Heavy-Duty Diesel Emission Reduction Project
Retrofit/Rebuild Component

prepared by NESCAUM
for the U.S. Environmental Protection Agency
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Executive Summary

The purpose of this document is to expand the use of retrofit pollution control technologies in heavy-duty engines through the development of consistent guidelines for voluntary retrofit programs. Such programs would be targeted to heavy-duty vehicles not affected by the federal Urban Bus Program and would include control technologies not certified under that program as well as Urban Bus Program certified technologies. Specifically, this document recommends 1) a protocol for calculating state implementation plan (SIP) credits for voluntary retrofit projects; 2) the structure of a third party retrofit verification system for retrofit technologies; and 3) an in-use testing program to ensure that emission reduction credits claimed are achieved in the field. The last chapter of this document outlines model state policies to reduce heavy-duty engine pollution through retrofit initiatives.

This effort builds on the above mentioned United States Environmental Protection Agency (EPA) initiative begun in 1993 to reduce urban residents' exposure to diesel exhaust, the Urban Bus Retrofit/Rebuild program. The program requires that urban buses operating in metropolitan areas with populations over 750,000 be equipped with EPA certified retrofit pollution control devices such as oxidation catalysts or be rebuilt using certified low emission components at the time of engine overhaul. To date, approximately 10,000 of 42,000 eligible urban buses have been retrofitted or rebuilt as a result of the program. Two states, New Jersey and California, have undertaken retrofit programs or guidelines as well. These efforts are intended to expand the significant emission reductions gained through the federal Urban Bus Program by promoting the use of pollution reducing technologies on the existing heavy-duty fleets in those states.

The need for reducing emissions from the nation's in-use heavy-duty diesel fleets is clear. Current inventories estimate that heavy duty engine emissions comprise 33% of all nitrogen oxides (NOx) pollution and 80% of all particulates (PM) from mobile sources in the Northeast states.[1] Emissions from these engines contribute to serious air pollution problems in the region. NOx causes eutrophication of lakes and streams, acid rain, and is a precursor to ozone which aggravates lung disease. Hydrocarbon (HC) emissions are also ozone precursors and are made up, in part, of toxic substances such as benzene, toluene, and 1,3 butadiene, some of which are known carcinogens. PM emissions are

[1] "Heavy-Duty Engine Emissions in the Northeast" NESCAUM May, 1997.

very high from diesel engines and are known to aggravate lung diseases such as asthma, emphysema, and bronchitis. In addition, PM has been labeled a probable human carcinogen by EPA and a toxic air contaminant by the California Air Resources Board. In order for states to achieve air quality goals, significant reductions in heavy-duty diesel emissions will need to be made.

The recommendations contained in this document are based on discussions of a workgroup organized by the Northeast States for Coordinated Air Use Management (NESCAUM). The workgroup was created to provide guidance to state and local agencies, as well as to private organizations that plan to retrofit heavy-duty diesel vehicles with pollution control devices. It included input from state and federal agency staff, testing laboratories, and control equipment manufacturers. In addition, a draft of these guidelines was distributed to EPA regional offices and the heavy-duty engine manufacturers. Their comments and suggestions were reviewed and incorporated by the workgroup into the recommendations contained in this report.

Primary Recommendations

All of the recommendations detailed below represent the views of the Retrofit/Rebuild workgroup and NESCAUM.

1. Use of Urban Bus Program Certified Technologies

Oxidation catalysts certified with the Urban Bus Program should be eligible without administrative or peer review for use in any highway heavy-duty engine, with states being allowed to claim a 20 percent reduction for PM, a 40 percent reduction for carbon monoxide (CO), and a 50 percent reduction for HC. These credits may be claimed before a project is implemented. Verification of emission reductions should be conducted during or after project implementation by 1) a review of retrofitting records and 2) through in-use emissions testing. These recommendations are detailed in Chapter I, section D and Chapter III.

For use of technologies certified with the Urban Bus Program that are engine specific such as rebuild kits, the workgroup recommends that a PM emission reduction credit of 20 percent be granted automatically when the rebuild kits are used in engines that the technologies are certified for under the Urban Bus Program. Chapter I, section B describes the credit allowed for ".1" technologies. As with the use of oxidation catalysts, reporting and in-use testing recommendations for rebuild kits are detailed in Chapters I.D and III.

2. Use of Technologies Not Certified with the Urban Bus Program

For all products that have not been certified with the Urban Bus Program, emissions testing should be conducted by the manufacturer to determine the emission reductions potential (percent reductions) of the retrofit/rebuild product. Similar data

should be required for the voluntary program as are required for certification with the Urban Bus Program (see Chapter III, section A for a detailed description). An engineering analysis should be conducted by the manufacturer to determine which engines the retrofit/rebuild equipment may be used on. These data and analysis will be reviewed by the third party verifier to establish the emission reduction level and applicability for engine families for the voluntary retrofit program.

3. Third Party Verification System

A third party verification system should be established which consists of an administrator and a peer review committee. The workgroup recommends that Environment Canada be the administrator for this program. The administrator will process all applications to the retrofit/rebuild program, review data for thoroughness, organize the work of the peer review group, make decisions on the level of in-use testing required, and communicate with EPA. The peer review committee should consist of temporary volunteer members from industry, laboratories, and trade organizations (such as the Society of Automotive Engineers) with expertise in heavy-duty engines and retrofit equipment. The committee will make determinations for emission control devices on the level of in-use testing, completion of the in-use testing requirement, acceptability of in-use testing method, emission reduction potential of emission control products, and engine families that control equipment can be used with.

4. In-use Testing Requirement

In order to verify the emission reductions claimed from retrofit projects and to assess control equipment durability a percentage of all emission control products installed as part of a retrofit/rebuild program should be tested in-use. The procedure for establishing the number of units to be tested in the field is outlined in Chapter III and is adapted from EPA's in-use compliance testing requirements for new pleasure craft marine engines. An in-use testing trigger should be established for different types of technologies based on unit sales. A 70% pass rate on tested units will be needed in order for devices to "test out" of the in-use requirement.

5. Calculating SIP Credits

In order to calculate SIP credits from retrofit projects, baseline emission factors for heavy-duty engines to be retrofitted needs to be established. The workgroup recommends that Federal Test Procedure (FTP) certification data for engine families be used as baseline emission rates for retrofitted engines. Emission reduction percentages (as recommended in this document for devices certified with the Urban Bus Program and as established by the third party verifier for devices not certified with the Urban Bus Program) can be applied to these baseline rates. Mass emissions reductions can be calculated for individual fleets using the formulas detailed in Chapter IV and information available to fleet operators such as vehicle mileage, hours in operation, or fuel consumption. In some cases, states may choose to develop baseline emission rates

through testing of heavy-duty engines in-use. The states will need to develop a testing plan in coordination with EPA to determine these baseline levels.

6. Retrofit/Rebuild Program Information/Website

The workgroup recommends that if possible all retrofit/rebuild devices certified with the Urban Bus Program and all devices "verified" through third party review be listed on a retrofit/rebuild website which states and others interested in undertaking retrofit projects can easily access. The retrofit website could provide SIP credit calculation formulas, information on emission control products, applicable engines, and EPA certification data for engine families.

7. Model State Retrofit Policies

States have policy and funding options to increase the use of retrofit devices to reduce heavy-duty diesel pollution. Retrofitting heavy-duty vehicles and machines to reduce PM, HC, CO, toxics, and in some cases NOx, can assist states in reaching air quality standards. Executive orders, contract requirements, and agency policies represent potential methods to increase the use of retrofit devices. Funding from federal sources such as the Congestion Mitigation Air Quality Improvement program (CMAQ), state funding in the form of bond issues and agency budgets, and supplemental environmental monies can provide financial support for retrofit projects. The last section of this report outlines model retrofit policies that have been used in the region, funding sources, and example strategies to increase the use of pollution control equipment.