State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS

PROPOSED AMENDMENTS TO HEAVY-DUTY VEHICLE REGULATIONS: 2004 EMISSION STANDARDS; AVERAGING, BANKING AND TRADING; OPTIONAL REDUCED EMISSION STANDARDS; CERTIFICATION TEST FUEL; LABELING; MAINTENANCE REQUIREMENTS AND WARRANTIES

Date of Release: March 6, 1998

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EXECUTIVE SUMMARY

In 1994, the Air Resources Board (ARB) approved a State Implementation Plan (SIP) for ozone. The SIP contains measures M5 and M6, which call for new state and national emission standards for highway heavy-duty diesel vehicles beginning in 2004. In June 1995, ARB, the United States Environmental Protection Agency (U.S. EPA), and the manufacturers of heavy-duty vehicle engines signed a statement of principles (SOP) calling for harmonization of ARB and U.S. EPA heavy-duty vehicle regulations. In October 1997, U.S. EPA adopted new emission standards, along with changes to the existing federal averaging, banking, and trading program (ABT), for heavy-duty diesel engines sold in the other 49 states. This report presents the staff's proposal to amend existing California exhaust emission standards for heavy-duty diesel engines to harmonize with the recently adopted federal requirements.

The heart of the proposal is an emission standard for new heavy-duty diesel-cycle vehicles which would be effective in 2004. The standard would limit emissions of oxides of nitrogen (NOx) and non-methane hydrocarbons (NMHC). The proposed standard, which is identical to the adopted federal standard, is 2.4 grams per brake horsepower-hour (g/bhp-hr) NOx plus NMHC; or 2.5 g/bhp-hr NOx plus NMHC with a 0.5 g/bhp-hr NMHC cap.

In addition to the 2004 standards, this proposal mirrors adopted federal requirements for durability, maintenance intervals, recordkeeping, warranties, certification test fuel, and engine useful life. As a package, these requirements would protect the air quality benefits of the proposed standards and help ensure that the engines remain cleaner longer. These requirements would apply to both diesel-cycle and Otto-cycle (typically gasoline-fueled) heavy-duty vehicles.

This proposal is designed to harmonize as closely as possible with the federal program, while still maintaining the emission reduction benefits of the California program. There are two critical areas where staff believes it is neither practical nor feasible to replicate the federal requirements: the medium-duty vehicle emission standards and the ABT program. U.S. EPA included engine-certified medium-duty vehicles (8,500 to 14,000 pounds gross vehicle weight) in its 1997 rulemaking. In 1995, the Board adopted the 2004 model-year 2.4 g/bhp-hr NOx plus NMHC (or 2.5 with a 0.5 NMHC cap) standard for California engine-certified medium-duty vehicles.

The ABT program provides flexibility to engine manufacturers by allowing them to average emission rates over all their engine families for compliance with the standard, to bank excess reductions for later use, and to trade excess reductions with other manufacturers. This proposal would allow participation in the national ABT program. ABT credits generated by heavy-duty vehicles before or after 2004 could be used beginning in 2004. Medium-duty vehicles could participate in the ABT program beginning in 2004. In contrast, the federal

program allows credits banked before 2004 to be used at any time, and medium-duty vehicles

could participate in ABT at any time. ARB staff believe those differences are necessary to protect the benefits of the California program.

ABT credits can be used by engine manufacturers for flexibility in complying with the emissions standards. Marketable credits, on the other hand, are emission reduction credits that can be sold or traded to any individual or business. This proposal includes optional reduced-emission standards that are below the required standard. Those who wish to obtain marketable credits would purchase a vehicle certified to an optional reduced-emission standard.

SIP measure M5 calls for a 2.0 g/bhp-hr NOx standard and some hydrocarbon reductions. Adoption of this proposal would reduce NOx emissions from new heavy-duty vehicles by half beginning in 2004. Based on engine certification data, NMHC emission levels have already been significantly reduced, and are expected to remain at current levels. Therefore, the SIP hydrocarbon reduction commitments have been met. SIP measure M5 also called for emission reductions from a California-only 2.0 g/bhp-hr NOx standard beginning in 2002, or through alternative measures. A California-only standard in 2002 is not considered feasible, because the technology (advanced exhaust gas recirculation) required to meet a 2.0 g/bhp-hr NOx standard will not be fully developed and commercially available by 2002. A California-only standard in 2002 also raises concerns about competitiveness for the California trucking industry, given that California-based firms would have to invest in the cleaner, more expensive technology earlier than out-of-state registered competitors. The technology available in 2002 would likely be limited to alternative fuels, and a full range of models is not expected to be available. Also, a California-only standard would only be partially effective, since heavy-duty vehicles registered out-of-state but operating in California are not subject to California emission standards. For those reasons, staff believes a California-only 2002 standard is not feasible. Therefore, the remaining measure M5 NOx emission reductions will be met through alternative measures described in SIP measure M5.

The estimated statewide benefits for the proposed adoption of the 2004 standards would be 96 tons per day of NOx and 2 tons per day of NMHC. The estimated California cost-effectiveness with adoption of the staff's proposal would be approximately $400 per ton of NOx plus NMHC reduced. This cost-effectiveness is well within the range of other motor vehicle control measure costs. The staff recommends that the Board adopt the staff proposal.

I.

INTRODUCTION

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

Mobile source controls are vital to attainment of air quality standards. Mobile sources account for about 60 percent of ozone precursors, statewide. California's plan for attaining the federal ozone ambient air quality standard is the 1994 State Implementation Plan (SIP). The SIP calls for national standards for new heavy-duty vehicles (HDVs) beginning with model year 2004.

In summer 1995, the Air Resources Board (ARB), the U.S. EPA, and heavy-duty engine manufacturers signed an agreement for the same emission standards nationwide, and a review of those standards in 1999. Heavy-duty engine manufacturers prefer to have the same engine standards nationwide, as it allows them to spread the cost of engine development over a broader fleet. In October 1997, the U.S. EPA adopted those national standards for engines in heavy-duty vehicles sold throughout the U.S., excluding California. This staff report presents California's proposed harmonization with those national HDV standards. The proposed standards, which are identical to the adopted federal standards, are 2.4 g/bhp-hr NOx plus NMHC (or 2.5 with a 0.5 NMHC cap). California's harmonization with nationwide heavy-duty vehicle standards furthers the competitiveness of California trucking firms involved in interstate commerce.

In addition to the proposed 2004 emission standards, this proposal mirrors adopted federal requirements for durability, maintenance intervals, recordkeeping, warranties, and

engine useful life. As a package, the requirements would protect the air quality benefits of the proposed

emission standards and help ensure that the engines remain cleaner longer. The durability, maintenance intervals, recordkeeping, warranties, and engine useful life requirements would apply to both diesel-cycle and Otto-cycle (typically gasoline-fueled) HDVs.

This proposal is designed to harmonize as closely as possible with the federal program, while maintaining the emission reduction benefits of the California program. There are two areas where staff believes it is not necessary or practical to replicate the federal requirements--the standards for diesel engines used in medium-duty vehicles, and the program for averaging, banking, and trading (ABT). For medium-duty vehicle diesel engines, California adopted the 2004 engine-certified medium-duty emission standards identical to the 2004 federal emission standards for those engines. Regarding the ABT program, this proposal would allow participation in a national program, with some restrictions until 2004. ARB staff believe the differences, discussed later in this report, are necessary to protect the benefits of the California program.

Chapters I and II of this report are the introduction and background, respectively. Chapter III contains a discussion on the need for the proposed emission standards. Chapter IV is a summary of the proposed requirements. Chapter V highlights the difference between the proposed California requirements and the adopted federal requirements. Chapter VI describes heavy-duty technological improvements that make the proposed standards feasible. Chapter VII discusses issues that arose during development of the requirements, and how they are addressed in this proposal. Chapter VIII covers the regulatory alternatives that were considered. Chapters IX and X contain the estimated economic and environmental impacts, as well as the cost effectiveness analysis pertaining to the proposed requirements. Finally, Chapter XII lists the references.

II.

BACKGROUND

Heavy-duty vehicle (HDV) gaseous emissions were first regulated by California in 1969, and by U.S. EPA in 1974. Over the years, more stringent emission standards have paralleled substantial improvements in control technology. Today's heavy-duty engines are much cleaner than the engines from the early 1970's: they emit about a third of the ozone precursors, and about a tenth of the particulate matter. This chapter provides an overview of current regulations as they pertain to HDVs. More specifically, it discusses HDV weight classes, HDV and medium-duty emission standards, inventory of and emissions from HDVs, and the 1994 Ozone State Implementation Plan (SIP) commitments for HDVs. It also defines several key terms used throughout the report.

A. VEHICLE CLASSES

Motor vehicles are classified as light-duty, medium-duty, and heavy-duty based on the gross vehicle weight rating (GVWR), a measure of the vehicle weight plus defined load weight. The HDV classification is further subdivided into light heavy-duty, medium heavy-duty, and heavy-heavy duty vehicles. The current California classification (medium-duty) for vehicles in the 8,501 to 14,000 pound GVWR range differs from the federal classification (light heavy-duty). Table II-1 lists the vehicle class and GVWR breakdown as they pertain to both the federal and California programs.

Table II-1
Vehicle Class and GVWR Breakdown

Vehicle Class	2B	3	4	5	6	7	8
GVWR (pounds)	8,501 - 10,000	10,001 - 14,000	14,001 - 16,000	16,001 - 19,500	19,501 - 26,000	26,001 - 33,000	33,000+
Federal	light heavy-duty				medium heavy-duty		heavy heavy-duty
California (1995 & later)	medium-duty		light heavy-duty		medium heavy-duty		heavy heavy-duty

Title 13 of the California Code of Regulations (CCR) defines HDV as any vehicle with a gross vehicle weight rating (GVWR) over 6,000 pounds except for passenger cars. However, it defines a medium-duty vehicle as 1) any pre-1995 model HDV having a manufacturer's gross vehicle weight rating (GVWR) of 8,500 or less; 2) any 1992 and subsequent model year heavy-duty LEV, ultra-low emission vehicle (ULEV), or zero emission vehicle (ZEV) having a manufacturer's GVWR of 14,000 pounds or less; or 3) any 1995 and subsequent model year HDV having a manufacturer's GVWR of 14,000 pounds or less.

For this proposal, the term heavy-duty refers to any vehicle 14,001 pounds or more GVWR. The term medium-duty, as used herein, refers to any vehicles over 8,500 pounds GVWR and less than 14,001 pounds GVWR.

B. HEAVY-DUTY DIESEL VEHICLE EMISSIONS

Eighty-five percent of HDVs are diesel-fueled. Table II-2 lists the number of HDVs in each weight class, based on California's motor vehicle emission inventory model MVEI7G 1.0c. As listed in the table, diesel-cycle engines tend to dominate the heavier weight classes where, because of their use in commerce, fuel efficiency is more important. Diesel-cycle engines include diesel-fueled, methanol, and certain gaseous-fueled engines derived from existing diesel-cycle engines. Diesel-fueled motor vehicles emit NOx and hydrocarbons (HC), which are ozone precursors. Diesel-fueled vehicles also emit particulate matter (PM) and carbon monoxide (CO). The primary pollutants of concern from diesel-fueled vehicles are NOx and PM.

Table II-2
1998 Estimated Number of California-Registered Heavy-Duty Diesel Vehicles

Light Heavy-Duty	Medium Heavy-Duty	Heavy Heavy-Duty	Urban Transit Bus
14,001 - 19,500 pounds	19,501 to 33,000 pounds	33,000+ pounds	
42,000	120,000	179,000	6,000

C. MOTOR VEHICLE EMISSION STANDARDS

California is the only state that has the authority to establish motor vehicle emission standards different from federal standards. Those standards must be equivalent to or more

stringent than federal standards. California's current emission standards for heavy-duty diesel engines and urban transit buses are aligned with the federal standards. California's current standards for medium-duty vehicles are more stringent than the current federal standards. Table II-3, below, lists current California mandatory emission standards for HDDEs used in HDVs, urban transit bus engines, and medium-duty diesel engines. Appendix B, Tables B-1 through B-6, lists both federal and California mandatory and optional standards for HDDE and urban transit bus engines for model years 1970 through 2004.

Table II-3
Current California Emission Standards for Diesel Engines
Used in Vehicles with a GVWR over 8,500 Pounds

Vehicle Category	GVWR (pounds)	Emission Standard in g/bhp-hr					
		NMHC	THC*	CO	NOx	PM	NOx plus NMHC
Heavy-duty diesel-cycle	over 14,000	1.2	1.3	15.5	4.0	0.1	----
Heavy-duty Otto-cycle	over 14,000	1.7	1.9	37.1	4.0	----	----
Urban transit bus	over 14,000	n/a	1.3	15.5	4.0	0.05	----
Medium-duty engine- certified	8,501 - 14,000	----	----	14.4	3.9	0.1	3.9

*Total hydrocarbons

In 1993, the Board revised California NOx, and PM emission standards for new urban transit buses (those in the heavy heavy-duty diesel engine range). In California, the standards were adopted for 1996 implementation and set at 4.0 g/bhp-hr NOx, and 0.05 g/bhp-hr PM, with a 0.07 g/bhp-hr in-use PM standard. Identical federal urban bus emission standards were implemented in 1998. Appendix B, Table B-2 lists both California and federal urban bus standards for model years 1970 and later.

In 1995 the Board revised California NOx and PM emission standards for new heavy-duty diesel engines (HDDE), other than the emission standards already adopted for urban transit buses. The new standards were set at 4.0 g/bhp-hr NOx and 0.1 g/bhp-hr PM for implementation in the 1998 model year. The standards for all other pollutants emitted from HDDEs remained unchanged. The 1998 California HDDE NOx and PM standards are the same as the 1998 federal HDDE standards. Tables B-2 and B-3 of Appendix B, list federal and California HDDE standards. Note that in some cases there are different emission standards for diesel-cycle engines

(compression ignition, typically diesel-fueled) and Otto-cycle engines (spark-ignition, typically gasoline-fueled).

California also has optional reduced-emission standards for HDVs and urban buses. Vehicles used to generate marketable emission reduction credits, for example, would need to be certified to a reduced-emission standard. Appendix B, Tables B-4 through B-6, contains the adopted and the proposed optional reduced-emission standards for HDVs and urban buses.

In 1995 the Board adopted amendments to the medium-duty vehicle (MDV) regulations, which apply to vehicles having a gross vehicle weight rating (GVWR) of 8,501 to 14,000 pounds. Medium-duty vehicles must certify to emission standards using chassis dynamometer test procedures, except diesel or incomplete vehicles which have the option of using engine dynamometer test procedures. Phase-in requirements and emission standards for engine-certified medium-duty vehicles are shown in Tables B-7 and B-8, respectively. MDVs certifying to engine-certification standards now must certify to Tier 1 standards or better. The Tier 1 engine-certification standards are 3.9 g/bhp-hr NOx plus NMHC, and 0.1 g/bhp-hr PM. In 2004, however, the adopted California standard for engine-certified medium-duty vehicles is
2.4 g/bhp-hr NOx plus NMHC (or 2.5 with a 0.5 NMHC cap).

D. STATE IMPLEMENTATION PLAN (SIP)

The 1994 State Implementation Plan (SIP) for Ozone is California's plan to attain the federal ozone standard. The SIP relies heavily on emission reductions from heavy-duty diesel-cycle vehicles. The proposals for emission reductions in the SIP are called "measures" and have been numbered. SIP measures M5 and M6 call for a lower-emission standard for new heavy-duty diesel vehicles, M4 calls for the early (pre-2002) introduction of lower-emission heavy-duty engines, and M7 is an accelerated vehicle retirement (truck scrapping) measure. ARB staff now believes M7 would not prove effective, and staff has proposed the withdrawal of M7 -- not in this rulemaking, but as a separate proposal. ARB staff has also proposed (as part of that separate proposal) adding an additional measure related to heavy-duty vehicles -- M17, which calls for pursuing a combination of increased in-use compliance (including NOx testing) and additional market-based incentives.

SIP measure M5 includes the requirements being considered in this ARB rulemaking. The recent U.S. EPA final rulemaking for heavy-duty diesel-cycle vehicles relates to SIP measure M6. SIP measure M6 calls for U.S. EPA to adopt a 2.0 g/bhp-hr NOx emission standard for new on-road heavy-duty diesel engines sold outside of California, beginning in 2004. A provision of the federal Clean Air Act, however, prohibits the introduction of the 2.0 g/bhp-hr NOx standard on a nationwide basis before 2004. The recent federal rulemaking fulfills that commitment. SIP measure M5 calls for a 2.0 g/bhp-hr NOx HDDE emission standard for new on-road heavy-duty engines sold in California, beginning in 2002, or

implementation of alternative measures which achieve equivalent or greater reductions. Alternatives to the early California-only NOx standard (years 2002 and 2003) to be considered include expanded introduction of alternative-fueled and low-emission diesel engines through demand-side programs and incentives, retrofit of aerodynamic devices, reduced idling, and speed reduction.
SIP measures M5 and M6 also call for reductions in hydrocarbon emissions from heavy-duty diesel vehicles.

NOx and reactive organic gas (ROG) emission reductions anticipated from measure M5 and M6 SIP in the South Coast Air Basin are listed in Table II-4. For purposes of this analysis, ROG and NMHC emissions are considered to be equivalent. Also shown are baseline emissions (not including effects of SIP measures) for heavy-duty diesel-fueled vehicles. These emissions were all based on the EMFAC7F/BURDEN7F, ARB's motor vehicle emission inventory model used during development of the 1994 SIP. The U.S. EPA's recent rulemaking fulfills the measure M6 SIP commitment for NOx emissions emission reductions. The full impacts of the 2004 standards on SIP measures M5 and M6 will be discussed later in this report.

Table II-4
State Implementation Plan Measure M5 and M6
Emission Reductions in the South Coast Air Basin
(Tons per day, based on EMFAC7F/BURDEN model)

Year	Baseline Inventory		SIP Measure M5		SIP Measure M6	
	NOx	ROG	NOx	ROG	NOx	ROG
2002	192	19	2	0	0	0
2004	193	19	15	1	1	0
2005	194	19	22	2	4	1
2007	199	18	32	3	7	1
2008	202	18	38	3	9	1
2010	208	19	56	5	16	2

E. USEFUL LIFE

The useful life for HDEs is that period of time or mileage during which the engine's actual emissions of a specific pollutant are required to remain at or below the level required

by the certification standard. Currently, the useful life for all pollutants except NOx from Otto-cycle heavy-duty engines and light heavy-duty diesel engines is 8 years or 110,000 miles. For medium heavy-duty diesel engines it is 8 years or 185,000 miles. Similarly, the useful life for heavy heavy-duty diesel engines, for all pollutants except NOx, is 8 years or 290,000 miles. The useful life for 1998 and later HDVs with respect to NOx is 10 years, with the same useful life mileage values (110,000 miles for light heavy-duty, 185,000 miles for medium heavy-duty, and 290,000 miles for heavy-heavy duty diesel engines).

F. DEFINITIONS

Marketable Credits - A program which allows emission reduction credits to be traded on the open market. Industry participation and use of marketable credits is restricted by individual programs.

Family Emission Limit (FEL) - The NOx, NOx plus NMHC, or PM FEL is declared by the engine manufacturers for each engine family upon engine certification. FELs can be expressed in grams per brake horsepower-hour (g/bhp-hr) or grams per Megajoule. FELs are declared at, above, or below the adopted emission standard. Only engine families with FELs established below the adopted emission standards would have emission reduction credits available to average, trade, bank or combination thereof. FELs exceeding the applicable standard would use or obtain emission reduction credits to address the shortfall.

Averaging, Banking, and Trading Program (ABT) - A program in which manufacturers average NOx, NOx plus NMHC, or PM emissions over the entire fleet to determine compliance with the applicable standard. If average emissions are below the applicable standards and a manufacturer generates emission reduction credits, they may be banked for future use. Unused or excess emission reduction credits could also be traded and sold to other engine manufacturers participating in the ABT program. The federal ABT program is an active on-going program. California-certified HDVs are not now authorized for participation in the ABT program.

III.

NEED FOR CONTROL

The 2004 California emission standards for highway heavy-duty diesel engines (HDDEs) that staff is proposing to the Board for adoption, represent a major step in reducing the human health and environmental impacts of ground-level ozone. These standards would also significantly reduce secondary nitrate particulate matter (PM). This chapter summarizes the air quality rationale for the proposed new standards.

A. OZONE

There is a large body of evidence showing that ozone (which is created by the photochemical reaction of NOx and hydrocarbons) causes harmful respiratory effects including chest pain, coughing, and shortness of breath, affecting people with compromised respiratory systems and children most severely. In addition, NOx itself can directly harm human health. Beyond their human health effects, other negative environmental effects are also associated with ozone and NOx. Ozone has been shown to injure plants and materials; NOx contributes to the secondary formation of PM (nitrates), acid deposition, and the overgrowth of algae in coastal estuaries.

California has made significant progress in controlling ozone. Statewide exposure to unhealthful ozone concentrations has been cut in half since 1980. The frequency and severity of pollution episodes is declining, and emissions are on a downward trend. However, more needs to be done. California still has six major areas that are designated as nonattainment with the one-hour federal ambient ozone standards. These are: the South Coast Air Basin, the Sacramento Metropolitan area, San Diego Air Basin, San Joaquin Valley Air Basin, the Southeast Desert Air Basin, and Ventura County.

The 1994 ozone SIP is California's plan for reaching statewide attainment with the ozone ambient air quality standards. The SIP calls for new measures to cut ozone precursor emissions from mobile sources to half of what the emissions would be under existing regulations. The largest planned new reductions from any SIP mobile source category are from the on-road heavy-duty diesel vehicle category. This proposal addresses SIP measure M5 in the on-road heavy-duty diesel category.

B. PARTICULATE MATTER

Particulate matter (PM), like ozone, has been linked to a range of serious respiratory health problems. Particles are deposited deep in the lungs and result in health effects including premature death; increased hospital admissions and emergency room visits; increased respiratory symptoms and disease; decreased lung function, particularly in children and individuals with asthma; and alterations in lung tissue and in respiratory tract defense mechanisms.

Currently there are a number of areas throughout California that are designated as nonattainment for PM-10 (particles smaller than 10 microns in diameter). Secondary nitrate PM (consisting mostly of ammonium nitrate) accounts for a substantial fraction of the airborne particulate matter in some areas of California. For example, in the Los Angeles Basin, secondary nitrate PM levels represent about 25 percent of measured PM-10. (U.S. EPA. 1997a) NOx from heavy-duty diesels and other sources is transformed in the atmosphere into fine secondary nitrate particles. Secondary PM tends to be a regional, rather than a strictly local problem. Regional-scale NOx controls, like the proposed heavy-duty diesel vehicle emission standards, are very effective in reducing secondary PM over a significant area.

IV.

SUMMARY OF PROPOSED HDE REGULATIONS

The staff recommends that the Board amend sections 1956.8, 1965, 2112, and 2036, Title 13, California Code of Regulations, as set forth in Appendix A. The proposal would require new heavy-duty diesel engines to meet a more stringent NOx plus nonmethane hydrocarbon (NOx plus NMHC) exhaust emission standard (2.4 g/bhp-hr or 2.5 g/bhp-hr with a 0.5 NMHC cap) beginning with the 2004 model year. Staff proposes that the Board allow participation in the federal averaging, banking, and trading (ABT) program for diesel engines and adopt new useful life extensions, maintenance intervals, emission warranties, and rebuild provisions for both HD diesel and Otto-cycle engines. These provisions would provide for harmonization with federal programs in these areas. Staff also proposes optional reduced-emission standards and labeling requirements for heavy-duty diesel vehicles. The following sections discuss the major provisions of the staff proposal in further detail. Differences from the federal program, including medium-duty vehicle engine-certification standards and test fuel, and the timing of ABT program eligibility, are discussed in detail in Chapter V.

A. APPLICABILITY

At the core of this proposal are the emission standards which would apply to new heavy-duty diesel engines (HDDE) used in HDVs. For this proposal, heavy-duty applies to those California-certified vehicles having a GVWR over 14,000 pounds. In contrast, the recently adopted federal standards apply to federally certified new HDVs over 8,500 pounds GVWR. In 1995, in anticipation of the federal rulemaking, California adopted emission standards for vehicles between 8,501 and 14,000 pounds GVWR. The California 2004 emission standards for engine-certified medium-duty vehicles are consistent with the new federal standards for 2004.

In addition to the heavy-duty diesel emission standards, this proposal contains provisions that apply to vehicles other than heavy-duty diesel vehicles. All the provisions in this proposal apply to vehicles produced for sale in California. Specific provisions of this proposal and the vehicle classes to which they apply are:

- Emission standards of 2.4 g/bhp-hr NOx plus NMHC (or 2.5 g/bhp-hr with a 0.5 NMHC cap) would apply to new heavy-duty diesel engines used in vehicles over 14,000 pounds GVWR beginning with the 2004 model year engines.

- New or revised useful life extensions, maintenance intervals, emission warranties, and rebuild provisions would apply to new heavy-duty diesel cycle engines and new heavy-duty Otto-cycle engines for vehicles over 14,000 pounds GVWR beginning in 2004.

- Participation in the federal ABT program would be allowed for California-certified heavy-duty diesel engines (over 14,000 pounds GVWR) upon adoption of this regulation. California-certified heavy-duty diesel engines could earn ABT credits and banked the credits for use in 2004 and thereafter. ABT would apply beginning in 2004 for California medium-duty diesel engines used in vehicles over 8,500 pounds thru 14,000 pounds GVWR.

- Provisions requiring federal fuel to be used for medium-duty vehicle engine certification would apply beginning in 2004.

- Minor recordkeeping requirements for rebuilders would apply beginning in 2004.

- New optional reduced-emission standards for heavy-duty diesel engines used in vehicles over 14,000 pounds GVWR would be available beginning in 2004.

- Amendments to the labeling requirements would apply to engines certified to optional standards, including multi-fuel mode engines, upon adoption.

B. EMISSION STANDARDS

1. Proposed Mandatory Emission Standards

Staff proposes that the Board adopt NOx plus NMHC emission standards for on-highway heavy-duty diesel-cycle engines. These standards would apply to model year 2004 and later. Engine manufacturers would have to certify heavy-duty diesel engines to one of two sets of NOx plus NMHC standards. The following table lists the proposed NOx plus NMHC emission standards, along with currently adopted CO and PM emission standards.

Table IV-1
Mandatory Heavy-Duty Diesel Emission Standards

Model Year	GVWR (pounds)	CO [a] (g/bhp-hr)	NOx plus NMHC [b] (g/bhp/hr)	PM [a] (g/bhp-hr)
2004	over 14,000	15.5	2.4, or 2.5 with 0.5 NMHC cap	0.1/0.05 [c]

Notes:

a. The listed CO and PM emission standards are previously adopted standards, for both U.S. and California engines.
b. The listed NOx plus NMHC emission standards were adopted by U.S. EPA in October 1997, and are proposed for California.
c. The 0.05 g/bhp-hr PM emission standard is the adopted certification standard for both U.S. EPA and California urban transit buses only.

As listed above, emission standards for CO and PM are proposed to continue at their current adopted levels. Because the board approved a 2.4 g/bhp-hr NOx plus NMHC (or 2.5 with a 0.5 NMHC cap) emission standard for California on-highway heavy-duty Otto-cycle engines in August 1995, no changes to Otto-cycle standards are included in this proposal.

The proposed standards reduce emissions of NOx from new diesel trucks and buses by approximately 50 percent, with reductions in HC as well. Reductions in NOx will also reduce secondary nitrate particulate matter. The resulting emission reductions will translate into substantial, long-term improvements in air quality in California and assist in attaining applicable ambient air quality standards.

2. Proposed Optional Reduced-Emission Standards

Optional NOx standards for 1998 and subsequent model year diesel-cycle engines are already in place. The optional reduced-emission standards range from 0.5 g/bhp-hr to 2.5 g/bhp-hr, at 0.5 g/bhp-hr increments. Optional reduced-emission standards are important to vehicle owners or operators who want to participate in incentive programs for the early introduction of low-emitting heavy-duty engines. HDEs certified to an optional reduced-emission standard could also generate marketable emission reduction credits that could be used in local air district mobile source emission credit programs. The staff proposes that current optional reduced-emission NOx standards for 1998 through 2003 model year diesel-cycle engines remain unchanged.

To continue support of marketable credit programs, the staff proposes that the Board adopt new NOx plus NMHC optional emission standards for 2004 and subsequent model year diesel-cycle engines. Beginning with the 2004 model year, staff is proposing a new set of diesel-cycle engine NOx plus NMHC optional reduced-emission standards from

0.3 g/bhp-hr to 1.8 g/bhp-hr, at 0.3 g/bhp-hr increments, for engines used in HDVs. This range of standards could be used to certify engines that emit substantially lower than the mandatory 2.4 g/bhp-hr NOx plus NMHC (or 2.5 with 0.5 NMHC cap) standard. Engines certified to these optional reduced-emission standards would be eligible for marketable credit programs. The manufacturer must declare at the time of certification whether they are certifying an engine family to an optional reduced-emission standard or an FEL.

3. Future Feasibility Review

Staff also proposes that the Board allow for review of the new emission standards, as agreed to in the SOP. Staff believes the proposed 2004 emission standards are technologically feasible, and achievable, particularly with the eight year lead time provided from the signing of the SOP. However, as part of the SOP, U.S. EPA and ARB agreed to a future review of the proposed standards. U.S. EPA will conduct its review in 1999, and ARB staff will participate. This review will reassess the appropriateness of the standards, including the need for and technical and economical feasibility of the standards, based on information available in 1999. The review will also include consider the need for federal fuel changes and the impact on engine technology.

The Board's final review would take place after U.S. EPA completes its 1999 review, and would determine what changes, if any, would be required for California. If due to new information the proposed standards are determined not to be technologically feasible for model year 2004, then staff would propose an appropriate level at a future date. The standards proposed in this California rulemaking, if adopted by the Board, would stay in effect until revised.

4. NMHC Test Method

Existing California NMHC measurement procedures for HDDEs would be used through 2003. Beginning with the 2004 model year, staff proposes the following three options for NMHC measurement procedures: 1) use a total hydrocarbon (THC) measurement in place of an NMHC measurement; 2) use a measurement procedure selected by the manufacturer with prior approval of the Executive Officer; or 3) subtract two percent from the measured THC value to obtain an NMHC value. HDEs using natural gas would have the added option of measuring NMHC through direct quantification of individual species by gas chromatography. The methodology must be specified at time of certification and will remain the same for the engine family throughout the engines' useful life. These proposed amendments would align the NMHC test methods with the federal test methods (Title 40, CFR, section 86.004-28, passim) beginning in 2004.

5. Non-conformance Penalties

A U.S. EPA rule (Title 40, CFR, Part 86, passim; see, for example, section

86.004-15) allows HDDE manufacturers to exceed the applicable standard (provided they do not exceed an upper limit), if they pay a non-conformance penalty. In essence, this penalty allows HDDE manufacturers to pay a fee for engines not complying with the applicable standards. California does not have a non-conformance penalty program in place. Allowing manufacturers to pay a fee for not complying would increase emissions, instead of reducing emissions. Hence, staff is not proposing that the Board adopt the federal provisions for non-conformance penalties.

6. Evaporative Testing Requirements

U.S. EPA's recent rulemaking did not contain any significant changes to evaporative testing requirements (Title 40, CFR, section 86.096-21, passim). California evaporative testing requirements differ from the federal requirements. Staff does not recommend any changes to the California evaporative testing requirements at this time.

7. Multi-fuel Mode Requirements

Staff's proposal also applies to engine families whose design allows engine operation in either of two distinct alternative fueling modes (multi-fuel mode engines). Multi-fuel mode engines have fuel modes characterized by use of one fuel or a combination of two fuels. For example, there are natural gas engines using diesel pilot injection for ignition. Under each fuel mode, emissions usually differ significantly. Under this proposal, vehicles would be required to operate primarily in the cleaner (lower-emitting) fuel mode. The auxiliary, higher-emitting mode would be used for fail-safe operation when a malfunction or inadvertent fuel depletion precludes operation in the lower-emitting (primary) fueling mode. This is similar to the federal requirements for multi-fuel mode operation (Title 40, CFR, Part 86, passsim; see for example, section 86.004-11).

Staff is proposing that manufacturers would be allowed to certify the engine to different NOx, or NOx plus NMHC standards in each fuel mode. For 1998 through 2003 model engines, the engine would be certified to the 4.0 g/bhp-hr NOx standard in the higher-emitting fuel mode, and would be certified to one of the 1998 to 2003 optional reduced-emission standards for NOx in the lower-emitting fuel mode.

For 2004 and subsequent model year engines, the engine would be certified to the proposed 2.4 (or 2.5 with a 0.5 NMHC cap) g/bhp-hr NOx plus NMHC standard in the higher emitting fuel mode, and to one of the proposed 2004 optional reduced-emission standards in the lower-emitting fuel mode. Multi-fuel mode engine families would be allowed to generate credits for use under marketable credit programs. However, multi-fuel mode engine families would not be eligible to participate in the ABT program.

C. HDV DURABILITY/WARRANTY PROVISIONS

Staff believes adoption of warranty/durability provisions that parallel the U. S. EPA's provisions would help ensure adequate durability and proper maintenance of the engine and emissions controls. These revisions are necessary because engine manufacturers would likely comply with the proposed standards by using emissions control technologies such as exhaust gas recirculation and exhaust aftertreatment. Because these control systems are subject to failure and failure of such systems would not necessarily cause decreased engine performance, failure of emissions control systems would not necessarily prompt the owner to perform repairs.

The primary reason for these provisions is to reflect the increased engine life of today's engines. The proposal includes an increase in the useful life mileage interval for heavy heavy-duty diesel engines from 290,000 miles to 435,000 miles, an increase in the minimum allowable maintenance intervals for several emissions-related components, and changes in the emissions defect and performance warranties. In addition, provisions are included to ensure that emission controls are properly addressed during the process of engine rebuilding and not removed or otherwise dismantled.

1. Useful Life Extension

In order to align this proposal with the federal definitions, staff proposes the Board adopt a revised useful life for the heavy heavy-duty diesel engine service class of 435,000 miles, 22,000 hours, or 10 years, whichever occurs first, for all pollutants beginning in model year 2004. Staff also proposes a useful life interval of 10 years, with the unchanged mileage intervals, for all heavy-duty engine sub-categories, Otto-cycle and diesel-cycle, and all pollutants.

2. Emissions Related Maintenance

Staff proposes the Board adopt changes to emission related maintenance intervals as listed in Table IV-2, with compliance required beginning in 2004. Proposed intervals are the same as federal intervals and are listed in miles or hours, whichever occurs first. The term
"add-on emissions-related component" is being defined as a component whose sole or primary purpose is to reduce emissions or whose failure will significantly degrade emissions control and whose function is not integral to the design and performance of the engine. Staff proposes that the Board adopt no change in the interval for exhaust gas recirculation (EGR) filters and coolers from its current interval of 50,000 miles (or 1,500 hours, whichever occurs first).

Table IV-2
Changes to Minimum Emission-Related Maintenance Intervals

Intended Service Class	Component or System	Change to Minimum Maintenance Interval
Otto-cycle Engines	EGR system (except filters and coolers)	Increase from 50,000 miles (1,500 hours) to 100,000 miles (3,000 hours)
Light HDDEs	EGR system (except filters and coolers)	Increase from 50,000 miles (1,500 hours) to 100,000 miles (3,000 hours)
	- Add-on emission-related components - Catalytic converter	Establish 100,000 mile (3,000 hour) interval
Medium and Heavy HDDEs	EGR system (except filters and coolers)	Increase from 50,000 miles (1,500 hours) to 150,000 miles (4,500 hours)
	- Add-on emission-related components - Catalytic converter	Establish 150,000 mile (4,500 hour) interval

3. Emissions Defect and Performance Warranties

For 2004 and subsequent model years, staff proposes the Board adopt requirements that are identical to the federal warranty requirements for both diesel and Otto-cycle HDEs used in HDVs. The staff proposes retention of the current California provisions and periods for emissions defect warranties, as listed in Table IV-3. To harmonize emission defect and performance warranties with the federal rule, the staff's proposal includes the following additional provisions:

- Emissions defect and performance warranty periods for highway HDEs would in no case be less than the manufacturer's basic mechanical warranty period for the engine family.

- Extended warranties on select parts would not extend the emissions warranty requirements for the entire engine but only for those parts.

- Extended mechanical warranties where responsibility is shared between the owner and the manufacturer are allowed. The manufacturer would be responsible for the manufacturer's share of the emissions warranty under the warranty agreement.

Table IV-3
Periods for Emissions Defect Warranties

Intended Service Class and/or Engine Component	Gross Vehicle Weight	Emissions Defect Warranty Period
HDVs with diesel-cycle engines	More than 14,000 pounds	A period of use of 5 years, 100,000 miles, or 3,000 hours of operations, whichever occurs first.
Medium-duty vehicles and engines used in the vehicles, under the optional 100,000-mile certification procedure	Between 8,501 pounds and 14,000 pounds, inclusive	A period of used of 10 years or 100,000 miles, whichever occurs first.
Diesel particulate control system components certified under the optional 100,000-mile certification procedure	Between 8,501 pounds and 14,000 pounds, inclusive	Five years or 50,000 miles, whichever occurs first, for failures of such components which do not result in failure of any other warranted part to perform as designed during the warranty period of the vehicle.
		10 years or 100,000 miles, whichever first occurs, for all other failures.
All vehicles certified to the optional emission standards, for fuel metering and ignition components contained in the state board's "Emission Warranty Parts List"	More than 8,500 pounds	A period of use of five years or 50,000 miles, whichever first occurs.
All other vehicles not listed above	More than 8,500 lbs	A period of use of five years or 50,000 miles, whichever first occurs.

4. Engine Service Manuals

Staff proposes that the Board adopt additional manufacturer requirements for service manuals starting in 2004, the same as U.S. EPA's. The manufacturers of diesel and Otto-cycle engines would provide owners with manuals specifying maintenance needed to ensure proper engine operation. Manufacturers are required to include in the engine service manual any maintenance that may be needed for emissions-related components after the end of the engine's regulatory useful life, including mileage/hours intervals, and procedures for determining whether maintenance or repair is needed. Manufacturers are not required to incorporate additional on-board systems beyond what they already have. However, the maintenance manual must include instructions for accessing and responding to any emissions-related diagnostic codes that may be stored in any existing on-board monitoring systems. The

recommended maintenance practices may be based on engineering analysis or other sound technical rationale. In the event that an emission-related component is designed not to need maintenance during the full life of the engine, the manual would need to contain, at a minimum, a description of the component, noting its purpose, and a statement that the component is expected to last the life of the engine without maintenance or repair. In addition, the manual would include the rebuild provisions as described in item 6, below, to ensure that owners and rebuilders are aware of the requirements.

5. Equipment Maintenance Signals

Under current law and regulations (Health and Safety Code section 43009), manufacturers must ensure that critical emissions-related scheduled maintenance has a reasonable likelihood of being performed in-use. Manufacturers may elect to provide such assurance by using some form of on-board driver notification when maintenance is needed on a critical emissions-related component. The signal may be triggered based either on mileage intervals or component failure. It is a violation of the Health and Safety Code to disable or reset the signal without also performing the indicated maintenance procedure.

Staff's proposal requires manufacturers of 2004 and later model year engines that use equipment maintenance signals to design the systems so that they do not cease to function at or beyond the end of the regulatory useful life. For example, if the signal is designed to be actuated based on mileage intervals, it must be designed to continue to inform the driver at the same intervals after the end of the useful life, as well as during the useful life. The manufacturer would not be held responsible or liable for recall due to signal failure in instances where the signal fails to function as designed beyond the useful life. Manufacturer recall liability is limited to failures during the regulatory useful life. The manufacturer is also not responsible for repairs when the signal does function after the end of the useful life unless such repairs are covered by the emission warranty.

6. Rebuild Provisions

Section 27156 of the California Vehicle Code prohibits tampering, when rebuilding engines or at any other times. That is, no one may remove or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations. A remanufactured engine must be rebuilt equivalently from an emissions standpoint, to the original certified engine. As a means of preventing tampering, staff proposes the Board adopt rebuild requirements for both diesel and Otto-cycle engines effective in 2004 and later. The proposed rebuild requirements would be the same as those adopted in the federal regulations. The proposed rebuild requirements are described below.

Staff believes that the proposed rebuild requirements are commonly accepted practices and would not add a significant additional burden on rebuilders. The staff's proposal would require that rebuilders have a reasonable technical basis for knowing that the

rebuilt engine is equivalent from an emissions standpoint to a certified configuration. That is:

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

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

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

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

7. Rebuild Record Keeping Requirements

Staff proposes that the Board adopt requirements consistent with the federal record keeping requirements for 2004 and subsequent model years. These requirements are consistent with customary business practices, and will assist in assessing compliance with the new rebuild provisions. The records would be kept by persons involved in the process of heavy-duty engine rebuilding or remanufacturing. Records would include the following:

- Mileage and/or hours at the time of rebuild;

- A list of the work performed on the engine;

- Any repair of emission control systems, including a list of replacement parts used, engine parameter adjustments, and design element changes;

- Emissions-related codes and equipment monitoring signals that are responded to and reset; and

- Responses to such signals and codes, and work performed as described in the rebuild provisions above.

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

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

In addition, rebuilders are only required to keep information on individual emissions-related diagnostic codes if the codes are addressed through a set of procedures that are not considered to be uniform. For example, if an engine is equipped with a sensor that monitors the EGR flow rate, the rebuilder may keep on record the specifications and procedures used to rebuild the EGR system in all instances. It is a general practice that engine remanufacturers keep these types of records in order to control the quality of their products.

8. Certification Test Fuel

The 1995 amendments to the medium-duty vehicle standards included provisions to allow manufacturers the option of certifying on California diesel fuel. Since California diesel fuel is cleaner burning than federal diesel fuel, this option should be beneficial to engine manufacturers. This option was provided to help manufacturers meet California medium-duty vehicle and engine standards, which are stricter than the federal standards. In 2004, emission standards for California-certified medium-duty diesel engines will be the same as federal standards. A proposed amendment to the test procedures would require that medium-duty diesel engines be certified on federal fuel beginning in 2004. In 1998 through 2003, when the California standards are more stringent, engines could continue to be certified on California diesel fuel.

D. ABT PROGRAM

The ABT program is designed to provide engine manufacturers flexibility in meeting applicable emission standards. Under the ABT program, manufacturers would average emissions across engine families to determine compliance with the applicable standard. If average engine family emissions are below the applicable standards, and a manufacturer generates ABT credits, unused or excess ABT credits could be banked for future use. Excess ABT credits could also be traded or sold to other engine manufacturers participating in the ABT program. If average emissions are above the applicable standard, manufacturers could use their own, or purchase ABT credits to meet the applicable emission standards.

For example, if the manufacturer commits to a 3.5 g/bhp-hr NOx emission level as an enforceable limit for an engine family, then that engine family is 0.5 g/bhp-hr below the current required 4.0 g/bhp-hr NOx standard for HDVs. The 0.5 g/bhp-hr emission increment would be used to calculate the ABT credit granted for banking or trading. This credit could be used in 2004 or later against the proposed 2.4 g/bhp-hr NOx plus NMHC standard.

Current federal regulations provide for an ABT program in the other 49 states. The federal ABT program was modified as part of the October 1997 federal rulemaking for the 2004 standards. The modifications provide manufacturers additional flexibility in meeting the lower 2004 federal HDDE NOx plus NMHC, and PM, standards. The modified federal program contains a family emission limit (FEL) approach, discussed in the following section of this chapter, for determining ABT credits generated for averaging, banking, and/or trading. The modified federal program applies to engines used in HDVs over 8,500 pounds GVWR for 1998 and subsequent model years.

Staff believes the modified portion of the federal ABT program could be an important element in making the emissions standards proposed for Board adoption appropriate with regard to technological feasibility, lead time, and cost. This program would provide important flexibility to manufacturers, helping them to transition their entire product lines to the new standards. It would also encourage the early introduction of cleaner engines, thus securing earlier emissions benefits.

California does not allow participation in the current federal ABT program. Staff proposes the Board adopt regulations to allow California participation in the modified federal ABT program, with some restrictions. Participation in ABT would apply to diesel engines used in HDVs (over 14,000 pounds GVWR). It would also apply to diesel engines used in MDVs (between 8,501 and 14,000 pounds GVWR). HDDE manufacturers would participate beginning with 1998 and subsequent model year engines, and MDDE manufacturers would participate beginning with 2004 and subsequent model year engines. Manufacturers participating in the ABT program would be allowed to trade ABT credits throughout California and the other 49 states.

Under the proposed provisions for ABT program participation, engine manufacturers certifying an engine family to emissions levels below the applicable standard would be eligible to receive ABT credits. ABT credits are calculated based on the level of emissions to which an engine family is certified. ABT credits represent the emissions increment below the required standard. Based on the emission increment, either the entire credit amount or a discounted credit amount would be granted to the manufacturer by the Executive Officer.

1. HDDE Participation in ABT Upon Adoption

Staff proposes that manufacturers of HDDEs for use in HDVs be allowed to generate NOx and PM ABT credits in California upon adoption of this regulation. ABT credits generated between 1998 and 2003 would be based on the emissions increment below the current required 4.0 g/bhp-hr NOx and 0.1 g/bhp-hr PM (0.05 for urban transit buses) HDDE emission standards. ABT credits could be generated and banked between 1998 and 2003, and used in California and elsewhere in the U.S. beginning in 2004. Thus, manufacturers could introduce engines that are cleaner than required, bank the credits, and use the credits beginning in 2004 if the average emissions exceed the proposed 2.4 g/bhp-hr NOx plus NMHC standard. There would be no increase in emissions, because averaged over time the manufacturers fleet would be meeting the required standards.

For 2004 and subsequent model years, staff's proposal would allow NOx plus NMHC and PM ABT credits to be generated. The NOx plus NMHC and PM ABT credits would be based on the emission increment below the proposed 2.4 g/bhp-hr NOx plus NMHC and current 0.1 g/bhp-hr (0.05 for urban transit buses) PM emission standards. Credits could be used throughout California and the other 49 states beginning in 2004.

2. MDDE Participation in ABT Beginning in 2004

Staff proposes that manufacturers of California-certified diesel engines for medium-duty vehicles (8,501 through 14,000 pounds GVWR) be allowed full participation in the federal ABT program beginning in 2004. The federal program allows manufacturers of MDDEs in this GVWR category to participate in the ABT program and generate credits beginning in 1998. Manufacturers of these MDDEs would like California to participate in the ABT program before 2004. However, ARB staff believes that allowing California MDDE participation in ABT before 2004 could increase emissions in California.

California requires lower NOx emissions from MDDEs than the federal program until 2004. This is shown by the comparison of selected California and federal emission standards in Table IV-4. During the time that California standards are stricter, it would be easier for medium-duty engine manufacturers to generate ABT credits in the other 49 states than in California. Those credits could be banked and used beginning in 2004 to allow manufacturers to certify engines to an average emissions level above the proposed 2.4 g/bhp-hr NOx plus NMHC (or 2.5 with a 0.5 NMHC cap).

Table IV-4
Comparison of California and Federal Requirements
for NOx Emission Levels for Medium-duty Diesel Engines
(8,501 - 14,000 pounds GVWR)

Year	California Standards	Federal Standards
1998-2001	3.9 g/bhp-hr NOx plus NMHC	4.0 g/bhp-hr NOx
2002 - 2003	3.0 g/bhp-hr NOx plus NMHC	
2004+	2.4 g/bhp-hr NOx plus NMHC	2.4 g/bhp-hr NOx plus NMHC

Generally, generating and banking ABT credits for later use would not result in increased emissions. Engines that are cleaner than required would be introduced early, and engines that exceed required standards would be introduced later. Averaged over time there would be no net increase in emissions.

The stricter California medium-duty standards create a different situation. ARB staff believes that, if allowed, medium-duty engine manufacturers would generate ABT credits in other states and use them in California beginning in 2004. That would increase emissions in California. The following two scenarios illustrate this concept. Both scenarios describe a hypothetical engine manufacturer that produces 300 engine-certified medium-duty vehicles for sale in California in the year 2004. In Scenario A (staff's proposal), ABT was not allowed for engine-certified medium-duty vehicles in California before 2004. In Scenario B, ABT was allowed.

- **Scenario A (no medium-duty ABT in California before 2004)** - Under staff's proposal, Manufacturer X produces 300 MDDEs for sale in California in 2004. Because ABT participation was not allowed in California before 2004, Manufacturer X cannot use banked credits. Therefore, Manufacturer X's 300 engines are certified (on average) to the proposed 2.4 g/bhp-hr NOx plus NMHC standard.

- **Scenario B (medium-duty ABT allowed in California before 2004) -** Manufacturer X generated ABT credits in 1998 by producing 300 MDDEs certified to a 3.5 g/bhp-hr NOx emission level and selling them in the other 49 states. Since the engines were certified below the required federal 4.0 g/bhp-hr NOx standard, Manufacturer X generated a 0.5 g/bhp-hr NOx credit for those engines. In 2004, Manufacturer X produces 300 engines certified to a 2.9 g/bhp-hr NOx plus NMHC emission level and sells them in California. Manufacturer X uses the 0.5 g/bhp-hr ABT NOx credit, generated outside of California, to certify those engines above the proposed 2.4 g/bhp-hr NOx plus

NMHC standard.

Table IV- 5 lists the tons of emissions that could potentially be emitted in California under each scenario. Scenario B, allowing Manufacturer X to generate credits before 2004 for use toward complying with the proposed 2004 standards, would increase emissions in California by 17 tons of NOx plus NMHC. This is a simplistic example for the complex ABT program. However, this example does illustrate staff's concern about the real potential for an increase in emissions in California. ARB staff recommends that manufacturers of MDDEs for engine-certified vehicles not be allowed to participate in ABT in California until 2004.

Table IV-5
Scenario A and B Estimated NOx plus NMHC Emissions in California over the Useful Life of the Engines

Scenario	Number of Engines	NOx plus NMHC Emissions Certification Standard (g/bhp-hr)	NOx plus NMHC Emissions (tons)
A	300	2.4	72
B	300	2.9	89

* Assuming 0.919 bhp-hr/mile and 110,000 mile useful life.

3. Generating ABT Credits Using the FEL

The federal ABT program allows emission credits to be generated based on an FEL approach. The FEL is an emission limit that the engine manufacturer selects for each engine family in its fleet. Generally, the FEL is based on an emission level that the manufacturer is confident a particular engine family could test to over the useful life of the engine. Similar to the federal provisions, staff proposes that ABT credits be determined based on an FEL declared by the engine manufacturer for each engine family.

Separate FEL declarations would be required for each engine family and each pollutant. To be eligible to generate credits in the ABT program, FELs would be declared below the adopted emission standard. The FEL must be based on an emission level calculated for the useful life of the engine family. Engine manufacturers with FELs established below the adopted emission standards would have ABT credits available to average, trade, bank or combination thereof. Manufacturers declaring FELs above the applicable standard would use or obtain ABT credits to address the excess emissions. As with the federal ABT program, staff proposes no limit on how long the credit could be banked before use.

Similar to the federal ABT program provisions, beginning in 1998 through 2003, manufacturers declaring a NOx FEL at or below 3.5 g/bhp-hr would receive full NOx emission- reduction credit. Manufacturers declaring a NOx FEL below 4.0 g/bhp-hr and above 3.5 g/bhp-hour, however, would receive only partial credit. The ABT credit would be reduced by 10 percent. PM ABT credits would be generated only if the NOx FEL and the PM FEL are both declared under the applicable standard. The amount of PM ABT credit generated, would be based on whether full NOx credit or partial credit was generated. For example, if both the NOx and PM FELs are declared below the applicable standards, and the NOx credit generated has been discounted by 10 percent, then the PM credit would also be discounted by 10 percent.

Beginning in 2004, the form of the standard changes to a combined NOx plus NMHC standard, and ABT credits generated then will be based on combined NOx plus NMHC values. This is the same as the federal program. Manufacturers declaring a NOx plus NMHC FEL at or below 1.9 g/bhp-hr would receive full NOx plus NMHC ABT credit. Manufacturers declaring a NOx plus NMHC FEL below 2.4 g/bhp-hr and above 1.9 g/bhp-hour, however, would receive only partial credit. The ABT credit would be reduced by 10 percent. PM ABT credits would be generated only if the NOx plus NMHC FEL and the PM FEL are both declared under the applicable standard. The amount of PM ABT credit generated would still be determined on whether full NOx plus NMHC credit or partial credit was generated. If the NOx plus NMHC FEL is declared below the NOx plus NMHC standard, and the PM FEL is declared at or above the PM standard, then ABT credits would only be generated for NOx plus NMHC. Below are two examples for clarification of this concept.

- If a manufacturer declares both the NOx plus NMHC and PM FELs below the applicable standards, and the NOx plus NMHC FEL at or below 1.9 g/bhp-hr, then full NOx plus NMHC and PM credit will be granted.

- If a manufacturer declares the NOx plus NMHC FEL below the 2.4 g/bhp-hr and above 1.9 g/bhp-hr, with a PM FEL declared above the PM standard, then the ABT credit would be discounted by 10 percent. In other words, the manufacturer would only receive 90 percent of the NOx plus NMHC credit, but no PM credit.

The upper limits for NOx plus NMHC and PM certification will be 4.5 g/bhp-hr and 0.25 g/bhp-hr, respectively. That is, no engine family may use credits to establish FELs above either of these levels.

4. Averaging Under the ABT Program

Under the ABT program, manufacturers would certify each engine family at,

below, or above the applicable NOx, or NOx plus NMHC emission standard. Engine families participating in the ABT program, with engines certified to emissions below the standard, would generate ABT credits for the amount of emissions under the standard. The manufacturer would take the average emissions of each engine family participating in the ABT program and establish whether emissions are below or above the applicable standard. If average emissions are above the standard, the manufacturer would have excess emissions to address. The manufacturer would use ABT credits from engine families generating credits to address excess emissions for engine families that have FELs above the applicable standard.

Similar to the modified federal program, NOx, NOx plus NMHC, and PM averaging for HDDE families would be allowed within engine families throughout California and the other 49 states. Averaging for diesel engines used in vehicles having a GVWR over 8,500 pounds thru 14,000 pounds would only be allowed after 2004.

Averaging between emission families would only be allowed for those engine families within the same averaging set. An averaging set for each engine family is determined by the vehicle's primary service class, based on its GVWR. For example, under the HDDE, there are three primary service classes: light heavy-duty, medium heavy-duty, and heavy heavy-duty. Each primary service class would be considered a separate averaging set.

NOx or NOx plus NMHC averaging between HDE families within the same averaging set would be as follows:

- The HDDE category is considered to have three primary service classes. These classes are determined by GVWR and are: light heavy-duty, medium heavy-duty, and heavy heavy-duty. Each primary service class is an averaging set, and averaging among all diesel-cycle engine families would be allowed within the same primary service class.

- The urban transit bus category is considered to fall under the service class based on its GVWR. Averaging within the same primary service class would be allowed.

PM averaging between HDE families within the same averaging set would also be allowed as follows:

- The HDDE category is considered to have three primary service classes. These classes are determined by GVWR (except urban transit buses - see below) and are: light heavy-duty, medium heavy-duty, and heavy heavy-duty. Each primary service class is an averaging set, and averaging among all diesel-cycle engine families would be allowed within the same primary service class.

- The urban transit bus category is considered its own primary service class, and therefore its own averaging set. Averaging would only be allowed among urban transit buses.

5. Banking ABT Credits

Under the staff's proposal, NOx, NOx plus NMHC, and PM ABT credits generated may be banked from engine families produced in any model year. Manufacturers would bank credits only after the end of the model year and after actual credits are reported to ARB staff. Manufacturers would report ABT credits at the end of every year. During the model year and before the end of the year, ABT credits originally designated in the certification process for banking would be considered reserved. If needed, banked credits could be used at a later date for trading and averaging within the same averaging sets.

Manufacturers withdrawing banked NOx, NOx plus NMHC, and/or PM credits would report this during certification and in their credit reports. Banked ABT credits for NOx, NOx plus NMHC, and PM would be available for credit withdrawal after 2004. Banked NOx plus NMHC and PM credits from diesel-cycle HDE families would not expire.

6. Recordkeeping and Reporting Under the ABT Program

Similar to the modified federal program, staff proposes that manufacturers maintain records during the model year as a means of tracking compliance with the emissions standards. The proposal requires manufactures to do the following:

- Monitor projected versus actual production as a means of checking end-of-year compliance with the emission standards.

- Provide the end-of-year model year reports to Chief of Mobile Source Operations Division, ARB.

- Maintain quarterly records and provide them to the Chief of Mobile Source Operations Division, ARB.

The Chief of Mobile Source Operations Division will review the records and reports provided by the manufacturer to determine compliance. If a credit shortfall is determined, the manufacturer will be permitted to purchase the necessary credits (from another manufacturer, if available) to correct the negative balance to zero. However, the credits purchased will be used at a 20 percent discount. The proposed California reporting requirements are in addition to federal ABT reporting requirements. ARB staff believe it is essential to track California-specific ABT information to determine emissions and to maintain program compliance. ARB staff believe that this reporting requirement is necessary for the health, safety, and welfare of the people of the state.

E. MARKETABLE CREDIT PROGRAM

Several air pollution control and air quality management districts have adopted and implemented marketable credit programs that include mobile source emission reduction credit programs. These programs have specific rules for the generation and use of mobile source emission reduction credits. Among the criteria followed in developing these rules are the principles that the reductions must be in excess of what is required by law, they must be real, and they must be quantified to an acceptable degree of certainty. Mobile source emission reduction credit programs provide flexibility to industry in meeting requirements for emission reductions needed to offset increases in emissions associated with economic growth. These programs also provide industry with flexibility to reduce emissions from certain mobile sources. The proposed optional emission standards, discussed earlier in this chapter, are supportive of these goals.

Similar to the federal rule, staff's proposal allows credits to be generated and designated as "non-manufacturer owned" and used in marketable credit programs. However, "non-manufacturer-owned credits" would not be useable in ABT programs. For example, manufacturers could elect to certify an engine family to one of ARB's credit standards; and then designate which sales for that family are marketable credits ("nonmanufacturer-owned credits"). Remaining sales of engines in that family would be used to generate ABT credits.

Credits generated through marketable credit programs would be generated based upon engine certification to one of the optional reduced-emission NOx certification standards for 1998 through 2004, or the proposed NOx plus NMHC certification standards for 2004 and subsequent model years. In contrast, the federal rule allows marketable credits to be generated based on the manufacturer's declared FEL. Table IV-6 lists the currently adopted NOx, and proposed NOx plus NMHC optional reduced-emission standards used for generating credits under the marketable credits program. The staff is not proposing marketable credits for PM.

Table IV-6
Optional Reduced-Emission Standards

1998 - 2003 Optional Reduced-Emission Standards (NOx in g/bhp-hr)	2004 and Subsequent Proposed Optional Reduced-Emission Standards (NOx plus NMHC in g/bhp-hr)
2.5	1.8
2.0	1.5
1.5	1.2
1.0	0.9
0.5	0.6

	0.3

F. MISCELLANEOUS REGULATORY AMENDMENTS

Past versions of California regulations have made some changes and additions to the federal language in order to address needs specific to California. The list below contains the changes to the Code of Federal Regulations (CFR) that are also incorporated as part of staff's proposal. The listed federal requirements were modified to conform with current ARB practices.

- **Incorporation of California-specific Sales Data** - The modification was made to require submission of California-specific sales and production data in addition to the U.S.-specific sales and production data called for in the federal language (Title 40, CFR, Part 86, passim; see, for example, sections 86.004-21).

- **Durability Testing** - The durability testing requirements (Title 40, CFR, Part 86, passim; see, for example, section 86.001-23) were modified to assure adequate durability test procedures are conducted. This modification would allow the Executive Officer to require revised durability test procedures in future model years, if the procedures used in the first model year are deemed not to conform to good engineering practices.

- **CO, PM and Smoke Data, and Diesel Testing** - The federal language (Title 40, CFR, Part 86, passim; see, for example, section 86.001-23) has been modified to minimize requirements for CO, PM and smoke data, and testing for diesel engines not fueled by petroleum fuel. These modifications would significantly reduce the testing requirement for engine manufacturers.

- **Compliance with Emission Standards** - Sections pertaining to compliance with the emission standards (Title 40, CFR, Part 86, passim; see, for example, section 86.004-28) were modified to provide for use of deterioration factors in the calculation of formaldehyde emissions. The calculated emissions are necessary for evaluation of compliance with California's formaldehyde emissions standards.

- **Maintenance Instructions** - The federal rule (Title 40, CFR, section 86.004-38) contains requirements that manufacturers make available to anyone involved in engine repair any information needed to make use of emission-related diagnostic information or equipment. This federal requirement was first effective in the 1994 model year, but was never formally adopted into California regulations. Staff recommends the board adopt this federal requirement to be effective in 2004.

V.

DIFFERENCES BETWEEN FEDERAL AND CALIFORNIA HDE REGULATIONS

For the most part, staff's proposal mirrors U.S. EPA's HDE regulations. As discussed below, however, the proposed California heavy-duty program differs from the federal program in some aspects. Aligning California's program completely with the Federal program would require policy changes to several California programs. Those policy changes would relax current California standards and would move the state farther away from attaining ambient air quality standards and meeting California's SIP commitments. Therefore, staff's proposal differs from the federal program in ways that staff believes are needed to protect the air quality benefits of ARB's mobile source program.

A. PROPOSED CALIFORNIA PROVISIONS DIFFER FROM FEDERAL PROVISIONS FOR VEHICLES FROM 8,501 TO 14,000 POUNDS GVWR

Two of the differences between this proposal and the adopted federal program relate to engine-certified medium-duty vehicles (8,501 to 14,000 pounds GVWR). First, U.S. EPA considers those vehicles HDVs, and included them in their rulemaking for the 2004 standards. In anticipation of the federal rulemaking, ARB approved regulations in 1995 that require all new engine-certified medium-duty vehicles to meet a 2.4 (or 2.5 with a 0.5 NMHC cap) g/bhp-hr NOx plus NMHC standard beginning in 2004. This proposal does not contain medium-duty engine certification standards, since we are already aligned with the federal program in that regard.

The second difference between this proposal and the federal program relates to when those engine-certified medium-duty vehicles could participate in ABT. Under this proposal, engine-certified MDV participation would be allowed after the 2004 model year. The federal program allows participation in ABT beginning in 1998 to provide ABT credits for 2004 and later. Staff believes allowing engine-certified medium-duty vehicles to participate before 2004 would weaken California's existing medium-duty vehicle requirements.

California's current standards for those vehicles are more stringent than the federal standards for some pollutants. Current federal standards for those vehicles include a 4.0 g/bhp-hr NOx standard, and a 1.3 g/bhp-hr HC standard. In contrast, the current California standard for this GVWR class is 3.9 g/bhp-hr NOx plus NMHC, and the 2002 standard is 3.0 g/bhp-hr NOx plus NMHC, which are more stringent. Manufacturers who simply comply with the required medium-duty standard, and are allowed to participate in the ABT program before 2004, could potentially generate ABT credits to be banked for use after 2004. Manufacturers could bank the generated credit and use it to delay compliance with the proposed 2004 standards. ARB staff believes that allowing MDVs early participation in the ABT program would reduce the air quality benefits of California's more stringent medium-duty standards and shift the benefits to the ABT program.

In addition, the medium-duty engine-certification standards were adopted in 1995 through the usual public rulemaking process, in consultation with industry. Engine manufacturers did not raise any concerns at that time about their ability to meet the 2004 standards without an ABT program. Therefore, staff recommends that engine-certified medium-duty vehicles be allowed to participate in ABT only after 2004.

B. CALIFORNIA MARKETABLE CREDITS DIFFER FROM FEDERAL MARKETABLE CREDITS

The staff's proposal uses the California optional credit standards for determining marketable credits. The federal rule uses the FEL approach. The federal rule included a provision that if a manufacturer so desired, the manufacturer could forego the credit for ABT and have it transferable to the purchaser of the vehicle with the engine such that the credit could be an "open market" credit. Under the federal rule the value of a marketable credit is determined in the same manner as an ABT credit. However, the staff's proposal incorporates the California marketable credit approach which is different than the federal approach. The two main differences between the California marketable credit and the federal FEL approach are that California's marketable credit:

- uses discrete credit standards (e.g. NOx standards in 0.5 g/bhp-hr increments) rather than continuous levels; and
- the first credit standard is significantly (25 to 30 percent) below the required standard.

The emission reduction credit would be based on engine certification to one of ARB's optional credit standards already set by Board policy and currently in regulation. Table V-1 lists the optional credit standards for 1998 and the proposed optional credit standards for 2004.

Table V-1
California Current and Proposed
Optional Reduced-Emission Standards for Heavy-Duty Vehicles

1998 Optional Credit Standards (NOx in g/bhp-hr)	2004 Optional Credit Standards (NOx plus NMHC in g/bhp-hr)
2.5	1.8
2.0	1.5
1.5	1.2
1.0	0.9
0.5	0.6
	0.3

C. CURRENT CALIFORNIA 2004 HDE REGULATIONS CONTAIN OTTO-CYCLE STANDARDS, THE FEDERAL HDE REGULATIONS DO NOT

In 1995, California adopted heavy-duty Otto-cycle engine standards for 2004 model year vehicles, using the same 2.4 (or 2.5 with a 0.5 NMHC cap) g/bhp-hr NOx plus NMHC approach. Otto-cycle engine standards were not adopted under the federal rule. Currently, U.S. EPA is considering the appropriate level for Otto-cycle engine standards. U.S. EPA intends to issue a Supplemental Notice of Proposed Rulemaking in the near future to address these engines specifically. When U.S. EPA issues their rulemaking pertaining to Otto-cycle engine standards, ARB will re-evaluate the need for modifying California Otto-cycle engine standards and regulations.

D. CURRENT CALIFORNIA HDE REGULATIONS DO NOT CONTAIN NONCONFORMANCE PENALTIES

The federal non-conformance penalties provide manufacturers flexibility in meeting the standards by allowing them to pay a fee for not complying with the 2004 emission standards. The staff's proposed regulations are also written with the intent to help manufacturers comply with regulations by providing them flexibility through incentive and credit based programs. However, California still needs to achieve net emission reductions in order to meet its SIP commitments. Therefore, staff does not propose to incorporate a nonconformance penalty program.

E. CALIFORNIA WOULD NOT ALLOW MARKETABLE CREDITS FOR PM

ARB currently allows marketable credits to be generated for NOx but not for PM from heavy-duty engines. In fact, there are no optional reduced-emission standards for PM from heavy-duty engines. Likewise, this proposal contains no provisions for marketable credits for PM.

VI.

TECHNOLOGICAL FEASIBILITY

There have been major advances in heavy-duty diesel engine technology over the last several years to meet current 4.0 g/bhp-hr NOx and 0.1 g/bhp-hr PM standards. Engine manufacturers continue to improve engine technology and future reductions may be achieved, at least to a level of 50 percent of current levels. Part of the technical challenge will be reducing NOx emission levels while maintaining current PM emission levels. In general, emission control strategies that reduce NOx tend to increase PM. Technologies such as alternative fuels may even allow more stringent standards for vehicles or equipment that now use diesel engines.

Based on progress to date on future control technology development, staff believes that the new standards are feasible with diesel technology for implementation in 2004. Manufacturers, through the SOP, have also agreed that substantial emission reductions are technologically feasible. Future HDDE technologies designed to meet the 2004 NOx plus NMHC standard (2.4 g/bhp-hr or 2.5 g/bhp-hr with 0.5 NMHC cap) will create substantial emission reductions that are needed for California to meet its SIP commitments. U.S. EPA, in its rulemaking, describes the major advances in diesel technology that will make the proposed standard technologically feasible. This chapter briefly discusses some of these advancements.

A. IMPROVEMENTS IN DIESEL ENGINES

Diesel engines operate by compression ignition which causes the fuel to ignite upon injection into highly compressed air at high temperatures. This results in high flame temperatures. NOx formation is directly dependent on the flame temperature. As combustion temperatures increase, NOx emissions also increase. Therefore, NOx control technologies generally focus on reducing the combustion temperatures and the duration of these high temperatures within the cylinder.

Utilization of aftertreatment devices and further improvements in diesel fuel injection, turbocharging, aftercooling, and combustion chamber modifications may provide substantial

NOx and PM emission reductions. Manufacturers have several emission control technology options to meet the proposed regulations.

1. Injection Timing/High Pressure Fuel Injection

Retarding injection timing (starting combustion later) reduces NOx through a reduction in the peak combustion temperature. However, this tends to increase PM emissions and fuel consumption. Manufacturers are developing higher pressure injection systems as one approach to reduce fuel economy impacts and PM emission increases. Higher injection pressures result in better atomization, better air utilization, more complete combustion, and consequently reduce PM emissions while improving fuel efficiency.

2. Advanced Induction Systems

Manufacturers have incorporated advanced turbochargers/aftercoolers in current diesel engines to provide better air/fuel management and lower intake air temperatures to meet lower emission standards. Turbocharging has a positive influence on the pumping losses of an engine and on the combustion efficiency through control of the air/fuel ratio. Aftercoolers cool the intake charge to reduce peak combustion temperatures, thus reducing NOx emissions. Engine manufacturers are currently improving both turbochargers and aftercoolers, in conjunction with other engine modifications, to achieve even lower emissions and better fuel economy.

3. Exhaust Gas Recirculation (EGR)

EGR on diesel engines provides another means to comply with the proposed mandatory emission standards. EGR is one of the most effective methods for reducing NOx emissions to low levels. Spent combustion gases recirculated back into the intake system serve as a diluent to lower the oxygen concentration and also increase the heat capacity of the air/fuel charge. Cooled EGR, (cooled through the aftercooler) is used to minimize combustion temperatures. This reduces peak combustion temperature and the rate of combustion, thus reducing NOx emissions. However, PM emissions may increase and fuel economy may decrease. Studies are being conducted to establish a means of using EGR, while minimizing PM increases and optimizing fuel economy. The proper balance of EGR and temperature may provide the proper characteristics for decreasing NOx emissions while not increasing PM emissions.

EGR has been viewed as a technology that would foul the turbocharger and aftercooler (if present) and other intake components with particulate matter and other contaminants present in the recirculated exhaust gases. However, with very low PM levels in current diesel engines, and low-sulfur diesel fuel, EGR systems should be feasible and durable for HD diesel engine applications. Staff believes that EGR could and will be used to reduce NOx emission to meet the proposed standards.

B. ALTERNATIVE FUEL TECHNOLOGY

Alternative fuels such as methanol, compressed natural gas (CNG), and liquefied natural gas (LNG) have provided manufacturers with new options to meet increasingly stringent emission standards. Compared to conventional diesel control-effectiveness, alternative fuel technology has already shown emission reductions in the range of 50 percent for NOx while maintaining low PM emission levels. Both CNG and LNG have been used in urban buses, medium heavy-duty, and heavy HDVs. Engines powered by both CNG and LNG have been emission tested at levels as low as 1.0 g/bhp-hr NOx.

VII.

OUTSTANDING ISSUES

Staff presented the concepts for the proposed regulations at a workshop on December 2, 1997. Engine manufacturers supported most of the concepts in the regulations as reasonable. However, some issues did arise as to whether the proposal truly harmonized with federal regulations. The following paragraphs briefly discuss the outstanding issues pertaining to the California 2004 HDE regulations.

A. ABT PROGRAM IS RESTRICTED TO ENGINES OVER 14,000 POUNDS GVWR UNTIL 2004

During the December 1997 workshop, staff stated that the ABT program would be restricted to participation by HDVs (over 14,000 pounds GVWR) only. Engine manufacturers presented their opinion that this restriction is contrary to the SOP agreement, since the SOP says "California confirms its intent to notice a public hearing to consider action to harmonize its regulations for dynamometer-certified engines greater than 8,500 pounds GVWR with the federal regulations adopted under this SOP, provided such action would not compromise California's obligations to comply with state and federal law including the SIP." Furthermore, engine manufacturers believe that the exclusion of vehicles in the greater than 8,500 pounds and less than 14,001 pounds GVWR greatly hinders flexibility, as well as interfering with their ability to produce engines for California in the 14,000 pounds and under GVWR range.

Maximum harmonization of the standards will occur in 2004 when 100 percent ULEVs are required of manufacturers producing MDDE (over 8,500 and under 14,001 pounds GVWR) for sale in California. The ULEV standard is set at 2.4 g/bhp-hr NOx plus NMHC (or 2.5 with a 0.5 NMHC cap). Staff has modified the workshop proposal to include a provision that allows medium-duty diesel participation in the ABT program after the 2004 model year. Prior to 2004, the 8,501 through 14,000 GVWR class will be covered under the current medium-duty program. Current medium-duty regulations were presented to the public and manufacturers, adopted, and implemented without an ABT program. Under the existing

medium-duty program, the 8,501 through 14,000 pound GVWR class can generate credits for meeting phase-in requirements before the applicable model year. However, those credits under the medium-duty program are related to the phase-in requirements and are different than the ABT credits. The phase-in requirements list the percentage of low emission vehicles (LEVs), ultra-low emission vehicles (ULEVs), and super-ultra low emission vehicles (SULEVs) that manufacturers are required to produce in each model year. Under the medium-duty program "vehicle equivalent credits" could be generated for producing more than the required amount of LEVs, ULEVs, or SULEVs. Under the ABT program, however, credits are generated based on the emission increment below the applicable emission standard. Credits generated under the medium-duty program apply to amount of vehicles produced, where as credits under ABT apply to emissions.

B. CALIFORNIA'S MARKETABLE CREDIT PROGRAM DOES NOT USE THE FEL APPROACH

The federal rule allows manufacturers to partition part of their ABT credits and assign them to other entities to use as marketable emission-reduction credits. The federal marketable credits are also generated using the FEL approach. Under the federal program, engine manufacturers would declare an FEL below the applicable standard to generate emission reduction credits. Upon certification of the engine family, the manufacture could designate part of the credit for ABT and part as marketable credits.

Staff's proposal, however, provides that California marketable emission reduction credits must be based on engine certification to one of ARB's optional reduced-emission standards already adopted by the Board and currently in regulations. These optional reduced-emission standards are a series of discrete standards, rather than a continuous set of emission levels. Further, the optional standards are significantly (at least 25 percent) below the required standard. Manufacturers expressed their disapproval of the California requirement for marketable credits. They believe that discrete standards remove much of their flexibility and incentive to certify engines for credit.

ARB staff believes the approach the Board has approved in the past continues to be appropriate. The discrete standards and the significant margin below the required standard (at least 25 percent) are important for protecting air quality. And while flexibility in ABT credits could make it easier for manufacturers to meet the mandatory standards, the marketable credits are a different issue. Marketable credits merely provide potential additional revenue to manufacturers. Therefore, staff believes the proposed optional-reduced emission standards for heavy-duty diesel vehicles are appropriate and protective of air quality.

C. OFF-CYCLE EMISSIONS

A major concern that has recently arisen is the possibility of widespread excess emissions from recent model diesel engines. These emissions are referred to as "off-cycle"

emissions because they may be occurring at operating modes that are poorly represented in the certification test procedure, or not represented at all. The staff is very concerned that if these emissions are occurring and are substantial, the progress toward attainment will be severely retarded. The staff has been working closely with the U.S. EPA to determine the extent of this potentially serious problem and the means to address excess emissions.

VIII.

REGULATORY ALTERNATIVES

A. DO NOT AMEND CURRENT CALIFORNIA HDE REGULATIONS

One alternative to this proposal would be to continue use of the current HDDE emission standards. However, ARB's mobile source program is required to be equivalent to, or more stringent in the aggregate than, the federal program. Since U.S. EPA adopted the more stringent standards for 2004 in October 1997, ARB must adopt the requirements in this proposal, or other requirements that would result in equivalent or greater air quality benefits. California needs to adopt the federal standards to maintain its ability to enforce compliance. Furthermore, under the SOP, ARB committed to harmonize ARB's HDE regulations with U.S. EPA's "...provided such action would not compromise California's obligations to comply with state and federal law including the SIP." Therefore, staff recommends the board adopt the California 2004 HDE regulations, as proposed.

B. ADOPT 2002 HDE REGULATIONS

SIP measure M5 calls for introduction of a lower-emission heavy-duty diesel vehicle standard beginning in 2002, or alternative measures. Introduction of the lower standard in 2002, rather than 2004, would provide early emission reduction benefits. Those early emission reductions are particularly critical to the attainment strategy in Sacramento and Ventura, which must obtain the ozone ambient air quality standards by 2005.

However, a provision of the Clean Air Act prevents U.S. EPA from adopting a standard beyond the current 4.0 g/bhp-hr NOx standard before 2004. Therefore, adoption of a 2002 standard would mean California would have a separate standard for two years. Because development of new technologies such as EGR are needed to comply with the 2.4 g/bhp-hr NOx plus NMHC standard, it does not appear feasible that compliance by all engine models could be achieved by 2002. In addition, separate state and national standards for heavy-duty trucks raise competitiveness issues for the California trucking industry. In addition, a separate state standard is not as effective in reducing emissions, due to the significant fraction of

interstate vehicles operating in California. Those vehicles are not based here, and are not easily controllable by California. In fact, it is estimated that only about 50 percent of the miles traveled in the state by 2002 and 2003 model year heavy-duty vehicles would be affected by a separate state standard. In considering a state standard differing from the federal standard during the SIP board hearing in 1994, the Board directed staff to put "more emphasis on some of those alternatives in order to . . . avoid the competitive disadvantage of differential timing for the introduction of the 2 gram standard." Because of the competitiveness issues, and the reduced effectiveness of a separate state standard, staff recommends adoption of the HDE standards for 2004, rather than 2002.

C. ADOPT MORE STRINGENT 2004 HDE REGULATIONS

Another alternative to this proposal would be to adopt more stringent 2004 HDE regulations. ARB does have regulatory authority to adopt more stringent HDE standards than those set by U.S. EPA. However, adopting separate, more stringent standards raises the competitiveness and effectiveness issues discussed above. ARB is committed to a future review of the technological feasibility of the proposed new standards following U.S. EPA's 1999 review. As a matter of course, staff will conduct on-going reviews (albeit less formal than the post-U.S. EPA review) of technology development and assess the need for even more stringent standards in the future. At this time staff believes harmonization with U.S. EPA's 2004 standards is appropriate.

D. ADOPT CALIFORNIA HDE REGULATIONS IDENTICAL TO FEDERAL REGULATIONS

Staff has determined that adopting identical HDE regulations and programs outlined in the current federal program would not be effective. In California, current programs and policies are more stringent then the federal program. Adopting HDE regulations identical to federal HDE regulations would be a relaxation of ARB's current mobile source program. This proposal would result in lower emissions than adoption of regulations identical to the U.S. EPA rulemaking. Staff believes that this proposal represents a close alignment with federal regulations, preserves the air quality benefits of California's existing mobile source program, and protects the competitiveness of the California trucking industry.

IX.

ECONOMIC IMPACTS

The proposed regulatory amendments harmonize California emission standards, useful life, warranty, and equipment maintenance requirements with federal regulations. The California adoption of the standards would not impose additional costs above the costs to comply with the federal standards. The adoption is actually expected to benefit engine manufacturers, which often face serious production inefficiencies when they have to comply with different standards. The harmonization of the standards would reduce production inefficiencies, thereby lowering compliance costs. Therefore, staff believes that the proposed amendments would have no noticeable impact on business competitiveness, California employment, or on business creation, elimination, and expansion. This chapter discusses, in greater detail, the potential cost and economic impacts of the proposed amendments based on U.S. EPA findings.

A. LEGAL REQUIREMENT

Sections 11346.3 and 11346.54 of the Government Code require State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination, or creation, and the ability of California business to compete.

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

B. AFFECTED BUSINESSES

Any business which is involved in manufacturing and/or rebuilding of highway HDEs can potentially be affected by the federal standards and the proposed state standards. Also affected are businesses which operate or service HDVs. No engine manufacturers are located in California. An estimated 385,000 heavy-duty diesel-cycle vehicles will be registered and

operating in California in 2004. Approximately 81 percent of the miles traveled by heavy-duty diesel vehicles would be California-registered vehicle mileage.

C. ESTIMATED COSTS TO ENGINE MANUFACTURERS

The costs of the proposed requirements to engine manufacturers have been estimated. The cost analysis is based on U.S. EPA's analysis, with minor adjustments because medium-duty vehicle standards (8,501 to 14,000 pounds GVWR) are not part of this proposal.

Engine manufacturers will likely use multiple technologies to meet the 2004 standards and the maintenance and durability requirements. To estimate the incremental impact of the federal standards on engine costs, U.S. EPA determined a plausible combination of technologies. U.S. EPA assumed engine manufacturers would use a combination of cooled EGR, combustion optimization, and improved fuel injection to meet the 2004 standards. U.S. EPA calculated the increased engine costs associated with developing the technology and utilizing it on HDEs. Assuming that engine manufacturers pass on the entire costs of the new standards to end users, the incremental increase in per-engine purchase price and operating cost has been estimated. These cost estimates are presented in Table IX-1.

The light HDV costs in the table are adjusted from the values used by U.S. EPA, as this regulatory proposal excludes the engines used in the 8,501 to 14,000 pound GVWR vehicles. The costs shown for vehicles in the 14,001 to 19,500 pound range should be comparable to the costs U.S. EPA used for those vehicles, although U.S. EPA did not break out the costs for vehicles in that specific weight range.

Table IX-1
Costs of HDEs
(1995$)

Vehicle Class	Current Engine Cost	Incremental Cost of the California Standards for Different Model Years		
		2004	2006	2009
Light heavy-duty (14,001-19,500 lb GVWR)	$8,950	$314	$278	$137
Medium heavy-duty	$12,400	$459	$417	$198
Heavy heavy-duty	$21,700	$598	$542	$311
Urban transit bus	$22,000	$533	$488	$270

The estimated costs include costs for hardware, assembly time, research and development, retooling, certification and maintenance. The incremental costs of the new federal standards are expected to decline over time. For example, the incremental lifetime cost of a new heavy HDV purchased in 2004 is estimated to be $598. The estimated incremental cost of a new heavy HDE purchased in 2009 or later is $311, reflecting the benefits of a "learning-curve." The standards were called for in ARB's 1994 SIP, and further defined in the SOP in July 1995, giving manufacturers nearly a decade. This lead time allows substantial technology development before reaching production.

U.S. EPA's analysis predicts that extended research will allow manufacturers to use simpler packages of emission control technologies, that innovations will lower the cost of production, and that manufacturers will have time to focus research efforts on eliminating problems such as increased fuel consumption or maintenance costs. Thus, U.S. EPA assumed no increased fuel consumption costs, and applied a 20 percent learning curve discount to variable costs beginning in 2006, and fixed costs expire by 2009. Again, the light HDV costs are adjusted from U.S. EPA's values as this proposal excludes the 8,501 to 14,000 pound GVWR vehicles.

D. POTENTIAL COSTS TO ENGINE REBUILDERS

Some of the provisions in this proposal relate to engine rebuilding practices. U.S. EPA estimates that 55 percent of engine rebuilds are done by the vehicle owner, about 26 percent are done by engine distributors and truck dealers, about 10 percent by independent shops, and about 8 percent by factory remanufacturers. (U.S. EPA, 1997b) Based on average mileage accumulation rates and typical mileage at time of rebuild, the typical time to rebuild would be 11 years for heavy-duty truck engines, and 9 years for urban buses. (U.S. EPA, 1997b) The number of rebuilds of 2004 model year engines in calendar year 2009 is expected to be insignificant, and thus no rebuild costs are included in Table IX-9.

Increased rebuild costs are mainly expected to result from the increased cost of servicing EGR systems. This could include solvent cleaning of the EGR tubing and replacement of the electronic control valve. Calculated in terms of net present value at the point of sale, the net effect of EGR servicing would be about $50 for medium heavy-duty vehicles and $100 for heavy heavy-duty vehicles and urban buses. (U.S. EPA, 1997b)

E. POTENTIAL IMPACTS ON BUSINESS

The new federal standards are expected to impose additional costs on engine manufacturers and rebuilders. A detailed analysis of these costs is provided in the U.S. EPA regulatory impact analysis of the new federal standards. The cost analysis shows that the new federal standards would cost engine manufacturers and rebuilders about $242 million nationwide in 2004 to modify "50-state" engine families. Of this annual cost, an estimate of $71 million would be spent on the modifications of light HDEs, $64 million on the

modifications of medium HDEs, and $107 on the modifications of heavy HDEs. These costs are expected to decline to $123 million in 2009 as the technology improves and the labor productivity increases. Estimated annual costs are, then, expected to rise to $180 million because of the growth in truck population. Table IX-2 presents total annual costs in 1995 dollars by vehicle class for 2004, 2009 and 2020.

Table IX-2
Estimated Nationwide Annual Costs for Improved HDVs
(Millions of 1995 dollars)

Vehicle Class	2004	2009	2020
Light heavy-duty (14,001-19,500)	71	41	49
Medium heavy-duty (19,501-33,000)	64	26	38
Heavy heavy-duty (33,000+)	107	56	93
Total Annual Cost	242	123	180

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

F. POTENTIAL COSTS DUE TO DIFFERENCES BETWEEN THE CALIFORNIA PROPOSAL AND THE FEDERAL RULE

The California proposal also includes some requirements which are slightly different than the federal requirements. Those differences are detailed in Chapter V. None of those differences are expected to change significantly the costs to California businesses and individuals relative to the federal requirements. A discussion of each of the differences and the associated effect on costs follows.

1. Proposed California Provisions Differ from Federal Provisions for Vehicles from 8,501 to 14,000 pounds GVWR

California has already approved new 2004 standards for medium-duty vehicles, in 1995, in anticipation of the federal rulemaking. Those standards for engine-certified medium-duty vehicles are the same 2.4 g/bhp-hr NOx plus NMHC (or 2.5 with a 0.5 NMHC cap) standards U.S. EPA adopted in October 1997. Therefore, medium-duty standards are not

included in this proposal. Likewise, the costs associated with those medium-duty standards were assessed when the standards were adopted, and are not included here. Comparing California requirements for engine-certified diesel-cycle medium-duty vehicles to the federal requirements:

- 2004 standards for engine-certified diesel-cycle medium-duty vehicles are equivalent to the federal standards.

- The federal rulemaking allows medium-duty vehicle participation in the modified ABT program from 1998 through 2004. The medium-duty standards California approved in 1995 did not allow for participation in ABT. The costs of those standards absent ABT were assessed at the time of adoption.

- To harmonize with the federal program for the 2004 standards, this proposal would allow engine-certified medium-duty vehicles to participate in ABT beginning in 2004. This should provide more flexibility to manufacturers, and should not significantly affect costs.

2. California's Marketable Credits Differ from Federal Marketable Credits

The federal rulemaking allows the use of the FEL for ABT and for marketable credits. This proposal would allow FEL for ABT, but not for marketable credits. Under this proposal, marketable credits would be issued under ARB's current marketable credits program and adopted credit standards. While this marketable credits approach does not offer manufacturers as much flexibility as the FEL approach, it should not substantially affect costs. Participation in the marketable credits program is voluntary.

3. Current California 2004 HDE Regulations Contain Otto-Cycle Standards, the Federal HDE Regulations Do Not

California adopted requirements for medium-duty Otto-cycle engines, and the costs associated with those standards were assessed at the time of adoption. Currently, U.S. EPA is evaluating the need to change federal Otto-cycle engine standards. If U.S. EPA issues a federal rulemaking pertaining to Otto-cycle engine standards, ARB will evaluate the need to modify California Otto-cycle engine standards. Because California already adopted Otto-cycle engine standards for 2004, there are no provisions in this proposal and no associated costs.

4. Current California HDE Regulations Do Not Contain Nonconformance Penalties

The federal rule allows manufacturers to pay a nonconformance penalties if

they do not meet FEL, and thus continue producing engines with excess emissions. Because nonconformance penalties would result in excess emissions, the staff's proposal would not allow the use of a nonconformance penalty. Since the nonconformance penalty is not intended to be a common means of compliance, it is generally set notably higher than the anticipated cost of compliance. Therefore, there should be no additional costs associated with the lack of a nonconformance penalty provision in this proposal.

5. California Would Not Allow Marketable Credits for PM

Under this proposal, marketable credits would be issued per ARB's current marketable credits program and adopted credit standards. Marketable credits for PM would not be allowed. While this marketable credits approach does not offer manufacturers as much flexibility as the FEL approach, it should not substantially affect costs. Participation in the marketable credits program is voluntary.

G. POTENTIAL IMPACT ON VEHICLE OPERATORS AND REBUILDERS

The proposed amendments are expected to have no noticeable impact on vehicle operators or rebuilders. The federal standards are estimated to increase annual expenses associated with operating HDVs by about 0.1 to 1.4 percent in 2004. In the short run, competitive market forces may prevent engine manufacturers and rebuilders from passing their cost increases on to vehicle operators. In the long run, the estimated incremental costs are expected to fall as engine manufacturers and rebuilders develop new technologies and learn more about the application and integration of those technologies. Thus, staff expects a minor increase in annual costs of operating these vehicles. Table IX-3 presents the range of the impact on the total annualized costs in 2004 by vehicle classification.

Table IX-3
Potential Impact on Annual Expenses of Vehicle Operators in 2004

Vehicle Class	Incremental Cost	Vehicle Cost	Operating Costs	Total Annual Costs*	% Increase of Total Costs
Light heavy-duty (14,000-19,500)	$314	$28,410	$17,150	$22,832	1.4
Medium heavy-duty (19,501-33,000)	$459	$46,132	$31,242	$40,468	1.1
Heavy heavy-duty (33,000+)	$598	$96,490	$108,027	$127,325	0.5

Vehicle Class	Incremental Cost	Vehicle Cost	Operating Costs	Total Annual Costs*	% Increase of Total Costs
Urban bus	$533	$224,000	$437,153	$481,953	0.1

***** Total annual costs are estimated assuming a useful life of 5 years for vehicles.

H. POTENTIAL IMPACT ON BUSINESS COMPETITIVENESS

The proposed amendments would have no significant impact on the ability of California businesses to compete with businesses in other states. The amendments would harmonize the California standards with the federal standards for heavy-duty diesel-cycle engines. Thus, California operators of heavy-duty diesel vehicles would not be disadvantaged relative to operators of these vehicles from other states. The harmonization of the standards should actually benefit engine manufacturers and rebuilders. This is because these manufacturers would not have to deal with different requirements which often result in production inefficiencies.

I. POTENTIAL IMPACT ON EMPLOYMENT

The proposed amendments are not expected to cause a noticeable change in California employment. The California adoption of the federal standards is likely to benefit most engine manufacturers although no engine manufacturers are located in California. The adoption of the federal standard in California is expected to benefit engine manufacturers, who might be faced with production inefficiencies if they had to comply with different California and federal standards. The harmonization of the standards would reduce production inefficiencies, thereby lowering compliance costs. Since these costs are generally passed on to vehicle operators, they could benefit from lower compliance costs. This would, in turn, moderate any adverse impact the federal standards might have on employment.

J. POTENTIAL IMPACT ON BUSINESS CREATION, ELIMINATION OR EXPANSION

The proposed amendments would have no noticeable impact on the status of California businesses. The new federal standards would not impose significant costs on HDV operators in California. However, it is conceivable that some small HDV operators with slim profit margins may be adversely affected by the standards. These operators may decide to leave the business.

K. POTENTIAL COSTS TO LOCAL AND STATE AGENCIES

As discussed in the chapter on regulatory alternatives, ARB must either adopt the

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

X.

ENVIRONMENTAL IMPACTS AND COST-EFFECTIVENESS

This chapter presents the air quality benefits and the cost-effectiveness of the proposed standards. Staff's analysis is based on U.S. EPA's national analysis, adjusted to reflect California costs and emission reductions. The proposed state standards and adopted national standards were committed to in the 1994 Ozone State Implementation Plan as part of SIP measures M5 and M6. This chapter presents an analysis of how the proposed standards fulfill the SIP commitments in those areas of the state that rely on measures M5 and M6 reductions for attainment. The proposed regulations would result in many benefits for California's environment, and would be cost-effective.

A. AIR QUALITY BENEFITS

1. Statewide Benefits

The estimated statewide emission benefits of the 2004 standards are shown in Table X-1. The M5 portion of the 2004 standards would result in an estimated 6 tons per day NOx and 8 tons per day NMHC emission reductions in 2004, and an estimated 96 tons per day NOx and 10 tons per day NMHC by 2010. These are benefits from the proposed adoption of the 2004 requirements in California. The M6 portion of the 2004 standards (the adopted national standard) would result in an estimated 23 tpd NOx by 2010. The M6 benefit would be from vehicles registered in other states that operate in California.

The proposed standard is a combined NOx plus NMHC standard. To calculate the emission benefits associated with the 2004 standards, it was necessary to assume individual NOx and NMHC levels for 2004 and subsequent model year engines. Thus, a 2.0 g/bhp-hr NOx emission level and a 0.4 g/bhp-hr NMHC emission level were assumed. U.S. EPA made the same assumptions in the analysis of the emission benefits of the federal standards. This
2.0 g/bhp-hr NOx standard was called for in SIP measures M5 and M6. This proposal and the October 1997 U.S. EPA rulemaking fulfill the SIP measure M5 and M6 commitments for a NOx standard beginning in 2004. This means that NOx emissions from new heavy-duty

diesel-cycle vehicles would be reduced by half beginning in 2004 -- a huge achievement.

Table X-1
Statewide Emission Reduction
Benefits of 2004 Standards

(Tons per day, based on MVEI 7G 1.0c model, rounded to the nearest whole number.)

Year	Number of California-Registered Vehicles	HDDV Baseline Emissions		M5 Benefits (2004 stds)		M6 Benefits* (2004 stds)	
		NOx	NMHC	NOx	NMHC	NOx	NMHC
2004	385,000	366	36	6	8	1	2
2005	392,000	364	36	24	9	5	2
2007	408,000	361	36	55	10	13	3
2010	434,000	370	37	96	10	23	3

* M6 emissions and emission reductions are generated by vehicles registered out-of-state and traveling in California.

For NMHC, it is more difficult to predict what the emissions levels would be with the proposed 2004 standards. Average NMHC emission levels are now less than 25 percent of the 1.2 g/bhp-hr NMHC standard. That is because the NOx and PM standards are typically more constraining than the NMHC standard, and the NMHC emission levels are more the incidental result of other engine design parameters. Another reason that NMHC emissions are significantly below the standards is that manufacturers have improved combustion efficiency, and/or added catalysts to reduce PM, with the added benefit of NMHC reductions. Although it is difficult to predict what the NMHC emission levels would be based on the proposed combined standard, the staff believes that the PM emission standard will continue to constrain NMHC emissions to current levels. The lower NMHC emission levels already achieved have not been fully reflected in the inventory. The NMHC benefits in Table X-1 above represent that adjustment. These lower NMHC benefits already achieved and the impact on the inventory and anticipated SIP emission reductions are described further in Section 3 of this chapter.

2. Ozone SIP Emission Reductions

The proposed 2004 standards would have emission reduction benefits statewide. Those benefits are particularly important in the ozone nonattainment areas that count on those benefits in their 1994 federal attainment strategy for the one-hour standard. Those areas currently are the South Coast Air Basin, the Sacramento nonattainment area, Ventura County, and the Southeast Desert Air Basin. In the San Joaquin Valley additional SIP reductions are needed so these benefits will be included in a 2000 SIP revision. In addtion, these reductions will be included in the 2003 ozone SIP for the new 8-hour standard.

The emission reductions in this section were calculated with the EMFAC7F/BURDEN7F model for ease of comparison with the emission benefits in the 1994 ozone SIP. The estimated NOx emission benefits of the proposed 2004 standards in the South Coast Air Basin are shown in Table X-2. This proposal would result in estimated emission reductions of 3 tons per day NOx in 2004, and an estimated 51 tons per day NOx emission reductions in 2010.

Table X-2
NOx Emission Reduction Benefits of this Proposal versus
SIP Measures M5 and M6 Anticipated Reductions
(tons per day, South Coast Air Basin, based on EMFAC7F/BURDEN7F)

Year	Baseline Inventory	M5 Commitments	Benefits of this Proposal	M6 Commitments	Benefits of National Standards
2002	192	2	0	0	0
2004	193	15	3	1	1
2005	194	22	13	4	4
2007	199	32	25	7	7
2010	208	56	51	16	16

In evaluating the NMHC emission reduction benefits of this proposal in relation to the SIP commitments, a review of the SIP baseline emission methodology is useful. The motor vehicle emission inventory model used for the SIP, EMFAC7F/BURDEN7F, included heavy-duty diesel ROG emission rates that were adjusted for purposes of establishing the SIP emission baseline. The unadjusted model had substantially higher NMHC emission rates than were warranted, given the values of certification emission levels for 1991 and later heavy-duty diesel engines at the time the SIP was prepared. The models inputs were adjusted to provide for NMHC emission rates of 0.4 g/bhp-hr for 1994 and later model years, reflecting early 1990's engine certification emission rates. Additional reductions of NMHC emissions through more stringent NMHC emission standards were part of measures M5 and M6.

In its October 1997 rulemaking and evaluation of emission benefits, the U.S. EPA evaluated the impacts of the 2.4 g/bhp-hr emission standard on HC emissions (essentially equivalent to NMHC for diesel engine emissions). In this evaluation, the U.S. EPA reviewed diesel engine certification data for the 1994 model year and determined that the average NMHC emission rate was 0.283 g/bhp-hr. This average is the result of many engines certifying below 0.4 g/bhp-hr and a few certifying above that level. U.S. EPA estimated the NMHC emission benefits of its rule by assuming that those engines that are above 0.4 g/bhp-

hr would reduce emissions to 0.4 gm-bhp-hr, and that those engines currently below that level would stay at the same emission level. The overall effect would be a 9 percent NMHC emission reduction.

The ARB staff conducted a similar investigation of certification levels for the 1994 through 1996 model year engines. When weighted for engine life and mileage, the average sales-weighted emission rates for California certified engines in the 1994-1996 period are below
0.25 g/bhp-hr. The emission rates determined by U.S. EPA and the staff are well below what is currently required. These low emission rates are the result of control strategies implemented to comply with the PM standards that became effective in 1991 and 1994 (0.25 g/bhp-hr and
0.1 g/bhp-hr, respectively). Because the PM emission standard will not change, the staff expects that NMHC emissions will remain at current levels.

To evaluate the emission reductions achieved from 1994 to date and those that will continue in the future, the staff adjusted the EMFAC7F emission rates to reflect the results of the review of the diesel engine certification data. The emission rates were set at values equivalent to 0.25 g/bhp-hr of NMHC for the 1994 and later model years. No changes to the 1991 through 1993 model years were made, although the certification emission rates for those model years indicate reduced emission rates within the model might also be appropriate.

The estimated NMHC reductions already achieved in the South Coast Air Basin are shown in Table X-3. These lower NMHC levels already achieved represent estimated emission reductions from the baseline of 4.3 tons per day NMHC in 2002, and an estimated 5.0 tons per day NMHC in 2010. For purposes of this analysis, NMHC and ROG emissions are equivalent. Because the reduced emission levels anticipated for measures M5 and M6 have already been achieved, California has met the SIP measure M5 and U.S. EPA has met the M6 ROG commitments.

Table X-3
NMHC Emission Reduction Benefits of this Proposal versus
SIP Measures M5 and M6 Anticipated Reductions
(tons per day, South Coast Air Basin, based on EMFAC7F/BURDEN7F)

Year	Baseline Inventory	M5 Commitments	Benefits of this proposal*	M6 Commitments	Benefits of National Standards*
2002	19	0.1	4.3	0	1.2
2005	19	1.8	4.5	0.6	1.3
2007	18	3.1	4.8	1.0	1.3

2010	19	4.8	5.0	1.5	1.4

* Benefits already achieved beginning in 1994.

While California has met the SIP measure M5 ROG commitments, this proposal achieves the majority, but not all, of the anticipated NOx emission reductions. SIP measure M5 calls for emission reductions from a California-only 2.0 g/bhp-hr NOx standard beginning in 2002, or by implementation of alternative measures that will achieve equivalent or greater emission reductions. As discussed in the chapter on regulatory alternatives, staff is not proposing adoption of a 2002 California-only NOx standard due to concerns about the feasibility of implementing the standard in 2002, California trucking industry competitiveness, and the partial effectiveness of a California-only standard.

The NOx emission reduction benefits of a 2002 standard instead of a 2004 standard are not part of this proposal. SIP measure M5 commitments that remain will have to be achieved through alternative measures. Those remaining M5 NOx emission reductions were calculated with the EMFAC7F/BURDEN7F model, and are shown in Table X-4. The analysis assumed a 2.0 g/bhp-hr NOx standard in 2002, affecting half the miles traveled by new 2002 and 2003 model year vehicles. The biggest impact of a 2002 standard would be in 2004, right after those 2002 and 2003 model year vehicles are introduced into the fleet. Therefore the biggest remaining M5 NOx commitment is in 2004, at 12 tpd in the South Coast Air Basin.

Table X-4
SIP Measure Remaining M5 Emission Reductions
Needed in the South Coast Air Basin
(tons per day, EMFAC7F/BURDEN7F)

	2002	**2004**	**2005**	**2007**	**2010**
NOx	2	12	9	7	5
NMHC	0	0	0	0	0

Similar calculations were performed for Sacramento and Ventura, which have deadlines in 2005 for attainment of the federal ambient ozone standard, and the Southeast Desert, which has a 2007 attainment deadline. The remaining M5 emission reductions for those areas are shown in Table X-5.

Table X-5
Remaining M5 Emission Reductions for Sacramento Air Basin, Ventura County, and the Southeast Desert Air Basin
(tons per day, EMFAC7F/BURDEN7F)

Non-Attainment Area	Year	SIP Emission Reduction Commitments		Emission Reduction Benefits of this Proposal		Remaining M5 Emission Reductions Needed	
		NOx	NMHC	NOx	NMHC	NOx	NMHC
Sacramento nonattainment area	**2005**	2.7	0.2	1.5	0.5	1.2	0
Ventura County	**2005**	1.0	0.1	0.6	0.2	0.4	0
Southeast Desert Air Basin	**2007**	5.2	0.4	4.1	0.6	1.1	0

3. PM_{10} SIP Reductions

The primary effect of the proposed standards on ambient PM levels will occur as a result of the large anticipated reductions in NOx. The NOx benefits were included in the South Coast and San Joaquin Valley PM_{10} attainment demonstration plans submitted to U.S. EPA in 1997. The attainment demonstrations were based on a 1:1 relationship between NOx and PM reductions for both these regions. The reductions from this proposal will also be included in the 2005 attainent plans that will be developed to meet the new federal $PM_{2.5}$ standards.

B. COST-EFFECTIVENESS

The estimated cost-effectiveness of the federal requirements is given in Table X-6. In 2004, the cost-effectiveness ranges from $200 to $1200 per ton of NOx plus NMHC reduced. By 2009, the cost-effectiveness is expected to be from $100 to $500 dollars per ton. The cost-effectiveness for aligning with the federal requirements in California is expected to be within this range. The typical cost-effectiveness for the California vehicles affected by this proposal is expected to be around $400 per ton. In dollars per pound, the cost-effectiveness of this measure would be about $0.20 per pound of ozone precursors reduced. As shown in Figure X-1, this compares favorably with the cost-effectiveness of mobile source and motor vehicle

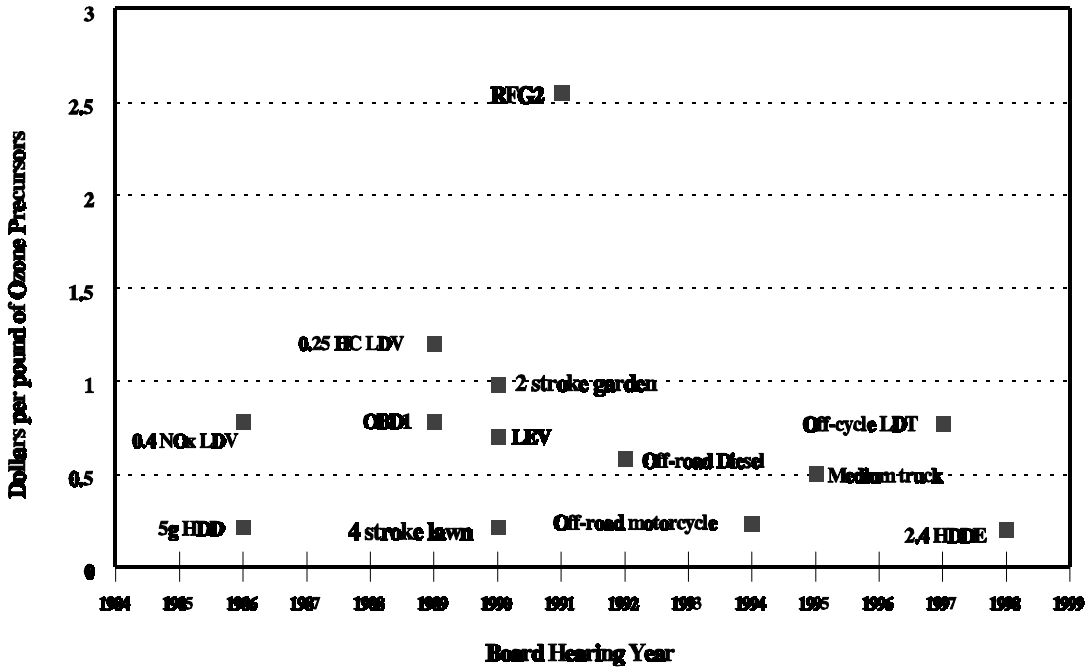
fuels

regulations adopted over the past decade. Those adopted measures had cost-effectiveness values from $0.17 to $2.55 per pound of ozone precursors reduced.

Table X-6
U.S. EPA Estimated Cost-Effectiveness of Federal Requirements

Vehicle Category	**Weight Rating** (GVWR)	**Cost-effectiveness ($/ton NOx plus NMHC)**		
		2004-5	2006-8	2009+
Light heavy-duty	8,500 - 19,500	$1200	$1100	$500
Medium heavy-duty	19,501 - 33,000	$500	$500	$500
Heavy heavy-duty	33,000+	$200	$200	$100

Figure X-1
Cost Effectiveness of Major Regulations
Motor Vehicles



XI.

SUMMARY AND STAFF RECOMMENDATION

The staff recommends that the Board amend Sections 1956.8, 1965, 2112, and 2036, Title 13, California Code of Regulations, and the incorporated "California Exhaust Emission Standards and Test Procedures for 1985 and subsequent Model heavy-Duty Diesel Engines and Vehicles", "California Exhaust Emission Standards and Test Procedures for 1987 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles", "California Motor Vehicle Emission Control label Specifications", and "Defects Warranty Requirements for 1979 Through 1989 Model Passenger Cars, Light-duty Trucks, and Medium-duty Vehicles; 1979 and Subsequent Model Motorcycles and Heavy-duty Vehicles; and Motor Vehicle Engines Used in Such Vehicles", as set forth in the proposed Regulation Order in Attachment A. If adopted, the proposal would harmonize California diesel HDV engine regulations with adopted U.S. EPA requirements for 2004. Staff's proposal, together with the adopted federal standards, would fulfill the majority of the M5 SIP commitments, with the remaining emission reductions achieved through alternative measures as called for in measure M5.

A. SUMMARY OF STAFF'S PROPOSAL

As presented in the previous chapters, staff's proposal was developed to harmonize California diesel HDV regulations with those adopted by the U.S. EPA. The staff's proposal would harmonize HDV requirements with federal requirements to a large extent without jeopardizing progress toward attainment of the ozone standard. The staff's proposal includes the following:

- A mandatory 2.4 g/bhp-hr NOx plus NMHC (or 2.5 with a 0.5 NMHC cap) emission standard for model year 2004 and later on-highway heavy-duty diesel-cycle engines. This standard is the same as the adopted federal 2004 standard for heavy-duty diesel cycle engines.

- Provisions to provide for a review of the new emission standards, after U. S. EPA's

1999 review, to reassess the appropriateness and feasibility of the standards.

- Provisions to allow participation in the federal ABT program and thus allow engine manufacturers flexibility in meeting the proposed emission standards. Heavy-duty diesel- cycle engines would be eligible to participate in ABT beginning in 1998, and could use the credits beginning in 2004. Engine-certified medium-duty vehicles could participate in ABT beginning in 2004. California-specific reporting requirements related to ABT would apply.

- Optional NOx plus NMHC emission standards, beginning with the 2004 model year, for on-highway heavy-duty diesel-cycle engines. The optional standards would range from 0.3 g/bhp-hr to 1.8 g/bhp-hr, at 0.3 g/bhp-hr increments.

- Labeling requirements for engines certified to optional standards, including multi-fuel mode engines.

- New NMHC measurement test method options.

- Heavy-duty diesel- and Otto-cycle equipment provisions that affect the useful life extension, emissions-related maintenance intervals, and warranties.

- Provisions requiring engine service manuals.

- Provisions requiring manufacturers to design equipment maintenance signals so that they do not cease to function at or beyond the end of the regulatory useful life.

- Amendments to the rebuild provisions, including record keeping requirements for rebuilt heavy-duty diesel-cycle engines.

B. STAFF RECOMMENDATION

Staff has presented the costs, and environmental impacts associated with the proposal. As presented in the previous chapters, costs associated with this proposal would be within the range of cost for existing regulatory measures. Furthermore, new and future HD diesel engine technology will make it feasible for manufacturers to meet the proposed standards. Lastly, this proposal would provide California with the reductions in NOx and ROG emissions, that are necessary to meet California's SIP commitments. Staff recommends that the Board adopt the proposed regulations described in Chapter IV, and attached in Appendix A.

XII.

REFERENCES

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

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

ARB, 1994b. The Feasibility of Reducing Emissions from Heavy-Duty Diesel Vehicles through Retrofitting Existing Diesel Engines, September 1994.

ARB, 1993. Public Hearing to Consider Amendments to Regulations Regarding California Exhaust Emission Standards and test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel-engines and Vehicles, to Specify Standards for 1994 and Subsequent Urban Bus Engines, April 23, 1993.

U.S. EPA, 1997a. Control of Emission of Air Pollution from Highway Heavy-duty Engines, October 1997, U.S. EPA, AMS-FRL-5908-8, RIN 2060-AF76.

U.S. EPA, 1997b. Draft Final Regulatory Impact Analysis: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines, June 20, 1997.

U.S. EPA, 1997c. Draft Summary and Analysis of Comments: Emissions of Air Pollution from Highway Heavy-Duty Engines, June 24, 1997.

U.S. EPA, 1996. Benefits of Mobile Source NOx Related Particulate Matter Reductions, October 1996, U.S. EPA Contract No. 68-C5-0010.

U.S. EPA, 1994. Summary of Local-Scale Source Characterization Studies, U.S. EPA-230-S-95-002, July, 1994.

APPENDICES

APPENDIX A

REGULATORY AMENDMENTS

APPENDIX B

EMISSION STANDARDS

This appendix contains summary tables of required California and federal emission standards for HDVs, and urban transit buses. It also contains tables that list the adopted and proposed California optional reduced-emission standards for HDVs and urban transit buses. Finally, it contains California engine-certified medium-duty vehicle (8,501 to 14,000 pounds GVWR) phase-in requirements and emission standards.

The information pertaining to California emission standards presented in this appendix was extracted from the California Code of Regulations, Title 13, Sections 1956.8 and 1960.1. For additional information, please refer to these sections in the California Code of Regulations. The information pertaining to the federal emission standards was extracted from the Code of Federal Regulations 40, parts 77 to 97. For additional information, please refer to these sections in the Code of Federal Regulations.

Table B-1
Federal Exhaust Emission Standards for Heavy-Duty Diesel Engines
(grams per brake horsepower hour)

Model Year	Test Mode	Hydro-carbons (HC)	Carbon Monoxide	Oxides of Nitrogen (NOx)	NOx plus NMHC	Particulate Matter	Smoke (Opacity)
1970-73	steady-state	--	--	--	--	--	Accel. 40% Lug 20%
1974-78	steady-state	--	40	--	16	--	Accel. 20% Lug 15% Peak 50%
1979-83	steady-state	1.5 --	25 25	-- --	10 5	-- --	Same
1984	steady-state OR transient	1.3 0.5	15.5 15.5	10.7 9.0	--	-- --	Same
1985-87	transient	1.3	15.5	10.7	--	-- --	Same
1988-89	transient	1.3	15.5	10.7	--	0.6	Same
1990	transient	1.3	15.5	6.0	--	0.6	Same
1991-93	transient	1.3	15.5	5.0	--	0.25	Same
1994-97	transient	1.3	15.5	5.0	--	0.10	Same
1998-2003	transient	1.3	15.5	4.0	--	0.10	Same
2004	transient	1.3	15.5	--	2.4; OR 2.5 with 0.5 HC cap	0.10	Same

Table B-2
California Heavy-Duty Emission Standards
(grams per brake horsepower-hour)

Model Year	Gross Vehicle Weight (pounds)	HC Non-methane	HC Total	CO	NOx	HC and NOx	PM
Otto-cycle and Diesel-cycle Engines [1]							
1969 - 1971	over 6,000	----	275	1.5	----	----	----
1972	over 6,000	----	180	1.0	----	----	----
1973 - 1974	over 6,000	----	----	40	----	16	----
1975 - 1976	over 6,000	----	----	30	----	10	----
1977 - 1978	over 6,000	----	----	25	----	5.0	----
	over 6,000	----	1.0	25	7.5	----	----
1979	over 6,000	----	1.5	25	7.5	----	----
	over 6,000	----	1.0	25	7.5	----	----
	over 6,000	----	----	25	----	5.0	----
1980 - 1983	over 6,000	----	1.0	25	----	6.0	----
	over 6,000	----	----	25	----	4.5	----
1984 - 1986	over 6,000	----	0.5	25	----	4.5	----
	over 6,000	----	1.3	15.5	5.1	4.5	----
1987 and Later Otto-cycle Engines [2]							
1987	8,500 - 14,000	----	1.1	14.4	10.6	----	----
	over 14,000	----	1.9	37.1	10.6	----	----
1988 - 1990	8,500 - 14,000	----	1.1	14.4	6.0	----	----
	over 14,000	----	1.9	37.1	6.0	----	----
1991 - 1994	8,500 - 14,000	0.9	1.1	14.4	5.0	----	----
1995 - 1997	over 14,000	1.7	1.9	37.1	5.0	----	----
1998 - 2003	over 14,000	1.7	1.9	37.1	4.0	----	----
2004 and later	over 14,000	----	----	37.1	----	2.4 or 2.5 with 0.5 NMHC cap	----
1987 and Later Diesel-cycle Engines [3]							
1987 optional	over 14,000	----	1.3	15.5	5.1	----	----
1987 - 1990	over 14,000	----	1.3	15.5	6.0	----	0.6
1991- 1993	over 14,000	1.2	1.3	15.5	5.0	----	0.25
1994 - 1997	over 14,000	1.2	1.3	15.5	5.0	----	0.1
1998 - 2003	over 14,000	1.2	1.3	15.5	4.0	----	0.1
2004 and later [4]	over 14,000	----	----	15.5	----	2.4 or 2.5 with 0.5 NMHC cap	0.1

Notes:

(1) For 1969 through 1972, HC emission standards are measured in parts per million; CO emission standards are measured in percent. From 1973 model year, all standards are measured in grams per brake horsepower hour (g/bhp-hr). In 1969 through 1978, emission standards are measured using the non-dispersive infrared method (NDIR). For 1979 only, manufacturers had the choice of using the NDIR method standard or the heated flame ionization detection method (HFID) standard, both are equivalent in stringency. From 1980 on emissions are measured with the HFID method. All 1969-83 tests are steady state, while 1984-86 vehicles could be certified to either a steady state standard or a transient standard. 1985 and newer diesel vehicles must be certified to the transient standard.

(2) These standards apply to gasoline, methanol, and all applicable gaseous-fueled engines except those engines derived from existing diesel-cycle engines. All vehicles are certified using the transient test procedure. Manufacturers of gasoline, natural gas, or liquefied petroleum gas engines may choose to certify to the total or the optional non-methane hydrocarbon standards. All standards are expressed in g/bhp-hr, unless otherwise noted. Standards listed for 2004 and later, have been adopted by California only.

(3) These standards apply to diesel, methanol, and all applicable gaseous-fueled engines including those engines derived from existing diesel-cycle engines. All vehicles are certified using the transient test procedure. Manufacturers of diesel, natural gas, or liquefied petroleum gas engines may choose to certify to either the total or the optional non-methane hydrocarbon standard. For methanol-fueled engines, the total hydrocarbons means organic material hydrocarbon equivalent (OHMCE). All standards are expressed as grams per brake-horsepower-hour (g/bhp-hr) unless otherwise noted.

(4) Standards listed for 2004 and later model year diesel engines, have been adopted by U.S. EPA, and are proposed for California.

Table B-3

California and Federal Urban Bus Standards
(in grams per brake horsepower-hour)

Year	Hydrocarbons (HC)		CO	NOx		PM		Proposed NOx plus NMHC
	Non-methane	Total		California	Federal	California	Federal	
1991-92	1.2	1.3	15.5	5.0	5.0	0.10	0.25	
1993	1.2	1.3	15.5	5.0	5.0	0.10	0.10	
1994-95	1.2	1.3	15.5	5.0	5.0	0.07	0.07	
1996-97	1.2	1.3	15.5	4.0	5.0	0.05 (1)	0.05	
1998	1.2	1.3	15.5	4.0	4.0	0.05 (1)	0.05 (1)	
	n/a			n/a		0.05		
2004 (2)		n/a	15.5		n/a		0.05	2.4 or 2.5 with 0.5 NMHC cap

Notes: (1) In-use standard of 0.07 g/bhp-hr
(2) Federally adopted standards; proposed California standards.
HC = hydrocarbons
CO = carbon monoxide
NOx = oxides of nitrogen
NMHC = non-methane hydrocarbons

Table B-4
California Heavy-Duty Vehicle Optional Reduced Emission Standards

Model Year	Primary Standard (NOx in g/bhp-hr)	Optional Standards (NOx in g/bhp-hr)	
		Range	Increment
1994-97	5.0	3.5 - 0.5	0.5
1997-2003	4.0	2.5 - 0.5	0.5

Table B-5
California Urban Bus Optional Reduced Emission Standards

Model Year	Primary Standard (NOx in g/bhp-hr)	Optional Standards (NOx in g/bhp-hr)	
		Range	Increment
1994-95	5.0	3.5 - 0.5	0.5
1996-2003	4.0	2.5 - 0.5	0.5

Table B-6
Proposed California Heavy-Duty Vehicle and Urban Bus
Optional Reduced Emission Standards

Model Year	Primary Standard (NOx plus NMHC in g/bhp-hr)	**Optional Standards** (NOx plus NMHC in g/bhp-hr)
2004 and later	2.4 OR 2.5 with 0.5 NMHC cap	1.8
		1.5
		1.2
		0.9
		0.6
		0.3

Table B-7
California Phase-in Requirements
for Engine-Certified Medium-Duty Vehicles

Model Year	Engine Certified Phase-in %		
	Tier 1	LEV	ULEV
1998	100	0	0
1999	100	0	0
2000	100	0	0
2001	100	0	0
2002	0	100	0
2003	0	100	0
2004	0	0	100

Table B-8
California Medium-Duty Engine Certification Emission Standards for Vehicles Weighing 8,001 to 14,000 Pounds

Model Year	Vehicle Weight (pounds)	Vehicle Emission Category	CO g/bhp-hr	NOx plus NMHC g/bhp-hr	PM g/bhp-hr	Foot Notes
MEDIUM-DUTY ENGINE CERTIFICATION STANDARDS						(1), (2), (3)
1995 through 2001	8,501 - 14,000	Tier 1	14.4	3.9	0.1	(4)
1992 through 2001	8,501 - 14,000	LEV	14.4	3.5	0.1	(4)
2002 through 2003	8,501 - 14,000	LEV	14.4	3.0	0.1	(4)
1992 through 2003	8,501 - 14,000	ULEV	14.4	2.5	0.1	(4), (5)
2004 and subsequent	8,501 - 14,000	ULEV	14.4	2.5	0.1	opt. A, (6)
2004 and subsequent	8,501 - 14,000	ULEV	14.4	2.4	0.1	opt.B, (6)
1996 and subsequent	8,501 - 14,000	SULEV	7.2	2.0	0.05	

NOTES:

(1) NOx plus NMHC is the sum of individual NMHC emissions and NOx. For methanol fueled engines, NMHC shall mean organic material hydrocarbon equivalent.

(2) In use compliance testing shall be limited to vehicles or engine with fewer than 90,000 miles.

(3) The PM standard is for diesel only.

(4) Manufactures have the option of certifying engines used in incomplete and diesel MDV from 8501-14,000 pounds, GVW to the HD engine standards and test procedures set forth in Section1956.8(e) or 1960.1, Title 13, CCR. Manufacturers certifying to HD engine standards and test procedures shall specify, in the application for certification, an in-use compliance test procedure, as provided in section 2139(c), Title 13, CCR.

(5) For engines certified to the 3.5 grams per brake horsepower-hour (g/bhp-hr) LEV standards, the in-use compliance standard shall be 3.7 g/bhp-hr for the first two model years of introduction. For engines certified to the 2002 and 2003 model year LEV standards, the in-use compliance standard shall be 3.2 g/bhp-hr. For engines certified to the 1992 through 2003 model year ULEV standards, the in-use compliance standard shall be 2.7 g/bhp-hr for the first two model years of introduction. For engines certified to the 1992 and subsequent SULEV standards, the in-use standard shall be 2.2 g/bhp-hr for the first two model years of introduction.

(6) Manufacturers have the option of certifying to either option A or B. Manufacturers electing to certify to Option A must demonstrate that the NMHC do not exceed 0.5 g/bhp-hr.