

**QUESTIONS AND ANSWERS:  
REGULATORY PROPOSAL FOR HEAVY-DUTY DIESEL  
SOFTWARE UPGRADE**

**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 available from our web site at:

<http://www.arb.ca.gov/msprog/hdsoftware/hdsoftware.htm>

Owners and operators of 1999 model year vehicles 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. In short, we need NOx reductions to protect public health and to preserve the state's federal highway funding.

### **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 significant additional 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 will likely 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 effects 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.