekend ozone levels, is outside the scope of this rulemaking. Since this comment only requests U.S. EPA participation in the ARB program, no further changes to the adopted requirements are necessary. However, as the U.S. EPA and the ARB continue to review the data, the ARB will review and improve the adopted requirements as warranted.

245. **Comment:** ARB has undercounted the hydrocarbon benefit of the proposal, because of ARB's assumption that HC benefits would phase in with the NOx standard phase-in. EPA, however, assumed the HC benefits would occur with the control of PM emissions, which occurs fully in 2007. (EMA)

Agency Response: While it is likely that California will experience the HC benefits in 2007 (when PM is required to be controlled by 90 percent), the ARB does not believe that it is appropriate to include these potential HC reductions in the inventory since inventory calculations are based on the adopted emission standards and phase-in. Further, this conservative approach was used by ARB in previous rulemaking. Therefore, no further changes to the adopted requirements and inventory analysis are necessary.

246. **Comment:** ARB has failed to estimate and include the carbon monoxide benefits of its proposal. As with HC, the CO benefits occur upfront in 2007. (EMA)

Agency Response: The ARB is proposing no change to the current CO emission standards for HDDEs. However, to align California requirements with the federal requirements, the ARB adopted a slight increase in the CO emission standard for medium-duty diesel engines from 14.4 g/bhp-hr to 15.5 g/bhp-hr. This slight increase in CO emissions was already included in the ARB's ISOR,[141] Section 10. Therefore, no further changes to the adopted requirements and inventory analysis are necessary.

247. **Comment:** ARB has failed to account for the benefits from the entire diesel fleet affected by the regulation by omitting vehicles 8,500-14,000 lbs. GVWR from its inventory analysis. (EMA)

Agency Response: The ARB has included all benefits and disbenefits from both medium-duty (8,501 lbs – 14,000 lbs. GVWR) and heavy-duty (14,001+ lbs GVWR) diesel engines. Emission impacts of the adopted requirements are included in the ARB's ISOR,[142] Section 10. Therefore, no further changes to the adopted requirements and inventory analysis are necessary.

248. **Comment:** By the failure to include ultra-low sulfur fuel requirements with this rulemaking, ARB has, likewise, failed to account for the PM benefits provided by the use of ultra-low sulfur diesel fuel from the entire in-use fleet. (EMA)

Agency Response: Low sulfur diesel fuel requirements are not included in, and therefore outside the scope of this rulemaking. Also see Agency Response to comments #8-#9. It is inappropriate to include and emission benefits from requirements that are not included in this rulemaking. Therefore, no further changes to the adopted requirements and inventory analysis are necessary.

VIII. LEGAL ANALYSIS

A. Due Process of Law.

249. **Comment:** The ARB proposal cannot be supported in the context of the U.S. EPA's Final 2007 Rule. Until those issues have been resolved with EPA, ARB must refrain from adopting any program for 2007 heavy-duty engines and vehicles and, certainly, should not attempt to adopt a program that is "identical" to EPA's until all the problems with the federal rule have been resolved. If ARB believes it should not delay the adoption of its own rule, then appropriate language should be included in the rule that

[141] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[142] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.

commits ARB to harmonize its requirements with those that will ultimately be implemented by EPA. (EMA)

Agency Response: Because California has separate authority under state law and the CAA to adopt its own motor vehicle standards (including standards for heavy-duty diesel engines), the Board did not need to wait for resolution of "problems" with the federal rule to adopt its own regulatory amendments for California. However, as the U.S. EPA and the ARB continue to review the data regarding technical issues, the ARB will review and improve the adopted requirements as warranted.

250. **Comment:** The timing of EPA's proposal, and the lack of clear provisions on which to comment, raise fundamental due process issues. By proposing regulations that are based in substantial part on requirements proposed in the prior heavy-duty engine and vehicle rulemaking *but that were not finalized until a mere 13 days before the close of the comment period on this rulemaking*, EPA has failed to provide interested parties due process of law to review, analyze and provide meaningful comment to EPA on its proposal.

Moreover, by failing to provide details or justification for many of its proposed requirements and programs, EPA has failed to provide due process of law under the CAA. Where EPA proposes a rulemaking, the due process principles incorporated into the CAA preclude EPA from subjecting a private party to the consequences of a rule without first providing both notice of what it proposes to do and the bases for its proposed actions. *See, e.g., Ass'n of Nat'l Advertisers, Inc. v. F.T.C.*, 627 F.2d 1151, 1165-66 (D.C. Cir. 1979). (EMA)

251. **Comment:** EPA has failed to provide an explanation of the bases for many of its proposals or sufficient details of those proposals within a reasonable timeframe such that industry may comment on them in a meaningful way. The courts have recognized that "[i]t is not consonant with the purpose of a rulemaking proceeding to promulgate rules on the basis of inadequate data, or on data that, [to a] critical degree, is known only to the agency." *Portland Cement Ass'n v. Ruckelshaus*, 486 F.2d 375, 393 (D.C. Cir. 1973). *See also Global Van Lines v. ICC*, 714 F.2d 1290 (5th Cir. 1983).

In sum, due process protections, as set forth explicitly in the CAA, require that EPA sufficiently describe in the NPRM the basis for any proposed rules such that interested parties may comment in a meaningful way. Inasmuch as EPA has failed to meet the specific requirements of the CAA, EPA has violated interested parties' rights to due process and has no authority to impose much of what it has proposed for heavy-duty engines and vehicles. (EMA)

252. **Comment:** EPA is required to provide an opportunity for the submission of both written comments and oral testimony on its proposed regulations. CAA Section 307(d)(5). The time for submitting comments must be "reasonable," and in no instance less than 30 days. CAA Section 307(h). The net requirement of these provisions is that the opportunity for comment must be meaningful, to give regulated parties and the public at large a fair opportunity to develop and submit comments on EPA's proposal. In a highly complex, technology-forcing regulations such as this one, it is particularly important to provide a full and fair opportunity to submit comments. However, in its rush to get this

rule out the door, EPA has fallen far short of providing a meaningful opportunity for comment.

This rule is not scheduled to take effect for seven years. As noted, the CAA requires only four years of lead-time. While Cummins believes that adequate lead-time is essential, it is equally important for EPA to provide a meaningful opportunity for public comment. In light of the time available before the effective date of this rule, EPA cannot justify its truncated public process. (Cummins)

253. **Comment:** Obviously and by EPA's own words, the supplemental test procedures are a significant component of the 2007 proposal. The supplemental test procedures are inextricably entwined with the stringency of the accompanying proposed standards. However, the referenced test procedures were not available on the date of the proposal, contrary to the statutory requirement that EPA include in the docket at the time of proposal "[a]ll data, information, and documents . . . on which the proposed rule relies." CAA § 307(d)(3)(C). Rather, EPA did not notice the availability of those test procedures for comment until, at the earliest, August 3, 2000 – a mere 11 days before the close of the comment period for the 2007 NRPM, and far less than even the minimum 30 days required by the CAA. Moreover, even with adequate time EPA failed in its obligation to set forth the basis and purpose of the 2007 NPRM, because the Agency failed to discuss the way in which the supplemental test procedures would be applied to the 2007 standards. As discussed in detail in an earlier section of these comments, blind application of the supplemental test procedures to the stringent 2007 standards raises many technical issues and complications that EPA has not considered adequately, due to the tortured procedural path followed by the Agency with regard to those test procedures. (Cummins)

254. **Comment:** EPA has failed to provide adequate time for anything other than a cursory assessment of the proposed Supplemental Emissions Requirements and Tests (SERTs). Although a description of a battery of SERTs was provided in the 2004 NPRM (October 29, 1999), the most recent description differs substantially from that earlier description, and was only made available on August 1, 2000, as part of the 2004 Final Rule. It is unreasonable to expect that the full impact of the latest SERT requirements could have been quantified in less then two weeks. The impacts of the SERTs, in the context of the 2007 proposal, are indeed far-reaching and profound. The comments that follow represent a preliminary and incomplete analysis and review of the complex SERT requirements conducted in the short time allowed. (Cummins)

Agency Response to Comments 250-254: These comments concern matters regarding comment periods for the U.S. EPA's 2007 Final Rule, which occurred almost a year before this ARB rulemaking. The supplemental emission test procedures were introduced to the engine manufacturers and the public when the U.S. EPA's 2004 Heavy-Duty Rule was noticed (October 1999) and finalized (October 6, 2000). Virtually identical test procedures were also released for public comment (October 20, 2000) during the ARB's 2005 NTE and Euro III ESC rulemaking process.

Revisions to the supplemental test procedures that have been adopted by the ARB in this rulemaking, are identical to the changes that have been finalized by the U.S. EPA in their 2007 Final Rule (January 18, 2001). The U.S. EPA's 2007 Final Rule also includes the adopted emission standards. Regulatory

requirements for public notice of the adopted requirements have been satisfied with a 45-day public notice that began on September 7, 2001, and ended with a public board hearing on October 25, 2001. All comments have been received and reviewed. Technological feasibility for both the emission standards and the supplemental test procedures is discussed in both staff reports (Initial Statement of Reasons). Further, responses to comments regarding technological feasibility of the supplemental test procedures are included in Section IV.C. Therefore, no further changes to the adopted requirements are necessary.

255. **Comment:** ARB also has failed to provide adequate due process by allowing insufficient time for review and comment on the proposal being considered by the Board. On September 7, 2001, proposed amendments were made available for public review and comment and were scheduled for consideration by the Board on October 25, 2001. Both the CAA and California law require that the ARB provide requisite due process in the adoption of new standards. (*See, e.g.,* California Government Code, section 11346.5.) The comprehensive and complex regulatory program that the Staff has proposed, despite its purported mirroring of federal requirements, requires substantial time for review and consideration, particularly as there are differences from the federal rule. The timetable that has been established for review, comment, and decision-making does not provide adequate due process to interested parties. Moreover, the request that comments be provided as early as ten days prior to the hearing "so that ARB staff and Board Members have time to fully consider each comment" (Notice of Public Hearing, p. 11.) leaves interested parties in a rather awkward – and even untenable – position: either attempt to provide meaningful comment on a complete overhaul of the California heavy-duty diesel engine regulatory program for 2007 in little over a month, or take an additional nine days to provide comment, but risk that the comments will not be fully considered by those charged with adopting them. (EMA)

256. **Comment:** The Staff summary in the Mail-Out (Mail-Out #MSC-01-08, p. 6.) devotes nine whole sentences to describing its ABT program. EMA and other interested parties must be given the opportunity to review the proposed regulatory text of ARB's entire ABT program. (EMA)

257. **Comment:** The proposed pull-ahead of the SERTs that the Board adopted without authority in December, 2000, has not yet become a final ARB rule. Thus, engine manufacturers are in the untenable position, as they were when commenting on the EPA 2007 NPRM, of being asked to provide comment on a proposal that incorporates provisions of a rule *not yet finalized*. ARB has not provided any discussion of the impact of its adopted-but-not-yet-final SERTs rule on the proposal at issue today. ARB notes that the EPA 2007 SERTs are "slightly different" compared to those adopted by the Board. It is not clear whether, in 2007, the ARB will revise its own SERTs program (assuming it eventually is finalized) to be consistent with that of EPA. In yet another respect, ARB's proposal is different from the EPA final 2007 Rule. And, in yet another respect, ARB has committed another procedural *faux pas* by failing to fully describe the proposal before requesting public comment. (EMA)

Agency Response to Comments 255-257: The ARB disagrees, and believes the commenter was provided with adequate due process. Proper notice was provided per the commenter's cited statute (Gov. Code section 11346.5), following the 45-day requirement in section 11346.4. But as the commenter well knows, the ARB exceeded this minimum process requirement by mailing the

commenter the broad outlines (Mail Out #MSC 01-08) of the future proposed regulations over three months earlier, to which the commenter responded before the 45-day notice. Further, the broad outlines clearly stated ARB's intent to conform California's HDDE requirements with those EPA adopted in the 2007 Final Rule (the notice for which the commenter filed 90 pages of comments almost a year earlier), and which the commenter had been actively litigating for months before the Mail Out. Finally, the request for written comments ten days ahead of a Board meeting is just that, a request, and is intended to reduce the state's burden of copying and distributing written comments within short time windows. However, the commenter's compliance with that request was completely voluntary, as the Board accepts written comments, and oral summaries of them, up to and including the end of the hearing on the regulatory item.

258. **Comment:** The ARB proposal must provide due process. In order to meet due process requirements, the Board and Staff must make all the necessary regulatory text, and other documentation, available for review by interested parties so they can comment meaningfully and with specificity on the proposal. ARB also must provide sufficient time for interested parties to review the proposal and provide meaningful comment. If engine manufacturers and other interested parties are not provided that opportunity, ARB will have failed in providing requisite due process, as required both under the CAA and California law. (*See, e.g.,* California Government Code, section 11346.5.). In addition, there must certainly be some sections of the EPA final rule that cannot be adopted without appropriate amendments for California.

In order to meet its due process obligations, ARB must make available for review all the necessary regulatory text and other documentation necessary for the adoption of a comprehensive regulatory program such as the one proposed for California. ARB further, should provide sufficient time for interested parties to review the regulatory language and provide meaningful comment. (EMA)

Agency Response: The Mail Out to which this comment responds preceded the 45-day comment period. Thus, the ARB provided the commenter with due process both by releasing the broad outlines of the proposed regulatory changes in this Mail Out, and by subsequently providing the full text of the proposed changes in the 45-day notice. Also see Agency Response to comment #255-#257.

B. Technologically Feasible and Cost Effective.

259. **Comment:** As noted above, EPA is obligated under CAA Section 202(a)(3)(A) to propose standards that are technologically feasible and cost-effective: Standards [shall] reflect the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the model year to which such standards apply, giving appropriate consideration to cost, energy, and safety factors associated with the application of such technology.

EPA has failed to meet its obligations with respect to the proposed heavy-duty engine program. As detailed in the technical portion of EMA's comments, EPA has failed fully to analyze and consider the technological feasibility of the proposed standards, including the multitude of supplemental test procedures and emission limits, the extreme ambient

conditions under which engines must be compliant, and other aspects of EPA's proposal. EPA has not provided an adequate analysis of technological feasibility and the cost-effectiveness of its proposal. Therefore, EPA has not met its obligations under the CAA. (EMA)

Agency Response: As noted previously, the U.S. EPA mentions that CAA requirements do not require the adoption of standards that require technologies that have already matured or are already in-use. Current technology with some improvements may be required. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR,[143] Section 6, and the U.S. EPA's RIA,[144] Chapter 3. Both discussions specify NOx adsorbers as a promising NOx reduction technology, and PM traps as a promising PM reduction technology. Since there is no difference between the California and federal requirements that would warrant a different technological feasibility demonstration, technologies cited in the U.S. EPA's RIA can expected to be used to comply with the adopted California requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Therefore, no further changes to the adopted requirements are necessary.

260. **Comment:** In developing standards and regulations for heavy-duty engines, EPA must adhere both to the substantive and procedural requirements of the CAA. The commenter goes on to describe how the U.S. EPA did not meet the CAA requirements as they pertain to "lead time and stability of standards," technological feasibility, cost-effectiveness, and due process. (Cummins)

Agency Response: As noted previously, the U.S. EPA mentions that CAA requirements do not require the adoption of standards that require technologies that have already matured or are already in-use. Current technology with some improvements may be required. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR,[145] Section 6, and the U.S. EPA's RIA,[146] Chapter 3. Both discussions specify NOx adsorbers as a promising NOx reduction technology, and PM traps as a promising PM reduction technology. Since there is no difference between the California and federal requirements that would warrant a different technological feasibility demonstration, technologies cited in the U.S. EPA's RIA can expected to be used to comply with the adopted California requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an

[143] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[144] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.
[145] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[146] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected.

Based on the CAA, the adopted standards must only be determined to be technologically feasible. Cost effectiveness is not required to be used to determine the appropriateness of the adopted standards. However, costs should be considered in applying the expected technologies. Therefore, cost effectiveness has been included to demonstrate that a thorough evaluation including technology and costs has been considered in evaluating the adopted requirements. Utilizing an incremental basis is not consistent with previous rulemaking or the CAA, which requires only technological feasibility determinations. Cost estimates of the expected components are included in both the U.S. EPA's RIA and the referenced cost analyses[147,148], both of which are referenced in the ARB's Staff Report. Therefore, no further changes to the cost analysis and adopted requirements are necessary.

C. Lead Time and Period of Stability.

261. **Comment:** EPA has proposed a revolutionary and completely unworkable phase-in scheme that is purported to blunt the force of these concerns regarding technical unfeasibility, which again is totally infeasible and also demonstrates the total lack of understanding by EPA of the realities of the marketplace. However, for economic reasons, the end result of this rule will be to force users of older, higher-emitting diesel engines to recondition the engines they own now, rather than buying new engines in 2007 and beyond. No end user can compete with much higher cost and less reliable engines, and therefore these engines simply will not be sold. Which trucking company will agree to purchase engines in 2007 so that it can be at a severe competitive disadvantage to those other trucking companies that purchase the current more reliable and better performing engines or recondition its older engines? Obviously, no company will purchase these engines and it is completely arbitrary.

The proposed standards are also not cost effective, and EPA has substantially underestimated the cost to achieve these standards (if at all possible) and the resultant cost of operation to the consumer of these engines. The engines will have much lower fuel economy, much higher product cost, will weigh more, and will be much less reliable and durable. EPA's attempt at showing the proposed regulations are cost effective is totally arbitrary and is not based in reality. (Cummins)

Agency Response: See Agency Response to comments #99-#101 and #102-#104, for responses to issues of phase-in, lead time, and stability. See Agency Response to comment #240, for response to the issue of pre-buying. See Agency Response to comment #215, for response to the issue of pre-buying and rebuilding. See Agency Response to comment #213, for response to the issue of cost effectiveness evaluation.

[147] ICF Consulting, 1999. "Economic Analysis of Vehicle and Engine Changes Made Possible by the Reduction of Diesel Fuel Sulfur Content, Task 2 – Benefits for Durability and Reduced Maintenance," prepared by ICF Consulting for the U.S. EPA, December 9, 1999.
[148] Engine, Fuel, and Emissions Engineering, 1999. "Economic Analysis of Vehicle and Engine Changes Made Possible by the Reduction of Diesel Fuel Sulfur Content," prepared by Engine, Fuel, and Emissions Engineering for the U.S. EPA, December 15, 1999.

The commenter provides opinions regarding engine fuel economy, cost, reliability, and durability. The technological feasibility demonstration and cost effectiveness evaluation provided in the U.S. EPA's RIA and the ARB's ISOR have demonstrated the requirements to be technologically feasible and cost effective. While current research has shown a slight fuel economy impact, the U.S. EPA expects engine manufacturers and aftertreatment system manufacturers to make further improvements in the provided lead time. Further, engine manufacturers are expected to continue to ensure the reliability of their products through in-use testing of their engines and aftertreatment systems prior to manufacture of these engines. Therefore, no further changes to the adopted requirements are necessary.

262. **Comment:** Section 202(a)(3)(C) of the CAA requires that the Agency provide adequate leadtime and period of stability for the introduction of new standards:

Any standard promulgated or revised under this paragraph and applicable to classes or categories of heavy-duty vehicles or engines shall apply for a period of no less than 3 model years beginning no earlier than the model year commencing 4 years after such revised standard is promulgated.

EPA has failed to propose standards within a reasonable timeframe as required by the CAA. At a minimum, EPA is obligated to provide both a three-year period of stability and four years' leadtime for introduction of the proposed heavy-duty engine and vehicle standards.

EPA's proposed phase-in for NOx, NMHC and formaldehyde standards violates the three-years' period of stability requirement. Moreover, EPA committed to providing more than the minimum period of stability when it signed on to the SOP and the 2004 Standards. EPA's proposal fails to meet the requirements of the CAA. (EMA)

Agency Response: The ARB agreed to the Statement of Principles (SOP), along with the U.S. EPA. The SOP committed to a three-year lead time for any reduction in HDDE emission standards. Since the adopted emission standards are phased-in beginning in 2007 and the previous emission standards will be implemented in 2004, the three-year lead time agreement is satisfied. Further, as detailed in the ARB's ISOR[149], Section 6, and the U.S. EPA's RIA[150], Chapter 3, technology required to satisfy the adopted requirements is technologically feasible within the adopted phase-in schedule. Additionally, the phase-in schedule remains stable at 50% for NOx and NMHC emissions standards for three years from 2007 through 2009. Furthermore, note that the Board has long argued, and EPA Administrators have long agreed, that CAA Section 209(b) may require U.S. EPA approval of requirements for the California market that force technology faster than the federal government might require. Therefore, no further changes to the adopted requirements are necessary. Also see Agency Response to comments #80-#82.

[149] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[150] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

263. **Comment:** EMA also notes that ARB has adopted NTE and Euro III supplemental emission standards for heavy-duty on-highway engines beginning in 2005. Those requirements currently are subject to legal challenge, based on their lack of leadtime and stability, and may never become final. If the 2005 supplemental standards can overcome those legal obstacles, however, any new standards that California adopts for heavy-duty engines can be implemented in California no earlier than 2008, in order to meet the minimum period of stability requirements established by the Clean Air Act. (EMA)

Agency Response: The NTE and EURO III supplemental test procedures have thus far overcome legal obstacles; with a lower court decision, dismissing a challenge to them, now on appeal. Further, it is ARB's position that the CAA's exacting stability and lead time requirements do not apply to California's requirements except as a possible guideline for technological feasibility, and no court has found to the contrary. Finally, even if the lead time and stability requirements did apply to California's standards, the requirements would not apply here, as NTE and EURO III are not standards but are test procedures to determine compliance with California's standards.

D. Arbitrary and Capricious.

264. **Comment:** The CAA prohibits any action by the Administrator in promulgating an EPA rule which is found to be "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law." CAA Section 307(d)(9)(A). Inasmuch as EPA clearly has contravened the applicable statutes, certain aspects of the proposed rule discussed in this Statement, if finally promulgated, will not withstand judicial scrutiny. In addition, EPA has articulated no rational nexus between the proposed actions to be taken, and the burdens, feasibility, cost and related factors that the Act requires EPA to consider in fashioning its proposed actions. Contrary to the CAA, EPA seemingly has ignored such critical factors in the NPRM. (EMA)

Agency Response: In the ARB's ISOR[151] (and the U.S. EPA's RIA[152]) the ARB details the negative health impacts from diesel emissions, the technological feasibility of emission control system options that are available to reduce diesel emissions, and validates that the emission control system options are cost effective. Therefore, the adopted requirements are not arbitrary nor are they capricious.

Further, the supplemental emission test procedures were introduced to the engine manufacturers and the public when the U.S. EPA's 2004 Heavy-Duty Rule was noticed (October 1999) and finalized (October 6, 2000). The test procedures were additionally released for public comment (October 20, 2000) during for the ARB's 2005 NTE and Euro III ESC rulemaking process. Revisions to the supplemental test procedures that have been adopted by the ARB, are identical to the changes that have been finalized by the U.S. EPA in their 2007 Final Rule (January 18, 2001). The U.S. EPA's 2007 Final Rule also includes the adopted emission standards.

[151] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[152] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

Regulatory requirements for public notice of the adopted requirements have been satisfied with a 45-day public notice that began on September 7, 2001, and ended with a public board hearing on October 25, 2001. All comments have been received and reviewed. Therefore, no further changes to the adopted requirements are necessary.

E. Statutory Authority - "Not To Exceed" Requirements And Other Supplemental Emissions Requirements And Tests.

265. **Comment:** EPA has exceeded its statutory authority and contravened the requirements of the CAA by proposing to adopt supplemental emission requirements. EPA's proposed supplemental emissions requirements constitute separate and more-stringent emission control standards in and of themselves. In clear contravention of the CAA, EPA has failed to demonstrate the technological feasibility, cost-effectiveness or overall efficacy of those supplemental standards. (EMA)

266. **Comment:** The NTE requirements are in clear violation of CAA Section 206(d). Lawful average-based standards are necessarily linked to representative and repeatable test procedures. This is specified under CAA Section 206(a)(1), which provides that "the Administrator shall test or require to be tested . . . any new motor vehicle engine . . . to determine whether such engine conforms with the regulations [the FTP-based standards] prescribed under section [202] of this title." 42 U.S.C. Section 7525(a)(1). Section 206(d) further mandates that the "Administrator *shall by regulation establish methods and procedures for making tests* [of conformance with engine emission standards]." 42 U.S.C. Section 7525(d).

Thus, the emission control standards that EPA is authorized to adopt must be coupled with well-engineered methods and procedures to test for an engine's compliance with those quantitative standards. Otherwise there is no fair, reliable and uniform way of ensuring or demonstrating compliance with the standard. Consequently, for any emission standard that EPA promulgates, the requisite testing procedure and apparatus must be sufficiently detailed and controlled to yield reliable and standardized results that can be generated by manufacturers, and then duplicated and validated by different testers and observers.

With respect to its new NTE standards, however, EPA has completely failed to establish and specify methods and procedures for testing compliance with the NTE requirements. For example, the NTE provisions of the 2007 Rule do not specify the testing equipment and protocols to be used to demonstrate compliance with the NTE standards. ("We have not specified the emission measurement equipment which could be used to determine compliance with the NTE." EPA's Response to Comments, p. 8-8.) Nor has EPA specified testing methods and conditions. To the contrary, standardized corrections for ambient test conditions are essentially precluded. See 40 CFR Section 86.1370-2007(e). Further, the NTE requirements also fail to specify how many 30-second segments of engine operation should be tested or how those segments should be selected. In fact, and contrary to its clear obligations under CAA Section 206(d) to establish specified methods and procedures for its NTE requirements, EPA essentially has put the burden and the risk of devising suitable test data and procedures squarely on the manufacturers. This is confirmed by the provisions of the NTE requirements relating to manufacturers' applications for engine certifications:

> The [HDDE] manufacturer must provide a statement in the application for certification that the diesel heavy-duty engine for which certification is being requested will comply with the applicable Not-To-Exceed Limits specified in Section 86.007-11(a)(4) when operated under all conditions which may reasonably be expected to be encountered in normal vehicle operation and use. The manufacturer also must maintain records at the manufacturers facility which contain all test data, engineering analyses, and other information which provides the basis for this statement, where such information exits. The manufacturer must provide such information to the Administrator upon request. 40 CFR Section 86.007.21(p)(1).

Under its NTE standards, therefore, EPA would have the manufacturers develop the requisite testing methods and procedures, and then provide those testing data and protocols (which presumably will differ from manufacturer to manufacturer) to EPA at its request. This leaves HDDE manufacturers to design and build their engines based on their best guesses of the types of testing and analyses that EPA will deem sufficient. But such a scenario necessarily also leaves manufacturers facing the prospect that their guesses might be wrong, and that EPA might later determine (after the engines are developed and awaiting certification) that the manufacturers' testing and data are insufficient to support a finding of compliance with the NTE requirements.

Such regulatory uncertainty is directly violative of the CAA. Again, CAA Section 206(d) requires that "[t]he Administrator [*not the manufacturers*] shall by regulation establish methods and procedures for making tests" of compliance with emission standards. The NTE requirements, however, turn this otherwise unambiguous requirement of CAA Section 206(d) completely on its head, and so are clearly unlawful. This is especially intolerable where the consequence of an engine experiencing even one 30-second exceedance of the NTE standards could be a denial or loss of certification or even the initiation of an engine recall. This intolerable situation is exacerbated even more by the fact that since there is no way to duplicate and confirm the result of a test that is not adequately defined or controlled, loss of certification could be based on a single spurious test result.[153] (EMA)

267. **Comment:** The NTE requirements are not average-based standards as required by CAA Section 202(a)(3). Because the standards that EPA adopts under Section 202(a)(3) are meant to reduce the emissions from engines as they are actually operated in-use, HDDE emission standards are properly and necessarily average-based standards assessed through representative and repeatable test cycles that reflect average in-use operations. Indeed, EPA has so construed its mobile source standard-setting authority in this way for more than 20 years.

[153] The fundamental unfairness and unlawfulness of the NTE requirements is perhaps best reflected by the fact that HDDE manufacturers can never actually prove that their engines fully conform with the NTE requirements. No matter how many 30-second "passes" there may be, there is always the prospect of some other 30-second segment that will fail the NTE requirements. Indeed, under the new NTE standards, it is only failures that can be proven; full compliance can never be proven or otherwise objectively demonstrated. This is fundamentally at odds with the CAA, which mandates engine standards *and tests* "to determine whether the vehicle or engine *conforms* with the regulations prescribed under Section 202 of [the CAA]." 42 U.S.C. § 7525(a). There are and can be no such tests for the NTE requirements, which renders them unlawful.

Commenter included D.C. Circuit Court cases to support statement that EPA's long-standing recognition and utilization of average-based standards is significant and that it is well-established that EPA may not lawfully abandon a long-standing interpretation of its statutory authority to set standards without providing a "reasoned basis" for doing so.

Here, EPA cannot provide a well-reasoned basis for abandoning its 20-year interpretation of its standard-setting authority. For example, the NTE is plainly irrelevant to the question of whether a HDDE satisfies the prescribed "primary" average-based emission standards (assessed on the FTP), or whether an HDDE will deliver the anticipated environmental benefits through compliance with the FTP-based standards, or over the HDDE's ten-year useful life. In fact, whether a random 30-second segment of a HDDE's operation is typical, wildly unusual or utterly unrepresentative of an engine's ability to conform fully with the underlying FTP-based standards is really anybody's guess. Thus, it is clear that the 30-second NTE requirements cannot reasonably, or even rationally, assess or ensure a HDDE's overall average compliance with the "primary" FTP-based standards.

Commenter included D.C. Circuit Court cases to support statement that under similar circumstances, the Court has consistently held that EPA may not lawfully impose a standard that "bears no rational relationship to the reality that it purports to represent."

Simply stated, a 30-second segment or snapshot of an engine's emissions does not reflect its average emissions over a representative cross-section of its in-use operations, and so is not a proper average-based standard under CAA Section 202(a)(3). (EMA)

> **Agency Response to Comments 265-267:** The supplemental emission test procedures were introduced to the engine manufacturers and the public when the U.S. EPA's 2004 Heavy-Duty Rule was noticed and finalized (October 6, 2000). The test procedures were additionally released for public comment (October 20, 2000) during for the ARB's 2005 NTE and Euro III ESC rulemaking process. Revisions to the supplemental test procedures that have been adopted by the ARB, are identical to the changes that have been finalized by the U.S. EPA in their 2007 Final Rule (January 18, 2001).
>
> As explained in previous rulemaking, the NTE and ESC test procedures only represent additional methods to test HDDEs and HDDVs. The results from these supplemental tests are compared to the existing emission standards. An additional compliance allowance for the NTE test is included to provide manufacturer's flexibility to control emissions during operation not included in the FTP test. This ensures that non-FTP emissions are at the same level as FTP emissions.
>
> Technological feasibility for the proposed requirements is summarized in the ARB's ISOR,[154] Section 6, and the U.S. EPA's RIA,[155] Chapter 3. Both discussions specify NOx adsorbers as a promising NOx reduction technology, and PM traps as a promising PM reduction technology. Since there is no difference between the California and federal requirements that would warrant a

[154] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[155] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

different technological feasibility demonstration, technologies cited in the U.S. EPA's RIA can expected to be used to comply with the adopted California requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected.

A thorough cost effectiveness analysis was performed by the U.S. EPA in their RIA,[156] Chapter 5. Those costs were used in the ARB's analysis in the ISOR,[157] Section 10. The cost effectiveness for the adopted requirements was determined to be within the range of previous rulemaking. Therefore, the adopted requirements are cost effective. Thus, no further changes to the adopted requirements are necessary.

F. Statutory Authority - Definition of "Defeat Device."

268. **Comment:** EPA has exceeded its statutory authority and contravened the requirements of the CAA by proposing to apply a definition of "defeat device" that prohibits engine manufacturers from using as components of their engine technologies certain commonly accepted and applied emission control technologies. (EMA)

Agency Response: There was no proposed or adopted change to the "defeat device" definition. Further, the ARB disagrees with the comments in that the current definition does not prohibit manufacturers from using components of engine technologies that are commonly accepted and are applied emission control technologies. The current definition does allow substantially used emission control strategies that trade off emissions between NOx and PM during the FTP test and the supplemental tests. Therefore, no further changes to the adopted requirements are necessary.

G. Unconstitutional.

269. **Comment:** EPA has engaged in an unconstitutional taking by eliminating the life of averaging, banking and trading credits which were guaranteed by EPA not to expire in its prior rulemaking on the 2004 Standards. EPA adopted, with EMA's support, a program under which credits would not expire. In fact, unlimited life credits were a key component of getting engine manufacturers to sign and support the SOP. Not only has EPA violated the prior commitment made in its regulations, but the Agency has engaged in an illegal, unconstitutional taking of engine manufacturers' property and other rights. (EMA)

Agency Response: In response to this comment, the U.S. EPA revised their 2007 Final Rule to incorporate additional flexibility to the ABT program. The first flexibility allows unlimited use of banked PM credits. Since the FEL is 0.02

[156] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.
[157] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.

grams per brake horsepower-hour, use of PM credits is not expected to be abused. The second flexibility allows NOx plus NMHC credits banked prior to 2007 to be exchanged for NOx credits that may be used in the 2007 and subsequent model years. In addition to the NOx FEL of 0.50 grams per brake horsepower-hour, these converted credits must be discounted by 20 percent to account for the NMHC portion. Further only 10 percent of total sales of engines certifying above the NOx FEL of 0.50 grams per brake horsepower-hour may use these converted credits. With the additional flexibilities already adopted, no further changes to the adopted requirements are necessary.

H. Promulgate and Enforce the Proposed High Altitude Requirements.

270. **Comment:** EPA has no authority to promulgate and enforce the high altitude requirements for HDDEs and HDDVs proposed in this rulemaking. The statutory and regulatory history concerning such requirements is unmistakable: for EPA to enforce HDDE and vehicle limits at high altitude, the Agency first must propose and promulgate proportional standards based on the criteria enacted by Congress. EPA has failed utterly to do so. Nowhere in the rulemaking record is there any analysis or determination of the need for and technological feasibility of the standards proposed. Moreover, EPA has failed to set specific high-altitude emission standards for HDDEs and HDDVs, which it must do in order to enforce any high altitude requirements. Without such analysis, EPA clearly has no authority to promulgate or enforce its proposed high altitude standards in the context of this rulemaking. (EMA)

271. **Comment:** The proposal – which would require a manufacturer to demonstrate compliance up to 5500 feet above sea level – is unprecedented and violates statutory requirements for the setting of high altitude.

EPA has never set high-altitude standards for heavy-duty engines, although EPA once proposed and then withdrew proportional high-altitude particulate standards for such engines. 50 Fed. Reg.10631-32 (March 15, 1985). Moreover, while EPA has promulgated definitions of "high altitude" for light-duty vehicles and light-duty trucks, those definitions do not apply to heavy-duty engines (and, moreover, they define “high altitude” as over 4000 feet, not 5500 feet).

What EPA has proposed in this rulemaking is, in effect, an “all altitude” standard – at least up to 5500 feet – for purposes of demonstrating compliance with the supplemental test procedures. In so doing, EPA has failed to follow the clear requirements of the CAA and has exceeded its statutory authority. (Cummins)

Agency Response to Comments 270-271: As explained by the U.S. EPA, the commenter misreads the noted statute that actually applies to engine manufactured prior to the 1984 model year. Further, verification with the adopted emission standards is determined with the FTP test and the supplemental tests. The existing NTE test does specify the altitude and temperature regions which the engine may be tested to verify compliance.

Technological feasibility for the proposed requirements is summarized in the ARB’s ISOR,[158] Section 6, and the U.S. EPA’s RIA,[159] Chapter 3. Both

[158] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.

discussions specify NOx adsorbers as a promising NOx reduction technology, and PM traps as a promising PM reduction technology. Since there is no difference between the California and federal requirements that would warrant a different technological feasibility demonstration, technologies cited in the U.S. EPA's RIA can expected to be used to comply with the adopted California requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected.

Technological feasibility was further explained by the U.S. EPA in their response to comment 3.1.1(M). The control effectiveness of both PM traps and NOx adsorbers, the primary emission control technologies expected to be used to comply with the adopted requirements, is not expected to be affected by the range in altitudes the NTE test allows. Therefore, no further changes to the adopted requirements are necessary.

I. Context of EPA Rule.

272. **Comment:** While EMA strongly supports harmonization of California's requirements with those in place nationwide, EMA cannot support ARB's proposal for 2007 because we do not fully support EPA's final 2007 Rule. EMA's continued concerns with the final rule have been raised by EMA, on behalf of certain of its members, in the context of the pending federal court litigation with EPA over the final 2007 Rule. EMA previously provided for the record a copy of its "Statement of Issues to be Raised" filed in the federal litigation in April, 2001. EMA also attaches hereto for the record and incorporates herein by reference as Attachment C a copy of its "Joint Brief for the Engine Manufacturer Petitioners" which it recently filed in the federal court action. (EMA)

Agency Response: The U.S. EPA adopted their 2007 final rule in January 2001. To date no legal challenge has overturned any part of those adopted requirements. The ARB has only adopted identical requirements. The ARB also supports harmonization with the additional consideration of the health of California residents. Should there be a decision by the U.S. EPA to revise the federal requirements, the ARB will also consider those changes. However, at this time, no change to the regulatory text is necessary.

273. **Comment:** EMA strongly supports harmonization, locally, nationally and internationally. As such, EMA appreciates ARB's efforts to harmonize California's emission standards for heavy-duty on-highway engines with those to be effective nationwide in 2007. (EMA)

Agency Response: The adopted requirements harmonize federal and state requirements for HDDEs beginning in the 2007 model year. Therefore, no further changes to the regulatory text are necessary at this time.

[159] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

274. **Comment:** There are some crucial areas in which the proposed ARB regulatory program differs from the EPA program. If those areas are not adequately addressed, they will create significant problems for California, as well as for engine manufacturers and our customers. (EMA)

Agency Response: The adopted requirements harmonize federal and state requirements for HDDEs beginning in the 2007 model year. There were no specific references to the differences. Therefore, no further changes to the regulatory text are necessary at this time.

275. **Comment:** The ARB is proposing to harmonize with a federal rule that has significant flaws and which in fact is being challenged. Among the provisions at issue are the feasibility of the NTE provisions, the accuracy of the measurement procedures, and the appropriateness of forced averaging. While we do support ARB's efforts to harmonize, it would be disingenuous for EMA to support ARB's proposal for 2007, since we do not fully support and currently are seeking changes to EPA's final 2007 rule. As such, we urge the ARB to commit by regulatory language, or by binding resolution, to fully harmonize its requirements to be consistent with any changes that ultimately might be implemented by EPA. (EMA)

Agency Response: The adopted requirements harmonize federal and state requirements for HDDEs beginning in the 2007 model year. The adopted requirements are identical to those adopted by the U.S. EPA in January, 2001, many issues of which have been litigated and upheld, including issues of technological feasibility, measurement accuracy, and averaging (see e.g. National Petrochemical and Refiners Association v. EPA 287 F.3d 1130 at 1136 (D.C. Circuit Court 2002)). Each of the specific issues has been addressed in other comments. The requirements have been demonstrated to be technologically feasible, the adopted measurement procedures reflect the most recent changes to the procedures to increase measurement accuracy, and averaging provisions provide flexibility and consistency with previous provisions. Should further legal action bring about a change to the federal requirements, the ARB will consider each change with respect to the effects on the California environment and its residents. Therefore, no further changes to the regulatory text are necessary at this time.

276. **Comment:** Engine manufacturers have further concerns with the lack of accurate measurement procedures and with the averaging, banking and trading provisions adopted by EPA and which the ARB intends to adopt. Rather than providing flexibility for engine manufacturers, which is the intent of AB&T provisions, manufacturers will effectively be forced to average simply in order to meet the rule's requirements. (EMA)

Agency Response: The commenter provided similar comments to the U.S. EPA during their rulemaking. In response to the comments, the U.S. EPA revised both NOx and PM emission measurement procedures and device specifications to reduce emission measurement variability. The ARB has adopted those same measurement procedures and measurement device specifications.

In response to this comment, among others, the U.S. EPA revised their 2007 Final Rule to incorporate additional flexibility to the ABT program. One is to allow unlimited use of banked PM credits. Since the FEL is 0.02 grams per brake

horsepower-hour, use of PM credits is not expected to be abused. Second, NOx plus NMHC credits banked prior to 2007 may be exchanged for NOx credits that may be used in the 2007 and subsequent model years. In addition to the NOx FEL of 0.50 grams per brake horsepower-hour, these converted credits must be discounted by 20 percent to account for the NMHC portion. Further, only 10 percent of total sales of engines certifying above the NOx FEL of 0.50 grams per brake horsepower-hour may use these converted credits. With the additional flexibility already adopted, no further changes to the adopted requirements are necessary.

277. **Comment:** A number of other issues that are not part of the federal litigation also must be resolved as part of the EPA rule implementation process and as part of the process of ARB harmonizing with that rule. Those issues include numerous ambiguities in the EPA program and many typographical errors in the final Rule, all of which must be corrected and, presumably, must also be corrected in the ARB proposal. (EMA)

Agency Response: The ARB has reviewed all regulatory text that has been adopted. To date, no ambiguities or typographical errors have been found in the regulatory text. Since the commenter did not make specific reference to any errors, no further changes to the regulatory text can be completed.

278. **Comment:** The issues that EMA has raised in the federal litigation on the EPA final 2007 Rule, and the other issues discussed above, apply equally to ARB's proposed program. Until those issues have been resolved with EPA, ARB must refrain from adopting any program for 2007 heavy-duty engines and vehicles and, certainly, should not attempt to adopt a program that is "identical" to EPA's until all the problems with the federal rule have been resolved. If ARB believes it should not delay the adoption of its own rule, then appropriate language should be included in the rule that commits ARB to harmonize its requirements with those that will ultimately be implemented by EPA. (EMA)

279. **Comment:** Cummins' concerns with the EPA final rule have been raised through the filing of a petition in federal court. Chief among the issues raised in the Cummins petition is 2007 rules have not been shown to be feasible. There is a lack of any credible technical evidence that the aftertreatment technology, which will be required to meet the 2007 standards, will be available in that time frame. In addition, Cummins has serious technical concerns about the ability of existing and even the newly adopted measurement methods to accurately guide the development of and then support the certification of the technologies needed to meet these stringent standards. Included in Cummins' written comments, which were submitted earlier, are copies of the Cummins written comments to EPA 2007 rule notice of proposed rulemaking, as well as the company statements of issues and the recently filed brief, both filed in federal court. The issues Cummins has raised in federal litigation on EPA final rule apply equally, of course, to the staff's proposed program. And we figure that until these issues have been resolved with EPA, that the ARB should refrain from adopting any program for the 2007 heavy-duty engines and certainly should not adopt the program that has the same faults as the federal rule. If the ARB believes it should not delay the adoption of its own rule, that appropriate language should be included in the rule that commits to harmonize with the rule ultimately implemented and put into effect by the EPA. (Cummins)

Agency Response to Comments 278-279: The adopted requirements harmonize federal and state requirements for HDDEs beginning in the 2007 model year. The adopted requirements are identical to those adopted by the U.S. EPA in January 2001. Although there is legal action pending regarding issues that include technological feasibility, no judgment has been delivered. Further, this issue has been addressed in other specific comments. As discussed by the U.S. EPA, CAA requirements do not require the adoption of standards that require technologies that have already matured or are already in-use. Current technology with some improvements may be required. Technological feasibility for the proposed requirements is summarized in the ARB's ISOR,[160] Section 6, and the U.S. EPA's RIA, [161] Chapter 3. Both discussions specify NOx adsorbers and particulate filters as promising technologies that are expected to be used to comply with the adopted requirements. Both cite extensive laboratory testing of the systems and some in-field durability testing. Laboratory testing has involved both transient and steady-state test cycles. Further, some steady state testing includes testing within the NTE control zone. While those tests demonstrate reductions up to the adopted levels, further testing is expected to demonstrate an additional compliance buffer. Due to the significant lead time for compliance with the adopted requirements, compliance is expected. Should further legal action bring about a change to the federal requirements, the ARB will consider each change with respect to the effects on the California environment and its residents. Therefore, no further changes to the regulatory text are necessary at this time.

J. Applicability.

280. **Comment:** We think as well the rule should apply to everyone and not just public transit buses, but school buses, tour trucks, trucks, stationary uses, marine applications. In so doing then, again, as you've heard today, we think the market will develop. It will attract interest in making the California heavy-duty diesel market a viable, not only for engine manufacturers, but emission control manufacturers. (MSTD)

Agency Response: The adopted requirements harmonize federal and state requirements for HDDEs beginning in the 2007 model year. This includes applicability to engines used in school buses, tour trucks, and trucks. The adopted requirements are identical to those adopted by the U.S. EPA in January 2001, and do not apply to stationary nor marine applications. Requirements for stationary applications are developed by the local agencies (air pollution control districts and air quality management districts), while requirements for marine applications need further review since usage and maintenance is significantly different compared to on-road applications.

For urban transit buses, ARB's previously adopted NMHC and CO emission standards are currently lower than those that were just adopted for on-road HDDEs. In addition, the phase-in schedule for the urban transit bus emission standards is more aggressive. While the ARB has made every effort to harmonize the requirements, the ARB also knows that most urban transit buses

[160] Staff Report: Initial Statement of Reasons, ARB, September 7, 2001.
[161] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA420-R-00-026, U.S. EPA, December 2000.

operate in highly populated and lower income areas. The ARB has considered revisions to the previously adopted emission standards and phase-in schedule. However, relaxation of the previously adopted emission standards and/or phase-in schedule would be detrimental to such “environmental justice” communities. Further, there is enough lead time to allow engine manufacturers to adjust the technologies necessary for compliance. Therefore, no further changes to the regulatory text are necessary at this time.

281. **Comment:** Lastly, I'd like to say that rather than establish an across-the-board statewide rule, we think it makes sense to allow provisions for rural areas, for attainment areas, for small and rural transmit systems. I think what needs to be considered in that study is the emissions in the air district. For instance, in our district we are less than one percent of the total emissions from buses of all kinds, so if we were to convert to an alternative fuel across the board, that does not have significant impact on air quality impact on our district. I realize statewide there's some considerations. (MSTD)

Agency Response: While it may seem ideal to develop regulations based on localities and areas, on-road diesel engines often travel throughout the state. Having statewide requirements for on-road HDDEs ensures consistent requirements for all on-road HDDEs. Additionally, the requirements are harmonized with the federal requirements to further ensure consistent requirements throughout the nation. Therefore, no further changes to the regulatory text are necessary at this time.