

APPENDIX A

**AIR DISTRICT APPLICATION TO ADMINISTER THE LOWER-EMISSION
SCHOOL BUS RETROFIT PROGRAM**

Lower-Emission School Bus Program

**APPLICATION TO ADMINISTER THE LOWER-
EMISSION SCHOOL BUS RETROFIT PROGRAM**

Fiscal Year 2000-2001

Issued by the California Air Resources Board

December 2000

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INTRODUCTION

In the fiscal year 2000-2001 budget, Governor Gray Davis provided \$50 million to implement a program to help school districts replace and retrofit school buses. The Air Resources Board will oversee the program, and develop program guidelines and project criteria. There are \$10 million in funding available to retrofit school buses. The retrofit program will be administered by the local air pollution control and air quality management districts that choose to participate. Grants will be awarded by the ARB to the participating air districts in April 2001. Air districts that wish to administer a local program to provide school bus retrofits may use this document to apply for funding.

TIMETABLE

December 7, 2000	Board meeting to consider approval of draft Program Guidelines
January 26, 2001	Air district applications to administer a retrofit program due to ARB
February 15, 2001	ARB reviews and approves applications to administer program
March 1, 2001	Air districts mail out solicitations/applications to school districts
May 1, 2001	Disbursement of funds to air districts
July 30, 2001	Air district reports on implementation efforts due
December 15, 2001	Air districts complete first round of awards to school districts
June 15, 2002	Air districts report any unencumbered monies
July 15, 2002	Any unencumbered air district money goes to other air districts that have exhausted their funds
September 15, 2002	Air districts award any additional funds
October 1, 2002	Requests for reimbursement due
January 1, 2003	Final reallocation of unencumbered funds

GRANT PROVISIONS

A. Lower-Emission School Bus Program Guidelines

1. The Guidelines shall be followed in implementing the Lower-Emission School Bus Retrofit Program.

B. Project Criteria

1. Districts shall fund only those projects that comply with the Lower-Emission School Bus Program Guidelines.

C. Air District funding

1. There is no match fund requirement to implement a retrofit program under the Lower-Emission School Bus Program.

D. Monitoring/Reporting

1. Districts shall monitor the projects they fund to ensure that the retrofits are installed and operated properly and according to the specified contracts.
2. By July 30, 2001, districts shall submit a status report on their efforts to implement the retrofit program. This shall include:
 - an list of applicants and allocations
 - names of staff responsible for program implementation
 - report on outreach activities (completed and planned)
 - financial summary of encumbered and unencumbered funds
3. Districts shall report to the ARB by June 15, 2002 any unencumbered funds. Funds unencumbered by July 15, 2002, may be reallocated to other air districts.

E. Project Selection

Districts shall select which of the qualifying school districts to fund based on a first-come, first-served basis. Applications received on the same business day shall be deemed as having been received at the same time for purposes of funding decisions. Air districts shall target larger fleets for retrofits whenever possible. Also, in a given fleet, as many of the school buses as technically feasible should be retrofitted to make the project more effective.

FUNDING ALLOCATION

The table that follows shows a tentative funding allocation. Districts may request more than their tentative allocation. The ARB will make the final allocations based on the number of requests received.

Tentative Funding Allocation		
Region	Funds in Millions	Approximate no. of PM Filters
South Coast AQMD	\$ 4.4	660
Bay Area AQMD	\$ 1.9	285
San Joaquin Unified APCD	\$ 0.9	135
San Diego APCD	\$ 0.8	120
Sacramento AQMD	\$ 0.4	60
Other Districts	\$ 1.6	240
TOTAL	\$10.0	1500

DISBURSEMENT OF FUNDS

ARB will determine the grant award allocations by February 15, 2001. Funds will be disbursed in a single payment to the air districts by May 1, 2001.

ARB encourages districts to implement the program quickly, and to have all the funds obligated via contract by July 30, 2001. Districts must submit a report on project status by July 30, 2001. The report should list projects, state funds spent to date, additional funds obligated via contract, any contracts being negotiated, and remaining state funds that have not yet been obligated.

Any funds not obligated under contract after one year may be reallocated to other districts that have exhausted their funding. Should ARB decide not to reallocate all remaining funds at that time, ARB reserves the right to require periodic progress reports, and to reallocate unobligated funding at any time thereafter.

**FISCAL YEAR 2000-2001 APPLICATION
FOR LOWER-EMISSION SCHOOL BUS RETROFIT PROGRAM FUNDS**

1. APPLICANT AIR DISTRICT

Air District Name _____

Street Address _____

City/Zip _____

Contact Person _____ Phone _____

**2. LOWER-EMISSION SCHOOL BUS RETROFT PROGRAM
FUNDING REQUESTED _____**

To the best of my knowledge and belief, data in this application are true and correct. The document has been duly approved and authorized by the governing board of the applicant and the applicant will maintain program compliance with the criteria listed in the Lower-Emission School Bus Program Guidelines.

3. AIR DISTRICT

Name (Typed) _____

Title _____

Signature _____ Date _____

APPENDIX B

**SCHOOL DISTRICT MODEL APPLICATION TO THE LOWER-EMISSION
SCHOOL BUS REPLACEMENT AND INFRASTRUCTURE PROGRAM**

AND

GRANT AWARD AND AUTHORIZATION FORM

Lower-Emission School Bus Program

**MODEL APPLICATION FOR LOWER-EMISSION SCHOOL
BUS REPLACEMENT AND INFRASTRUCTURE GRANT**

Fiscal Year 2000-2001

Issued by the California Air Resources Board

December 2000

(COVER LETTER FROM CEC OR AIR DISTRICT)

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INTRODUCTION

In the fiscal year 2000-2001 state budget, Governor Gray Davis provided \$50 million to implement a program to help school districts replace and retrofit school buses. The Air Resources Board will oversee the program and develop program guidelines. The \$40 million school bus replacement program directs \$25 million to fund alternative fuel buses and \$15 million to fund intermediate diesel buses, and will be administered by the California Energy Commission (CEC) or by participating large air districts. This document is an application for funding for school districts that wish to apply for funding for school bus replacements and alternative-fuel fueling stations. School districts will apply for funding to the CEC or the air district, whichever is administering the program in their jurisdictions.

TIMETABLE

December 7, 2000	ARB Board meeting to consider approval of guidelines
March 1, 2001	CEC and air districts circulate applications to schools
April 1, 2001	Applications for funding due from school districts
May 15, 2001	CEC and air districts make bus and infrastructure awards
July 1, 2001	Funding agreements signed
July 15, 2001	All school bus orders placed with vendors by school districts
January 1, 2002	All alternative-fuel station contracts with providers executed by school districts
January 1, 2002	Unencumbered bus replacement funds allocated by CEC
June 1, 2002	New buses delivered and infrastructure completed
July 15, 2002	All requests for reimbursement for purchases submitted by school districts

GRANT PROVISIONS

A. School Bus Replacement Criteria Overview

1. California public school districts that own and operate school buses, including under provisions of a joint powers authority, can apply for school bus funds. These include Type 1 and 2 school buses (conventional, medium/heavy duty, special needs, cut-aways, etc.) Specific information as to the school bus requested shall be provided in the application.
2. Only replacement buses will be funded. Fleet expansion buses are not eligible for funding.
3. Heavy-duty alternative-fuel engines must be certified to the ARB optional, reduced-emission NO_x standard or 2.5 g/bhp-hr and a 0.03 g/bhp-hr PM level, or diesel engines to 3.0 g/bhp-hr NO_x and 0.01 g/bhp-hr PM levels. Medium-duty engines must meet the SULEV optional standard of 2.0 g/bhp-hr NMHC+NO_x.
4. Buses that operate on any fuel except gasoline can be requested if required engine emissions standards are met.
5. Availability of required fuels by delivery of the buses shall be documented. Provisions shall be made to to avoid possible mis-fueling.
6. Priority shall be given to the replacement of in-use pre-1977 model year school buses.
 - First, each new purchase shall replace any in-use diesel pre-1977 model year school bus and the replaced bus shall be crushed or removed from the country.
 - Second, any pre-1977 heavy-duty gasoline buses shall be replaced and crushed or removed from the country.
 - Where fleets contain too few or no pre-1977 buses, pre-1987 diesel buses shall be replaced. These buses shall be crushed, or be retired or removed from the country.
 - Then, any pre-1987 heavy-duty gasoline buses shall be scrapped, or removed from the country.
7. All replaced buses must be in current use and have current CHP certification. The application form calls for specific information related to the replaced bus.

B. Infrastructure Criteria Overview

1. Qualifying proposers may request funding to offset the cost of procuring new slow-fill alternative-fuel refueling equipment or expanding the capacity of an existing refueling station.
2. New capacity requested will be directly related to the capacity needed by the new alternative-fuel buses awarded through this program.
3. Need for alternative-fuel infrastructure shall be documented as called for on the application.
4. Upon approval, funding may be used to purchase slow-fill equipment or used to buy down the cost of a public access fast-fill facility. However, requested funding must be based on cost of slow-fill capacity needed for the new buses.

FUNDING ALLOCATIONS

A. Amounts of Funding

1. The State Department of General Services maintains a state bid list that lists prices of various school buses. Funding requested for purchase of a bus shall be consistent with the prices on the current state bid list. With the exception of the purchase and installation of seat belts, the school district is responsible for the cost of any options not included in the prices on the list.
2. Basis for the amount of funding requested for purchase of alternative-fuel refueling infrastructure shall be documented in the application. Amounts requested for funding shall be based on the cost of slow-fill stations. Awards will not exceed, on average, 10 percent of the new bus funding awarded to the applying school district.

B. Matching fund requirement

1. The school district shall provide 25 percent in match funding for each bus purchased, up to a \$25,000 maximum per bus.
2. The school district shall provide any matching funds required to purchase alternative-fuel refueling equipment.
3. The source of match funding for bus purchases and infrastructure shall be documented and attached to this application. If other grant funds are being used as match funding, detailed information on required use of those funds shall be included.

C. Authorizing Resolution

1. A school board resolution authorizing submittal of the application shall be submitted with the application.

D. Disbursement of Funds

1. Funds will be paid on a reimbursement basis at the time of vehicle delivery to the school district. Proof of vehicle delivery must accompany any request for reimbursement of approved funds. All requests for reimbursement must be received by July 15, 2002. Upon request, monies owed can be paid directly to the bus vendor.
2. Funds will be paid on a reimbursement basis at the time of completion of the alternative-fuel refueling facility. Proof of completion shall accompany any request for reimbursement of approved funds. All requests for reimbursement must be received by July 15, 2002. Upon request, monies can be paid directly to the infrastructure provider.

PROJECT IMPLEMENTATION

A. Project Selection and Award of Funds

1. Funding for school buses will be awarded through a non-competitive process. Each agency awarding the funds will select an equitable award process.
2. In the event the funds are not encumbered by July 15, 2001, by any air districts that administer the program, the remaining funds may be assigned by the CEC to fund any backlog of school bus funding requests.

B. Project Completion Deadlines

1. School bus orders must be placed no later than July 15, 2001.
2. Contracts with providers of alternative-fuel infrastructure must be executed by January 1, 2002.

C. Monitoring and Reporting

1. School districts must notify the funding agency when the funded buses are ordered and again when the buses arrive on site.
2. School districts must notify the funding agency when any alternative-fuel equipment is ordered or construction contracts let, and then when the equipment is operating.
3. School districts receiving funding for diesel buses must notify the funding agency when contracts are signed for the purchase of low-sulfur fuel.

**MODEL GRANT APPLICATION FORM FOR THE
LOWER EMISSION SCHOOL BUS REPLACEMENT PROGRAM**

School District: _____

Street Address: _____

City: _____ County _____ State: CA

Zip Code: _____

Air District

Jurisdiction: _____

School District Contact Person:

1) Name/Title: _____

2) Phone No.: _____ Fax: No.: _____

3) Email: _____

Bus Replacement Funds Amount Requested: _____

Matching Funds Amount : _____

Sources of School District Matching Funds (please list by amount):

Written documentation must be attached to this application explaining in detail the source of matching funds. Also, an authorizing resolution from the school board approving the matching funds must be attached .

Fueling Infrastructure Funds Amount Requested: _____

Additional Information:

INFORMATION ON BUSES TO BE REPLACED

Bus ID No.	VIN No. Engine Size	Type (1,2)	Cumulative Mileage	Year Built	Make	Fuel Type

INFORMATION ON REPLACEMENT BUSES REQUESTED

Make And Model Year	Estimated Delivery Date	Engine Size	Engine Manufacturer	Fuel Type	Type (1,2)	Cost Of Bus

Please explain availability of the required fuel and refueling capability on delivery date for new buses:

FUEL INFRASTRUCTURE GRANT APPLICATION

Please answer all questions below. If non-applicable, write N/A.

Amount of funds requested: _____

Number of new CNG school buses applied for: _____

Number of CNG buses presently on site: _____

The requested funds will be used for (please circle one):

New Facility / Upgrade Existing Facility

Local Gas Utility Company

Distance (miles) to nearest off-site CNG Fueling Station: _____

Please attach a statement of reasons why it is not feasible to refuel at an off-site fueling station.

Existing fueling station:

Actual size of on-site CNG compressor, if any (In CFM) _____

CNG Fuel Storage Capacity if any: _____

Actual number of CNG Fueling Posts (two hoses/post): _____

Natural Gas Pressure at Main (PSIG): _____

Is this station accessible to the public? YES / NO

New fueling station:

CFM capacity needed for additional buses: _____

Number of CNG Fueling Posts needed (two hoses/post): _____

Will this station be accessible to the public? YES / NO

Lower-Emission School Bus Program
GRANT AWARD & AUTHORIZATION FORM
Fiscal Year 2000-2001

Your fiscal year 2000-2001 application for funding under the Lower-Emission School Bus Program: Replacement Buses, has been approved as follows:

School District:
Grant Award:
Required Match Amount:
Grant Number:

You are authorized to administer a local program according to the requirements described in the following documents, which are attached and incorporated as part of this grant:

- Completed Application to Lower-Emission School Bus Replacement Program (Attachment A)
- Lower-Emission School Bus Program Guidelines (Attachment B)
- Contacts (Attachment C)

The undersigned parties agree to the terms and conditions as set forth in this grant. The undersigned parties certify under the penalty of perjury that they are duly authorized to bind the parties to this grant.

California Energy Commission:
Or Air Distict:

School District:

Signature of Authorized Official

Signature of Authorized Official

Name:
Title:

Name:
Title:

Date: _____

Date: _____

APPENDIX C

**SCHOOL DISTRICT APPLICATION TO THE LOWER-EMISSION
SCHOOL BUS PM RETROFIT PROGRAM**

AND

GRANT AWARD AND AUTHORIZATION FORM

(cover letter from air district)

LOWER-EMISSION SCHOOL BUS PROGRAM

**MODEL APPLICATION FOR SCHOOL BUS
PARTICULATE MATTER RETROFIT GRANT**

Fiscal Year 2000-2001

Issued by the California Air Resources Board
December 2000

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INTRODUCTION

In the fiscal year 2000-2001 state budget, Governor Gray Davis provided \$50 million to implement a program to help school districts replace and retrofit school buses. The Air Resources Board will oversee the program and develop program guidelines. The \$10 million school bus PM retrofit program will be administered by air districts that choose to participate. This document is an application for funding for school districts that wish to apply for funding for school bus particulate matter retrofits. School districts will apply for funding to the air district.

TIMETABLE

December 7, 2000	Board meeting to consider approval of draft Program Guidelines
March 1, 2001	Air districts mail out solicitations/applications to school districts
May 1, 2001	Disbursement of funds to air districts
July 30, 2001	Air district reports on implementation efforts due
December 15, 2001	Air districts complete first round of awards to school districts
July 15, 2002	Any unencumbered air district money goes to other air districts that have exhausted their funds
September 15, 2002	Air districts award any additional funds
October 1, 2002	Requests for reimbursement due
January 1, 2003	Reallocation of any unencumbered funds

GRANT PROVISIONS

A. School Bus PM Retrofit Criteria Overview

1. California public school districts that own and operate school buses, including under provisions of a joint powers agreement, are eligible to apply for funds. School transportation companies that provide transportation services, under contract to public school districts, may also apply for funding.
2. Only in-use 1977 and newer model year diesel-powered buses qualify for retrofits.
3. All retrofit devices must be certified by ARB to achieve an 85% reduction in PM.
4. School districts and transportation companies are encouraged to retrofit all eligible buses in the fleet.
5. School districts and transportation providers shall be responsible for obtaining low-sulfur diesel fuel to ensure proper operation of the retrofit device. Provisions shall be made to avoid mis-fueling of retrofitted buses.

FUNDING ALLOCATIONS

A. Amounts of Funding

1. Program will pay for the full cost of retrofit devices and installation, estimated to be \$6000 to \$7500.
2. Program will pay an incremental low-sulfur fuel cost of \$500.00 per retrofitted bus.

B. Matching fund requirement for the PM Retrofit Program

1. No matching funds are required of the school district or transportation company.
2. School districts and transportation companies shall be responsible for routine maintenance of the retrofit devices.

C. Authorizing Resolution

1. A school board resolution authorizing submittal of the request for funds shall be attached to the application for funding.

D. Disbursement of Funds

1. Funds will be paid on a reimbursement basis by the air district after the installation of the retrofit devices. Proof of installation shall accompany any request for reimbursement of approved funds. All requests for reimbursement must be received by October 1, 2002.
2. Upon request, monies can be paid directly to the retrofit provider. Funds for the incremental fuel cost of \$500.00 per retrofitted bus shall be paid after installation of the retrofit devices. Proof of contract with fuel supplier shall accompany any request for payment of approved funds. All requests for reimbursement must be received by October 1, 2002. Upon request, monies can be paid directly to the fuel supplier or other designated entity.

PROJECT IMPLEMENTATION

A. Project Selection and Award of Funds

1. Funding for retrofitting of school buses will be awarded through a non-competitive process. Each agency awarding the funds will select an equitable award process.
2. In the event the funds are not encumbered by July 15, 2002, by any air district that administers the program, the remaining funds will be assigned to other air districts.

B. Project Completion Deadlines

1. All retrofit device orders shall be placed no later than February 15, 2001 or within 60 days of award of funds, whichever is later.

C. Monitoring and Reporting

1. School districts receiving funding must notify the funding agency when the retrofit devices are ordered and again when the devices are installed.
2. School districts receiving funding must notify the funding agency when contracts are signed for the purchase of low-sulfur fuel.

**MODEL GRANT APPLICATION FORM FOR THE
SCHOOL BUS PARTICULATE MATTER RETROFIT PROGRAM**

School District: _____

Street Address: _____

City: _____ County _____ State: CA

Zip Code: _____

Air District
Jurisdiction:

School District Contact Person:

Name/Title: _____

Phone No.: _____ Fax: No.: _____

Email: _____

An authorizing resolution from the school board or similar authority approving this application must be attached.

Amount of Funds Requested _____

Additional Information:

<p>LOWER-EMISSION SCHOOL BUS PROGRAM</p> <p>PARTICULATE MATTER RETROFIT GRANT AWARD & AUTHORIZATION FORM</p>
<p>Fiscal Year 2000-2001</p>

Your fiscal year 2000-2001 application for funding under the Lower-Emission School Bus Program: PM Retrofit Program, has been approved as follows:

School District:
Grant Award:
Grant Number:

You are authorized to administer a local program according to the requirements described in the following documents, which are attached and incorporated as part of this grant:

- Completed Application to PM Retrofit Program (Attachment A)
- Lower-Emission School Bus Program Guidelines (Attachment B)
- Contacts (Attachment C)

The undersigned parties agree to the terms and conditions as set forth in this grant. The undersigned parties certify under the penalty of perjury that they are duly authorized to bind the parties to this grant.

**Air Quality Management District
 Or Air Pollution Control District:**

School District:

Signature of Authorized Official

Signature of Authorized Official

Name:

Name:

Title:

Title:

Date: _____

Date: _____

APPENDIX D

EXHAUST AFTERTREATMENT TECHNOLOGY

EXHAUST AFTERTREATMENT TECHNOLOGY

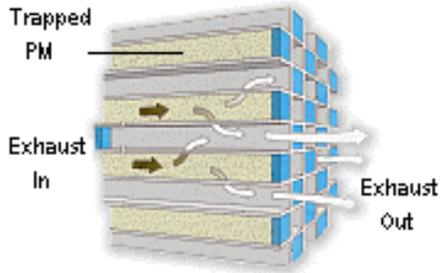
In 1998, following an exhaustive 10-year scientific assessment process, the Air Resources Board (ARB) identified particulate matter (PM) from diesel-fueled engines as a toxic air contaminant (TAC). Diesel particulates are small, generally less 2.5 microns in diameter. These particles are complex substances typically consisting of a carbon core with adsorbed hydrocarbons, sulfates, water and inorganic materials. Diesel PM emissions are estimated to be responsible for about 70 percent of the total ambient air toxics risk. In addition to these general risks, diesel PM can also present elevated localized or near-source exposures. A significant near-source exposure group is school children. The Lower-Emission School Bus Program proposes to reduce this potential risk by replacing high-polluting school buses with new buses, and by installing special exhaust filters on remaining older buses.

Special exhaust filters as aftertreatment or retrofit devices are available to reduce emissions from the diesel-powered school buses. These devices have been available for many years and have a proven track record of durability and effectiveness in heavy duty vehicles. The Lower Emission School Bus Program proposes to fund ARB certified aftertreatment devices that reduce diesel particulate matter (PM) emissions by at least 85%. Most of these devices are similar to current automobile catalytic converters and can be easily installed on existing buses. However, to perform effectively these devices require the use of low sulfur fuel. Use of diesel aftertreatment devices has been limited because high levels of sulfur is detrimental to their operation. The increased availability of low sulfur diesel fuel now makes widespread use of these devices practical.

The most commonly available aftertreatment device is a diesel particulate filter (DPF). Installation involves placing the DPF in the vehicles' exhaust system. In many cases the DPF replaces the existing engine muffler. The following section discusses filters suitable for this program.

A. Diesel Particulate Filters

Today, there are over 7,500 diesel particulate filters (DPF) units in use worldwide. Some of these systems have exceeded 375,000 miles of in-field use. The product is currently being used in eight heavy-duty vehicle fleets in southern California and at the New York Metropolitan Transportation Authority. The product is commercially available and being demonstrated in California school buses. In total, the technology has accumulated hundreds of millions of miles. DPF technology can achieve up to, and in some cases exceed, 85 percent reduction in PM. The filters may also reduce emissions of carbon monoxide, hydrocarbons, and in some cases oxides of nitrogen. The graphic below illustrates one type of DPF.



A typical system consists of a filter positioned in the exhaust stream designed to collect particulate emissions while allowing the exhaust gases to pass through the system. Over time, particulate matter generated by a diesel engine is sufficient to fill up and plug a filter. Therefore, a means of disposing of the trapped particulate must be provided. The most promising means of disposal is to oxidize (or burn) the trapped particulate during regular vehicle operations, thus regenerating the filter.

Two basic types of particulate filters are used: passive and active. Most passive diesel particulate filters (DPF) remove PM by collecting particles and oxidizing them during vehicle use. The oxidation process is referred to as regeneration. Passive DPFs typically rely on a precious metal catalyst contained in the filter to allow regeneration at common engine exhaust temperatures. In active filters the regeneration temperature is achieved by means of an external heat source. This typically involves an electric or other heat source to increase oxidation in the filter. There are many techniques used to facilitate regeneration. However, most DPF filters are passive self-regenerating filter systems using precious metals, like automobile catalytic converters. Usually, these DPF devices collect particulate matter and oxidize it when the exhaust temperatures are above 530°F. DPF systems do not appear to cause any additional engine wear or effect normal vehicle maintenance. However, DPF devices may require periodic maintenance to remove ash caused by motor oil combustion residues.

Several mature DPF technologies have emerged. A side by side school bus demonstration of Johnson Matthey's CRT™ diesel particulate filter and Engelhard's DPX™ catalytic soot filter is currently underway. A system manufactured by Ceryx is also being tested in school buses. All systems require the use of low-sulfur diesel fuel, i.e., fuel with sulfur less than 15 parts per million (ppm).

Johnson Matthey's CRT™ device combines a platinum catalyst and a filter element. The catalyst oxidizes NO to NO₂ and uses the produced NO₂ as an oxidant to remove the PM trapped in the filter. This method removes PM and a small percentage of exhaust NO_x. Engelhard's DPX™ device uses a different catalyst system that does not significantly affect exhaust NO_x. Ceryx Incorporated's QuadCAT™ device is designed to replace the conventional muffler/silencer on a diesel engine. The QuadCAT™ is designed to reduce PM and oxides of nitrogen (NO_x).

Independent research programs are underway to study the effects of different levels of sulfur in diesel fuel. In one such program in southern California, Detroit Diesel Corporation, Johnson Matthey, and Engelhard will demonstrate use of British Petroleum's new diesel fuel containing virtually no sulfur. This fuel may enable catalysts and particulate filters to operate more efficiently with increased durability. Johnson Matthey's CRT™ has demonstrated PM reductions greater than 90 percent by using ultra-low sulfur fuel.

A number of filter materials have been developed. Currently, ceramic monoliths, fiber wound cartridges, silica carbide and paper filters have been used commercially. The collection efficiencies of these filters range from 50 to over 90 percent.¹ All of these materials achieve high efficiencies; however, development work continues with the materials to (1) optimize the filter collection efficiency while reducing back pressure, (2) improve the regeneration process, and (3) improve the mechanical strength of the filter designs.

The exhaust temperature of a diesel school bus engine is not always high enough to initiate regeneration. A number of techniques are used to lower the regeneration temperatures found in bus exhaust. For example, in the CRT™ and DPX™ devices the filter element is coated with a catalyst. The application of a catalyst reduces the required regeneration temperature. Other techniques include the use of fuel-borne catalysts, electrical heating elements, or combustion of atomized fuel in the exhaust system to increase the temperature of the exhaust gas to start regeneration.

Diesel particulate filters are typically optimized for the particular vehicle application. This ensures the maximum control efficiency possible, while minimizing or eliminating adverse effects of the system on the engine or vehicle performance. Use of catalyzed DPFs also greatly reduces odors typically exhibited in diesel exhaust. A slight fuel economy penalty may be experienced with DPFs. This is usually attributed to the backpressure caused by a plugged DPF. Some forms of DPF regeneration involve the use of fuel burners, and if these methods are used, a 5 to 10% fuel economy penalty could be experienced. For example, Ceryx Incorporated's QuadCAT™ device uses fuel to assist in regeneration.

Filter systems do not appear to cause any additional engine wear or affect vehicle maintenance. Maintenance of the system itself should be minimal, because manufacturers are designing systems to minimize maintenance requirements during the useful life of the system.

Demonstration programs using first generation DPFs were conducted during the 1980's and into the early 1990's. Some of these systems were complex and reliability was an issue. Subsequently, manufacturers began development and

¹ Emission Control Retrofit of Diesel-Fueled Vehicles, MECA, March 2000

commercialization of second-generation systems. These simpler and more reliable systems can easily achieve PM reductions greater than 85 percent. In Europe diesel vehicles retrofitted with DPFs are offered commercially. Sweden's Clean Cities program has resulted in the commercialization of DPFs in urban transit buses. Passive filters have been installed in over 10,000 trucks and buses. Some of these vehicles have accumulated over 300,000 miles since being retrofitted. Sweden's very low sulfur diesel has enabled the use of the DPFs. Heavy-duty trucks in Germany, Finland, and France are also being retrofitted with filters. Other demonstration programs are being carried out in Taiwan and Hong Kong.

Diesel particulate filters have been used commercially in off-road equipment since 1986. The types of equipment retrofitted include mining equipment, material handling equipment, forklifts, street sweepers and utility vehicles. Germany and Austria have mandatory retrofit requirements for underground mining equipment. In the United States filters are being used in the Big Dig project in Boston. Construction equipment such as earthmovers and front loaders were retrofitted with particulate filters.

Currently, the South Coast AQMD and the ARB are conducting a demonstration program in which about 60 school buses have been retrofitted with particulate filters (the ARB is providing testing support).

B. Need for Low Sulfur Fuel

California established specifications for diesel fuel in 1990 (CARB diesel). These specifications included a 500 ppm limit on sulfur content. The typical sulfur level in CARB diesel fuel is 120 ppm. Certification of DPF devices requires the use of CARB diesel that contains 15 ppm or less sulfur. Each DPF technology has somewhat different response to sulfur levels in diesel fuel. All manufacturers agree that the sulfur levels below 15 ppm ensure optimum emission control and DPF durability.

Staff expects the low sulfur diesel fuel to cost 3 to 5 cents more per gallon than current CARB diesel. During the ARB the Transit Bus Fleet Rule development, several California refiners stated their intent to provide low sulfur diesel fuel to transit bus fleets. These refineries have the capability to produce sufficient quantities of low sulfur fuel for statewide requirements.

School districts in urban areas should be able to obtain low sulfur fuel at reasonable cost. It is unclear whether rural areas would be able to obtain low sulfur fuel at the expected cost of 3 to 5 cents per gallon above current CARB diesel. Depending on the volumes involved it may not be cost effective to deliver low sulfur diesel fuel to remote areas. Availability of low-sulfur fuel should not be a concern given the expected demand from transit and the school bus fleets expected to participate in the retrofit program.