State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS

# PUBLIC HEARING TO CONSIDER ADOPTION OF THE HEAVY-DUTY DIESEL ENGINE SOFTWARE UPGRADE REGULATION (CHIP REFLASH)

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## EXECUTIVE SUMMARY

The residents of California continue to be exposed to air quality that exceeds both the state and the national standards for ozone (or smog). Heavy-duty diesel engines are a significant source of oxides of nitrogen (NOx) emissions, which are part of an atmospheric reaction that forms smog. The Air Resources Board (ARB or the Board) lowered the NOx emission certification standard for heavy-duty diesel engines in 1991 and again in 1998 as part of the on-going effort to attain clean air. However, much of these emissions benefits have not been realized in-use due to dual calibrations used by the engine manufacturers in certain 1993-1998 model year heavy-duty diesel engines. (Dual calibration means one calibration was used during the emissions test and another calibration was used for on-highway use that was not emissions tested). In fact, the real-life emissions of these 1993-1998 model year engines are significantly higher than one would expect from their certification standards due to this “off-cycle” computer programming used by the engine manufacturers.

Both the ARB and the U.S. Environmental Protection Agency (U.S. EPA) reached agreements with the engine manufacturers that were to significantly offset the excess emissions caused by the off-cycle programming. The agreements included a number of mitigating measures that have been done, including development of low NOx software. However, years later, a core component of the agreements - installing the low NOx software - has been done on less than ten percent of the engines.

At this point, the software has been developed and it has been demonstrated to effectively mitigate much of the excess emissions with no adverse consequences. Heavy-duty diesel vehicles only need to go to dealerships to have the low NOx software uploaded (a one half hour to one hour process). However, because the software is not being installed as expected under the agreements with the manufacturers, the excess emissions continue to go unchecked. The ARB staff is recommending that the Board adopt a requirement that owners and operators of 1993-1999 model year heavy-duty trucks, school buses, and motor homes that use 1993-1998 model year heavy-duty diesel engines upgrade the software in their engine’s electronic control module (ECM).

The ARB staff is recommending a staggered implementation schedule that would require installations before 2005. Enforcement would occur through the ARB’s Heavy-Duty Vehicle Smoke Inspection Program and Periodic Smoke Inspection Program, where the software could readily be checked. The penalty for non-compliance for most vehicles would be $300 if the low NOx software were installed within 45 days of issuance of a citation, and an additional $500 penalty if the low NOx software were not installed until after 45 days of issuance of a citation.

The emissions benefits associated with the low NOx software upgrade are significant. NOx emissions would be reduced 30-40 tons per day in 2005 from California-registered vehicles and an additional six to nine tons per day from out-of-state registered vehicles. The cost-effectiveness of the proposal is excellent. At less that $100 per ton of NOx reduced, it is more cost-effective than many regulatory control measures already adopted by the ARB.

# I. OVERVIEW

## A. INTRODUCTION

### 1. What is the ARB proposing?

The California Air Resources Board (ARB or Board) staff is proposing to reduce air pollution by requiring owners and operators of trucks, school buses, and motor homes with 1993-1998 model year heavy-duty diesel engines to upgrade the software in the electronic control module (ECM) of these engines. Software upgrades were developed by the engine manufacturers and are available now for most 1993-1998 model year engines used in 1993-1999 model year vehicles.

### 2. What is a heavy-duty diesel engine software upgrade?

Most heavy-duty diesel engines produced in the 1990s use software that causes the engines in-use to emit oxides of nitrogen (NOx) at two or three times above allowable certification test levels. Heavy-duty diesel software upgrade (also referred to as low NOx software upgrade or chip reflash) is simply software installed in the ECM that reduces these excess NOx emissions.

### 3. What are off-cycle NOx emissions?

The U.S. Environmental Protection Agency (U.S. EPA), the Department of Justice, and the ARB discovered that seven large manufacturers had, during the 1990s, designed engines with advanced computer controls (software) that maximized fuel economy and created “off-cycle” NOx emissions during certain periods of vehicle operation, such as long-haul driving. Over a million heavy-duty diesel engines manufactured over a period of nearly ten years emitted off-cycle NOx emissions. Most of these engines are still emitting off-cycle NOx emissions today.

### 4. Why was low NOx software developed?

The software was developed as part of the Low NOx Rebuild Program stipulated in the federal Consent Decrees signed by the U.S. EPA, the Department of Justice, and the affected engine manufacturers. The State of California has similar agreements, called “Settlement Agreements.”

### 5. What are the Consent Decrees and the Settlement Agreements?

The federal Consent Decrees and the California-specific Settlement Agreements are legally-binding agreements with seven engine manufacturers requiring them to partially mitigate their off-cycle NOx emissions and to take corrective action to ensure that future new engines do not produce off-cycle NOx emissions. As part of

the Consent Decrees/Settlement Agreements, the engine manufacturers are required to provide low NOx software upgrades free of charge upon rebuild or upon request.

## B. APPLICABILITY

### 1. Who would be affected by the proposed heavy-duty diesel software upgrade regulation?

Most owners and operators of 1993-1999 model year heavy-duty diesel trucks, school buses, and motor homes that use 1993-1998 model year engines and that operate in California must ensure that their vehicles have the appropriate low NOx software installed. Distributors and dealers must provide the appropriate low NOx software to the vehicle owner or operator upon request.

### 2. Would out-of-state vehicles be subject to the proposed requirements?

Yes. If adopted, owners and operators of 1993-1999 model year heavy-duty diesel vehicles (trucks, school buses, and motor homes) that use 1993-1998 model year engines and are registered out-of-state but travel within California would also be required to ensure that the engines in their vehicles have the appropriate low NOx software installed.

### 3. How do I tell if my heavy-duty diesel vehicle would need low NOx software installed?

Check your engine emission control label for the manufacturer of the engine and the engine model in your heavy-duty diesel vehicle.

Caterpillar, Cummins, and Renault have low NOx software for 1993-1998 model year heavy-duty diesel truck engines. Detroit Diesel, Mack, and Volvo have low NOx software for 1994-1998 model year heavy-duty diesel truck engines. International (formerly Navistar) has low NOx software for its 1998 model year heavy-duty diesel truck engines. Engines referred to as truck engines are used not only in trucks, but also in school buses and motor homes. If low NOx software has been developed for your vehicle's engine, you would be required to install it under the proposed regulation, once it is adopted.

The ARB staff has prepared a list of engines that have low NOx software available. Compare your engine manufacturer and engine model with the prepared list, which is included as Appendix C to this staff report, or is available from our web site at: http://www.arb.ca.gov/msprog/hdsoftware/hdsoftware.htm Owners and operators of 1999 model year trucks, school buses and motor homes would also need to check their engines against this list, since many 1999 model year vehicles are equipped with engines produced in 1998.

**4. How many California-registered vehicles would be required to install low NOx software?**

We estimate that there are about 100,000 California-registered heavy-duty diesel trucks, school buses, and motor homes with 1993-1998 model year engines eligible for low NOx software upgrade. Between four and ten percent of these vehicles may already have the low NOx software upgrade installed.

**5. How many out-of-state vehicles would be required to install low NOx software?**

We estimate 300,000 to 400,000 out-of-state heavy-duty diesel vehicles with 1993-1998 model year engines visit California and would be subject to the proposed regulation.

## C. NEED FOR NOx REDUCTIONS

**1. What are the health effects associated with NOx emissions?**

NOx is a pollutant that is harmful to human health. It causes lung irritation and lung damage. NOx also reacts in the atmosphere to form ozone (smog) and contributes to the secondary formation of particulate matter, which results in haze. Smog contributes to breathing difficulties and lung tissue damage. Particulate matter contributes to increased respiratory disease, lung damage, cancer, and premature death. NOx, and the ozone and fine particulate matter it forms, are especially damaging to children, contributing to slower lung growth and development and decreased lung functioning.

**2. Why does California need NOx reductions?**

California is required to attain the National Ambient Air Quality Standards (NAAQS) and the more stringent California standards. Failure to meet the NAAQS could subject California to lawsuits and sanctions, including the loss of federal highway funds. Without this measure and others, residents of California would continue to breathe unhealthy air. <u>In short, we need NOx reductions to protect public health and to preserve the state's federal highway funding.</u>

**3. Does California have a plan to meet the National Ambient Air Quality Standards?**

California's plan for meeting the NAAQS is contained in our State Implementation Plan, or SIP. The ARB is currently updating California's SIP and is working with local air districts and the U.S. EPA to develop, adopt, and implement strategies to reduce emissions from all pollution sources in various regions in California. Once the SIP is approved, the strategies in the SIP become legally-binding commitments.

The local, state, and federal strategies in the SIP must together reduce emissions by an amount sufficient to meet the NAAQS by a specified timeframe for a specific region. The reductions from this proposed regulation are a critical component to achieving the total emission reductions needed to meet our SIP commitments.

## D. PROPOSED REQUIREMENTS

### 1. When would I have to have low NOx software installed?

If the regulation is adopted by the Board as proposed by the staff, the low NOx software upgrade must be installed between April and December 2004, depending on the model year of the engine in your vehicle. Our proposal is as follows:

| | |
|---|---|
| 1993-1994 model years | By April 30, 2004 |
| 1995-1996 model years | By August 31, 2004 |
| 1997-1998 model years | By December 31, 2004 |

### 2. How do I get the low NOx software installed?

Go to your local engine dealer or distributor and request the low NOx software for your engine. You may choose to arrange to have the low NOx software upgrade installed when your vehicle is having other maintenance performed in order to avoid an additional trip to the engine dealer or distributor. In some cases, owners with large fleets may be able to arrange for the software to be installed on-site.

### 3. Can the software be installed outside of California?

Yes. The low NOx software is available throughout the nation, not just in California. Vehicle owners and operators may use their own local engine dealers and distributors for the installation of the low NOx software upgrade.

### 4. How long would the low NOx software installation take?

The low NOx software upgrade takes only about 15 to 30 minutes to install on your engine's ECM. In some cases, the installation may take longer (if, for example, your ECM is especially hard to access). Of course, time is required for driving your vehicle to and from the engine dealer or distributor. Additionally, there may also be waiting time once you are at the dealer or distributor -- this could be reduced or eliminated by scheduling an appointment. If the low NOx software upgrade is performed at the same time as you are having other service performed, your vehicle should not be out of service any additional significant amount of time.

### 5. How would the low NOx software installations be enforced?

The ARB enforcement staff already inspects heavy-duty vehicles at California Highway Patrol (CHP) weigh stations, randomly selected roadside locations, and

fleet facilities for excessive smoke and tampering. This proposal would amend the inspection process to add a scan tool evaluation to verify that the correct low NOx software has been installed. Failure to have the low NOx software installed would result in a citation accompanied by monetary penalties.

**6. Is this like smog check for trucks?**

No. There are no in-use emission limits that vehicles would have to meet as part of this proposal.

**7. What is the proposed penalty for not installing the low NOx software as required?**

The penalty would be $300 if the low NOx software were installed within 45 days of issuance of a citation. If the software were not installed until after 45 days of issuance of a citation, there would be an additional $500 penalty. The penalties for the failure to install the low NOx software apply to both California-registered vehicles and out-of-state registered vehicles, and would be in addition to any penalties incurred in the HDVIP for excessive smoke and tampering.

**8. Are there any proposed exemptions from these penalties?**

The $300 penalty would be waived for California-registered school buses if the low NOx software were installed within 45 days of issuance of a citation. If the software were not installed until after 45 days of issuance of a citation, both the $300 penalty and the additional $500 penalty would apply.

## E. BENEFITS AND COSTS

**1. How much would the low NOx software installation cost?**

The low NOx software should be provided and installed free of charge to vehicle owners and operators. Engine manufacturers have a responsibility to mitigate the excess NOx emissions caused by the "computer-based strategies" they programmed into their engines. The ARB staff believes the applicable Consent Decrees and Settlement Agreements require manufacturers to supply the Low NOx software at no added cost whenever it is requested.

Some engine manufacturers have provided the software free of charge to all that request it. Unfortunately, some engine manufacturers are not installing the low NOx software free of charge unless it is installed in conjunction with an engine rebuild. If those engine manufacturers continue refusing to reimburse the dealers/distributors, dealers and distributors might pass charges on to the vehicle owner/operator for about one-half to one hour of labor. The ARB is pressing the engine manufacturers to meet their obligations so that the vehicle operators and owners incur no costs.

**2. What will be the cost to the vehicle owner/operator?**

The only cost to the vehicle owner should be the time that the vehicle is out-of-service. We have estimated two hours as the average time out-of-service. This estimate includes time: 1) to drive the vehicle to the dealer or distributor facility; 2) to install the low NOx software; and 3) to return the vehicle back to service. If you make an appointment with your dealer or distributor, your waiting time would be minimized. This "time cost" can be reduced to next to nothing if the low NOx software is installed at the same time as another service or repair is performed on your vehicle.

**3. How would low NOx software affect fuel economy?**

Manufacturers have reported negligible fuel economy differences. Several fleets have had the low NOx software installed prior to rebuild and have reported no noticeable differences in their fuel use. However, there is a potential for a minor fuel economy penalty. We expect the average fuel economy penalty, if any, to be below one percent.

**4. How would low NOx software affect the operation of my vehicle?**

According to the engine manufacturers, the low NOx software upgrade should have no adverse affects on the operation of your vehicle.

**5. How much would the proposed requirements reduce emissions?**

This regulation, once implemented, will reduce NOx emissions 30–40 tons per day statewide from California-registered vehicles by the year 2005. We estimate that NOx emissions will be reduced by an additional six to nine tons per day by 2005 from out-of-state registered vehicles traveling in California. The NOx benefits from this regulation are equivalent to taking more than 600,000 passenger vehicles off the road in 2005.

**6. Is the proposed regulation cost-effective?**

Yes, the proposed regulation is cost-effective at less than $100 per ton of NOx reduced. This cost-effectiveness value assumes that there are no labor charges to the vehicle owner for the installation of the low NOx software. The proposed regulation compares favorably with the cost-effectiveness of other ARB mobile source regulations.

## F. OTHER QUESTIONS

### 1. How many software installations have already been done?

To date, about four percent to ten percent of heavy-duty diesel vehicles with eligible engines have already had the low NOx software upgrade installed. This means that between about 4,000 and 10,000 heavy-duty diesel vehicles registered in California now have the low NOx software upgrade. Of the vehicles registered out-of-state that travel in California, we estimate that between 12,000 and 40,000 now have the low NOx software upgrade.

### 2. Why haven't more software installations been done?

There are several factors that may be causing the low rate of low NOx software installation to date.

First, engines are lasting longer than the ARB expected. When the Low NOx Rebuild Program was included in the Consent Decrees/Settlement Agreements, the ARB expected engine rebuilds to occur at around 300,000 to 400,000 miles of service based on prevailing information regarding engine rebuild practices. Under this precept, most heavy-duty diesel trucks with 1993-1998 model year engines should have been rebuilt by now. But the increased durability of the diesel engine has enabled many engines to run 750,000 to 1,000,000 miles before needing a rebuild.

Second, engines subject to the Consent Decree/Settlement Agreement Low NOx rebuild requirements are used in school buses and motor homes, which travel significantly fewer annual miles than do long-haul trucks. Additionally, the poor economy during the past few years may have contributed to vehicle owners delaying their engine rebuilds.

Finally, in some cases the software upgrade installations may not be occurring at the time of rebuild, even though it is required.

### 3. Why didn't the U.S. EPA and the ARB recall these vehicles and require software upgrade when we first found the problem?

During the Consent Decree/Settlement Agreement negotiations, the U.S. EPA and the ARB expected that installing the low NOx rebuild kits at the time of engine rebuild would minimize the amount of time a vehicle is out-of-service, would offset any changes in fuel economy, and would achieve a higher compliance rate. It therefore seemed more reasonable to require the installation of the low NOx rebuild kits at the time of engine rebuild (particularly if hardware were involved), rather than to mandate a truck recall.

Since then, we have learned that software alone can fix the problem, engine manufacturers have reported negligible fuel economy differences, and the software installation rate under the Low NOx Rebuild Program has been very low. Accordingly, the ARB staff is proposing this regulation to ensure that we achieve the emission reductions expected in California under the Consent Decrees/Settlement Agreements. There is no reason to wait until rebuilds are performed, and each day of delay causes adverse health impacts that could be avoided. Thus, we are proposing this regulation to quickly reduce excess NOx emissions and protect public health.

## G. RECOMMENDATION

### 1. What is the staff recommendation for Board action?

We recommend that the Board adopt new section 2011, title 13, California Code of Regulations, and amend the following sections to support the new section: 2180.1, 2181, 2184, 2185, 2186, 2192, and 2194. The proposed new regulatory language and amendments are set forth in the Proposed Regulation Order in Appendix A.

# II. BACKGROUND

## A. HEAVY-DUTY DIESEL VEHICLES AND EMISSIONS

Under the ARB's existing program to control emissions from mobile sources, heavy-duty vehicles, regardless of fuel type, are defined as vehicles with gross vehicle weight ratings (GVWRs) greater than 14,000 pounds. The heavy-duty vehicle category, which is dominated by vehicles powered by diesel engines, includes vehicles such as dump trucks, solid waste collection vehicles, fuel cargo tankers, larger delivery trucks, urban buses, school buses, motor homes, and line haul trucks.

Diesel engines are compression ignited, which means that the fuel and air mixture is ignited by high pressure in the combustion chamber instead of by spark plugs as used in gasoline-fueled vehicles. Regulating the amount of fuel injected into the combustion chamber controls the power output. The primary pollutants of concern from diesel engines are NOx and particulate matter (PM). The high temperatures and excess air cause the nitrogen in the air to combine with available oxygen to form NOx. PM emissions result from fuel droplets that have not completely combusted.

In contrast to their high NOx and PM emissions, diesel engines in heavy-duty vehicles emit relatively low levels of carbon monoxide (CO), carbon dioxide ($CO_2$), and reactive organic gases (ROG). Nonetheless, these emission impacts are important due to the potential of CO to create "hot spots" that affect public health (although nearly all areas of California are in CO attainment), the role of $CO_2$ in global warming, and the reaction of ROG in the atmosphere to form ozone.

## B. EMISSION STANDARDS

The federal Clean Air Act grants California the authority to adopt and enforce rules to control mobile source emissions within California – California is the only state in the nation with the authority to establish its own unique motor vehicle control program. In doing so, however, the ARB is required to adopt state requirements that are as stringent as, or more stringent than, the federal requirements.

Table 1 below presents the California heavy-duty diesel engine emission standards to which 1993-1998 model heavy-duty diesel engines, excluding urban bus engines, were originally required to certify using the Federal Test Procedure (FTP). The California emission standards were aligned with the federal emission standards for the model years shown.

Section IV of this staff report provides the emission limits that the low NOx software upgrades are designed to achieve. While the low NOx software upgrades

reduce off-cycle NOx emissions, they do not reduce NOx emissions to the levels that the engines were required to achieve at the time of original certification using the FTP.

**Table 1**
**California Heavy-Duty Diesel Engine Emission Standards**
**(for engines used in vehicles with GVWRs greater than 14,000 pounds, excluding urban bus engines)**

**In grams per brake horsepower-hour (g/bhp-hr)**

| Model Year | Carbon Monoxide | Non-methane Hydrocarbons | Total Hydrocarbons | PM | NOx |
|---|---|---|---|---|---|
| **1991 - 1993** | 15.5 | 1.2 | 1.3 | 0.25 | **5.0** |
| **1994 - 1997** | 15.5 | 1.2 | 1.3 | 0.10 | **5.0** |
| **1998** | 15.5 | 1.2 | 1.3 | 0.10 | **4.0** |

### C. EMISSIONS INVENTORY

The baseline statewide emissions inventory for all on-road heavy-duty diesel vehicles with GVWRs greater than 14,000 pounds is shown in Table 2 below. These emission estimates, based on the ARB's emission inventory modeling program, EMFAC2002 version 2.2, represent the emissions contribution of all heavy-duty diesel vehicles before the implementation of this regulatory proposal.

**Table 2**
**Baseline Emissions for**
**On-Road Heavy-Duty Diesel Vehicles > 14,000 lbs. GVWR**
**(Statewide, Annual Average, tons per day)**

| Pollutant | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| **ROG** | 28 | 27 | 23 | 18 | 16 |
| **NOx** | 741 | 673 | 524 | 346 | 239 |
| **PM10 (exhaust)** | 17 | 14 | 11 | 8 | 7 |
| **CO** | 135 | 123 | 108 | 94 | 88 |

## III. NEED FOR CONTROL

The proposed software upgrade regulation is an important step in further reducing the human health and environmental impacts of NOx and ozone. This section summarizes the air quality rationale for the staff's proposal.

### A. NOx

NOx is a combination of highly-reactive gases formed when fuel is burned at a high temperature. Combustion of fuel by motor vehicles is the most significant source of NOx production. NOx causes a wide variety of health and environmental problems through formation of ozone, toxic chemicals, and acid rain. This is of

particular concern for the San Joaquin Valley, which hosts at least two significant trucking corridors. Reacting with other compounds, NOx results in the secondary formation of PM in the form of nitrates. These atmospheric particles contribute to visibility impairment in both urban areas and national parks. NOx, and the ozone and fine particulate matter it forms, are especially damaging to children, contributing to slower lung growth and development and decreased lung functioning. Reducing NOx emissions is an essential component of California's strategy for cleaner air.

## B. OZONE

Ozone is formed when NOx and volatile organic compounds react in the presence of sunlight and heat. California has a serious, statewide ozone problem and is home to the top four most ozone-polluted metropolitan areas (Los Angeles-Riverside-Orange County, Fresno, Bakersfield, and Visalia-Tulare-Porterville), as ranked by the American Lung Association in 2003. Ozone causes harmful health effects ranging from eye irritation, sore throats, and coughing, to lung damage, cancer, and premature death. Those who may be severely affected include children, the elderly, and individuals with compromised respiratory systems. Even healthy children and adults who play or exercise outdoors are also at risk. In addition to human health affects, ozone interferes with the ability of plants to produce and store food, and damages the foliage of trees and other plants. It is estimated that ozone is responsible for one to two billion dollars in reduced crop production in the United States each year.

## C. STATE IMPLEMENTATION PLAN

The federal Clean Air Act requires each region that violates National Ambient Air Quality Standards (NAAQS) to develop a State Implementation Plan (SIP). The local, state, and federal strategies in the SIP must together reduce emissions by an amount sufficient to meet the NAAQS by a specified timeframe for a specific region. California's SIP is a collection of region-specific plans that detail how each area will meet the air quality standards. These plans include permitting and monitoring programs, local air district rules, state regulations, and federal controls. California has SIPs for meeting ozone, PM, and CO air quality standards for areas of nonattainment.

We have made significant progress in controlling ozone throughout California by reducing NOx and ROG emissions. Statewide exposure to unhealthful ozone concentrations has been cut in half since 1980. However, California still has areas that violate the one-hour federal ozone standard. In addition, most of California does not attain the more health-protective state and new federal standards for ozone. As such, additional reductions in NOx emissions are critical for achieving federal and state ozone standards.

The ARB is currently updating California's SIP and is working with local air districts and the U.S. EPA to develop, adopt, and implement strategies to reduce

emissions from all pollution sources in various regions in California. Once the SIP is approved, the strategies it contains become legally-binding commitments. The Board already approved one regional element of the California SIP on June 26, 2003 – the San Joaquin Valley PM10 SIP. On September 25, 2003, the Board is scheduled to consider the South Coast SIP. This regulatory proposal is a component of these two regional SIP elements. The reductions from this proposed regulation are critical to achieving the total emission reductions needed to meet our SIP commitments.

## IV. NEED FOR THE PROPOSED REGULATIONS

### A. OFF-CYCLE EMISSIONS

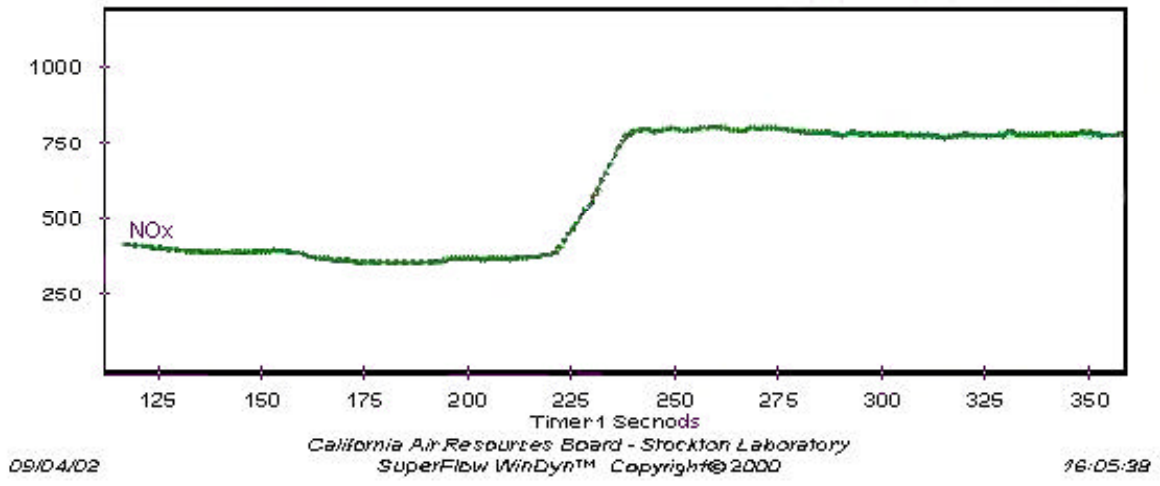
The U.S. EPA, the Department of Justice, and the ARB discovered that seven large manufacturers had, throughout the late 1980s and 1990s, designed engines with advanced computer controls that maximized fuel economy during certain typical periods of vehicle operation, such as long-haul driving. These computer-based strategies, utilized on engines in trucks, school buses, urban buses, and motor homes, allowed the engines to comply with emission limits when being tested on the FTP, but caused increased NOx emissions during highway driving. This type of programming is sometimes referred to as "dual mapping." The result was in-use NOx emissions significantly higher than the emission levels to which the engine was certified. We call these high NOx emissions "off-cycle" or excess NOx emissions. Over a million heavy-duty diesel engines manufactured over a period of nearly ten years emitted excess NOx emissions nationwide. Most continue to do so.

Figure 1 below demonstrates the representative increase in NOx emissions when an engine switches to off-cycle mode. Based on test data from the ARB's Stockton Inspection and Maintenance Development Laboratory, Figure 1 shows that after about 220 seconds of engine operation in a steady state mode typical of on-highway driving, the engine's alternative control map program begins operation resulting in an approximate doubling of NOx emissions. These increased NOx emissions are emitted from almost 100,000 California-registered vehicles driving on the road everyday. An additional 300,000 to 400,000 affected 1993-1999 model year vehicles travel in California from out-of-state emitting increased NOx emissions from the off-cycle engine mode.

**Figure 1**

**Graph of Off-Cycle NOx Emissions**

**PPM (concentration) vs. Time**




## B. CONSENT DECREES AND SETTLEMENT AGREEMENTS

The federal Consent Decrees and the California-specific Settlement Agreements are legally-binding agreements with the affected engine manufacturers. These agreements require the engine manufacturers to partially mitigate off-cycle NOx emissions from existing engines and to take corrective action to ensure that future new engines do not produce off-cycle NOx emissions. In addition to the low NOx rebuild requirements discussed below, other key provisions of the Consent Decrees/Settlement Agreements are: 1) the requirement for the majority of affected engine manufacturers to begin producing engines meeting the NOx plus non-methane hydrocarbons (NMHC) emission standard for 2004 and later model year engines by October 1, 2002 – over one year ahead of when originally required by the U.S. EPA and the ARB; and 2) the requirement for affected engine manufacturers to certify engines by October 1, 2002, using supplemental certification procedures known as the Not-To-Exceed (NTE) test and the EURO III European Stationary Cycle (ESC) test, in addition to the FTP. A brief discussion of the supplemental test procedures (the NTE and the ESC) is presented in the next section.

## C. LOW NOx REBUILD REQUIREMENTS

### 1. Emissions Limits

The affected engine manufacturers agreed to reduce NOx emissions from pre-settlement engines through certain software and/or minor hardware changes made to the engines through the use of low NOx rebuild kits. The manufacturers[1] were given two emission-limit options as shown in Table 3 below. Option B has higher emission limits than Option A, but includes an additional model year of engines. A generic version of the Low NOx Rebuild Program language is contained in Appendix B to this staff report. Appendix B is intended to help clarify the Low NOx Rebuild Program requirements. Appendix B, however, is not a legal document and is not intended to represent the minor manufacturer-specific requirements in the individual Consent Decrees/Settlement Agreements.

**Table 3**
**Low NOx Rebuild Requirements**

| **Option A (1994 – 1998)** | | | **Option B (1993 – 1998)** | | |
|---|---|---|---|---|---|
| | **MHDDE** | **HHDDE** | | **MHDDE** | **HHDDE** |
| **Euro III (ESC)** | 6.0 g/bhp-hr | 7.0 g/bhp-hr | **Euro III (ESC)** | 6.5 g/bhp-hr | 7.5 g/bhp-hr |
| **NTE** | 7.5 g/bhp-hr | 8.75 g/bhp-hr | **NTE** | 8.1 g/bhp-hr | 9.38 g/bhp-hr |

Upon rebuild of any engine in an engine family specified in the Consent Decrees/Settlement Agreements, the low NOx rebuild kit is to be installed at no additional cost to the vehicle owner. The Consent Decrees/Settlement Agreements indicate that the low NOx rebuild kit is to be installed on engines being rebuilt with accumulated mileage greater than 290,000 miles on a heavy heavy-duty diesel engine (HHDDE) and greater than 185,000 on a medium heavy-duty diesel engine (MHDDE). HHDDEs are used in vehicles with GVWRs greater than 33,000 pounds, while MHDDEs are used in vehicles with GVWRs of 14,001-33,000 pounds. The Consent Decrees/Settlement Agreements also stipulate that low NOx rebuild kits are to be installed on engines with less than the specified mileage where the service event includes replacement or reconditioning of more than one major cylinder component in all of the engine's cylinders. Finally, the affected engine manufacturers must make low NOx rebuild kits available to anyone that requests one.

The Consent Decrees/Settlement Agreements also subject urban bus engines to the low NOx rebuild requirements due to off-cycle emissions. However, the Consent Decrees/Settlement Agreements contain provisions allowing manufacturers to exclude engines manufactured at a low volume from the low NOx rebuild

[1] Except Navistar – For Navistar/International, the low NOx rebuild only applies to 1998 model year engines without stipulated NOx limits

requirements. The two manufacturers of urban bus engines, Detroit Diesel Corporation and Cummins, have used the low volume exemption for their urban bus engines. As a result, no low NOx rebuild kits are available for urban buses. In estimating the emission benefits of this proposal, we did not include any emission reductions from the urban bus engine category.

## 2. Engine Rebuild Practices

An engine rebuild generally involves the disassembly of the engine to a point where high wear components are checked and measured against the Original Equipment Manufacturer specifications, replaced or reconditioned as necessary, and reassembled. The components that are checked during the rebuild process are engine bearings, piston rings, rod, valves and springs, and gaskets and seals. An "in-frame" rebuild is carried out when the engine is still in the vehicle, while an "out-of-frame" rebuild takes place after the engine is removed from vehicle. The difference between these two rebuilds lies in the thoroughness of the service. In addition to replacing the same parts as an in-frame rebuild, an out-of-frame rebuild may replace the camshaft bearing, turbocharger, and other fuel system components, such as fuel injectors and the fuel injection pump, that are inaccessible during in-frame maintenance.

Under the Consent Decrees/Settlement Agreements, low NOx software is to be installed upon engine rebuild, or when otherwise requested (e.g., at other service events). At the time of negotiations for the Consent Decrees and the Settlement Agreements, the prevailing assumption was that engine rebuilds were occurring at mileage intervals of about 300,000 to 400,000 miles. Nowadays, heavy-duty diesel engines are performing well for longer periods of time and engine rebuilds occur closer to when the engine has accumulated 750,000 to 1,000,000 miles. While engine manufacturers have complied with the provisions of the Low NOx Rebuild Program requiring them to develop low NOx rebuild kits (i.e., software upgrades), rebuilds are not occurring as expected and only a small percentage (about four to ten percent) of eligible engines have had the software upgrades installed. As such, the Low NOx Rebuild Program is not achieving its expected emission benefits.

It is important to note that while the Consent Decrees/Settlement Agreements contain mileage accumulation thresholds for installation of the software upgrades upon rebuild, there are no regulatory requirements mandating engine rebuilds at specific mileage intervals or that they be performed at all. The decision to perform an engine rebuild is mostly an economic decision on the part of the vehicle owner and it is generally performed only when other maintenance will not correct such problems as increased oil consumption, loss of performance, poor fuel economy, or engine failure.

### 3. Engine Certification Test Procedures

Prior to the implementation of the Consent Decrees/Settlement Agreements, new heavy-duty engines were certified to applicable emission standards based on compliance with a standardized laboratory test method known as the FTP. The FTP mimics the light loads and low speeds typical of urban driving. The high speed, high load operating conditions typical of on-highway heavy-duty trucks, or other heavy-duty vehicles operating in a steady-state mode, are not well represented on the FTP.

Due to the limitations of the FTP in capturing a heavy-duty engine's emission levels over a range of simulated driving conditions, the Consent Decrees/Settlement Agreements included provisions requiring compliance with the supplemental test procedures (the NTE and ESC) by October 1, 2002. The supplemental test procedures are more representative of typical on-highway driving conditions than the FTP and will help ensure that future new engines do not continue to emit off-cycle NOx. Recognizing the effectiveness of the NTE and the ESC in testing heavy-duty engine emission levels over the majority of real world driving conditions, both the U.S. EPA and the ARB have adopted rules requiring the use of the supplemental test procedures, in addition to the FTP, for new engine certification. While the U.S. EPA requirements do not become effective until the 2007 model year for federally-certified engines, engines produced for sale in California must be certified using the supplemental test procedures, in addition to the FTP, beginning with the 2005 model year (except for urban bus engines, which are not required to submit to testing under the supplemental procedures until the 2007 model year).

Because of their ability to mimic more real world driving conditions, the supplemental test procedures are also the basis for the emission limits contained in the Low NOx Rebuild Program. The low NOx software upgrades are designed to meet specified emission limits on the NTE and ESC tests and will reduce off-cycle NOx emissions from existing engines. However, the software upgrades will not reduce NOx emissions to the levels that the engines were required to achieve at the time of original certification using the FTP. Neither the Low NOx Rebuild Program nor this regulatory proposal contain requirements for in-use testing to verify emission levels.

## D. POTENTIAL CONCERNS ABOUT LOW NOx SOFTWARE INSTALLATION

The Consent Decrees/Settlements Agreements require the affected engine manufacturers to report the impact of low NOx software on fuel consumption, driveability, and safety. According to the manufacturers, there are negligible impacts on fuel economy and no detected impacts on driveability and safety.

Not only have the manufacturers reported negligible fuel economy differences, several fleets have had the low NOx software installed prior to rebuild and have also

reported no noticeable differences in their fuel use. However, there is a potential for a minor fuel economy penalty. We expect the average fuel economy penalty, if any, to be below one percent.

Nationwide, approximately 90,000 vehicles have already had the low NOx software installed. While this represents a small percentage of the total vehicles nationwide for which low NOx software upgrades are available, it is still a significant number of vehicles. We are not aware of any truck owner/operator complaints regarding significant changes in fuel economy or performance as a result of the installation of the low NOx software.

Another concern is the potential for the engine's ECM to stop working. Based on limited data provided to us by distributors, we estimate the current ECM failure rate at the time of low NOx software upgrade to be less than one percent. Replacing a failed ECM can cost $1500 or more. If the ECM fails at time of software installation, the truck owner/operator would naturally assume the failure was related to the software installation. Although the Consent Decrees/Settlement Agreements are silent on ECM failure, we believe the manufacturers should assume some responsibility for their functioning. However, apportioning financial responsibility for failure of ECMs, many of which are now out of warranty, is ultimately between the customer and the dealer or distributor performing the service. We will continue to evaluate reported incidences of ECM failure.

## V. PROPOSED REQUIREMENTS

We are proposing to reduce NOx emissions by requiring owners and operators of trucks, school buses, and motor homes with 1993-1998 model year heavy-duty diesel engines to upgrade the software in the ECM of these engines. Software upgrades have been developed by the engine manufacturers and are available now for affected 1993-1998 model year engines, which are used in 1993-1999 model year vehicles.

The affected engine manufacturers agreed to reduce NOx emissions from existing engines through certain software and/or hardware changes made to the engine. However, all low NOx rebuild kits developed by the engine manufacturers include only software changes; they do not include any hardware changes to the engine. Therefore, the installation of low NOx software does not involve a significant modification to the engine. The low NOx software installation is not restricted to times of regularly scheduled major maintenance or engine rebuild and may therefore be installed during other service events.

The following sections discuss the major provisions of the proposed regulation.

## A. APPLICABILITY

The requirements to install low NOx software apply to owners of eligible 1993-1999 model year vehicles and to engine dealers and distributors. Eligible vehicles are those equipped with 1993-1998 model year engines for which low NOx software is available. A list of the engines with low NOx software available is in Appendix C of this staff report. The requirements apply to all eligible vehicles operating in California whether registered in California or elsewhere.

## B. LOW NOx SOFTWARE LABEL

Our proposal requires that a label be affixed to each engine upon installation of the low NOx software. The proposed label requirements mirror those in the Consent Decrees/Settlement Agreements. Therefore, the same label that has been used for compliance with the Low NOx Rebuild Program under the Consent Decrees/ Settlement Agreements may be used for compliance with this regulation.

The label is to include an identifiable characteristic that indicates that the engine has low NOx software, a place for the date of installation, and the name of the individual who performed the installation. The label material is to be suitable for the location and fabricated so that the label cannot be removed intact. Finally, the placement of the label is to be consistent with California law.

## C. EXEMPTIONS

For California-registered school buses, the initial $300 penalty for failing to install the low NOx software by the appropriate compliance date would be waived if the software were installed within 45 days of issuance of a citation. However, if the software were not installed until after 45 days, both the $300 penalty and the additional $500 penalty would apply.

## D. IMPLEMENTATION SCHEDULE

As proposed by the ARB staff, the low NOx software upgrades must be installed between April and December 2004, depending on the model year of the applicable engine. Our proposal is as follows:

| | |
|---|---|
| 1993-1994 model years | By April 30, 2004 |
| 1995-1996 model years | By August 31, 2004 |
| 1997-1998 model years | By December 31, 2004 |

## E. ENFORCEMENT

Installations of the low NOx software would be verified by ARB enforcement staff through the existing Heavy-Duty Vehicle Inspection Program (HDVIP) and the

Periodic Smoke Inspection Program (PSIP). In the HDVIP, the ARB staff already inspects heavy-duty vehicles at California Highway Patrol (CHP) weigh stations, randomly selected roadside locations, and fleet facilities for excessive smoke and tampering. The PSIP requires fleet operators to self-inspect their vehicles and to repair those exceeding smoke opacity limits.

When implemented, we expect that existing enforcement staff will be targeting enforcement of this regulation during its first two or three years to ensure that the low NOx software upgrades are indeed occurring as required. Due to the near-term compliance dates of this proposal, we do not anticipate that significant on-going staff resources will be required to target enforcement of this regulation in the long-term.

As part of this proposal to require the installation of the low NOx software, we are also proposing to amend the HDVIP to include an evaluation of both in-state and out-of-state vehicles to verify that the correct low NOx software has been installed on each applicable heady-duty diesel vehicle. This evaluation will be performed using a scan tool provided by each engine manufacturer. Out-of-state vehicles will not be subject to any fleet facility inspections. This proposal also includes amendments to the PSIP that require fleets subject to the PSIP to demonstrate installation of the applicable low NOx software through record keeping requirements. Failure to have the low NOx software installed by the compliance dates shown above would result in a citation accompanied by the monetary penalties described below.

## F. PENALTIES

Under the proposed regulation, the penalty for failing to install the low NOx software by the specified compliance dates would be $300 if the low NOx software were installed within 45 days of issuance of a citation. If the software were not installed until after 45 days of issuance of a citation, there would be an additional $500 penalty. The proposed penalties for the failure to install the low NOx software apply to both California-registered vehicles and out-of-state registered vehicles, and would be in addition to any penalties incurred in the HDVIP for excessive smoke and tampering. However, the $300 penalty would be waived for California-registered school buses if the low NOx software were installed within 45 days of issuance of a citation. If the software were not installed until after 45 days, both the $300 penalty and the additional $500 penalty would apply.

## G. RECORDKEEPING

The proposed regulation requires vehicle owners and operators to record certain information associated with the low NOx software upgrade upon installation. This information, which is necessary to demonstrate the installation of the low NOx software for each applicable engine, includes: 1) the name, address, and phone number of the facility performing the installation; 2) the name of the person performing the installation; 3) the date of the installation; and 4) a description of the

eligible engine, including the engine family name and number, and the low NOx software installed. This information is likely to be contained on a repair receipt or completed work order. The records required to demonstrate the installation of the low NOx software are important for ensuring that the NOx reductions are achieved and that public health is protected.

# VI. REGULATORY ALTERNATIVES

## A. DO NOT AMEND CURRENT CALIFORNIA REGULATIONS

One alternative we considered was not going forward with this regulatory proposal. In this case, low NOx software installations would only occur under the existing provisions of the Low NOx Rebuild Program, if at all. As already discussed, the software upgrades are not occurring as anticipated and thus the Low NOx Rebuild Program is not achieving significant emission reductions in a timely manner.

We rejected this alternative because we have proposed SIP commitments to obtain the potential NOx reductions achieved by installing low NOx software. Not implementing this proposal will slow California's progress in attaining the federal NAAQS. Installing low NOx software is critical to reducing off-cycle NOx emissions to the maximum extent possible right now and to achieving our SIP emission reduction targets.

## B. INSTITUTE SOFTWARE UPGRADE ON A VOLUNTARY BASIS

The engine manufacturers encouraged implementing a voluntary program to install the low NOx software. Two of the affected engine manufacturers have offset projects or supplemental emissions projects that provide incentives to vehicle owners to install the low NOx software prior to engine rebuild. Even with these incentives available, the number of engines that have the low NOx software installed has remained very low. An improvement over the current situation might be realized with the addition of incentive money provided by the state. We estimate that up to 15 percent of the fleet could be captured with a 300 dollar per vehicle incentive at a cost to the state of up to 5 million dollars. The associated emission reductions are estimated to be zero to six tons per day of NOx.

We did not pursue this alternative for a couple of reasons. The first reason that staff rejected this approach is because the engine manufacturers have a responsibility to mitigate the off-cycle NOx emissions caused by the "computer-based strategies" they programmed into their engines. But more importantly, only nominal NOx reductions could be achieved, thus hindering our ability to meet our SIP emission reduction targets.

### C. REQUIRE LOW NOx SOFTWARE TO BE DEVELOPED FOR ALL 1993-1998 MODEL YEAR ENGINES

Low NOx software has not been developed for every 1993-1998 model year heavy-duty engine manufactured by the affected engine manufacturers. Under the Consent Decrees/Settlement Agreements, the manufacturers were given two options for developing the low NOx software. In one option, software for 1994-1998 model year engines has been developed and the NOx emission allowance is slightly lower than in the other option. In the other option, software for 1993-1998 model year engines has been developed and the NOx emission allowance is slightly higher. Since some manufacturers chose the option to develop low NOx software for only the 1994-1998 engines, that means there is no low NOx software for the 1993 engines manufactured by those companies. In addition to the two options for developing the low NOx software, the engine manufacturers were not required to develop low NOx software for engines manufactured in low volumes.

We considered proposing a regulation to require that additional low NOx software be developed for the 1993 model year engines and the low-volume engines that do not currently have low NOx software available. We rejected this alternative because of the time and effort necessary to develop the new software for the relatively few number of vehicles not captured by this regulatory proposal.

### D. SUMMARY

No alternative considered by the agency would be more effective in carrying out the purpose for which the regulation is proposed or would be as effective or less burdensome to affected private persons than the proposed regulation.

## VII. OUTREACH AND STATUTUORY AUTHORITY

### A. OUTREACH

We conducted workshops on February 24, 2003, and June 25, 2003, to introduce the regulatory proposal concept and then later to describe some of the specifics as the proposal was being further developed. The public was notified of these meetings via notices sent by mail to interested parties on certain ARB mailing lists and via e-mail notification stating that the workshop notice had been posted on the ARB web site.

Interested parties notified via mail included air pollution control officers throughout California, members of environmental organizations, parties interested in heavy-duty vehicle programs, such as the Heavy-Duty Vehicle Inspection Program, school bus program affiliates, and environmental justice affiliates. Because the regulatory proposal affects engine dealers/distributors, we made a concerted effort

to develop a mailing list to include them. At the same time, we created a new e-mail list serve to service anyone with an e-mail address.

After the first workshop, as our regulatory proposal development progressed, we became concerned that individuals who owned vehicles with 1993-1998 model year heavy-duty diesel engines had not been adequately engaged in the public process. We developed a letter directed to the largest number of 1993-1998 model year heavy-duty diesel engine owners. This letter was directed at over 40,000 owners/operators of 1993-1998 model year trucks registered in California. This letter was attached to the second workshop notice and sent to both the interested parties already mentioned and to the truck owners/operators whose addresses were gleaned from a DMV database.

During the regulatory proposal development, face-to-face meetings were held with the affected engine manufacturers. Telephone conversations have been conducted with trucking associations (both state and national associations), with engine manufacturer representatives, with engine dealers/distributors, and with truck owners/operators. Preliminary workshop notices were shared with the California Trucking Association and the American Trucking Association. Workshop notices were also mailed to trucking associations in the three states contiguous with California – Oregon, Nevada, and Arizona. The ARB has been proactive and thorough in the outreach efforts for the Heavy-Duty Diesel Engine Software Upgrade regulatory proposal.

Prior to the enforcement dates, the ARB staff will make a dedicated effort to inform affected truck owners/operators of this proposed regulation, should the Board adopt it. Our outreach will include mailing notices through Department of Motor Vehicles (DMV) records, distributing informational notices at HDVIP inspection points, posting informational notices at truck stops, and working with dealers and trucking associations to further disseminate information.

## B. STATUTORY AUTHORITY

Sections 39600 and 39601 of the Health and Safety Code authorize the ARB to adopt standards, rules, and regulations and to do such acts as may be necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law. In section 43000 of the Health and Safety Code, the Legislature has declared that the emission of air pollutants from motor vehicles is the primary cause of air pollution in many parts of the state. In sections 39002 and 39003 of the Health and Safety Code, the Legislature has charged the Board with the responsibility of systematically addressing the serious air pollution problem caused by motor vehicles. Another section, Health and Safety Code Section 43013, and specifically subsection (h) therein, directs the Board to adopt standards to reduce air contaminants from vehicular sources, including NOx emissions from diesel vehicles. Also, Health and Safety Code Section 43018 directs the Board to endeavor to achieve the maximum degree of emission reduction possible from vehicular sources

to accomplish the attainment of state ambient air quality standards by the earliest practicable date. Finally, section 43701(b) of the Health and Safety Code requires the Board to adopt regulations that require heavy-duty diesel vehicles to utilize emission control equipment and alternative fuels to reduce emissions to the greatest extent feasible.

### C. NOTICE OF DISPUTE

Six of the seven affected engine manufacturers have sent the ARB a jointly-signed letter (dated August 22, 2003) claiming that requiring installation of low NOx rebuild kits before the time of normal engine rebuild would breach Settlement Agreements between those manufacturers and the ARB. By sending the ARB this letter, the engine manufacturers have initiated the dispute resolution process that begins with attempts to resolve this issue through informal negotiations. Only after informal negotiations have failed would this issue be submitted for formal mediation. These potential negotiations and mediation, which may occur concurrently with this regulatory proposal, may or may not lead to a resolution of the dispute before the Board considers this regulatory proposal. The ARB believes that the Consent Decrees/Settlement Agreements do not preclude the ARB from using its regulatory powers to require the installation of low NOx software before the time of normal engine rebuild.

## VIII. ENVIRONMENTAL IMPACTS AND COST-EFFECTIVENESS

### A. EMISSION BENEFITS OF PROPOSED REGULATION

**Table 4**
**Estimated Statewide NOx Reductions from Software Upgrade**
**Calendar Year 2005, tons per day**

| California-Registered Vehicles | Out-of-State Registered Vehicles Operating in California | Total |
|---|---|---|
| 30-40 | 6-9 | 36-49 |

Table 4 above presents the estimated emission benefits of this regulatory proposal. The estimated statewide NOx reductions in 2005 are 30 to 40 tons per day from California-registered vehicles. The estimated reductions from out-of-state vehicles traveling in California in 2005 are estimated to be an additional 6 to 9 tons per day of NOx, for total reductions of 36 to 49 tons per day. Out-of-state vehicles account for about 25 percent of the heavy heavy-duty diesel truck (trucks with GVWRs greater than 33,000 pounds) mileage and emissions in the California emissions inventory.

#### 1. Calculation of Emission Reductions

The estimated emission reductions are based on vehicle miles traveled, confidential Consent Decree data on engine manufacturer market share, engine time

in off-cycle mode and engine emissions level in off-cycle mode, as well as estimated emissions levels after software upgrade.

In estimating emission reductions, we corrected for a number of factors: the applicable model years for each manufacturer, the number of vehicles that have already received the software upgrade, the manufacturers' low volume exemption, and the differences between calculated NOx emissions and modeled NOx emissions. The range of estimated benefits reflects the uncertainty in those corrections.

### 2. South Coast SIP Emission Reductions

The estimated NOx emission reductions in the South Coast Air Basin in 2010 as a result of this proposed regulation are 8 to 10 tons per day. These reductions are SIP creditable (included in the inventory and therefore can count towards SIP commitments) emission reductions from California-registered vehicles. However, due to the uncertainty in the number of 1993-1999 model year vehicles that would still be involved in interstate commerce in 2010, no reductions from out-of-state vehicles are included in the estimated NOx benefits for the South Coast region.

## B. COST-EFFECTIVENESS

The proposed software upgrade regulation is very cost-effective at less than $100 per ton of NOx reduced and compares favorably with the cost-effectiveness of other ARB mobile source regulations. The cost-effectiveness value assumes no labor costs are incurred by vehicle owners for the software installation because the engine manufacturers are required to cover these costs under the Consent Decrees/Settlement Agreements.

# IX. ECONOMIC IMPACTS

## A. LEGAL REQUIREMENT

Sections 11346.3 and 11346.5 of the Government Code require state agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment includes 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 non-discretionary cost or savings to local agencies and the cost or savings in federal funding to the state.

## B. AFFECTED BUSINESSES

In developing this regulatory proposal, the ARB staff evaluated the potential economic impacts on representative private persons or businesses. There may be as many as 40,000 businesses, up to 3000 school districts, and over 5000 motor home owners that operate vehicles powered with 1993-1998 model year heavy-duty diesel engines affected by this proposal. Also affected are approximately 100 dealers/distributors for Caterpillar, Cummins, Detroit Diesel, Mack/Renault, International (Navistar), and Volvo that have the capability to install low NOx software into an eligible engine's ECM. Finally, this proposal will also affect the seven engine manufacturers mentioned already – each of which is located outside of California. The total statewide costs that businesses and individuals may incur to comply with this regulation over its lifetime are up to eight million dollars.

### 1. Number of California-registered vehicles

There are about 100,000 heavy-duty diesel vehicles with 1993 through 1998 model year diesel engines registered in California. That total is based on 2002 DMV registration records. It excludes urban buses, for which the applicable engine manufacturers have used their low volume exemptions from the provisions of the Low NOx Rebuild Program.

After sorting DMV registrations to account for the companies that own multiple trucks, we believe that there are approximately 40,000 companies that own heavy-duty diesel vehicles affected by this proposal and 100 heavy truck dealers/distributors in California.

### 2. Number of out-of-state vehicles

We estimate 300,000 to 400,000 out-of-state registered vehicles will visit California and would be subject to the regulation. This is based on DMV- reported 1.37 million International Registration Program (IRP) vehicles that visited California in 2002 (DMV, 2003). Of the California-registered vehicles, about 29 percent have 1993-1998 model year engines. We would expect trucks used in interstate commerce to be somewhat newer than the general truck population. Therefore, our estimate assumes that about 22 percent to 29 percent of out-of-state registered vehicles visiting California would be subject to the regulation.

While our legal obligation is to assess the potential for adverse economic impacts on California business enterprises and individuals, we also want to acknowledge the potential impact on enterprises and individuals outside of California. Because we want to promote a level playing field for California businesses, we are also requiring 1993-1999 model year trucks, buses, and motor homes registered out-of-state to comply with this regulatory proposal, when implemented.

## C. POTENTIAL COSTS TO VEHICLE OWNERS OR OPERATORS

Because the engine manufacturers are required to pay for the installation costs of the software upgrade under the provisions of the Consent Decrees/Settlement Agreements, the only costs to the vehicle owners or operators should be the time that the vehicle is out-of-service. We have estimated two hours as the average time out-of-service. This estimate allows for time to: 1) drive the truck to the dealer/distributor facility; 2) to install the low NOx software; and 3) to return the truck to service. An appointment is essential to minimize the wait time for the low NOx software installation. We have estimated the dollar amount for vehicle time out-of-service at one hundred dollars per vehicle. This cost can be reduced to next to nothing if the low NOx software is installed at the same time as other service or repair is performed on the vehicle.

In the event that the engine manufacturers refuse to provide reimbursement to their dealers/distributors, the cost to the vehicle owner or operator may include half an hour to one hour of labor at a minimum. The ARB is pressing the engine manufacturers to meet their obligations so that no labor costs are incurred by vehicle owners or operators.

## D. POTENTIAL COSTS TO ENGINE DEALERS/DISTRIBUTORS

There should be no cost to the dealers/distributors whether the engine manufacturers reimburse them or they charge the vehicle owner/operator. Under the Consent Decrees/Settlement Agreements, the low NOx software is to be provided free of charge to anyone that requests it. Engine manufacturers have provided dealers/distributors with codes to use for billing the manufacturers for costs associated with low NOx software installations at the time of rebuild. We believe that the engine manufacturers should allow use of these reimbursement codes for low NOx software installation prior to rebuild.

At the time of this writing, the actions of the engine manufacturers have created uncertainty among engine dealers/distributors. Some dealers/distributors have stated that they do not have reimbursement codes from the engine manufacturers to cover their labor costs for installing low NOx software prior to an engine rebuild. Other dealers believe that they are to install the low NOx software for anyone that asks and that the engine manufacturer will reimburse them for their labor. Some dealers are charging both for labor and the low NOx software when installed before rebuild. Other dealers are providing the software at no charge, but charge for labor. We expect to resolve these differences in reimbursement practices by working with the engine manufacturers and the engine dealers/distributors prior to implementation of this proposal, if adopted by the Board.

### E. POTENTIAL COSTS TO ENGINE MANUFACTURERS

Costs to engine manufacturers are not increased beyond their costs to comply with the Consent Decrees/Settlement Agreements. Engine manufacturers have a responsibility to mitigate the excess NOx emissions caused by the "computer-based strategies" they programmed into their engines. The ARB staff believes the applicable Consent Decrees/Settlement Agreements require manufacturers to supply the Low NOx software at no added cost whenever it is requested.

Engine manufacturers may see this proposal as an acceleration of the requirements under the Consent Decrees/Settlement Agreements with the possibility of increasing their costs of reimbursing engine dealers/distributors for labor. We believe that most 1993-1998 model year engines should have been rebuilt and had the low NOx software installed by now, and therefore this cost is illusory.

Some engine manufacturers are already providing the software free of charge to anyone that requests it. Unfortunately, some engine manufacturers are not installing the low NOx software free of charge unless it is installed in conjunction with an engine rebuild. The ARB is pressing the engine manufacturers to meet their obligations so that dealers are reimbursed and vehicle operators and owners incur no costs.

### F. POTENTIAL COSTS TO STATE AND LOCAL AGENCIES

The proposed requirements are not expected to result in an increase in costs for state and local agencies. We recognize that some state and local agencies, particularly school districts, may have 1993-1999 model year vehicles affected by the proposed requirements. We expect state and local agencies would eliminate any time out-of-service costs associated with complying with the proposed requirements by scheduling low NOx software installation at the same time as other scheduled maintenance. We expect state and local agencies, in many cases, have regular maintenance scheduled. School buses, for example, are inspected annually by the California Highway Patrol, and thus would need to be well-maintained

## X. ENVIRONMENTAL JUSTICE

The ARB is committed to integrating environmental justice in all its activities. On December 13, 2001, the Board approved its Environmental Justice Policies and Actions, which formally established a framework for incorporating environmental justice into the ARB's programs, consistent with the directives of state law. Environmental justice is defined as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. While this practice applies to all communities, our Environmental Justice Policies and Actions assist us

in implementing regulations and programs that can provide direct benefits to communities disproportionately impacted by pollution.

Our Environmental Justice Policies and Actions are intended to promote the fair treatment of all residents in California and to cover the full spectrum of ARB activities. Underlying the Board's environmental justice policies is the recognition that we need to engage community members in a meaningful way as we carry out our activities. People should have the best possible information about the air they breathe and what is being done to reduce unhealthful air pollution in their communities. The ARB recognizes its obligation to work closely with all stakeholders; communities, environmental and public health organizations, industry, business owners, other agencies, and all other interested parties to successfully implement the environmental justice policies.

This regulation, when adopted, will provide immediate air quality benefits by reducing NOx emissions from the wide variety of older heavy-duty diesel vehicles, many of which operate in neighborhoods (for example, school buses) and in mixed-use communities (residential/commercial/industrial areas). Reducing emissions from heavy-duty diesel vehicles will aid in our efforts to protect the health and safety of residents and workers in these areas.

## XI. SUMMARY AND STAFF RECOMMENDATION

### A. SUMMARY OF STAFF'S PROPOSAL

As presented in the previous sections, the staff proposal is designed to provide significant reductions of NOx emissions through low NOx software upgrades to most 1993-1998 model year heavy-duty diesel engines. The staff's proposal includes the following:

- Owners of 1993-1999 model year trucks, school buses, and motor homes with 1993-1998 model year heavy-duty diesel engines would be required to upgrade the software in their engines' ECM.
- The low NOx software shall be installed by April 30, 2004 (for 1993-1994 model year engines), by August 31, 2004 (for 1995-1996 model year engines), and by December 31, 2004 (for 1997-1998 model year engines).
- The penalty for non-compliance would be $300 if the upgraded software were installed within 45 days of issuance of a citation, and an additional $500 penalty if the software were not installed until after 45 days of issuance of a citation. Owners of California-registered school buses would have a waiver of the $300 penalty, if the upgrade were performed within the required 45 days.
- The requirement would apply to all applicable engines, including those used in heavy-duty diesel vehicles registered out-of-state.

## B. STAFF RECOMMENDATION

The ARB staff recommends that the Board adopt a new section 2011, title 13, California Code of Regulations and amend sections 2180.1, 2181, 2184, 2185, 2186, 2192, and 2194, title 13, California Code of Regulations. The regulation is set forth in the Proposed Regulation Order in Appendix A.

## XII. REFERENCES

American Lung Association, 2003. State of the Air: 2003. http://www.lungaction.org/reports/sota03_full.html.

ARB, 1998. 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, March 6, 1998.

ARB, 2003. Proposed 2003 State and Federal Strategies for the California State Implementation Plan, May 2003.

DMV, 2003. Telephone conversation Francine Davies, Department of Motor Vehicles, on July 8, 2003.

U.S. EPA, 1995. Heavy-Duty Engine Rebuilding Practices, March 21, 1995.

U.S. EPA, 2000. Notice of Final Rulemaking, Control of Emissions of Air Pollution From 2004 and Later Model Year Heavy-Duty Highway Engines and Vehicles; Revision of Light-Duty On-Board Diagnostics Requirements, Signed by Carol Browner, United States Environmental Protection Agency Administrator, July 31, 2000; 65 Federal Register 59896, October 6, 2000.