APPENDIX B

RETROFIT PROJECT SUMMARIES

California Carl Moyer Program/Project #1.1
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 5, 2005 **Location:** California

Report based on status of project as of December 31, 2004

Contact Organization: California Air Resources Board (ARB)

PROJECT DESIGN

Project Description – The Carl Moyer Program was established in 1998 to provide grants throughout the state to promote diesel emission reductions. Funding is allocated annually by the California legislature from the state's general funds and requires a local match of $1 for every $2 of state funds. Historically, the Program focused on NOx emissions reductions, but changes were enacted by the legislature in 2004 to allow consideration of projects designed to reduce exclusively PM or HC emissions. Moyer funds can be used to cover the cost of replacement, repowering, or retrofits of virtually all on-road and nonroad diesel engines.

Program Administration – ARB administers the Carl Moyer Program. ARB has established program guidelines and distributes the funds to the state's air quality management districts. The districts in turn are responsible for soliciting proposals and awarding funds in accordance with the ARB guidelines. ARB distributes funds to the air districts based on two criteria: 1) attainment of the federal ozone standard and 2) population. Each district receives a minimum funding allocation currently set at $100,000 annually, but set to increase to $200,000 in 2006. To ease the financial burden, the state legislature has capped the local matching fund limit at $12 million.

Funding – From 1998 through 2004, approximately $152.5 million has been allocated for the Program by the state legislature. Funding for the Program is expected to increase significantly in 2005 by up to $140 million annually.

Authorized Emission Reduction Strategies -- The Program can be used to help offset the incremental costs of heavy-duty vehicles and equipment replacement. The replacement vehicles or engines must be certified to more stringent NOx emission standards than the vehicle/engine being replaced. For retrofits and repower projects, the equipment used must be certified by ARB to reduce NOx emissions by at least 15%.

Vehicles/Equipment Participating in the Program – During the period between 1998 and 2002, NOx emissions were reduced from approximately 4,950 on-road and nonroad engines (2,870 diesel repower and 2,080 diesel engine replaced with alternative-fueled or electric engines). During that period, the funding distribution by application type was: on-road (45%), agriculture pumps (25%), marine vessels (19%), other nonroad (10%), and locomotives (1%).

California Carl Moyer Program/Project #1.1
Retrofit Project Summary

Emission Reduction Benefits – During the period 1998-2002 alone, ARB estimates that the Program has resulted in reduced NOx emissions of more than 5,100 tons annually at an average cost-effectiveness of approximately $3,000/ton. In addition, ARB estimates that the program has resulted in 320 tons of PM emissions annually.

Future Program Enhancements -- As noted above, the state legislature in September 2004 modified the Carl Moyer Program to allow funding for PM and HC emission reduction projects. The legislation also opened up funding for light- and medium-duty vehicle retrofits, repowers and replacements, as well as a broader variety of agriculture projects. Finally, the legislation provided for an additional funding from an adjustment of the tire fee and allowed districts to raise motor vehicle registration fees by $2 to raise matching funds for the program.

General Comments – The Carl Moyer Program is widely recognized as a highly successful funding program to reduce emissions from existing diesel engines. The Program has received consistent support in the state legislature. Finally, the Program has served as a model for other state programs.

For more information regarding the Carl Moyer Program visit www.arb.ca.govmsprog/moyer/moyer/htm.

California Diesel Risk Reduction Plan/Project #1.2
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 5, 2005 **Location:** California

Report based on status of project as of January 26, 2005

Contact Organization: California Air Resources Board (ARB)

PROJECT DESIGN

Project Description – In 1998, ARB identified diesel PM as a toxic air contaminant and adopted the California Diesel Risk Reduction Plan (DRRP) to bring about a significant reduction in diesel PM emissions. The goals established by the program called for a 75% reduction in diesel PM emissions by 2010 and an 85% reduction by 2020. These goals were established on the assumption that 90% of the fleet could achieve an 85% reduction using DPFs. The program identified a number of initiatives including more stringent emission standards for new on- and nonroad vehicles and engines, cleaner diesel fuel (<15 ppm sulfur), actions to insure that in-use emission performance does not exceed the applicable requirements, and the control/retrofit of existing on-road and nonroad diesel engines.

Program Administration – ARB administers the DRRP program. ARB has established regulations setting tighter emission standards for new vehicles and engines, limiting the sulfur content in on-road and nonroad diesel fuel to less than 15 ppm sulfur and has adopted in-use emission reduction requirements for eight categories of diesel-powered vehicles/equipment (see below). ARB has also established and administered a retrofit technology verification program to identify retrofit technologies that may be employed to help meet ARB's program regulating existing diesel engines.

Regulation of PM Emissions from In-Use Engines – To date, ARB has adopted emission control programs covering eight categories of diesel vehicles/engines. The categories and the number of vehicles/equipment affected are as follows:

- Transit buses (8,000)
- Refuse trucks (13,000)
- Stationary engines (26,000)
- Transportation refrigeration units (40,000)
- Portable engines (35,000)
- Idling school buses (26,000)
- Commercial idling (409,000)
- Intrastate locomotive and harbor craft fuel (5,000)

Other regulatory initiatives are planned for 2005 (non-urban bus transit fleet vehicles, public on-road fleets, private utilities, marine, and stationary agriculture engines), for 2006 (public NS private nonroad fleet and private on-road fleets), and for 2007 (agriculture nonroad equipment)

California Diesel Risk Reduction Plan/Project #1.2
Retrofit Project Summary

In designing the regulatory programs for existing diesel engines, ARB uses an approach based on: 1) the use of best available retrofit technology, 2) phase-in the compliance requirements, and 3) providing compliance flexibility.

First, under the best available control technology approach, retrofit (based on the highest applicability level), repowering with a newer engine, replacing an existing vehicle with a new diesel or alternative fuel vehicle, and vehicle retirement are all options. Second, the phase-in dates for compliance are based on such factors as retrofit technology availability, new vehicle availability, and fuel availability (e.g., availability of ULSD). Finally, ARB seeks to provide compliance flexibility to ease the burden of compliance. This compliance flexibility includes allowing additional time to repower if no retrofit technologies are available, recognizing the special needs of small fleets, evaluating different approaches very low usage fleets and considering early compliance credit.

Retrofit Technology Verification Process – In order for a retrofit technology product to be used in the California DRRP program, that product must be verified by ARB. ARB has established a rigorous verification process under which retrofit technology applicants must submit detailed emission testing data and durability demonstrations. Also, ARB has established specific warranty requirements and in-use compliance testing. In 2004, ARB and EPA agreed in general to honor retrofit products verified under either the ARB or EPA verification programs.

Under the ARB program, retrofit technologies may be verified to one of three PM verification levels:

- Level 1 (equal to or greater than 25% PM reduction)
- Level 2 (>50% PM reduction)
- Level 3 (equal to or greater than 85% PM reduction or a 0.01 g/bhp-hr PM level)

ARB also provides an optional 15% minimum NOx reduction verification.

Lower-Emission School Bus Program – In addition to the mandatory elements of the DRRP program, ARB has administered the Lower-Emission School Bus Program. Since 2000, state and local school districts have been allocated over $70 million to reduce emissions from school buses. Under the program, over 400 new buses have been purchased and eventually up to 3,000 or more existing buses will be retrofitted with DPFs.

Program Overview – ARB has made considerable progress in advancing its DRRP. A number of regulatory initiatives have been adopted and are being developed. The ARB program has provided a testing ground for mandatory-type programs and a growing number of technologies are being verified. While advances in DPF technology design and application continue to evolve, ARB has found that the application of DPF technology to existing on-and off-road diesel engines is not as broad-based as originally envisioned. In designing regulatory initiatives, ARB has opted to provide considerable flexibility in meeting applicable PM emission reduction requirements.

For more information on the California DRRP visit www.arb.ca.gov/diesel/dieselrrp.htm.

I-95 Construction Retrofit Project/Project #4
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 21, 2005 **Location:** New Haven, CT

Report based on status of project as of February 8, 2005

Contact Organization: Connecticut Department of Transportation (CT DOT)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The purpose of the program is to reduce diesel emissions from the federally funded construction along I-95 in Connecticut. The CT DOT has added a contract specification that requires all contractors and sub-contractors to reduce emissions from construction equipment 60 hp and greater by installing emission control technology or use cleaner fuels. To date, 75-85 pieces of construction equipment have been retrofitted with DOCs.

Public Education & Outreach

Partners – U.S. DOT (funding), CT DEP, CT DMV, CT DOT, NESCAUM (technical support), Parsons-Brinkerhof (design of equipment), and Connecticut Construction Industries Association

Status – The original project (Q Bridge corridor) has been completed. The program is now being extended to new construction projects.

Funding – U.S. DOT is providing the funding to cover the costs of the DOCs.

Major Program Elements – Program elements include conducting the Environmental Impact Study (EIS), preparing the contract specifications for new projects, meetings with all partners to gain acceptance, particularly by the construction industry, selecting DOCs as the technology to be used, and having the DOCs installed by equipment owners.

Mandatory – Use of emission control technology required by contract specification. U.S. DOT essentially covers the increased cost of using emission control technology. DOCs were selected because the engines can be as old as 30-40 years and because the duty cycles result in low exhaust temperature profiles.

Overall Comments on the Program – CT DOT reports that the project has been virtually problem free. The project has produced excellent results and the success of the program has been widely acknowledged. Several states have contacted CT DOT seeking information regarding the program.

VEHICLE/EQUIPMENT FLEET APPLICATION

Construction equipment covered by the requirement includes excavators, cranes, manlifts, dozers, loaders, rollers, compressors, gradalls, vibro hammers, and combination hoes. The equipment is owned by the construction companies.

I-95 Construction Retrofit Project/Project #4
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System -- DOCs

Costs/Warranties – When the contracts were first let, $2,000 was provided to cover the hardware and installation costs.

Delivery – Three to four month delays in deliveries. The supplier cited the emerging market in Tokyo as the reason for the delay.

Installation/Maintenance – The construction companies did each installation

Failures/Repairs/Replacement – One construction company installed the DOCs with plans to remove them once the construction project was completed. The DOCs were installed in such a way that they were not secured firmly. As a result, some DOCs were damaged and had to be replaced.

Impact on Vehicle Performance – No reported adverse impacts.

FUELS AND LUBRICANTS

Equipment retrofitted with DOCs are operated with on-road diesel fuel (350-500 ppm sulfur)

ADM/American Lung Association of Missouri Clean School Bus Program/Project #8 Retrofit Project Summary

BACKGROUND INFORMATION

Date: June 21, 2005 **Location:** Missouri

Report based on status of project as of June 30, 2005

Contact Organization: American Lung Association of Missouri

PROJECT DESIGN

Project Description/Objectives/Outreach/Project Evaluation – In June, 2003, in fulfillment of a Supplemental Environmental Project (SEP) requirement of a Consent Decree resulting from a judgment related to violations of certain air quality emission regulations, the Archer Daniels Midland Company (ADM) agreed to provide, and has established, a grant to the American Lung Association of Missouri (ALAM) to manage and implement the St. Louis Clean School Bus Program. The overall goal of the Program is to reduce diesel emissions in the St. Louis air shed, thus reducing the exposure of school children and other sensitive populations to the unhealthy effects of poor air quality. The Program objective is to successfully install EPA-verified diesel emission retrofit products on as many school buses as funding will permit by the end of 2005. Approximately 2,500 school buses operate in the metro St. Louis area and transport nearly 200,000 pupils every day of the school year. These school buses produce nearly 50 tons of volatile organic compounds (VOCs), 170 tons of NOx, and 5 tons of particulate matter (PM) in a year of operation.

The program is divided into three phases. Phase I involved development of a program plan and performance of a comprehensive assessment of technology options that the initial school districts in the program could consider, based on 32 factors for consideration. Phase II comprised the initial implementation of the program and included nine school districts. From those school districts, approximately 350 buses have been retrofitted with diesel oxidation catalysts (DOCs) in the initial phase. Phase III began in the spring of 2005 and involved additional school districts using privately-owned carriers with their school buses outfitted with DOCs. Over 800 school buses are expected to be equipped with retrofit products funded by the program. Limited emission testing is planned to be performed to help quantify the emission reduction benefits from the program.

Public Education and Outreach – Program partners conducted extensive outreach activities with school districts in the metro St. Louis area. This was accomplished via a series of workshops on retrofit technologies. The program received extensive coverage in the media.

Partners – ALAM administers this program on behalf of ADM. Emissions Advantage, LLC (EA) performed the Phase I technology evaluation and provides assistance in the program to help ensure the successful technical application of the retrofit products among the participating school districts. EA personnel have extensive hands-on experience with the development and implementation of diesel engine retrofit programs. Fleetessentials, LLC, a provider of technology-based products and services to fleets of all types, is the supplier of the DOCs and related installation hardware, and provides local technical support for installation assistance. The St. Louis Association of Community Organizations (SLACO) provides strong community support, outreach and education services aimed at the school district administration, parents, and transportation staff, and played a significant role in developing interest in the program among the participating school districts.

ADM/American Lung Association of Missouri Clean School Bus Program/Project #8
Retrofit Project Summary

Status – As of June, 2005, 350 school buses from nine school districts were retrofitted with DOCs. An additional 400-500 more buses, virtually all from private carrier fleets, are expected to be retrofitted by the end of 2005.

Funding – $1.1 million of program funding is being provided by ADM in fulfillment of its consent decree SEP. Additional in-kind contributions estimated at over $75,000 are being provided for retrofit product installation by the school districts and private school bus carriers, and for various forms of education and outreach assistance.

Major Program Elements – The Phase I technology evaluation and product selection effort was guided by EA, with the technology and product selections performed by the initial participating school districts. This process resulted in the selection of muffler-replacement diesel oxidation catalysts (DOCs) as the technology to be used in the program. Subsequently, a request for proposal (RFP) was developed and sent to all then-current suppliers of EPA-verified DOCs. The RFP included 30 evaluation items for vendors to respond to, so that a "best value" vendor selection could be made. Responses were received from five product suppliers offering a total of 17 different DOC products. Pre-Phase I efforts were devoted to solicitation of potentially interested school districts, via a series of workshops held to explain the program and participation requirements. For school districts and private carriers that expressed an interest in participating in the program, a complete inventory of each fleet and vehicles characteristics was provided to Fleetessentials and EA for initial evaluation to determine which vehicles would qualify for participation, based on several factors, including: availability of retrofit DOC products, expected retirement date, vehicle operating/maintenance condition, and presence of an existing catalyst. This process was an essential element in eliminating potentially problematic buses, those to be retired in three years or less, and those manufactured with a catalyst installed as original equipment.

In exchange for the supply of muffler-replacement DOCs at no cost, each school district and private carrier agreed to install the DOCs supplied to them. The use of all new installation hardware, including muffler hangers, clamps, nuts and bolts, allowed the installations to be performed with ease. Fleetessentials provided all of the information needed to the retrofit product manufacturer so that a complete installation "kit" was prepared specifically for each vehicle in the program, and arranged for retrofit product deliveries to each school district in a manner that was not disruptive to their fleet operation. Constant follow-up was provided by Fleetessentials to each school district during the installation process to assist with solutions to minor installation difficulties.

Voluntary – The program is made possible by a $1.1 million SEP.

Overall Comments on the Program – Thus far, the program has achieved the objectives of having several hundred retrofit DOCs installed without any major difficulty. The remainder of the installations are expected to be accomplished with equal success. No complaints have been received from the participating school districts. In fact, several school district staff have praised the performance of the program and the noticeably cleaner exhaust from the retrofitted school buses. The constant support and problem-solving assistance provided by the product supplier has resulted in an overall installation process that has been accomplished very smoothly. As with any program of this magnitude, several problems arose, including the need to deal with some delays in the initial delivery of DOCs from the product manufacturer, and the need to "redesign in the field" several pieces of installation hardware provided by the DOC product manufacturer, in order to achieve an effective installation. In several instances,

school buses of the same make, model, and year of manufacture (with very close serial number sequence) were found to have different exhaust system configurations, requiring modifications to be made to the installation hardware provided by the DOC product manufacturer.

VEHICLE/EQUIPMENT FLEET APPLICATION

DOCs, have been and are continuing to be installed on school buses ranging from model year 1992 to 2004. Types C and D school buses from every manufacturer with diesel engines from every school bus engine supplier are being retrofitted. All school bus fleets are installing DOCs on vehicles that are expected to be operational for at least three years.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs are being used in the program.

Emission Performance/Testing – Emissions Advantage developed a detailed inventory of emissions from all of the fleets in the program, and will develop estimates of the emission reductions attributable to the DOC retrofits. Limited emission testing is planned to be performed on several of the school buses, to confirm the emission reduction effectiveness of the DOCs.

Costs/Warranties – The "best value" DOC retrofit product manufacturer selection process developed by Emissions Advantage resulted in a program price for the DOCs of $770 each for DOCs with a 4-year or 100,000 mile warranty, and $870 each for a 5-year or 150,000 mile warranty.

Delivery – Some delivery delays were experienced in receiving the DOCs from the product manufacturer. This resulted in the inability to install many of the DOCs during the Summer months when more time was available to perform installations.

Installation/Maintenance – DOC installations are being performed by the fleet operators (school discticts and privately-owned carriers). No installation problems have been reported. The DOCs have not required maintenance. For each vehicle to receive a DOC, a review of vehicle maintenance records was performed to eliminate any vehicles that would be potentially problematic.

Failures/Repairs/Replacement – To date, only one DOC failure has been reported. The failure was in the form of severe plugging due to incorrect maintenance action for a fuel injector replacement, which resulted in excess diesel fuel leaking into the cylinder combustion chamber causing excess PM build-up on the catalyst substrate, and a subsequent loss of engine power from increase exhaust system back pressure. The problem was identified quickly and solved by using the correct injector installation technique, and the DOC was replaced, since it was not salvageable.

Impact on Vehicle Performance – No reported problems, other than the one described above.

FUELS AND LUBRICANTS

ULSD is not available in the metro St. Louis area. All of the school bus fleets use No. 2 low-sulfur highway diesel fuel. In the Winter, several fleets use No.1 low-sulfur diesel fuel or a No. 1/No.2 blend.

Washington State Clean School Bus Program/Project #10
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 6, 2005 **Location:** Washington

Report based on status of project as of December 31, 2004

Contact Organization: Washington Department of Ecology (DOE)

PROJECT DESIGN

Project Description/Objectives/Outreach/Project Evaluation – In 2003, the Washington State Legislature established funding for the five-year Washington State Clean School Bus Program. In Washington, nearly 475,000 children ride more than 9,000 school buses on 20,000 routes totaling more than 90 million miles annually. The program was created to address concerns about school children's exposure to diesel exhaust and the amount of air pollution created by diesel school buses. To date, over 1,750 school buses have been retrofitted with DOCs. The retrofit technology is provided by a state-selected contractor. In subsequent program years, DPF and crankcase emission control technologies will be included in the program. The program also funded one clean fuel infrastructure project and two clean fuel projects (offsetting the cost differential of purchasing the cleaner fuels) and plans to have a total of 10 clean fuel projects by the end of program. The clean fuel projects involve B20 or ULSD.

Public Education and Outreach – Program partners conducted extensive outreach activities with the individual school districts. The program received extensive coverage in the media. DOE personnel and others have described the Washington State School Bus Program in various workshops and conferences.

Partners – The Washington Department of Ecology, the state's seven local air quality agencies and the State Office of the Superintendent of Public Instruction (OSPI) jointly administers the program in cooperation with the participating school districts.

Status – As of September 31, 2004, 1,221 school buses in 212 school districts were retrofitted with DOCs, 400 more buses than the target for the first year. Washington DOE estimates that the annual emission reductions from these retrofits will equal 28.3 tons of CO, 8.5 tons of HC and 4.8 tons of PM. During the period of October 2004 to December 2004, an additional 530 buses were retrofitted and 900 retrofit kits were delivered to school districts.

Going into the second year, the program will carry forward nearly $4.3 million in funds. The program plan, as originally envisioned, anticipated retrofitting 5,000 school buses. Savings from the state contract will enable the program to retrofit about 7,500 buses. Approximately 8,000 public school buses and 1,000 privately owned school buses are eligible for retrofits, not including the purchase of 800 to 850 new school buses. The program also anticipates completing 10 clean fuel infrastructure projects by 2008.

Funding – Program funding is derived from vehicle transfer fees that are estimated to generate $5 million per year over the five-year life of the program that is scheduled to end July 1, 2008.

Washington State Clean School Bus Program/Project #10
Retrofit Project Summary

Major Program Elements – The early months of the program focused on project design and the second half of the first year was dedicated to moving forward with the retrofits. DOE, the local air quality agencies, and OSPI formed a working group to evaluate technical issues, to provide educational outreach to the school districts, to design the program and to develop a retrofit schedule. Tasks completed during this period included:

- Surveying school districts and assessing bus fleet characteristics
- Identifying and selecting emission control equipment
- Establishing a centralized state contractor for purchase and installation of the hardware
- Establishing a financial management system

Voluntary – The program is made possible by approximately $25 million in state funds that will be available over 2004-2008.

Overall Comments on the Program – DOE reports the program thus far has achieved the objectives of not hindering the performance of the school buses or inconveniencing any route scheduling have been achieved. No complaints have been received from the participating school districts. In fact, many school district superintendents, principals, fleet managers, and mechanics have praised the performance of the program. DOE also reports that the state retrofit technology provider has performed well in servicing vehicles and retrofitting the vehicles. The program has faced several challenges, but the partners are dedicated to quickly identifying and correcting any problems when they occur.

One issue reported by participating regional air quality agencies has been some delays in supplying all of the DOCs ordered to all school districts. There are several possible reasons for the delays. First, the number of retrofit technologies requested during the first year greatly exceeded the expected demand. Second, the program is committed to ensuring that all participating school districts receive DOCs on roughly the same schedule which has resulted in delivery delays to some school districts that ordered a large number of DOCs.

VEHICLE/EQUIPMENT FLEET APPLICATION

DOCs, and beginning in 2005, crankcase emission controls will be retrofitted on 1982-2000 model year school buses. DPFs, high efficiency wiremesh DOCs, and crankcase emission controls will be candidate technologies for retrofit on 2001 and later model year school buses. Buses that are constructed on van-type or cutaway front-section vehicles that weigh <10,000 GVWR are not covered in the program. These types of buses have a service life of 10 years or 150,000 miles. The 1998 and new model year buses of this type are already equipped with DOCs. The service life of the 1997 and older buses of this type is not sufficient to make these buses good candidates for DOC retrofit.

Washington State Clean School Bus Program/Project #10
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs are being used in the current phase of the program. In the future, crankcase emission controls, DPFs, and high-efficiency wiremesh DOCs will be included in the program.

Emission Performance/Testing – DOE calculated the emission reductions by using EPA's retrofit emission reduction model.

Costs/Warranties – Under the state contract, the most common DOC kit costs $1,182 installed. Less common DOC kits cost $1,353, $1,470, and $1,706, but the price of these devices is reduced to $1,182 when the quantity purchased is over 100 units. The warranty for DOCs is 5 years/100,000 miles. DOE estimates that the successful negotiated bulk equipment purchase of DOCs has resulted in a savings of $518,925.

Delivery – Some delivery delays were experienced by some school districts from the state contractor. Delays were due in part to the fact that the actual number of DOCs ordered exceeded the expected demand. In addition, delays were due to the fact that the program was committed to insuring that all participating school districts received at least some of the DOCs ordered on roughly the same schedule.

Installation/Maintenance – DOC installations are being performed by the state contractor. No installation problems have been reported. The DOCs have not required maintenance.

Failures/Repairs/Replacement – No reported problems.

Impact on Vehicle Performance – No reported problems.

FUELS AND LUBRICANTS

The program proposes to complete 10 cleaner fuel or cleaner fuel infrastructure projects by 2008. To date, program funding has been used to cover the cost differential for ULSD and B20.

For a copy of Report to the 2005 Legislature visit www.ecy.wa.gov/biblio/0402029.html

Bay Area Transit Project/Project #13
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 14, 2005 **Location:** San Francisco Bay Area, CA

Report based on status of project as of February 11, 2005

Contact Organization: County Connection

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project was initiated in 2002 and by July 2006, up to 2,700 transit buses are scheduled to be equipped with LNC/DPF systems. ULSD is being used to fuel the buses.

Public Education & Outreach

Partners – Bay Area transit companies (funding, program implementation, and buses) and the technology supplier (technical support).

Status – Currently, 44 transit buses have been equipped with LNC/DPF systems and 87 additional buses will be equipped by July 2005. As noted above, up to 2,700 transit buses are scheduled to be equipped with LNC/DPF technology by July 2006.

Funding – Funding provided by Bay Area transit companies

Mandatory – Transit authorities are subject to ARB emission reduction requirements. The LNC/DPF system was selected as an alternative to CNG because transit officials felt the system could be applied to all types of transit vehicles where as CNG was not nearly so adaptable.

VEHICLE/EQUIPMENT FLEET APPLICATION

The transit companies own the buses.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The LNC/DPF system is equipped with a backpressure monitor.

Installation/Maintenance – When the LNC/DPF systems were installed, new turbochargers were also installed. ARB verification requires that the filters be cleaned once a year. The cleaning process takes approximately 2.5 hours.

Training – Training was provided by the technology supplier.

Failures/Repairs/Replacement – Several of the systems experienced plugging on the front face of the LNC. Transit officials noted that maintaining proper exhaust temperatures at the inlet to the LNC/DPF

Bay Area Transit Project/Project #13
Retrofit Project Summary

system solves this problem. The backpressure sensors were too sensitive, triggering the light to come on signaling a need to clean the system. The technology provider is working on an adjustment to the electronics to reduce the sensitivity of the sensor.

Impact on Vehicle Performance – Other than the plugging of the front face of the LNC, in some cases, and the sensitivity of the sensor, no other problems were reported. Transit officials noted that the vehicles have no visible smoke from the tailpipe, which has resulted in a public relations success.

FUELS AND LUBRICANTS

The transit buses are fueled by ULSD (<15 ppm sulfur).

Dallas Area Rapid Transit Retrofit Project/Project #18
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 15, 2005 **Location:** Dallas, TX

Report based on status of project as of February 4, 2005

Contact Organization: SST EMTEC

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project involved retrofitting 371 Dallas Area Rapid Transit (DART) buses with a low-pressure EGR/DPF system. The buses are fueled with ULSD fuel. DART has a reduced idling initiative.

Status – All low-pressure EGR/DPF systems have been installed on the transit buses. All the retrofitted buses have been in service for at least a year.

Funding – All funding was provided under the Texas Emission Reduction Plan (TERP) Program

Voluntary – The project was made possible by availability of TERP funding to retrofit the buses and a commitment by DART to reduce emissions from its transit buses.

VEHICLE/EQUIPMENT FLEET APPLICATION

The transit buses are owned by DART and operated in normal transit service. They are equipped with engines ranging from 150 to 400 hp.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The technology is a combined low-pressure EGR/DPF system that includes a backpressure monitor.

Emission Performance/Testing – Some emission testing was performed.

Costs/Warranties – The EGR/DPF system cost is in the range of $12,000 to $15,000. Installation was extra.

Installation – Installation of the system took a two-person team eight hours to complete.

Training – The technology providers provided technical support and trained the distributor to perform the retrofits.

Failures/Repairs/Replacement – The cause of several engine turbocharger failures and related DPF failures is under investigation.

Dallas Area Rapid Transit Retrofit Project/Project #18
Retrofit Project Summary

Impact on Vehicle Performance – No problems have been reported. The issue of condensation forming in the exhaust system that occurred in the Houston Transit program with the low-pressure EGR/DPF system did not occur in the DART program. One possible explanation might be that the City of Dallas does not experience the high humidity episodes that occur in the City of Houston. Also, the EGR/DPF system in Dallas was mounted horizontally and the system in Houston was vertically-mounted, but is not clear that horizontal or vertical mounting was a factor.

FUELS AND LUBRICANTS

ULSD fuel is being used in the project.

Boston Public School Program/Project #23
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 8, 2005 **Location:** Boston, MA

Report based on status of project as of January 6, 2004

Contact Organization: Boston Public Schools

PROJECT DESIGN

Project Description/Objectives/Partners/Outreach – The program objective is to retrofit school buses with DPFs and fuel the buses with ULSD. The project was funded by two SEPs that resulted from enforcement actions against Waste Management and Mystic Exelon. Project partners include Boston Public Schools, Waste Management, Mystic Exelon, engine manufacturers, DPF manufacturers, the fuel supplier and distributor, U.S. EPA, Laidlaw, and First Student. EPA Region 1 and the engine and technology manufacturers provided technical support. Outreach included several press events that were conducted to publicize the retrofit program. Massachusetts has an anti-idling regulation and some education regarding the regulations was included in the project.

Status – The project is underway with the Waste Management portion of the project near completion. DPFs equipped on 32 International buses with International 466 engines experienced backpressure problems due to filter plugging. The exhaust temperatures were inadequate to regenerate the DPF and 32 filters were removed. Eighty-five Caterpillar buses retrofitted with DPFs and one International bus with a 466 engine were successful because the DPF used was designed to regenerate at lower temperatures. The DPF technology used on the Caterpillar buses and the one International were more expensive than the DPF used on the first 32 International buses. The Mystic Exelon SEP funded project is still at the planning stage.

Funding – Waste Management ($1.4 million) and Exelon Mystic ($3.25 million)

Major Program Elements – Planning and implementing elements include arranging for, and implementing, special ULSD fuel handling to insure that sulfur contamination does not occur. Performed data logging to insure the driving cycles of buses equipped with DPFs would generate sufficient temperatures for regeneration. Despite assurances by the engine manufacturer, still had problems with inadequate temperatures on the International buses once the program began. The program was evaluated in terms of the number of buses successfully retrofitted.

Voluntary – Funding from SEPs provided the incentives to participate in the program. Boston Public Schools worked with the engine and DPF manufacturers to select buses and technologies for the program.

VEHICLE/EQUIPMENT FLEET APPLICATION

Thirty-two 1997 model year International buses equipped with International 444 engines were equipped with DPFs. These filters plugged and had to be removed. A different DPF technology was used to equip 85 model year 2000 Freightliner buses equipped with Caterpillar buses with

Boston Public School Program/Project #23
Retrofit Project Summary

3126/C7 engines and one International bus equipped with an International 466 engine. These buses are still in operation. Data logging was performed on the candidate buses, but despite the data logging, the exhaust temperature of the International buses in actual operation is insufficient to bring about proper regeneration and the filters plugged. The City of Boston owns the school buses, but contracts for operation/maintenance with independent contractors [Laidlaw (1st year) and First Student (2nd year). The buses average about 1,200 to 1,500 miles annually. Ambient temperatures in the winter are as low as –20F and as high as 90F in the summer. The buses are operated at sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Two different DPFs provided by different manufacturers were used in the program and the buses were fueled with ULSD. The first design DPF was installed on 32 International buses. The DPFs plugged and were removed. A different design DPF was installed on the 85 Freightliner buses equipped with Caterpillar engines and one International bus and these buses are still operating.

Emission Performance/Testing – No emission testing was conducted.

Costs/Warranties – One DPF design costs approximately $5,000 (for International buses) and the other cost approximately $10,000 (for Caterpillar buses). Warranties included in the price of the technology. The engine warranty was not affected.

Delivery/Installation/Maintenance – The vendors recommend a six to 12 week lead-time for delivery. Installation of DPF and backpressure monitor took about six to eight hours. Several of the DPFs on the Caterpillar buses have been cleaned of ash. Boston Public Schools is considering the purchase of replacement DPFs to start a rotation where a clean filter would be installed on the bus and the dirty DPF would be cleaned.

Training – Training was provided for the vehicle/fleet mechanics and operators. The engine manufacturer installed the DPFs on the Caterpillar buses.

Failures/Repairs/Replacement – As noted, the DPFs on the 32 International buses failed due to low exhaust temperature that resulted in the DPFs failing to regenerate. The DPF supplier provided a refund for the DPFs. The Caterpillar buses with DPFs have been operating as expected and without problems.

Impact on Vehicle Performance – The DPFs failures on the International buses resulted in increased backpressure and down time to remove the filters. The DPFs equipped on the Caterpillar buses have operated without any problems and have had no noticeable impact on fuel economy.

FUELS AND LUBRICANTS

Fuel Properties – ULSD (<15 ppm sulfur). No supply or performance problems were reported.

Massachusetts Central Artery/Tunnel Project/Project #28
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 21, 2005 **Location:** Boston, MA

Report based on status of project as of January 6, 2005

Contact Organization: Northeast States for Coordinated Air Use Management (NESCAUM)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project involved retrofitting DOCs on over 250 pieces of construction equipment being used on Boston's major highway/tunnel construction project ("the Big Dig"). The objective of the project was to improve air quality in an urban environment. There were several phases to the project. Phase 1 was a pilot program involving the retrofit of DPFs and DOCs on nonroad engines used at the Salem power plant. Phase 2 involved the purchase of 60 DOCs by the Massachusetts Highway Department (MHD) for installation on construction equipment used in the project. Phase 3 was the adoption of a contract requirement that contractor-owned diesel equipment be retrofitted with DOCs for the remainder of the construction project. As part of the program evaluation, Environment Canada (EC) will conduct emission testing on a number of DOC-equipped construction vehicles and equipment. The Big Dig project had a reduced idling program in place for dump trucks and other equipment not in active use. Also, staging areas were established away from buildings to minimize exposure to diesel exhaust from idling vehicles and equipment.

Education and Outreach – Press releases and press conferences were conducted on the Big Dig Phase 1and 2. The events received TV and press coverage. Video footage of the performance of retrofitted equipment received wide attention. An SAE paper was prepared on the pilot project.

Project Partners – Project partners included Massachusetts DEP, U.S. EPA Region 1, the Manufacturers of Emission Control Technology (MECA) and its member companies, the Northeast States for Coordinated Air Use Management (NESCAUM), EC, the MHD, the Massachusetts Turnpike Authority, and the construction contractors. MECA, MECA members, EC, and NESCAUM provided technical support.

Status – The project was completed on time.

Funding – MA DEP SEP funds ($50,000) were used for the Salem power plant pilot program. MHD contributed $100,000, and the contractors split the costs with FHA during Phase 2of the project. MECA and its members donated 10 DOCs.

Major Program Elements – The project included three phases: Phase 1(Salem pilot program); Phase 2 60 DOCs); and Phase 3(MHD required contactors to retrofit construction equipment in certain areas of the project).

Massachusetts Central Artery/Tunnel Project/Project #28
Retrofit Project Summary

Voluntary/Mandatory –

Voluntary – Phases 1 and 2 were voluntary and the incentives included funding and providing positive media coverage of the construction fleets' participation. Data logging during Phase 1 was used to help determine the appropriate technology for Phases 2 and 3. DOCs were selected for Phase 2 and 3 of the project.

Mandatory – Phase 3 was mandatory in that the construction contractors were required by the artery/tunnel project contacts to retrofit construction equipment to reduce aldehyde odors. The provision was contained in the odor control section of the contract. DOCs were selected as the technology to be utilized because the data logging indicated the exhaust temperature of the construction equipment covered by the contract provision was adequate to support the use of DOCs.

The program is being enforced by maintaining an inventory of the equipment retrofitted and by having EC test a few of the DOC-equipped construction equipment. The rate of compliance has been very high because contractors are required to report retrofit information to MA DEP. One issue that arose was that contractors tended to purchase parts from suppliers with whom they were most comfortable doing business, rather than going to companies that supply verified DOCs. As a result, some unverified DOCs were used which did not reduce PM.

Overall Comments on the Program – NESCAUM reported that the verified DOCs provided significant PM, HC, CO, and toxic exhaust emissions reduction at a low cost. The exhaust temperature profile of the equipment used in the Big Dig construction project, in most instances, was inadequate to support utilization of passive DPFs. DOCs have broad application and are easy to install and operate. NESCAUM noted that at the time of the project, the lack of verified DOCs for nonroad applications was an issue and even now there is a need for more nonroad engine verified technologies. Finally, NESCAUM indicated that while DOCs do not have the same emission control capability as DPFs; DOCs are an important technology to use to improve local and regional air quality.

VEHICLE/EQUIPMENT FLEET APPLICATION

Equipment retrofitted with DOCs included: Nichi, Caterpillar, SIC, Terex, and JLG lifts; Mantis cranes; John Deere and Caterpillar dozers; and Cradel excavators. The model years of the equipment ranged from 1994 to 2000, with most of the equipment being 1999 or 2000 model year. Most of the equipment retrofitted was post-1996 model year. All equipment used on the Big Dig project is owned by the contractors. Equipment had to be on site for a specified amount of time in order to qualify for retrofit. A wide range of nonroad equipment can be retrofitted with DOCs including cranes, front-end loaders, generators, and excavators. Sufficient space on the equipment to install the DOC can be an issue in some cases. The average annual hours of operation for the equipment was 3,000 hours. Data logging was conducted by the DOC manufacturers. Ambient temperatures ranged from 10 to 100F and the equipment was operated at sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The DOC technology was installed as a muffler replacement.

Massachusetts Central Artery/Tunnel Project/Project #28
Retrofit Project Summary

Emission Performance/Testing – EC used a portable emission-testing device during the pilot program. For subsequent evaluations, several DOCs will be removed and sent to EC for emission testing.

Costs/Warranties – The DOC costs range from $1,500 to $2,500 including installation. There have been no reported operating or maintenance costs. The warranty period is 4,000 hours.

Delivery/Installation/Maintenance – Maintenance was not performed prior to the installation of the DOCs. The DOCs were delivered on time. The DOC suppliers either installed the device or trained the mechanics to install the DOCs. Installation typically took one to two hours. In some cases equipment was disqualified because of space constraints (e.g., the existing muffler was smaller than the DOC or it was wedged into the chassis). No maintenance has been necessary.

Training – The DOC suppliers trained the mechanics on how to replace a standard muffler with a DOC.

Failures/Repairs/Replacement – No reported problems or failures with the DOCs.

Impact on Equipment Performance – No reported adverse impacts on equipment performance. Fuel usage is closely monitored by equipment managers and there were no noticeable impacts on fuel consumption for the DOC-equipped engines.

FUELS AND LUBRICANTS

Standard highway diesel (approximately 350 ppm sulfur) was used on the Big Dig project. There was a small pilot program using emulsified diesel. Big Dig managers wanted to use the emulsified fuel in a larger demonstration, but the fuel distribution problems proved too difficult. NESCAUM commented that the practice of wet hosing could make distribution of specialized fuels (such as emulsions) difficult and expensive. Also, the use of specialized fuels is complicated by pre-existing contractual obligations with the fuel suppliers.

MBTA Locomotive Project/Project #34
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 14, 2005 **Location:** Boston, MA

Report based on status of project as of January 6, 2005

Contact Organization: EPA Region 1

PROJECT DESIGN

Project Description/Objectives/Outreach/Project Evaluation – The project consisted of retrofitting a specially configured DOC on a Massachusetts Bay Transportation Authority (MBTA) locomotive to assess emissions reductions and durability of the device in order to demonstrate the application of DOC technology to this type of engine.

Partners – Partners included U.S. EPA (funding), MBTA (provided the locomotive used in the project and mechanical and operational services), Environment Canada (conducted emission testing) and the technology manufacturer (technical support).

Status – During the initial phase of program, the DOC plugged after three weeks of operation. The next phase of the program is under consideration.

Funding – EPA provided a grant of $95,000. MBTA is providing in-kind contribution in the form of mechanical and operational services.

Major Program Elements – The elements of the program included developing a design for the DOC to have sufficient capacity and to fit within the available space; installing the DOC; switching to low-sulfur diesel fuel; and emission testing.

Voluntary – The EPA grant made the project possible. The program attracted limited interest on the part of retrofit technology suppliers. The technology provider who was willing to participate was only able to provide a DOC given the space constraints on the locomotive engine.

VEHICLE/EQUIPMENT FLEET APPLICATION

The DOC was retrofitted on a model F40PH locomotive equipped with a GM EMD 645E3, 2238kW (3000 hp) @ 893 rpm, 16-cylinder, 170L displacement engine. The engine was owned and operated by MBTA and was used to power commuter rail service in greater Boston. The exhaust temperature at the DOC outlet ranged from 66C at low idle to 338C at notch eight. Ambient temperatures during the three weeks of operation were approximately 60F and the locomotive operated at sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The DOC was specially designed to provide adequate capacity and to fit within the limited space available.

MBTA Locomotive Project/Project #34
Retrofit Project Summary

Emission Performance/Testing – Environmental Canada provided baseline and emission testing according to EPA's locomotive test procedures utilizing portable field testing equipment.

Costs/Warranties – The DOC cost $18,000 and the installation was performed by MBTA personnel.

Installation/Maintenance – Prior to installation of the DOC, a top-deck overhaul was performed. The installation took a full day. The time needed to complete the installation was to be expected given the special design and the difficulties fitting the technology in the available space. For example, a flange on the DOC needed to be cut off and the engine cover needed to be slightly modified.

Failures/Repairs/Replacement – After three weeks of operation with significant reductions, the DOC clogged and failed to operate properly. The DOC was removed. Locomotive 2-stroke engines emit a lot of oil. In addition, the locomotive engines in commuter rail service spend a lot of time at idle and do not generate the temperatures needed for the DOC to function effectively. The program partners indicated that for this type of application, some type of regenerating technology likely will be needed.

Impact on Vehicle Performance – When the DOC plugged, the backpressure increased and the engine started running poorly.

FUELS AND LUBRICANTS

Emission testing was performed with low sulfur diesel (260 ppm sulfur, cetane 48.4 and aromatics 29% by weight) and ULSD (18 ppm sulfur, cetane 43.9 and aromatics 22.4% by weight). The fuel cost differential for the low sulfur and ULSD fuel during operation and testing was $1,900.

Wissahickon School Bus Project/Project #39
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 9, 2005 **Location:** Wissahickon, PA

Report based on status of project as of January 16, 2005

Contact Organization: Wissahickon School District

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project encompassed retrofitting 31 buses with DPFs and 14 buses with DOCs and fueling the School District's 75 vehicles with ULSD. The project was funded by a grant awarded, through a competitive process from the Pennsylvania Department of Environmental Protection (DEP). The program was a joint public/private funded imitative. The project's success will be evaluated in terms of any problems that may occur related to the fuel and retrofit equipment used. No emission testing is planned. Using EPA's model for calculating emission reductions, the District estimates that over the next seven years the program will reduce HC emissions by 1.86 tons, CO by 5.4 tons, and PM by 0.82 tons. Reduced idling was not included as part of the program.

Public Education and Outreach -- The project received considerable attention in the media and elsewhere. On April 7, 2003, the EPA Administrator launched the Clean School Bus USA Program at Wissahickon High School. The Pennsylvania Department of Environmental Resources held a media event to recognize the program partners and developed videotape for release to all schools in the state. The project was reported in numerous school board and petroleum industry related publications as well as in the *Philadelphia News* and National Public Radio.

Partners – The program partners included the U.S. EPA (funding and project guidance, including help with the development of the bid specifications and bid analysis), the DEP (project guidance and funding), 3M Corporation (project funding and student environmental education), the retrofit technology provider (technical support with retrofit installations, temperature data logging, and filter maintenance), and the ULSD supplier.

Status – The conversion to ULSD and the retrofit installations are complete. The evaluation process is ongoing.

Funding – The District was awarded $250,000 by DEP. Grant funds included money from the U.S. EPA and 3M Corporation.

Major Program Elements – Program partners evaluated the bus fleet to determine which buses would be retrofitted with DOCs and which would be retrofitted with DPFs. Temperature data logging and technology installations were also major implementation elements. The transition to ULSD involved depleting the current supply to a low level and then commencing deliveries of the ULSD.

Wissahickon School Bus Project/Project #39
Retrofit Project Summary

Voluntary – The incentives to encourage fleet participation was the funding and positive publicity for the School District. The technologies for the program (DPFs and DOCs) were selected by EPA and DEP prior to the District being selected as the grant recipient.

VEHICLE/EQUIPMENT FLEET APPLICATION

The 41 Blue Bird model front-mounted engine bus fleet is owned and operated by the School District. DPFs were initially installed on six buses with Cummins 8.3L engines, 20 buses with Cummins 5.9L engines and one bus with an International DT466 engine. The DOCs were installed on six buses with Cummins 8.3L engines and eight buses with Cummins 5.9L engines. There were early indications that the 1990-1991 Cummins 8.3L engines were not achieving the retrofit technology provider's temperature goal of 325C for 25% of the duty cycle that was needed for the DPF to regenerate (self-clean). The DPFs on these buses would begin to clog within 30 days of use. The DPF provider installed insulating blankets on the vehicle manifolds, but the insulation failed to provide the additional temperature needed for regeneration. Eventually, the DPFs were removed from all of the buses with the Cummins 8.3L engine.

The school buses are used to transport students to and from school and travel an average of 11,126 miles annually. The buses operate at about 200 ft above sea level with ambient temperatures ranging from -18F to 99F.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The technologies used in this program were muffler replacement DOCs and DPFs. The DPF systems included backpressure alarm systems. As noted above, the DPFs on the buses equipped with the 1990-1991 Cummins 8.3 L engines plugged prematurely because the exhaust temperatures were not adequate to initiate DPF regeneration. Those DPFs were removed. The DPFs and the DOCs on the other buses have operated without any problems.

Emission Performance/Testing – Data logging was performed by the technology supplier on the candidate buses for DPF retrofit. No emission testing was conducted. Emission reductions were estimated using U.S. EPA emission reduction calculation guidance.

Costs/Warranties – The total hardware and installation costs was $144,686.75. A warranty was included at no additional cost. Maintenance (filter cleaning) currently costs $22.40 per vehicle.

Delivery – Product delivery was about a month late due to production delays in manufacturing the technology.

Installation/Maintenance – No pre-installation was performed. The installations took approximately three hours per vehicle. Older vehicles had to have insulation blankets installed on the exhaust pipes to help maintain higher exhaust temperatures. The District purchased a DPF cleaning station to provide a more thorough cleaning of the filters. DPFs need to be cleaned anywhere from once to twice a year. The

Wissahickon School Bus Project/Project #39
Retrofit Project Summary

time to remove and re-install the filter is about 15 minutes. The filters were cleaned at a high temperature cleaning station that took about eight hours to regenerate the filter and about 15 minutes of labor to run the cleaning station.

Training – Training for the District's fleet mechanics was provided by the technology supplier.

Failures/Repairs/Replacement – As noted above, the temperature profile of the buses equipped with 1990-1991 model year Cummins 8.3L engines was inadequate to support the use of DPFs. The DPFs clogged prematurely and eventually were removed. The DPFs on the other buses and the DOCs have operated without any reported problems.

Impact on Vehicle Performance – The bus drivers observed a slight power loss when the DPFs needed to be cleaned. This usually occurs in about six to 12 months depending on the miles driven and the age of the bus. The District reported no noticeable change in fuel consumption of the retrofitted buses.

FUELS AND LUBRICANTS

Fuel Properties –0.003 – 15 ppm maximum sulfur, cetane index minimum 40; lubricity gram minimum 3,100, viscosity at 100F 1.4-1.6, and Cloud point maximum is 10F. Additives were added to the ULSD by the supplier prior to delivery

Supply/Operational Experience – No reported problems with supply or use of the ULSD**.**

Birmingham City School Bus Program/Project #40
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 8, 2005 **Location:** Birmingham, AL

Report based on status of project as of December 12, 2004

Contact: Alabama Department of Environmental Management (DEM)

PROJECT DESIGN

Project Description/Objectives/Partners/Project Evaluation – DOCs were retrofitted on 70 buses in the City of Birmingham School System. The purpose was to reduce emissions from the diesel engines in order to lessen school children's exposure to diesel emissions and to address air quality issues in Birmingham. Partners included: the Alabama DEM (secured funding, bidding out services, program organization and oversight, and fleet identification and selection); U.S. EPA (funding, provided information on potential contractors, program development advice, retrofit selection advice); the Birmingham City School System (provided fleet vehicles); the Jefferson County Department of Health (program oversight); the DOC supplier (provided and installed the DOCs and provided technical support); and the engine manufacturers (technical support). There was no idling reduction program in connection with the retrofit project.

With regard to project evaluation, DEM calculated the emission reductions using default reduction estimates for the DOCs. As for vehicle performance, DEM and the DOC provider followed up with the fleet manager to ensure that the buses were operating properly. No problems were reported.

Status – The project was completed in November 2002. The installation of the DOCs was much faster than DEM expected.

Funding – EPA provided $75,000 and DEM provided approximately $4,000 to ensure that all of the eligible buses were retrofitted.

Major Program Elements – The major planning elements included securing adequate funding, fleet identification, and retrofit device selection. The major implementation elements included completing the biding process and installing of the DOCs.

Education/Outreach – The primary outreach activities involved educating the fleet manager on the purpose of the project and providing an opportunity for the fleet manager to meet with the engine manufacturers and other technical experts to gain information on the relationship between the emission control devices and the buses. The main objective was to let the manager know that the installation of the devices would not have any adverse effects on his buses.

Voluntary – Once the fleet manager and school system were assured that installation of the DOCs on the buses would not affect the buses' performance, they agreed to support the project. The fact that the emission reductions would benefit school children and the community as a whole and the fact that there would be no cost to the school system were sufficient incentives for the school district.

Birmingham City School Bus Program/Project #40
Retrofit Project Summary

With regard to the selection of retrofit technology, DEM considered, but rejected, the idea of using DPFs because ULSD was a prerequisite to using DPFs and ULSD fuel was not readily available. DEM, based on in-house research and in consultation with EPA, selected DOCs.

Overall Comments on the Program – DEM stated that the project was a resounding success. There were no problems in the installation or operation of the DOCs and there were no reported adverse effects on the vehicles or fuel consumption. One issue occurred during the bid process. The State Department of Finance (DOF) identified the vendors that were to receive the RFP. The DOF used the term "catalytic converter" rather than "diesel oxidation catalysts" in its database to identify prospective bidders. As a result, numerous requests were received from muffler shops, but none of the DOC providers were notified. As a result, the RFP had to be re-issued. DEM stressed the importance of closely tracking the bid process.

VEHICLE/EQUIPMENT FLEET APPLICATION

The 70 school buses equipped with DOCs were 1998-2001 model year Internationals and Freightliners with Cummins 5.9L and International electronic front-mounted engines. The buses are owned by the City of Birmingham School System to transport 7,000 children to and from school and school functions. The retrofitted buses are expected to travel over 100,000 miles during the remainder of their useful lives. Ambient temperatures range from 36 to 90F and Birmingham is 600 ft above sea level.

DEM initially wanted to retrofit the older, "dirtier" school buses in the fleet. After consulting with the feet manager and the Director of Public Transportation for the Alabama Department of Education, DEM discovered that Birmingham's school bus fleet, as well as the statewide fleet, was much newer than expected. DEM decided to retrofit the newer buses to ensure that the DOCs would remain in service for the longest time possible to maximize the benefits of the project.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The DOCs were installed as muffler replacements.

Emission Performance/Testing – No emission testing was performed; emission reductions were estimated using EPA's verified emission levels for DOCs.

Costs/Warranties – The total cost, including hardware and installation, ranged from $1,098 to $1,238 depending on the model year. The warranty covered the useful life of the device and included in the purchase price.

Delivery/Installation/Maintenance – No engine alterations were necessary. The installation required the removal of the existing muffler and installation of the new DOC/muffler system. Installation of the DOCs on 70 buses took the vendor's two employees less than one week. The buses retrofitted represented different year models, chassis manufacturers and other differences. With one model, special brackets were needed and this caused a slight delay in retrofitting those buses, but it did not delay the

overall installation process. No other problems were encountered. The DOCs have not required any maintenance.

Training – No training was provided to fleet personnel because the devices were installed by the vendor's employees.

Failures/Repairs/Replacement – There have been no problems with the technology. There have been no reported impacts on the technology from extended idling.

Impact on Vehicle Performance – According to the fleet manager there have been no adverse impacts on vehicle performance or fuel consumption.

FUELS AND LUBRICANTS

Conventional highway diesel fuel was used.

Clayton County School Bus Project/Project #41
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 11, 2005 **Location:** Clayton County, GA

Report based on status of project as of December 28, 2004

Contact Organization: Georgia Environmental Protection Division (EPD)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project was designed to retrofit 60 school buses in the Clayton County School District with DOCs. DOCs were chosen because they were the most cost effective retrofit option at the time of the project. The project did not include a reduced idling program. The project was evaluated based on the success of the installation and operation of the emission control equipment. The semi-annual reports provided feedback on the operation of the DOCs.

Education/Outreach – EPD met with the seven candidate school districts to explain the program and conducted a subsequent meeting with the school district that was selected for the program. A press release was sent to the local press announcing the selection of the winning school district.

Partners – Partners included the U.S. EPA (funding), Georgia EPD (program management), Clayton Country School District (provided the buses and installed the DOCs), and the DOC supplier (technical assistance).

Status – Clayton County School District installed the DOCs over the period of October 2002 to February 2003. Semi-annual reports were submitted. The final report will be submitted in January 2005.

Funding – U.S. EPA provided a $75,000 grant to fund the program.

Major Program Elements – Major planning elements included determining the best type of fleet to retrofit, determining the best type of retrofit technology to use, developing partners, and developing the contractual tool to reimburse the participating fleet. Next, EPD sent requests for projects to seven metro Atlanta school districts. Once the Clayton County School District was selected as the award recipient, it issued an RFP for the technology. EPD then reimbursed Clayton for the costs of DOCs purchased.

Voluntary – Full financial support supplied by the grant and the encouragement of EPD provided the incentives for the school districts to participate. Verified technologies were used. DOCs were selected based on the amount of pollution reduced per dollar cost. DPFs were ruled out because ULSD fuel was not available.

Overall Comments on the Program – The project was an overall success. EPD reported that the DOCs were easy to acquire, install, use and are a dependable technology. There were no DOC delivery, installation or operation issues. There were no reports of adverse

Clayton County School Bus Project/Project #41
Retrofit Project Summary

impacts from the technology on either engine performance or fuel consumption. The only problem encountered was the reimbursement mechanism for the school district. EPD resolved this issue by allowing only one invoice per month to be sent to EPD.

VEHICLE/EQUIPMENT FLEET APPLICATION

The 60 DOCs were retrofitted on 1999-2001 model year Blue Bird buses (65-71 passenger capacity) equipped with Cummins/ISB 5.9L front-mounted engines. Some of the buses originally identified as candidates for DOC retrofit already had DOCs installed. The buses, which are owned by the school district, operate an average of 15,543 miles per year and consume a total of 504,500 gal/yr. The buses operate year round at an altitude of 500 ft above sea level and the ambient temperatures range from 30 to 95F.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs were used in the project.

Emission Performance/Testing – No emission testing took place. Emission reduction calculations were based the EPA verified levels of emission controls for the DOC design selected.

Costs/Warranties – The cost of DOCs, including installation and maintenance, was $1,293. A 100,000 mile warranty was provided at no extra cost.

Delivery – The DOCs were delivered on time.

Installation/Maintenance – The DOC supplier installed the first two DOCs and trained the mechanics on how to install the devices. The remaining 58 DOCs were installed by the school district's fleet mechanics. Installation took approximately two hours with no reported problems. No maintenance has been performed on the DOCs

Failures/Repairs/Replacement – No reported operational problems with the DOCs.

Impact on Vehicle Performance – No reported adverse impacts on vehicle performance or fuel consumption.

FUELS AND LUBRICANTS

Conventional on-road No. 2 diesel was used. The sulfur content was less than 500 ppm.

Charlotte-Mecklenburg School Bus Project/Project # 42
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 8, 2004 **Location:** Charlotte-Mecklenburg County, NC

Report based on status of project as of December 22, 2004

Contact: Charlotte-Mecklenburg Schools

PROJECT DESIGN

Project Description/Objectives/Partners/Project Evaluation – The project is designed to reduce CO, PM, and HC emissions from school buses by installing DOCs. Partners include the Mecklenburg County Air **Quality** agency, which is serving as technical advisors and providing emission reduction calculations, the Charlotte Mecklenburg Schools, which is coordinated the installation of the DOCs, and the supplier who installed the devices and provided technical support in dealing with the retrofitted DOCs. All North Carolina schools follow a reduced idling policy. Idling is limited to five minutes and no bus may run without the driver being within three feet of the bus. Many of the newer buses in the fleet are equipped with automatic shutoff devices.

Public Outreach – Public outreach included a press conference held in conjunction with the EPA adoption of the on-road heavy-duty engine emission standards. A retrofitted bus was on display and a representative from the school district was available to answer questions

Status – The installations were completed on time and the DOC-equipped buses are operating in service.

Funding – U.S**.** EPA awarded a grant of $50,000. Staff time provided by the agency and the school district was an in-kind contribution.

Major Program Elements – The Charlotte-Mecklenburg Schools' Purchasing Department handled the bidding process. The school district reported that using the Purchasing Department to develop the RFP for the DOCs made the entire process much easier, which included meetings with the bidders and evaluating their qualifications. Lift buses that load from the rear and non-electrically timed engines were selected because installing DOCs on these buses would provide the greatest emission reductions and these buses are scheduled to operate for several more years before retirement. Once the vendor and buses were selected, the retrofits took place in the bus yard during the middle of the day to minimize the downtime for each bus. Project reports are submitted to EPA quarterly.

Voluntary – The air quality agency and the school district worked together to submit an application for EPA funding. No other incentive was needed. DOCs were selected because ULSD fuel was not available in the area and because DOCs provide emission reductions at a reasonable cost.

Overall Comments on the Program – Project participants noted that they would have conducted the project in the same manner if they had to do again. They stated that they will use the same retrofit technology in future projects.

Charlotte-Mecklenburg School Bus Project/Project # 42
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

The project involved 58 1995 to 1999 Navistar school buses equipped with International DT 466, 190 hp front-mounted engines. The buses are owned by the state of North Carolina. Installation of the DOCs was completed in Spring2004. The ambient temperatures range from 30 to 100F and the buses operate 500-990 ft above sea level. The mileage of the operated buses varied and it is difficult to estimate an annual rate because the DOC-equipped buses have only been operating for six to eight months, including the summer months.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The retrofit devices were muffler replacement DOCs.

Emission Performance/Testing – No data logging or emission testing was performed. Emission reductions were estimated using EPA's retrofit calculator.

Costs/Warranty – The cost of the DOCs was $841.51 per bus. Parts and labor was $749.01 and $97.50, respectively. A 3 year/100,000 mile warranty was provided at no extra cost.

Delivery/Installation/Maintenance – Prior to installation, the exhaust pipe and supporting clamps were checked for damage. The products were delivered on time and the installation took approximately one hour with no problems reported. A visual check of the DOC and installation hardware has been included as part of the routine maintenance.

Failures/Repairs/Replacement – No failures or problems have been reported.

Impact on Vehicle Performance – No reports or complaints were received. Very minimal to no overall fuel economy was noted. Fuel use was on par with the previous year.

FUELS AND LUBRICANTS

Standard highway diesel fuel with a sulfur content of up to 500 ppm was used.

Chicago Utility Vehicle Project/Project #43.1
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 16, 2005 **Location:** Chicago, IL

Report based on status of project as of February 5, 2005

Contact Organization: City of Chicago Department of the Environment (DEP)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project was conceived to reduce emissions from City of Chicago utility vehicles by retrofitting four refuse trucks and four street sweepers with DPFs, and to rebuild the engines of three fire trucks. The objective was to achieve emission reductions and to demonstrate to other communities, businesses, and industries the type of actions that could be taken to reduce diesel exhaust emissions. There was no reduced idling component to the program. The program will be evaluated by estimating the emission reductions using EPA's emissions calculator.

Public Education & Outreach – Presented information regarding the project at the Clean Air Innovations Conference (August 2004). Installed signs on all retrofitted vehicles to inform others of the project. Reached out, through the Clean Air Counts Campaign, to area Councils of Government and fleet manager associations.

Partners – U.S. EPA (funding), Metropolitan Mays Caucus (dispersed EPA funds to the City of Chicago as a grant), and the City of Chicago (applied the funds to pay for the retrofits).

Status – The project is completed.

Funding – EPA grant, though of Metropolitan Mayors Caucus, paid for the entire project. The project cost was $107,750.

Major Program Elements – The major planning element of the program was coordinating the project with other City of Chicago departments. The implementation elements were identifying the vendor, selecting the most appropriate EPA-verified technologies, and continuing coordination with other City of Chicago departments.

Voluntary – The program was undertaken to demonstrate the application of retrofit technologies to a municipal fleet. The funding by EPA to cover the costs of the retrofits was beneficial in moving the project forward.

Overall Comments on the Program – The Chicago DEP reported that, overall, the retrofitted technology was pretty straightforward and could be adapted to the fleet vehicles/equipment without having to make major modifications to the retrofit equipment (some small modifications were necessary to insure proper installation). One of the filters clogged extremely quickly because the equipment was fueled with #2 low sulfur diesel fuel. The vendor had indicated that while ULSD fuel was recommended,

Chicago Utility Vehicle Project/Project #43.1
Retrofit Project Summary

low sulfur #2 diesel fuel (<500 ppm sulfur) could be used. When the vehicles equipped with DPFs were fueled with diesel fuel containing <30 ppm sulfur, the problem of premature filter plugging did not occur.

VEHICLE/EQUIPMENT FLEET APPLICATION

All vehicles and equipment in the program were owned by the City of Chicago. The four street sweepers were 2004 model year Elgin Pelican models equipped with John Deere 4045T, 150 hp engines, operated an average of 1,068 hours/year, and consumed an average of 1,322 gallons/year of fuel. The four refuse trucks are 2004 model year Autocar Expeditor models equipped with Caterpillar C10, 305 hp engines, operate an average of 780 hours/year, and consumed on average, 1,690 gallons/year of fuel. The three fire trucks were 1993 model year Spartan/Luverne Commander models equipped with Cummins C8.3L, 300 hp engines, operated an average of 560 hours/year, and consume on average, 1,147 gallons/yearr of fuel.

Ambient temperatures ranged from -1 to 85F and the vehicles operated at about 550 to 610 ft above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Refuse trucks and street sweepers were retrofitted with muffler replacement DPFs equipped with backpressure monitor systems.

Emission Performance/Testing – The City of Chicago Department of Fleet Management is in the process of procuring temperature measurement equipment. Estimated emission reductions will be made using the EPA emission reduction calculator.

Costs/Warranties – The cost of the DPFs installed was $9,675 each for the street sweepers and $8,450 each for the refuse trucks. A one-year warranty was included in the product cost. The engine overhaul for the fire trucks was $11,750 each.

Delivery – The products were delivered on time.

Installation/Maintenance – The engines were inspected to insure proper operation prior to retrofit technology installation. The product vendor performed the installations. The retrofits took approximately 12 hours per unit. Minor modifications to the DPF system were necessary to insure proper installation. After the redesign of the system was made, there were no installation problems.

Training – The DPF vendor provided training on filter cleaning.

Failures/Repairs/Replacement – One of the DPFs retrofitted on a refuse truck clogged very quickly because ULSD was not used. For those vehicles fueled with ULSD (<30 ppm sulfur) this problem did not occur. For the vehicle with the filter that clogged, the backpressure monitor proved useful in warning that the filter needed to be cleaned.

Chicago Utility Vehicle Project/Project #43.1
Retrofit Project Summary

FUELS AND LUBRICANTS

Where #2 low sulfur diesel fuel (<500 ppm sulfur) was used, there was a problem with the DPF clogging very quickly. Where ULSD (<30 ppm sulfur) was used, the problem of rapid filter plugging did not occur. No special lubricating oil was used.

Chicago Refuse Truck Project/Project #43.2
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 16, 2005 **Location:** Chicago, IL

Report based on status of project as of February 5, 2005

Contact Organization: City of Chicago Department of the Environment (DEP)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project was conceived to reduce emissions from 75 City of Chicago refuse trucks. The objective was to achieve emission reductions and to demonstrate to other communities, businesses, and industries the type of actions that could be taken to reduce diesel exhaust emissions. There was no reduced idling component to the program. The program will be evaluated by estimating the emission reductions using EPA's emission calculator.

Public Education & Outreach – Presented information regarding the project at the Clean Air Innovations Conference (August 2004). Installed signs on all retrofitted vehicles to inform others of the project. Reached out, through the Clean Air Counts Campaign, to area Councils of Government and fleet manager associations.

Partners – U.S. EPA (funding), and the City of Chicago (applied the funds to pay for the retrofits).

Status – The project is completed.

Funding – EPA grant of $200,000 paid for the entire project. The project cost was $107,750.

Major Program Elements – The major planning element of the program was coordinating the project with other City of Chicago departments. The implementation elements were identifying the vendor, selecting the most appropriate EPA-verified technologies, and continuing coordination with other City of Chicago departments.

Voluntary – The program was undertaken to demonstrate the application of retrofit technologies to a municipal fleet. The funding by EPA to cover the costs of the retrofits was beneficial in moving the project forward. The technologies selected were EPA-verified.

Overall Comments on the Program – The Chicago DEP reported that the type of vehicles selected were well suited for the project, since they were high-use, high profile equipment operated throughout many neighborhoods in the city. However, the program required considerable effort to coordinate the logistical issues that arose between the installer, the fleet operator, and users of the vehicles in order to minimize mounting delays and service interruptions. DEP also noted that the installation of the technology was pretty straightforward and could be adapted to the vehicles without having to do major modifications.

Chicago Refuse Truck Project/Project #43.2
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

All the refuse trucks were owned by the City of Chicago. The vehicles retrofitted with DOCs included 39 model year 2001-2002 Volvo Expeditor trucks equipped with Cummins ISM, 305 hp engines, 20 model year 2003 Autocar Expeditor trucks equipped with Cummins ISM, 320 hp engines, and 16 model year 2004 Autocar Expeditor trucks equipped with Caterpillar C10, 305 hp engines. These trucks were operated in the range of approximately 6,575 to 7,750 miles/year and consumed fuel on average in the range of 2,900 to 3,500 gallons/year. Ambient temperatures range from -1 to 85F and the vehicles operated at about 550 to 610 ft above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The refuse trucks were retrofitted with muffler replacement DOCs.

Emission Performance/Testing – The City of Chicago Department of Fleet Management is in the process of procuring temperature measurement equipment. Estimated emission reductions will be made using the EPA emission reduction calculator.

Costs/Warranties – The cost of the DOCs, including mounting hardware, was $1,900 each plus $210 each for installation. A one year warranty was included in the product cost.

Delivery – The products were delivered on time.

Installation/Maintenance – The engines were inspected to insure proper operation prior to retrofit technology installation. The product vendor performed the installations. The retrofits took approximately three to four hours per unit. Minor modifications to the DOC system were necessary to insure proper installation. After the redesign of the system was made, there were no installation problems.

Training – No training was provided.

Failures/Repairs/Replacement – No problems reported.

Impact on Vehicle Performance – No adverse impacts reported.

FUELS AND LUBRICANTS

No. 2 diesel fuel (<500 ppm sulfur) was used.

Hammond/Portage School Bus Project/Project #44
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 28, 2005 **Location:** Northwest Indiana

Report based on status of project as of January 17, 2005

Contact Organization: Indiana Department of Environmental Management (IDEM)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation –The Indiana Department of Environmental Management (IDEM) received a U.S. EPA (EPA) grant in the amount of $50,000 for diesel retrofits in Northwest Indiana. These funds were originally intended to retrofit the entire diesel fleet of the City of Hammond with DOCs. After inspecting the fleet it was determined that only 20 of the school buses were appropriate for retrofitting. The remaining funds of approximately $20,000 are being spent in the Portage Township Community Schools in Porter County, Indiana. The clear objective of both of these projects was to decrease tailpipe emissions, thereby, improving air quality for the children, bus drivers, bus technicians and citizens in the area.

Partners – In addition to the state Quantity Purchase Agreement (QPA) vendor of the DOCs, both schools have been active partners in these projects. Both Hammond and Portage have provided their own bus technicians for the installation of the DOCs.

Status –The Hammond retrofit project was completed relatively soon after receipt of the EPA grant.

Funding – See project description.

Major Program Elements – Between the time of the Hammond retrofit project and the soon to be implemented Portage retrofit project, several challenges were overcome. IDEM solicited bids for a state QPA for DOCs, which would provide end users with the lowest possible price per unit on EPA-verified DOCs. Second, the QPA is an existing contractual agreement between IDEM and the selected vendor, providing the end user with an existing contract as a means to purchase the equipment, thus eliminating the need for the schools to deal with the bid process. The QPA approach has been enthusiastically accepted by all current retrofit partners.

The EPA grant did not fund any outreach and education associated with the project. However, in the many diesel presentations given since the implementation, this project has served as a great example of what can be done to better air quality in and around our children's schools.

There was no anti-idling (reduced idling) policy included in the project. However, the School City of Hammond does have a reduced idling policy in place. Additionally, in cooperation with the School Transportation Association of Indiana (STAI), which has associate members encompassing about 95% of Indiana's school systems, IDEM developed and implemented a voluntary state-wide reduced idling policy. This STAI resolution was unanimously passed at the STAI annual conference in Spring 2004.

Hammond/Portage School Bus Project/Project #44
Retrofit Project Summary

Voluntary/Mandatory – Project participation was certainly voluntary. There was, however, no need for incentives to motivate the school systems in Northwest Indiana. School systems, as well as citizens, in Northwest Indiana are very aware of the poor air quality of the area.

Overall Comments on the Program – One of the most surprising aspects to the program planners and participants was the overall ease of installation of the DOCs; it was much easier than anticipated.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – At the time of the Hammond project, DOCs were really the best option available because of the lack of ULSD. Now ULSD is available in Northwest Indiana and can be purchased for a relatively competitive price. However, even with the ULSD option in Northwest Indiana, IDEM and the Portage schools chose to move forward with DOCs to provide the technology for as many buses/children as possible.

Emission Performance/Testing – Since the project installed EPA-verified retrofit technology, there was no need for product evaluation. The project itself, however, was and will be evaluated based on the acceptance of the bus drivers and technicians as it relates to the technology itself. From the standpoint of air quality, the project will be evaluated based on the clear improvement in air quality in the area.

Costs/Warranties –

- Hammond Schools bus technicians: $655.60 ($32.78 x 20 buses)
- DOC installation pipe clamps: $600.00 ($15.00 x 40 clamps)
- DOC equipment: $27,672.43 ($1,414,82 x 2 DOCs plus $1,380.15 x 18 DOCs)

Training: – The mechanics received a short training course on the correct installation of the equipment, but the drivers/operators were not provided any training.

Failures/Repairs/Replacement – None have been reported.

FUELS AND LUBRICANTS

Hammond Schools are currently using a B20 blend. Portage Schools are researching and taking bids for ULSD and B20.

Hamilton County School Bus Project/Project #45
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 11, 2005 **Location:** Hamilton County, OH

Report based on status of project as of December 14, 2004

Contact Organization: Hamilton County Department of Environmental Services (HCDOES)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project encompassed retrofitting 34 Cincinnati Public School (CPS) buses with DOCs and fueling the 74 bus fleet with B20 for the 2004/2005 school year (10 months). The program is designed to reduce school children's exposure to diesel exhaust emissions, to showcase the retrofit program to other school districts, to demonstrate the viability of B20 fuel, to establish a reduced idling program with the privately-owned bus company, and to demonstrate that bus retrofits are a viable option for the use of SEP funds. The project will be evaluated by the input received from the bus company maintenance supervisor, by a survey of the bus drivers, and by input from administration officials, teachers, parents, and others. The program included a voluntary reduced idling program (no idling when ambient temperatures are above 20F).

Education/Outreach – Press releases were sent out in December 2003. Newspaper and TV stories followed in January and February 2004. HCDOES conducted outreach activities aimed at the bus drivers, parents, and school administrators on the benefits of reduced idling program. Drivers received lanyards and mugs with the slogan "Be Idle Free – Turn the Key". Once a week, a prize patrol checked for buses with no idling. Nicer thermos mugs for drivers and goodies for children were awarded as prizes.

Project Partners – Partners included HCDOES (overall coordination of the grant and funding); Cincinnati Public Schools, Riggs Bus Company (provided the fleet for the program), U. S. EPA (funding), Tri-State Alternative Fuels Coalition (funding), the technology vendor (technical support), diesel fuel supplier and B20 supplier.

Status – DOCs were installed and B20 fueling began in August 2004.

Funding – U.S. EPA ($95,500), TriState Alternative Fuels Coalition ($4,500), and HCDOES ($20,000)

Major Program Elements – Planning elements of the program included ensuring that the DOCs were installed before the start of the school year, obtaining Ohio Highway Patrol approval of the DOC installations, coordinating the B20 incremental cost billing with the fuel supplier, and developing an anti-idling campaign for the bus drivers. Implementation elements included developing an acceptable "invitation to bid" procurement process, developing a contract between HCDOES and the winning vendor, keeping the bus company and engine manufacturers informed about the installation process, and communicating with the bus company and the fuel company regarding fuel shipments and cost allocations.

Hamilton County School Bus Project/Project #45
Retrofit Project Summary

Voluntary – Funding provided an incentive to participate in the program. DOCs were selected because of their low maintenance and cost. USLD was not available locally, but B20 was.

Overall Comments on the Program – HCDOES stated that to date, experience with DOCs and B20 fuel has been problem-free. Absolutely no problems occurred with the selection or operation of the vehicles and retrofit technology participating in program. The maintenance supervisor reported less exhaust odor in the morning after start-up and that the buses appeared to be getting better fuel mileage (a program is planned to monitor fuel consumption). The only issue was the six to eight week delivery time of the DOCs. The supplier came to the bus yard and installed the DOCs. Buses were ready for dry runs just days before the school year started.

VEHICLE/EQUIPMENT FLEET APPLICATION

The buses in the fleet included 1999 to 2003 Freightliners equipped with Cummins 5.9L engines and 1994 to 2004 Internationals equipped with International DT 360, DT 408 and DT 466 engines. All buses had front-mounted engines. The buses are owned by Riggs Bus Company. The buses in the fleet operated on average 18,000 to 22,000 miles per year. The ambient temperatures ranged from 0 to 70F and the buses operated at 300-400 feet above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The retrofit technology used was a muffler replacement DOC.

Emission Performance/Testing – No emission testing was performed.

Costs/Warranties – DOCs cost $995 including installation and a 5 year/100,000 mile warranty.

Delivery – The DOC delivery took six to eight weeks due to a backlog caused by high demand.

Installation/Maintenance – No engine maintenance was performed prior to installing the DOCs. The DOC supplier's technicians performed installation of the 34 DOCs over a 3-day period. No maintenance of the DOCs has been necessary.

Training – No training was provided because the technology supplier's technicians installed the DOCs.

Failures/Repairs/Replacement – No operational problems have occurred with the DOC.

Impact on Vehicle Performance – No adverse impacts on vehicle performance. The maintenance supervisor believes the buses are getting better fuel mileage. HCDOES plans to work with the fleet operator to monitor several buses to verify fuel consumption.

FUELS AND ADDITIVES

Twenty percent biodiesel (B20) is being used and to date, there have been no reported problems. The buses have not yet operated in cold weather. The biodiesel does contain a cold weather stabilizer.

DIRT Program/Project #47
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 24, 2005 **Location:** Colorado

Report based on status of project as of December 10, 2004

Contact Organization: Denver Regional Air Quality Council (RAQC)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation –The goal of the DIRT Program is to work with the nonroad diesel industry to find private companies that operate around sensitive populations and would like to differentiate themselves from their competitors by utilizing "clean" technology. Program partners will work with the Rocky Mountain Fleet Manager's Association (RMFMA) and Colorado Contractor's Association (CCA) to find interested private companies.

Public Education & Outreach – Kick-off press announcement

Partners – As a part of the efforts to identify ideal fleets and sensitive populations, Colorado Department of Public Health and Environment's Air Toxics Program is a critical program partner. Colorado's Air Toxics Program is operated by the Air Pollution Control Division (APCD) and is designed to monitor and reduce HAPs which include diesel emissions. As a part of the Air Toxics Program efforts, APCD will provide technical assistance for the DIRT Program and provide opportunities to present program details to other communities at Colorado Air Toxics stakeholder meetings**.**

Once candidate fleets are selected, the RAQC will work with program partners to affix DOCs and the closed crankcase filtration to heavy-duty off-road diesel engines to reduce vehicle emissions of PM up to 30%, CO up to 32.5% and HC up to 42% (these emissions reductions are based on data from the EPA Verified Technology List for the Donaldson Series 6100 DOC plus Spiracle).

Status –The project is in the early planning stage, and will be evaluated based on the successful implementation of the project and demonstrated emissions benefits.

Funding –The program is being funded by a $75,000 EPA grant.

Major Program Elements –

- Stakeholder development and education
- Grant writing
- Identification of equipment to be retrofitted
- Development of installation schedule
- RFP development for equipment
- Installation of equipment

Voluntary –Participation was encouraged by the Program's offer to pay the majority of the equipment cost.

DIRT Program/Project #47
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System –DOCs (manufacturer undetermined at this point) in conjunction with Donaldson Spiracle CCCF will be installed on the nonroad equipment. The DOCs, as a technology, were chosen due to the lack of ULSD fuel in the Rocky Mountain region. Spiracle units were chosen since not much testing of these units has been done in a nonroad setting. The combination of equipment should provide solid emissions reductions**.**

Emission Performance/Testing –The project will attempt to try some emissions testing but the cost, transport, and taking equipment off-line is expected to be seen as unacceptable to any nonroad equipment owner.

Training – None anticipated on the front end of the program**.**

Failures/Repairs/Replacement – Not yet known

Impact on Vehicle Performance – Not yet known

Sacramento Metro Air Quality Management District/Project #49
Retrofit Project Summary

BACKGROUND INFORMATION

Date: December 21, 2004 **Location:** Sacramento Metropolitan Area, CA

Report based on status of project as of December 13, 2004

Contact: Sacramento Metro Air Quality Management District (AQMD)

PROJECT DESIGN

Project Description/Objectives/Partners – Project designed to fund installation of particulate matter control devices on vehicles participating in the Sacramento Emergency Clean Air Transportation (SECAT) Fleet Modernization Program. The SECAT Program is designed to scrap pre-1991 HDDVs and fund replacement with 2000 or later model year vehicles. Installing retrofit devices on replacement vehicles further reduces PM emissions. The SECAT Program uses emissions factors extracted from ARB's EMFAC2002, the main mobile source emission model for California. Partners include the Sacramento Area Council of Governments (SECAT program administration and funding) and ARB (verification of claimable reductions under the California State Implementation Plan).

Status – Retrofit project is in planning phase awaiting award of competitive RFP process. After RFP has been awarded, participants will be solicited to install devices.

Funding – California Traffic Congestion Relief Program ($50 million); Federal CMAQ Funding ($20 million); SACOG Air Quality Funding ($3 million); U.S. EPA Cooperative Agreement Funding for diesel retrofits ($100,000).

Major Program Elements – Major planning elements included obtaining retrofit information, analyzing of target fleet characteristics, applying for U.S. EPA funding, releasing an RFP and eventually awarding the proposal. Implementation elements will include soliciting participants, identifying local installation facilities, meeting with truck dealers and industry representatives, and coordinating the funding streams. Outreach and education activities will be coordinated with the existing SECAT outreach program and, in addition, will center conducting retrofit education programs for new projects and encouraging past participants to install the selected retrofit devices. The project will be evaluated based on overall cost effectiveness, owner evaluations, and product durability.

Voluntary – The program is voluntary and fleets will be recruited that are committed to improve air quality or willing to try new technologies.

VEHICLE/EQUIPMENT FLEET APPLICATION

Vehicle selection process has not started. Target vehicles are purchased through the Fleet Modernization Program. All participating vehicles will be certified to a 0.10 g/bhp-hr PM emission level and to NOx standards ranging from 2.4 to 5.0 g/bhp-hr. These target trucks are typically used for seasonal agriculture and bulk (aggregate) hauling. Annual mileage for participating vehicles averages between 30,000 to 50,000 miles per year. Ambient temperature

Sacramento Metro Air Quality Management District/Project #49
Retrofit Project Summary

ranges from 40 to 105F and the operating altitudes range from sea level to 2,000 ft. A few vehicles travel up to 7,000 feet with 5% to 6% grades.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Retrofit technologies have not been selected. Project will use ARB verified products and no additional emission testing will be conducted.

FUELS AND LUBRICANTS

All vehicles will use either ARB diesel fuel or Federal diesel fuel.

Anchorage School Bus Project/Project #50
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 8, 2005 **Location:** Anchorage, AK

Report based on status of project as of January 10, 2005

Contact Organization – Alaska Department of Environmental Conservation (DEC)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project involved retrofitting 74 school buses owned and operated by the Anchorage School District (ASD) with DOCs. Conventional diesel fuel was used. The project was evaluated in terms of the successful retrofit of all 74 buses with no operational problems. ASD, independent of the project, has been following U.S. EPA's reduced idling guidelines.

Pubic Education & Outreach – DEC presented the ASD fleet manager with an award for his hard work and efforts on the project. The awards ceremony was covered by the press. DEC is currently working on a webpage summarizing Alaska's retrofit projects. DEC has also provided information on the project to several environmental groups, who in turn, included information on the project in their newsletters.

Partners – Partners included the ASD (program implementation), DEC (provided the initial concept, funding, guidance for program requirements and served as the contact with EPA Region 10), and U.S. EPA (funding). The ASD Department of Student Transportation fleet manager provided technical support, particularly with the development and oversight of the retrofit installation process.

Status – Successfully completed.

Funding – U.S. EPA provided the original grant of $65,000. DEC secured $80,000 in separate funding from a SEP project resulting from a settlement. The total project cost was $92,000, with all of the SEP funds and $12,000 of the original EPA funds used to fund the project. The remaining $53,000 from the EPA grant is now being used to fund another project.

Major Program Elements – Program elements included determining the appropriate technology, determining the qualifications of the contractor to perform the retrofit, devising a method to insure payment of the contractor, securing project funding, and establishing the schedule for installing the DOCs.

Voluntary – DEC spoke with a number of fleets about retrofit opportunities. The only incentive available was the possibility of funding to cover the cost of equipment on their fleet vehicles. ASD's participation resulted primarily from the ASD fleet manager's personal interest. Given that ULSD was not available, DOCs were determined to be the best retrofit technology available.

Anchorage School Bus Project/Project #50
Retrofit Project Summary

Overall Comments on the Program – DEC reported that the project was very successful due, in large part, to the interest and commitment of the ASD fleet manager. The only problem was the late delivery of DOCs. There were no problems with the installation and operation of the DOC-equipped buses.

VEHICLE/EQUIPMENT FLEET APPLICATION

The 74 school buses retrofitted with DOCs are owned by the ASD and are used to transport students to and from school and school events. The buses retrofitted were over 5 years old. Buses in the fleet operate an average of approximately 8,700 miles annually. The buses operate at sea level to 1,500 feet with ambient temperatures averaging 20F in January and 60F in July.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs.

Emission Performance/Testing – No emission testing took place. DEC used the EPA verified technology emission levels to calculate emission reductions.

Costs/Warranties – At $92,000 for 74 buses, the average cost worked out to be $1,280 per retrofit. However, this figure does not consider the additional 10 buses that the contractor agreed to retrofit without costs to make up for the delay in delivering the DOCs. The original estimated cost was approximately $1,500. The cost included installation and a warranty.

Delivery – Delivery of the DOCs was delayed for nearly a month. No explanation for the delay was given.

Installation/Maintenance – Retrofitting the 74 buses was spread out over a two-month period and with only a few minor problems, all of which were addressed. The contractor was responsible for installation.

Failures/Repairs/Replacement – No problems were reported

Impact on Vehicle Performance – No problems were reported. DEC did note that the tailpipes on the DOC-equipped buses tended to rust on the inside faster than on the other school buses. DEC suggested that this may have occurred because the DOC reduced the PM which otherwise would have coated the tailpipe and provided protection against rust.

FUELS AND LUBRICANTS

Conventional on-road diesel fuel (<500 ppm sulfur) was used to fuel the fleet.

National Park Service Biodiesel Project/Project #51
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 9, 2005 **Location:** Denali National Park, AK

Report based on status of project as of January 24, 2005

Contact Organization: Alaska Department of Environmental Conservation (DEC)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project involves using fish oil derived biodiesel in stationary power generators outfitted with DOCs in Denali National Park. Alaska DEC is interested in developing and implementing strategies to reduce power generation and home heating emissions. DEC is supporting efforts to develop a local source of affordable ULSD.

Partners – The National Park Service (logistical and mechanical support), the Alaska Energy Authority (provide fuel through a contract), Alaska DEC (program support and allocates funding from EPA for fuel cost differential and retrofit hardware), and U.S. EPA (funding)

Status – Project is in the planning stage.

Funding – The U.S. EPA is providing funding for this project. The National Park Service is contributing in-kind services.

Major Program Elements – Major planning elements include: 1) identifying an affordable source of raw material (fish oil), 2) identifying the process by which the fish oil would be made into biodiesel, 3) identifying a way to test biodiesel in a controlled environment, 4) identifying a way to purchase biodiesel and 5) determining who would handle fuel transportation and who will install the retrofit technologies selected. The implementation elements of the program include: 1) establishing a way to transport the biodiesel into Denali National Park, 2) selecting a method for storing the biodiesel, and 3) insuring that gelling of the biodiesel does not occur.

Voluntary – The National Park Service has set a goal to be petroleum-free over the next ten years. This project is an attempt to help meet that goal. The incentives to initiate the project were the availability of funding and the desire to improve air quality, and avoid potential oil spill cleanup by switching from diesel fuel to 100% biodiesel. DPF technology was considered but because a continuous supply of biodiesel based ULSD could not be guaranteed, the decision was made to select DOC technology for this project.

Overall Comments on the Program – Project partners have determined that fish oil can produce a fully functional biodiesel fuel in current diesel engines. However, the fuel gels at just below 32F and this will prove problematic for winter use. DEC suggests that changes in fuel storage (i.e., heated and insulated) or blending would have to occur for this fuel to be practical in Alaska's most rural environment. The program is designed to determine the utility of the fuel in remote areas of the state and its potential for reducing diesel emissions.

National Park Service Biodiesel Project/Project #51
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

The two power generators are 2001 model year Onan 55 kW/DGCB equipped with Cummins 239.39, model 4BT3.9G4. The generators operate one at a time from May 1 through September 31, 24 hours a day, seven days a week. This is about 1,800 hours per generator per season. July temperatures range from 50 to 72F but can get below 50F in July at Toklat. Freezing is not uncommon. The generators operate at approximately 3,000 ft. above sea level. At the time of retrofit, the engines are expected to have no more than 5,000 hours of operation.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The DOCs will likely be retrofitted in May/June 2005.

FUELS AND LUBRICANTS

Fuel Properties – The plan is to use 100% biodiesel.

Supply -- The biodiesel supplier will be a contractor to the Alaska Energy Authority.

Operation – There is concern about gelling problems with the biodiesel fuel at temperatures below 32F. For the majority of time during the operating season (May through September) temperatures are expected to be above freezing.

Everett School Bus/Project #56
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 1, 2004 **Location:** Everett, WA

Report based on status of project as of February 14, 2005

Contact Organization: Durham School Services

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – Three different projects encompassed the Everett School District retrofit program. Project 1, which was funded by the U.S. EPA through the Puget Sound Clean Air Agency (PSCAA), is designed to demonstrate the effectiveness of DPFs, DOCs and ULSD fuel. Project 2, also funded by EPA through PSCAA, involved the installation of one DPF and four DOCs. Project 3, which was funded by EPA though the National School Transportation Association (NSTA), involved the installation of five DPFs and helped cover extra cost of ULSD. Part of the program evaluation will include assessing any drivability issues that may arise.

Durham School Services, the Everett School District contract bus provider, had a reduced idling policy well before the project started. The policy limits warm-up idling and mandates shutting down the engine when on school grounds.

Public Education & Outreach – Conducted news briefing with local and national news media. The story was aired on both. An article ran in the local paper, and another story was included in the school newspaper.

Partners – EPA (funding), PSCAA (distributed funding and technical support) Everett School District (program support), NSTA (distributed funding and selection of supplier for Project 3), Durham School Services (provided the buses and administrative support, and performed some of the retrofit installations), and technology suppliers (technical support)

Status – Project 1 was completed, but not on time due to delays in receiving the emission control technology. Project 2 was completed, but not on time due to a contract dispute between PSCAA and the technology provider. NSTA selected the technology supplier and Durham School Services selected the buses for Project 3. Durham School Services is in the process of installing the technology.

Funding – The U.S. EPA provided the funding that was in turn distributed to Durham School Services by PSCAA and NSTA. The Durham School Services provided in-kind contributions.

Major Program Elements – Program elements included: 1) selecting the buses for retrofit, 2) securing the ULSD fuel, 3) issuing press releases to the public on the program, and 4) installing the retrofit technologies.

Voluntary – Everett School District was eager to try new technologies that could improve the safety and health of school children. The technologies used were selected by PSCAA.

Everett School Bus/Project #56
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

The buses are owned and operated by Durham School Services. The six buses equipped with DOCs and the 14 buses equipped with DPFs in Project 1 were 1992-1993 model year International buses (71 passengers) equipped with DTA 360 front-mounted engines. In Project 2, the four buses equipped with DOCs were 1995 International buses (71 passengers) equipped with DT 466 front-mounted engines, and the one bus equipped with a DPF was a Thomas bus (81 passengers) equipped with a Caterpillar 3126 rear-mounted engine. The buses operate on average approximately 12,000 miles a year. The International buses average 8.3 mpg and the Thomas bus averages 6.5 mpg. The ambient temperatures range from 20 to 90F and the buses operate between 50 and 105 ft. above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs and DPFs equipped with backpressure monitoring systems were used in the program.

Emission Performance/Testing – Opacity testing was performed before and after retrofit, and retesting is being performed on an annual basis. An example of opacity testing results is shown below:

Baseline	19%
DOC+ULSD	10%
DPF+ULSD	0%
ULSD	10%

Costs/Warranties – For Project 1, the DPFs cost approximately $5,600 and the DOCs were $2,500. For Project 2, the DPFs cost approximately $10,000 and the DOCs cost approximately $3,000.

Delivery – Delivery of the DPFs in Project 1 was delayed a few weeks because the manufacturer had a backlog of orders. The DPF for Project 2 was delivered on time

Installation/Maintenance – DPF installation took approximately 3 hours, and DOC installation took approximately one hour. After the DPFs in Project 1 started to plug, the filters were reversed on the buses once a month and sent to the technology provider every other month for more extensive cleaning.

Training – Durham School Services noted that minimal training was given to mechanics and no additional training was needed. Drivers were briefed on the program and instructed to report any drivability issues.

Failures/Repairs/Replacement – All but two of the DPFs in Project 1 failed because the exhaust temperature was insufficient to enable filter regeneration. No reported problems with the DOCs.

Impact on Vehicle Performance – Durham School Services reported that there is no evidence that the backpressure increase caused by the plugged DPFs caused any engine damage.

Everett School Bus/Project #56
Retrofit Project Summary

FUELS AND LUBRICANTS

ULSD (<15 ppm sulfur) was used in the project. Durham School Services reported that there was no measurable difference in fuel economy when the switch was made to ULSD.

Kent School Bus Project/Project #59
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 14, 2005 **Location:** Kent, WA

Report based on status of project as of January 5, 2005

Contact Organization: Diesel Solutions/Puget Sound Clean Air Agency (PSCAA)

PROJECT DESIGN

Project Description/Objectives/Partners/Outreach/Project Evaluation – Project involves retrofitting school buses with DOCs. A second phase is planned to retrofit DPFs. ULSD fuel is being used. The project served as a pilot program for using local SEP funds. Partners included Diesel Solutions, a public/private sector partnership (general program support), PSCAA (Administrative Support), the school district, and the DOC provider (technical support). A press event was held and a press release issued. Kent School District participates in the State's voluntary reduced idling program. The project will be evaluated at its conclusion by inspecting the DOCs on the buses and conducting a survey of the fleet operators/mechanics. PSCAA plans to do an emissions calculation at the end of the project to estimate the emission reduction achieved from the project.

Status – DOCs have been installed on 63 buses; retrofit of the DPFs has not started.

Funding – Local SEP funded the retrofit of eight DOCs and will cover the costs of the DPF retrofits. Washington State School Bus Program funding covered the retrofit of 55 buses with DOCs.

Voluntary – The funding provided the incentive for participating in the program and the school district's strong support for environmental initiatives.

Overall Comments on the Program – The DOC portion of the project was successful; no operational issues were reported. The school district was very supportive of the program. Bus drivers commented favorably on the lack of smoke and odor from the DOC-equipped buses.

VEHICLE/EQUIPMENT FLEET APPLICATION

The DOCs were retrofitted on buses with 1987-90 model year Caterpillar 3208 and 1988-98 model year Cummins 5.9L engines.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs.

Emission Performance/Testing – No emission testing is planned.

Costs/Warranties – DOCs cost $1,000 to $1,100; the school district performed the installations. The warranty was 5 years/100,000 mile.

Kent School Bus Project/Project #59
Retrofit Project Summary

Delivery/Installation/Maintenance – No problems with the supply or delivery of the DOCs were reported. Installation was performed by the school district fleet mechanics and took approximately two hours. No maintenance has been needed.

Training – The DOC supplier provided technical support.

Failures/Repairs/Replacement – No reported failures or problems with the DOCs.

Impact on Vehicle Performance – No reported adverse impacts of vehicle performance; the bus drivers commented positively on the lack of smoke and odor from the DOC-equipped buses

FUELS AND LUBRICANTS

ULSD (<15 ppm sulfur) was used. No supply or operational problems were reported. The price differential was approximately $0.03 to $0.05 per gallon.

Northshore School Bus Project/Project #60
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 9, 2005 **Location:** Northshore, WA

Report based on status of project as of January 18, 2005

Contact Organization: Northshore School District

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project entailed retrofitting 32 DOCs on a variety of different model year, engine type and bus chassis lengths. During the first year of the program (September 1, 2003 to September 1, 2004) the buses were fueled with ULSD and during the second year (September 1, 2004 to September 1, 2005) the buses are being fueled with a B20 biodiesel fuel. When the project is complete, Puget Sound Clean Air Agency (PSCAA) will submit a letter to the state legislature with the findings and results. Once the evaluation is complete, the District will consider a possible next phase involving DPF retrofits. The School District already has a policy of no idling at the schools.

Partners – Northshore School District (program implementation), PSCAA (funding and program support), the U.S. EPA (funding), and the technology provider (technical support)

Status – All 32 buses have been retrofitted with DOCs, and Phase 1 (ULSD) was completed on time. Phase 2 (B20) is now underway.

Funding – A grant awarded by the PSCAA.

Major Program Elements – Cleaning the District's two in-ground 10,000-gallon diesel tanks before the project started, and working with the technology provider to select the candidate buses for DOC retrofit.

Voluntary – The incentives were the funding and having over half of the District's fleet retrofitted with DOC to reduce emissions.

VEHICLE/EQUIPMENT FLEET APPLICATION

The 32 school buses, which are owned by the School District, were retrofitted with DOCs consisting mainly of Blue Bird buses equipped with Cummins 8.3L, 250 hp engines or GM Blue Bird buses with 6.5L, 160 hp engines. The mileage on the buses at the time of retrofit ranged from 10,000 to over 150,000 miles. The buses operated at 30 to 50 ft. above sea level with ambient temperatures ranging from 20 to 90F.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs.

Northshore School Bus Project/Project #60
Retrofit Project Summary

Emission Performance/Testing – PSCAA conducted opacity and four-gas emissions testing with the buses fueled with both ULSD and the B20 blended fuel.

Delivery – The DOCs were delivered one week late.

Installation/Maintenance – Installation was performed by the technology provider and all 32 retrofits were completed in two days.

Failures/Repairs/Replacement – No reported problems

Impact on Vehicle Performance – No reported adverse impacts on vehicle performance.

FUELS AND LUBRICANTS

ULSD – No supply or operational problems reported with the ULSD (<15 ppm).

B20 Blended Fuel – During the second week of using the B20 blend, some of the GM 6.5L engines shut down while in route. The project was delayed until the cause of problem was identified. The District determined the problem was with a module on the electric fuel pump. The District reported that it was never established that using biodiesel caused the problem with the module. The project resumed on January 3, 2005, but only on 30 selected buses rather than the entire fleet.

North Kitsap School Bus Project/Project #61
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 8, 2004 **Location:** North Kitsap, WA

Report based on status of project as of December 28, 2004

Contact: Puget Sound Clean Air Agency (PSCAA)

PROJECT DESIGN

Project Description/Objectives/Partners/Outreach/Project Evaluation – The project consisted of retrofitting 48 buses with DOCs and operating the buses on standard highway diesel fuel. The Partners include: PSCAA (administrative support for the project); the North Kitsap School District; U.S. EPA (funding), the State of Washington (funding) and the DOC supplier. The State of Washington has a voluntary reduced idling policy, but North Kitsap does not participate in the program.

Status – Installation of the DOCs was completed in September 2003 and the buses are operating in service.

Funding -- The U.S. EPA made two grants totaling $39,000 and the State of Washington contributed $53,000.

Major Program Elements – The major program elements included recruiting the school district, selecting the type of retrofit technology, obtaining funding, preparing an RFP for the retrofit technology, selecting the technology supplier and overseeing the installation of the DOCs on the school buses.

Voluntary – Obtaining the funding provided the necessary incentive for the school district's participation.

Overall Comments on the Program – The school district was very happy with the program. The delivery and installation of the DOCs were performed on schedule. School district personnel have helped promote similar programs in other school districts.

VEHICLE/EQUIPMENT FLEET APPLICATION

The 48 buses retrofitted with DOCs included: 1990-1994 model year Blue Bird buses (20 to 86 passengers) equipped with 6 and 8 cylinder Caterpillar and Cummins engines (5.9 to 10.4 liter); 1991-1995 model year CARP buses equipped with 6 cylinder, 5.9 liter Cummins engines; 1999 model year AMTRAN buses equipped with 6 cylinder, 7.6 liter International engines; 2000 model year Thomas buses equipped with 6 cylinder, 7.2 liter Caterpillar engines. The buses are owned by the school district. The buses operate at sea level to 300 ft. and the ambient temperatures range for 20 to 85F.

North Kitsap School Bus Project/Project #61
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs are being used in the program.

Emission Performance/Testing – No emission testing is planned.

Costs/Warranties – Up to $91,720 was provided to cover the costs of the DOCs including hardware, installation, and taxes. The warranty, which was included at no added cost, was 12 months/20,000 miles.

Delivery/Installation/Maintenance – The DOCs were delivered on time and the buses were retrofitted on schedule over the summer months. There were no reported problems during the installation phase. The technology supplier was required to submit bi-weekly progress reports through completion of the installation of the DOCs on all of the buses. No maintenance of the DOCs has been necessary.

Training – No formal training was provided, but the technology supplier had informal discussions with the bus fleet personnel.

Failures/Repairs/Replacement – The ceramic catalyst support (substrate) on one DOC broke apart. The supplier replaced the DOC and inspected the DOCs on the other buses in the fleet to assess the mechanical integrity of the devices. No other problems were discovered. No other operating issues have been reported.

Impact on Vehicle Performance – No adverse impacts have been reported

FUELS AND LUBRICANTS

Conventional diesel fuel (500 ppm sulfur limit) is being used in the program.

Washington State Ferry Project/Project #62
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 2, 2005 **Location:** Washington State

Report based on status of project as of February 25, 2005

Contact Organization: Washington State Department of Transportation (DOT)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project plans to move the entire Washington State ferry fleet (24 vessels) from high sulfur diesel (HSD) (3500 ppm sulfur) to low sulfur diesel (LSD) (350 ppm sulfur) and will include a pilot program testing ULSD (15-30 ppm sulfur) and biodiesel blended at 20% biodiesel and 80% LSD. These fuels will be evaluated in four different ferries (three ferries using B20 and one ferry using ULSD). The U.S. EPA and Puget Sound Clean Air Agency (PSCAA) provided $40,900 for the ULSD project. Project partners had planned to use the grant to pay for the ULSD pilot program, hoping to purchase and consume approximately 1.5 million gallons of the cleaner fuel over a period of about one year. However, due to a higher than anticipated cost differential for the ULSD ($0.07 per gallon), DOT anticipates consuming half that amount of fuel before the grant funding is exhausted. Seattle City Light is providing approximately $375,000 to fund the B20 pilot program, which is expected to consume up to 1.5 million gallons of B20 that is expected to last into December 2005. Over the first six months of the B20 pilot, the cost difference between LSD and B20 has ranged from $0.23 to $0.21 per gallon. DOT is paying for the LSD to fuel the rest of the fleet (less than $0.01 per gallon more than HSD). The project will be evaluated based on update of fleet-wide emissions estimates that reflect the fuel quality changes. The engine manufacturers will perform injector testing after the ULSD and biodiesel fuel pilot programs are complete to evaluate long-term engine wear.

Public Education & Outreach – A press conference was held on May 21, 2004 with the governor, the Washington State Ferry CEO, and partner agency heads to announce the initiative. The event received a great deal of media coverage and generated numerous inquiries about the program. The project partners also placed biodiesel signs, banners and posters on the ferries involved in the biodiesel pilot test. Also, information was posted on the project's website.

Partners – The program has numerous partners, including: 1) Washington State DOT (program support, technical support and funding), 2) U.S EPA Region 10 (funding), and 3) Seattle City Light (funding). Others providing technical support included the engine manufacturers, the fuel suppliers, the Clean Cities Coalition, and numerous biodiesel experts.

Funding -- U.S. EPA ($40,900 to fund the incremental cost of ULSD), Seattle City Light (Approximately $375,000 to fund the incremental cost of the B20 fuel) and DOT approximately $180,000 annually to pay for the cost differential of the LSD).

Voluntary – Funding played an important role in allowing the pilot program to go forward. DOT and partners in the program have a strong commitment to reduce diesel emissions form the state ferries.

Washington State Ferry Project/Project #62
Retrofit Project Summary

FUELS AND LUBRICANTS

Low Sulfur Diesel (<350 ppm sulfur) – The conversion from HSD to LSD was easy for those vessels that were fueled by tanker truck. DOT simply ordered LSD rather than HDD (fuel is not stored by the fleet, it is provided by private commercial suppliers). Switching from HSD to LSD required capital upgrades at the marine dock where fuel is stored. The construction took longer than anticipated. DOT reports that there have not been any problems to date.

ULSD (15 to 30 ppm sulfur) – DOT reported that there have been no problems or failures associated with the ULSD pilot program to date. The engine injectors on the vessel using ULSD will be removed in March 2005 and examined by the OEM engine manufacturer.

Biodiesel (B20) – DOT reports that there have been some problems with the biodiesel pilot program. In order to avoid the typical initial fuel filter clogging problems that many biodiesel users experience, the fuel tanks were cleaned before introducing the biodiesel. The fuel filters initially still clogged. DOT reported serious problems with poor biodiesel fuel quality and filter clogging when the weather turned cold around the end of November.

The Fleet stopped accepting B20 on December 11, 2004. Since that time, the project partners have been working with the fuel suppliers to identify and solve the problem. DOT notes that the fuel suppliers and others have been very dedicated in trying to identify and solve the problem. Dot suggested that "Sterols" were precipitating the fuel during the cold weather when it was being transported from the Midwest to Tacoma, WA. The biodiesel manufacturer and local supplier have changed some of their manufacturing, transportation, storage, and blending practices and DOT is hopeful these changes will solve the problem. DOT indicated it planned to begin accepting B20 back into one of three ferries in March 2005. If there are no problems, B20 will be phased-in for use on the other two ferries.

Puyallup School Bus Project/Project #65
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 14, 2005 **Location:** Puyallup, WA

Report based on status of project as of January 5, 2005

Contact Organization: Puget Sound Clean Air Agency (PSCAA)

PROJECT DESIGN

Project Description/Objectives/Partners – Project involves retrofitting up to 80 school buses with DOCs. ULSD and B20 fuels are being used. Partners included Diesel Solutions, a public/private sector partnership (general program support), PSCAA (Administrative Support), State of Washington (funding), the school district, and the DOC provider (technical support) and the fuel supplier.

Status – DOCs have been installed on 17 of the 80 school buses.

Funding – The funding for the DOCs was provided by the Washington State School Bus Program.

Voluntary – The funding provided the incentive for participating in the program.

VEHICLE/EQUIPMENT FLEET APPLICATION

To date, the DOCs have been retrofitted on buses equipped with International DT 360, Cummins ISB 215, and Ford 1060 engines.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs.

Emission Performance/Testing – No emission testing is planned.

Costs/Warranties – DOCs are provided under the State Program at a cost of $1,100 to $1,200 including installation. The warranty was 5 years/100,000 miles.

Delivery/Installation/Maintenance – Problems with the delivery of the DOCs did occur; DOCs were not initially available for all model bus/engines scheduled for retrofitting because the State contractor could not keep up with the greater than anticipated demand and because under the State Program, all regions of the State were to receive at least some deliveries on the same schedule. The DOC provider performed the installations. No maintenance has been needed.

Failures/Repairs/Replacement – No reported failures or problems with the DOCs.

Puyallup School Bus Project/Project #65
Retrofit Project Summary

Impact on Vehicle Performance – No reported adverse impacts of vehicle performance.

FUELS AND LUBRICANTS

ULSD (<15 ppm sulfur) and B20 fuel was used. No supply or operational problems have been reported to date with either the ULSD or B20 fuel.

Whatcom Transportation Authority/Project #68
Retrofit Project Summary

BACKGROUND INFORMATION

Date: December 21, 2004 **Location:** Whatcom County, Washington

Report based on status of project as of December 12, 2004

Contact: Northwest Air Pollution Authority (NWAPA)

PROJECT DESIGN

Project Description/Objectives/Partners – Retrofit 34 1994-1998 urban transit buses with DPFs and run the entire fleet of 44 buses on ULSD. Partners include NWAPA, Whatcom Transportation Authority (WTA), U.S. EPA Region 10, fuel supplier, and retrofit technology distributor. As part of this project, the engine control software was reset to limit idle time to five minutes.

Project Status – Project commenced in the summer of 2002 and final installations of DPFs on all vehicles were completed in March 2004. Project is now in operation and maintenance mode.

Funding – U.S. EPA ($65,000), Conoco Phillips ($215,000 for capital costs), WTA bears operating costs and the fuel cost premium (estimated to be $30,000-35,000). Technical support provided by retrofit manufacturer and distributor.

Major Program Elements – Evaluate the usability and sources of ULSD, the feasibility of DPF technology for the specific engine applications and operations. Obtain the necessary approvals and commitment for the retrofit project. Execute grant agreements and contracts for fuel and retrofit technology. Program partners jointly developed an outreach campaign focused on WTA's county-wide service area. Over 100 local political, business, environmental and private sector leaders were invited to the kick-off ceremony. A press package was prepared, which resulted in favorable coverage in the regional newspaper, and was coordinated with print advertising and on-bus advertising focusing on "the clean bus."

Voluntary – The 100% grant funding made the project possible. WTA evaluated technologies and concluded that only the DPF could provide dramatic emission reductions for the fleet while retaining the original powertrain.

VEHICLE/EQUIPMENT FLEET APPLICATION

Thirty-four 1994-1998 Orion V transit coaches owned by WTA equipped with rear-mounted Cummins M-11 Select and Select Plus engines were equipped with DPFs and operated on ULSD (10 additional buses were also operated on ULSD). The typical WTA urban transit duty cycle is 14 hours per day, five days per week, 14 miles per hour average speed, and 35,000 miles per year. The equipment has been run year-round for over two years in all weather conditions (20-95F). The service area ranges from sea level to 1000 ft. Data logging information was collected.

Whatcom Transportation Authority/Project #68
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Catalyst-based diesel particulate filter

Emission Performance/Testing – Pre- and post-installation tests have demonstrated opacity reductions from an average of 3.2% to an average of 0.4%. Northwest Air Pollution Control Authority estimates that the retrofit project eliminated 7,068 pounds of PM10 annually in Whatcom County.

Costs/Warranties – Initial installed retrofit cost for the DPF and control software was $7,115 plus tax. The DPF cleaning interval has run for just over a year with a cost per cleaning of $250 with a four-hour labor requirement. The warranty on the DPF system and components included in the price of the system was 5 years/100,000 miles with a one-year cleaning interval (reduced subsequently to six months). WTA pays $0.08 per gallon premium for the ULSD. There is no delivery premium because the fuel suppler is within 15 miles of the refinery. The total premium amounts to $24,000 annually for the 300,000 gallons of fuel used.

Delivery/Installation/Maintenance – No special maintenance was performed, but recommend in the future to check for excess oil consumption. The installation time for removing the existing DOC and installing the DPF took from four to six hours. Some field modifications were needed for the DPF mounting brackets, the existing charge cooler brackets, and the body components. Due to space limitations, the vendor's initial design DPFs were sized too small (9-inch diameter) resulting in the DPF cleaning interval to be unacceptably short (three months or less). Other contributing factors were overfilling lube engine oil, and the worn condition of certain coach engines. The DPFs were replaced under warranty with larger diameter DPFs (10.5-inch diameter). DPFs are cleaned off-site at the product vendor's facilities.

Training – Operators received a short orientation on the DPF project, including an explanation of the indicator lights, and how the bus would behave in a "derated power" situation. Mechanics received a two-hour orientation and training on the system, cleaning procedures, and troubleshooting.

Failures/Repairs/Replacement – Initially, the frequent soot build-up in the under-sized DPFs due to excessive backpressure required that vehicles be operated at a low power "derated" condition and required the bus to be out of service. Once the original DPFs were replaced under warranty with larger diameter DPFs, the DPF cleaning interval was extended to one year. There has also been a pattern of service interruptions due to failures in the backpressure sensor and exhaust temperature thermocouples, as well as problems with the control software module. NWAPA described the technology manufacturer and supplier as being responsive to problems that arose and invaluable to the eventual success of the program.

Impact on Vehicle Performance -- When the DPF is performing satisfactorily, there is no adverse impact on the vehicle performance. There was no impact on fuel economy. Idling is limited to five minutes to prevent DPF soot build-up and in those situations where the bus must be idled for five minutes, a fast idling setting is used.

Whatcom Transportation Authority/Project #68
Retrofit Project Summary

FUELS AND LUBRICANTS

ULSD is supplied locally and there have been no issues related to either supply or quality to date.

Medford School Bus Project/Project # 70
Retrofit Project Summary

BACKGROUND INFORMATION

Date: December 27, 2004 **Location:** Medford, MA

Report based on status of project as of December 21, 2004

Contact Organization: Medford School District

PROJECT DESIGN

Project Description/Objectives/Partners/Outreach/Project Evaluation -- The program objective is to retrofit the District's school buses with 31 DPFs and 40 DOCs (the number DPFs may decrease and the number of DOCs may increase depending on the number of buses suitable for retrofitting with DPFs). ULSD fuel is being used. The project aims to improve local air quality and in turn to improve the health of the students riding in the buses, as well as the community at large. The partners include the City of Medford, the Medford School District, the school bus operator (Vocell), the fuel supplier, and the technology provider. The program will be evaluated by conducting pre- and post-implementation surveys of parents and bus drivers to gauge the effectiveness of the program.

Reduced Idling Campaign – A reduced idling campaign was initiated with a kick-off event (mayor, school superintendent, and the bus company). The program established no-idling zones around schools, has bus monitors to assess drivers' compliance with the policy, and established a best driver of the month award with a prize donated by a local business.

Education and Outreach – Information sent to pediatricians' offices about the Clean School Bus Campaign, no-idling zones and signs posted, and reduced idling policy signed at a press event. Running a parallel reduced idling campaign with presentations to PTAs, press events and meeting with school committees.

Status – The project is at the implementation phase; the first retrofits (DPFs) are scheduled for the last two weeks of December 2004. The buses have been running on ULSD since October 2004. The project was delayed for several reasons. The original DPF technology could not be used because the engine exhaust did not reach sufficient temperatures for regeneration. The City had to wait for another DPF technology to receive EPA verification and then it went through the bid process again. The City will issue an RFP for the DOCs after the DPF installations get underway.

Funding – City of Medford received a grant from U.S. EPA totaling $483,300. The City is providing $22,950 in matching hours and Vocell is providing $20,000 in matching hours.

Medford School Bus Project/Project # 70
Retrofit Project Summary

Technical Support – The technology distributor is providing technical support for the installations of the DPFs and the fuel supplier is monitoring the technical support for the ULSD. The ULSD fuel is being stored in a tank at the school bus provider's site.

Major Program Elements – Planning elements included identifying the partners and working with the contractors, developing specifications for the RFP for the retrofit technology, addressing the procurement laws of the city and state, and establishing a reduced idling campaign. The implementation elements included working with the partners, scheduling meetings, and ensuring that the technology is delivered and installed.

Voluntary – The school bus provider received the retrofit technologies for free. In essence, the incentive is the program itself. The decision whether to use a DPF will be based on whether the exhaust temperatures are adequate for regeneration.

VEHICLE/EQUIPMENT FLEET APPLICATION

The candidate buses include Internationals (1990 and 1992 model years equipped with 7.3L engines, 1990 and 1994 model years equipped with 408 engines, 1995 model year equipped with 444 engines, 1995, 1999, 2002 and 2004 model years equipped with DT 466 engines), Cummins (2001 model year equipped ISB engines), Chevrolet (1991 model year equipped with 8.2L engines) and an Amtran (1999 model year equipped with a DT466 engine). DPFs were targeted for selected 1999 and LMY engines.

The buses in the program are owned by Vocell Bus Company, Inc. and the City has a contract with Vocell to be the transportation provider through June 2006. The buses provide transportation for the majority of the schools in Medford, several near-by communities, and the Northeast Metropolitan Regional Vocational School District. Service also includes transportation for field trips and athletic events. The buses average 11,583 annually and are operated at sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – DPFs and DOCs. As noted above, some buses originally targeted for DPFs were rejected because data logging found that the temperatures were inadequate for regeneration. As a result, the city has decided to retrofit DPFs on fewer buses and DOC on more buses than originally planned. Also, the City is looking at a recently verified DPF technology that regenerates at lower temperatures.

Costs – The costs of the DPFs selected are approximately $10,700; warranty is included in the cost of the technology. Cost of the DOCs has not yet been determined.

Delivery/Installation/Maintenance – Regular maintenance is planned prior to installation of the devices. There was a five day delay in delivery; the reason is unknown. Estimated time for installation of the devices is three to four hours (installations yet to take place).

Training – The Department of Environmental Protection conducted reduced idling training for the bus drivers.

Medford School Bus Project/Project # 70
Retrofit Project Summary

FUELS AND LUBRICANTS

The buses are running on ULSD (<15 ppm sulfur). No fuel related problems reported since usage started in October 2004. No special lubricating oil was used.

State of Maine School Bus Project/Project #71
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 10, 2005, **Location:** State of Maine

Report based on status of project as of December 30, 2005

Contact Organization – Maine Department of Environmental Protection (DEP)

PROJECT DESIGN

Project Description/Objectives/Partners/Project Evaluation – The project covers the entire State of Maine. It is designed to retrofit up to 300 school buses from as many as 27 school districts. Any school district that meets the program objectives (e.g., has a reduced idling program) is eligible to participate. The principal technology is a DOC plus crankcase emission control system. Three school districts will participate in a pilot program using a DOC/fuel-borne catalyst (FBC) system. Project partners included the U.S. EPA (funding); Maine DEP (program administration), Maine DOE, the Maine Association for Pupil Transportation (MAPT), the technology suppliers (training), and the individual school districts. Maine has the highest rates of asthma in the U.S.

All schools participating in the program are required to have a reduced idling program that is limited by the ambient temperatures (over 20F for five minutes and –10 to 20F for 15 minutes). The program will be evaluated by conducting surveys at the end of the second year.

Public Education/Outreach – All school districts invited to participate. A website was used to publicize the program. A press event with the U.S. EPA Administrator was held and pre releases were issued. The technology vendors provided training for the bus fleet mechanics at the annual MAPT conference.

Status – The program is just getting underway. Limited information was available.

Funding – The U.S. EPA awarded a grant of $567,376 to the Maine DEP to administer the statewide program. The DOC plus crankcase emission control was viewed as the most cost effective PM control. The DOC/FBC technology was selected for the pilot program based PM reductions and the technology supplier's estimate that up to a 7% fuel savings could be expected.

Major Program Elements – Program elements included collaboration between partners, selecting the retrofit technologies and suppliers, preparing the project proposal, inviting the school districts to participate, and identifying school districts that will participate in the program.

Voluntary – U.S. EPA funding made the program possible.

State of Maine School Bus Project/Project #71
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

Information not available.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – DOC plus crankcase emission controls is the primary technology system in the program. A DOC/FBC system is being used in a three-school district pilot program. The wide geographic area (the entire State of Maine) discouraged some vendors from applying to participate.

Installation/Maintenance – Maine DEP reported that having the suppliers train the mechanics and then having the mechanics install the devices was cost effective.

Performance – No information was available.

FUELS AND LUBRICANTS

A precious metal FBC was used in combination with a DOC in a three school district pilot program. Schools selected for the pilot program were required to have central fueling facilities that could use a FBC.

Corning-Painted Post School Bus Project/Project #72
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 4, 2005 **Location:** Corning/Painted Post, NY

Report based on status of project as of: January 4, 2005

Contact Organization: Corning Incorporated

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – Project goal is to retrofit the Corning-Painted Post School District bus fleet with U.S. EPA certified emission control systems and fuel the fleet with ULSD. The criteria for success will be focused on fuel economy impacts remaining within acceptable limits with costs not deviating beyond fiscal limitations. Corning Inc. is also hoping to demonstrate no additional downtime in the fleet due to the modification, and no noticeable difference in operational efficiency apparent to the users and operators. A school district Policy already limits idling.

Partners – Corning Inc. (consultation on technology and application, provided substrates and filters); Donaldson Company (consultation on technology, retrofit application training, ongoing support for applications); and Engelhard Corp. (DPX systems at reduced costs).

Status – Transition to ULSD fuel has been complete for approximately one year. Nearly all of the 16 buses have been completed, with the exception of two units which required the addition of a Donaldson Spiracle unit. The retrofit is expected to be completed during the winter of 2005.

Thus far, and based upon the selected criteria, the program has been a success. Observations show no apparent change in operation characteristics or cost to date. There has been a noticeable decrease in emissions based upon visible tailpipe exhaust (or lack thereof) and cleanliness of exhaust system.

Funding – The total value of the project is $233,094. EPA funding was provided through the Clean School Bus USA totaling $149,694. Additional "in-kind" contributions from the partners listed above have totaled $83,400.

Major Program Elements – Corning Inc. & Donaldson Company assisted in the planning of the project based upon previous retrofit applications to date. Data logging for exhaust temperature was necessary to determine the viability for DPF vs. DOC applications. Planning for the actual retrofits was based upon completion of data gathering and system availability.

Major implementation elements of the project included procurement and complete changeover from standard diesel fuel to ULSD, as well as actual retrofit activities for DOC/DPF and Spriacle CCV systems.

Public Outreach aspects of the project included a small number of community presentations, Clean School Bus USA literature, and various press announcements.

Corning-Painted Post School Bus Project/Project #72
Retrofit Project Summary

Voluntary – The incentives used to encourage involvement were largely based on organizational assessment: Corning Inc & the Donaldson Company were/are involved as a means to promote technologies and real world application of equipment and supplies.

VEHICLE/EQUIPMENT FLEET APPLICATION

All listed vehicles are owned by the Corning-Painted Post Area School District. Buses are split into two categories: route and activities. Route buses are those used to transport students to and from schools. Activities buses are used to travel to distant locations for special events such as sporting events or class trips.

Total mileage for the fleet was, and has continued to be, approximately 280,000 annually. Current average mileage for route buses is approximately 6,000 miles and approximately 30,000 miles for activities buses.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System Costs –

Engelhard DPX systems – approximately $25,000
Donaldson DOC systems – approximately $11,000
Donaldson Spiracle units – approximately $13,000
Particulate filter cleaning system – $3,000
ULSD premium over standard diesel fuel – approximately $1.80 per gallon vs. $1.55 per
Media & signage – approximately $500

Equipment costs are not representative of retail as in-kind contributions are included.

Warranties – Engelhard DPF, Donaldson DOC and Spiracle are warranted per EPA's Voluntary Retrofit Program and California Diesel Retrofit Program: 5 years/100,000 miles

Fuel Delivery –ULSD is currently not readily available in the Northeast. Fuel for this project has been trucked almost exclusively from New Jersey. Due to this, the integral cost is higher than expected and the delivery timing and logistics have emerged as an issue/problem.

Installation/Maintenance – Donaldson's Spiracle system required custom mounting for nearly every application. Otherwise, increases in maintenance activities are seen as minor.

Impact on Vehicle Performance – There has been a very noticeable decrease in emissions from retrofitted buses. ULSD fuel appears to offer very similar mileage numbers and limited wear on equipment. ULSD also has no need for winterization.

FUELS AND LUBRICANTS

ULSD < 15ppm Sulfur, cetane number 44, and aromatic content 16.8% by volume

WNCRAQA School Bus Project/Project #76
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 11, 2005 **Location:** Western North Carolina

Report based on status of project as of December 30, 2004

Contact Organization: Western North Carolina Regional Air Quality Agency (WNCRAQA)

PROJECT DESIGN

Project Description/Objectives/Outreach/Project Evaluation – The project was designed to retrofit 437 school buses with DOCs in Buncombe, Haywood, Madison, and Transylvania Counties in western North Carolina. The primary objective of the project was to reduce PM emissions from school buses, with the secondary goal of reducing ozone precursors and toxic air pollutants.

The project will be evaluated qualitatively through observations of visible smoke and odors reported by bus drivers and riders, the school districts' transportation departments, WNCRAQA staff and the community. Additionally, the pollution reduction potential of the DOCs installed on the buses has been quantified by using EPA's Voluntary Diesel Retrofit Reduction verified emission reduction levels.

Buncombe County Schools had a reduced idling program in place and committed to strengthening that program. The other three county school districts committed to implementing a reduced idling program. The new policy includes the following measures: 1) buses should not idle more than five minutes; 2) buses should not park "nose to tail" when it can be avoided; 3) buses should not idle when loading and unloading on school grounds; 4) buses should not park on school grounds near buildings with air-intake systems; and 5) no bus should run without the driver being within three feet of the bus.

Project Partners – Partners in the project included the WNCRAQA (project management), the four participating county school districts' transportation departments (provided the fleets of buses), the North Carolina Department of Public Instruction (NCDPI) (approval to modify the buses), the U.S. EPA (funding and technical assistance), the DOC supplier (technical assistance) and the DOC distributor (technical assistance).

Education/Outreach – Press releases were issued for both phases of the project. A press conference was coordinated with the press release for the second phase of the project. Educational display boards were developed for use at community events. Finally, a video summarizing the over all accomplishments was developed and aired on the local county government television channel.

Status – The first phase of the project was completed in 2003 with 88 buses retrofitted in the Buncombe County school district. The second phase was completed in August 2004 with an additional 349 buses retrofitted in the four counties participating in the program.

Funding – EPA funded the first phase ($75,000 grant) and the second phase ($274,455 grant).

WNCRAQA School Bus Project/Project #76
Retrofit Project Summary

Major Program Elements – The major planning elements of the program included recruiting partners, collecting fleet information, developing a grant work plan, coordinating media outreach and developing an equipment installation schedule. The implementation elements of the plan included submitting the grant application, conducting the equipment bid process, selecting the contractor, installing the equipment and preparing periodic reports.

Voluntary – As incentives to participate in the program, WNCRAQA informed the school districts' transportation departments that: 1) the project would be fully funded by EPA; 2) WNCRAQA would handle all administrative aspects; 3) the project would be good for air quality, and 4) the project would be a good public relations opportunity. DOCs were selected because ULSD was not available to enable the use of DPFs.

Overall Comments on the Program – Success of the program entailed being sensitive to the concerns of the school districts' transportation departments. Rather than engage in a debate on whether children were at risk to harmful pollutants from riding buses, the focus was placed on the benefits of reducing exhaust emissions for the whole region. Bus drivers and others noted that both odor and smoke were reduced from the DOC-equipped buses. The overall impression was that DOCs are beneficial and cost effective. No operational problems with the DOCs or adverse impacts on the buses were reported.

VEHICLE/EQUIPMENT FLEET APPLICATION

The buses retrofitted in the program represented a wide range of chassis models (International, Freightliner, Ford, Chevrolet), engine manufacturers (Navistar, Caterpillar, Detroit Diesel, Mercedes-Benz, and GM). The model years ranged from 1985 to 2003. The buses are owned and operated by the school districts' transportation departments. The annual operating hours ranged from less than 500 to nearly 2,000 hrs. The ambient temperatures range from 25 to 84F and the average elevation in the area is 2,165 ft. above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The retrofit technology utilized was a muffler replacement DOC.

Emission Performance/Testing -- No emission testing took place. Estimated emission reductions are based on EPA retrofit technology verified emission reduction levels.

Costs/Warranties – The installed cost of the DOCs was approximately $800 and the purchase price included a 5 year/100,000 mile warranty.

Delivery – The DOCs were delivered on time.

Installation/Maintenance – Installation was performed by the DOCs distributor and took one hour or less. No installation problems were reported. The DOCs have not required any maintenance.

Training – No training was necessary because the DOC distributor installed the DOCs.

WNCRAQA School Bus Project/Project #76
Retrofit Project Summary

Failures/Repairs/Replacement – No reported problems or failures.

Impact on Vehicle Performance – No reports of adverse impacts on vehicle performance resulting from the use of the DOCs.

FUELS AND LUBRICANTS

No. 2 diesel used for the project. The maximum level is 500 ppm sulfur, but the regional average is 300 to 350 ppm sulfur.

MRDD/City of Springfield School Bus Program/Project #78
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 8, 2005 **Location:** Springfield, OH

Report based on status of project as of December 17, 2004

Contact: Regional Air Pollution Control Agency (RAPCA)

PROJECT DESIGN

Project Description/Objectives/Partners/Outreach/Project Evaluation – The project is designed to demonstrate the effectiveness of retrofit emission control technology on a typical urban school bus. The program involves the selection of 38 buses in the Montgomery County Board of Mental Retardation and Development Disabilities (MRDD) School District and 25 buses in the City of Springfield School District. RAPCA hopes to use the retrofit program in these two fleets as a model to encourage other districts in Southwestern Ohio to retrofit their school buses. The main contributors to the project are the RAPCA and the MRDD (worked together to obtain the grant). The Springfield City School District is also a partner. The U.S. EPA provided funding. The DOC supplier provided the main source of technical support. An anti-idling program was incorporated in the project.

Education & Outreach – Information packets were distributed to area school districts describing the program and discussing the reduced-idling campaign. RAPCA issued two news releases. The first described the initial DOC installations on the MRDD school buses and the second was designed to promote a reduced-idling day.

Status – The project is in the final quarter of the program and 63 buses have been retrofitted with DOCs.

Funding -- EPA provided a grant of $67,975 and a matching local contribution of $16,492 was provided.

Major Program Elements – The planning phase included research on area school districts to determine interest in participation in the program, developing outreach materials, and conducting research on anti-idling policies. The program implementation phase includes completing the retrofits on the school buses and encouraging other school districts in the area to participate in the future. A reduced idling policy was developed for area schools. The project will be evaluated based on the success of the DOC installations and the number of other school districts implementing retrofit projects and adopting reduced-idling policies.

Voluntary – Funding enabled the retrofit program to go forward. School districts were encouraged to participate in the reduced-idling program in order to reduce children's exposure to diesel exhaust and to achieve fuel savings. DOCs were selected because they were relatively inexpensive, were easy to install, and required no maintenance.

MRDD/City of Springfield School Bus Program/Project #78
Retrofit Project Summary

Overall Comments on the Program – School districts are financially strapped and it is difficult to encourage them to spend funds on retrofit technology when they have other pressing needs. Federal funding would be most helpful. To date, outside of a DOC hanger issue during installation, the program is going forward without problems.

VEHICLE/EQUIPMENT FLEET APPLICATION

The 33 buses originally targeted for DOC retrofit are 1999 Internationals equipped with DT 466 Turbo front-mounted engines. Since the DOCs cost less than originally estimated, an additional 30 buses were retrofitted. Information was unavailable for these buses. The estimated mileage for the MRDD buses was 7,500 miles/year. Information regarding the City of Springfield buses was not available. The school buses are owned by the school districts and are used to transport students to and from school and for school activities. The ambient temperature in which the buses operate ranges from 0 to 90F and the altitudes range from 900 to 1,000 ft.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Sixty-three buses were retrofitted with DOCs.

Emission Performance/Testing – No emission testing was conducted

Costs/Warranties – The cost of the DOCs was approximately $64,000 and labor approximately $6000. The warranty was 5 year/100,000 miles at no additional cost.

Delivery/Installation/Maintenance – No pre-installation maintenance was performed. The DOCs were delivered on time. Average installation took about 1.5 hours per bus. The only technical issue involved finding hangers for the DOCs that would fit on the buses. Finding these special brackets added several weeks to the project. RAPCA suggested that retrofit vendors should understand the hardware needs for all the various bus makers. To date, no DOC maintenance has been needed.

Training – DOC supplier provided the training.

Failures/Repairs/Replacement – To date, no problems reported.

Impact on Vehicle Performance – To date, no adverse impacts reported

FUELS AND LUBRICANTS

Regular highway diesel fuel is being used in the project.

Texas Adopt-A-School Bus Project/Project #80
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 8, 2005 **Location:** Houston, Dallas-Fort Worth and Austin areas, TX

Report based on status of project as of December 28, 2004

Contact Organization: Texas Energy Conservation Office

PROJECT DESIGN

Project Description/Objectives/Partners/Outreach/Project Evaluation – The Adopt-A-School Bus Program is a joint venture to improve air quality and to reduce diesel exhaust emitted by school buses. Partners include the State Energy Conservation Office, the Education Foundation of Harris County, the North Central Texas Council of Governments (COG), the Clean Air Force of Central Texas and other community partners in the Houston area. The program is administered by an independent steering committee and operates under the auspices of the Education Foundation of Harris County. In the Dallas/Fort Worth area, the North Central Texas Council of Government administers the program. In the Austin/Central Texas area, the Clean Air Force of Central Texas administers the program. The projects include retrofitting DOCs on school buses and using TexLED (ULSD). The program will also include reflashing the engines to reduce NOx. The service provider trained the school district mechanics. The U.S. EPA's standard language for reduced idling was adopted as part of the program. The program will be evaluated through documentation on regular maintenance schedules.

Status – In the Dallas/Fort Worth area, 29 buses have been retrofitted. In the Houston area, 22 buses have been retrofitted. In the Austin area, 17 buses will be retrofitted. A fourth project in Laredo, TX is just getting underway with plans to retrofit 33 buses with DOCs.

Funding – Funds are being provided by the Education Foundation ($300,000), North Central Texas COG (250,000) and the Clean Air Force ($150,000). The Houston area is seeking additional local funding.

Major Program Elements – Coordinating between team members, selecting the type of retrofit technologies, and determining when the engine reflashing will take place (e.g., during routine engine maintenance).

Voluntary – Incentives included funding for retrofit technologies and the incremental cost of the ULSD and taking action to protect the health of the school children.

Overall Comments on the Program – Technology supplier backlogs have caused considerable project delays. The issue of pricing differences has arisen. A key to a successful program is to gain the support of the transportation personnel.

VEHICLE/EQUIPMENT FLEET APPLICATION

The school buses are owned by the school districts participating in the program. No data regarding bus/engine models was available. The buses operate in a range of sea level to 300 ft. and ambient temperatures can vary by up to 30F.

Texas Adopt-A-School Bus Project/Project #80
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

DOCs are being used. Reflashing the engines is also part of the program. Data logging was performed on some buses. There have been significant delays in the delivery of the DOCs by the supplier. Since the program is just getting underway, no information is available regarding the installation, maintenance, performance or impacts on the vehicles.

FUELS AND LUBRICANTS

TexLED fuel (<15 ppm sulfur) is being used for the project.

Clean Yellow Fleets for Blue Skies Program/Project #81
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 23, 2005 **Location:** Front Range, CO

Report based on status of project as of January 12, 2005

Contact Organization: Clean Yellow Fleets for Blue Skies Program (CYF)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The Clean Yellow Fleets for Blue Skies Program (CYF) was designed to retrofit school buses along the Colorado Front Range with DOCs, Spiracle closed crankcase filtration units, and cover the incremental cost of biodiesel fuel. The objective of the program is to retrofit larger-type C & D route buses to protect the health of the largest population of children possible**.**

A formal anti-idling policy was not a part of the program. However, Congestion Mitigation and Air Quality (CMAQ) funds were used to purchase anti-idling technology (Wabasto engine preheat systems) and districts understand that idling is not in their best interests from a fuel cost and employee health perspective.

Partners –

- Denver RAQC (program coordinator)
- 16 participating school districts (Academy 20, Colorado Springs District 11, Adams 12, Adams 14, Adams 50, Aurora, Boulder, Cherry Creek, Denver, Douglas County, Englewood, Jefferson County, Littleton, Mapleton, St. Vrain, and Thompson)
- Instrument Sales and Service, Inc. (ISS) and Donaldson (retrofit equipment provider)
- EPA Region 8 (technical assistance)

Status: –The project is in the early stages of implementation. Program design and planning are completed and equipment installation has begun. Participating school districts have started using biodiesel fuel.

Funding – There are two funding sources for the program. U.S. EPA provided $400,000 for the purchase of DOCs and Spiracles ($200,000) and biodiesel fuel ($200,000). Another $950,000 was secured from the Federal Highway Administration (FHWA) CMAQ program. In addition to DOCs and Spiracles, this funding covered the purchase of engine preheat systems to reduce bus idling. Both funding sources covered the retrofit of approximately 800-1,200 buses (40%–60% of the fleet) in 16 school districts. These 16 districts comprise the majority of school districts in the Colorado Front Range.

Major Program Elements – The project, the first large-scale effort of its kind in the Denver metro area, has encountered a number of challenges throughout the project. Program stakeholders have successfully resolved all issues to-date. These have included:

- RFP development for equipment and fuel
- Determining what to do with older buses (pre1991) that districts wanted to retrofit

Clean Yellow Fleets for Blue Skies Program/Project #81
Retrofit Project Summary

- Installation of equipment
- Constant education and outreach to districts to keep everyone moving in same direction
- Outreach at Colorado School Pupil Transportation Association (CSPTA) and Colorado Department of Education conferences
- Kick-off press event in October 2004

Voluntary – Soliciting participation was achieved, as the project manager has put it, using a "show me the money" approach. The RAQC would get the funding and the districts would install the technology. Otherwise, this project could have never happened with our state and local budget crises.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

The DOCs were chosen due to the lack of ULSD fuel in the Rocky Mountain region. The RAQC thought that testing biodiesel with this technology was a good demonstration project since we had not heard of it being done. Engine preheat technology was chosen since the use of this equipment translates to direct cost savings for the districts. Basically, the RAQC wanted DOCs installed since they operated 24 hours per day, seven days a week and were independent of fuel. School districts wanted engine preheats and biodiesel.

Emission Performance/Testing – No emissions testing has been performed to-date due to budget constraints. The RAQC is working with the State of Colorado Department of Public Health and Environment to try and perform some emissions testing. For project grant application, EPA verified emissions levels were used for emissions benefit calculations.

Costs/Warranties – The DOC warranties were 5 years or 150,000 miles. The Spiracle Units are 5 years or 150,000 miles. The engine preheat warranties are 2 years.

Delivery/Installation/Maintenance: – A critical delay was experienced related to the manufacturing timeframe. Once candidate buses were identified, ISS and Donaldson came to the Denver area to inspect many buses that had OEM DOCs on them and to address pre-1991 bus issues, which took approximately one month. The product takes 8 weeks to manufacture. Donaldson then had a fire in its plant further delaying the project. Overall, it should take approximately 16 weeks to get the product (due to be delivered mid-January 2005).

Failures/Repairs/Replacement – Implementation now underway

Impact on Vehicle Performance – Implementation now underway

FUELS AND LUBRICANTS

B20 was used, and was provided by multiple vendors. Summer and winter additives were used in our biodiesel fuel. These are usually proprietary and the information is unavailable.

Clean Yellow Fleets for Blue Skies Program/Project #81
Retrofit Project Summary

The RAQC thought that bidding out biodiesel fuel purchases to one vendor would be the best way to get the best price and product. School districts agreed to this initially but it became apparent that districts had no intent of switching their fuel provider to one the group selected. This is due to the fact most districts have long-term relationships with their fuel provider based on solid customer service. The use of biodiesel supplied from different vendors has been a learning experience. Some vendors understand the goal of the project and some are out to gouge program participants

Paradise Valley School Bus Project/Project #83
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 7, 2005 **Location:** Paradise Valley, AZ

Report based on status of project as of January 7, 2005

Contact Organization: Paradise Valley School District

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project consisted of retrofitting 20 Paradise Valley School District school buses with DPFs and operating the entire diesel fleet on ULSD. The project will be evaluated by conducting periodic opacity testing and evaluating driver satisfaction. The District has asked its drivers to limit bus idling and instituted a more formal policy since introducing ULSD. Under the District's policy, buses are not to idle at the schools unless the ambient temperatures require climate control on the buses for special needs students.

Public Education and Outreach – The media was contacted after the District was awarded the grant.

Partners – Paradise Valley School District (program management), U.S. EPA (funding) and the engine and retrofit technology provider (technical support).

Status – All 20 buses were retrofitted with DPFs in 2004 and are currently operating. ULSD has been used since January 2004 to fuel the entire district diesel fleet (buses and support vehicles).

Funding – The U.S. EPA provided $300,000 in funding and the District provided matching funds/services in the amount of $37,000.

Major Program Elements – In the planning phase, the District's Purchasing Department developed and advertised the RFP for the ULSD. The District also developed the RFP for the DPFs and established a schedule for conducting the opacity testing. The implementation phase included ordering the ULSD fuel on a timely basis to insure an adequate supply, and coordinating the technicians' shifts to install the DPFs and to conduct the opacity testing.

Voluntary – EPA funding made the project possible. The technology was selected using EPA's verified DPFs.

Overall Comments on the Program – The District described the program overall as a good experience. Retrofitting the DPFs was not a difficult process, and once experience was gained, the retrofit process went much smoother and faster than expected. There were no reported problems with the DPFs or adverse impacts on vehicle operation and fuel consumption. Switching to ULSD resulted in several fuel pump failures on maintenance pick-up trucks. The ULSD fuel deliveries have been consistent and there have been no problems with ULSD supply.

Paradise Valley School Bus Project/Project #83
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

The school buses retrofitted with DPFs included 2001 and 2003 model year International buses equipped with DT466 engines and 2001 model year International buses equipped with DT444 engines. The buses are owned by the School District. The buses are used to transport students to and from school and school activities. The buses operate between 10,000 and 25,000 miles per year. The ambient temperatures range from 30 to 115F and the buses operate at approximately 1,500 ft above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The DPFs were muffler replacements, and the system included a backpressure monitor. The Districts reported that the monitors "proved useful".

Emission Performance/Testing – Data logging was performed on three of the school buses prior to installing the DPFs. Periodic opacity testing is being performed. The buses are tested on a loaded dynamometer applying a single load of 12.7-15.8 bhp while operating at 37-40 mph. The equipment is a chassis dynamometer with Red Mountain Engineering, Inc. smoke opacity meter, "smoke check J1667" and a five gas analyzer, OTC "micron-gas 3718".

Costs/Warranties – DPF cost, including warranty, was $7,583. Installation of the DFFs and emission testing is approximately $12,000 as of the end of 2004.

Delivery – The DPFs were delivered on time.

Installation/Maintenance – No pre-DPF installation was performed. The DPF distributor supervised the initial installations. Local vendors from the Arizona Bus Center provided technical support for the installation of the DPFs. The average time for a DPF installation was approximately five hours and there were no major problems. No DPF maintenance has been required to date.

Failures/Repairs/Replacement – No problems or failures have been reported.

Impact on Vehicle Performance – No adverse impacts on vehicle performance or fuel consumption have been reported related to the use of DPFS.

FUELS AND LUBRICANTS

Fuel Properties – The ULSD fuel properties are <15 ppm Sulfur; cetane #53.5 (typically), and aromatic content 20% volume.

Supply and Delivery – Fuel deliveries have been consistent and there has been no problem obtaining fuel from California in a timely fashion.

Cost – The cost differential has varied from about $0.08 per gallon to $0.30 per gallon.

Impact on Vehicles – When the ULSD was first introduced, it caused some seals on older fuel pumps to fail. As a result, the fuel pumps on seven maintenance vehicles needed to be rebuilt.

Clovis Unified School District School Bus Project/Project #84
Retrofit Project Summary

BACKGROUND INFORMATION

Date: DRAFT: February 9, 2005 **Location:** Clovis, CA

Report based on status of project as of December 7, 2004

Contact: Clovis Unified School District (CUSD)

PROJECT DESIGN

Project Description/Objectives/Partners – Clovis Unified School District, Transportation Department received a U.S. EPA grant on October 10, 2003 to implement a project demonstrating the retrofit of 41 school buses retrofitted with DOCs and using an emulsified fuel, six buses retrofitted with DOCs and using ULSD, and five buses equipped with DPFs and operated on ULSD. The project expects to achieve reductions of tailpipe NOx and PM emissions by up to 50%. Project partners included CUSD, ARB and Valley CAN (funding), the technology/fuel emulsion additive supplier (assistance in preparing the proposal, technical assistance, and donated a DPF), and the U.S. EPA (technical assistance).

Public Education & Outreach – CUSD conducted a kick-off media event with EPA. Members of the community have made positive comments about the reduction in visible smoke. Local media have run a number of feature stories showcasing the program. Other school districts have contacted CUSD for information and have expressed interest in the program. The Center for Advanced Research and Technology (CART), which is an advanced education and research center for high school students, has been involved with air quality testing of the bus fleet.

CUSD has had an idle reduction policy in place since the late 1990s and is in compliance with the California idle reduction requirement.

Status – The project was delayed four months because the emission reduction hardware was not available. Once the hardware arrived, installation of the retrofit products on the buses was completed by Fall 2004, and the project is now on track. The remainder of the project will monitor and evaluate the hardware and the use of the emulsified fuel. CUSD described the project as being very successful overall.

Funding – EPA ($286,700), Valley CAN ($39,000), and ARB ($0.25 per gallon to offset the cost of the fuel).

Major Program Elements – CUSD worked with technology manufacturers to identify technology and vehicle applications, obtained funding, obtained and installed hardware and received delivery of emulsified fuel.

Voluntary – Funding made the project possible. CUSD initially was interested in looking to control emissions of its DDC 671 engines because they had high levels of smoke emissions. CUSD worked with the vendor to develop and implement the project.

Clovis Unified School District School Bus Project/Project #84
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

The buses involved in the program include: 31 1990 model year Crown buses (78 passenger capacity) equipped with DDC 6V92, 252 hp rear-mounted engines (DOC/emulsified fuel); six 1990 model year Crown buses (90 passenger capacity) equipped with DDC 6-71, 270 hp middle-mounted engines (DOC/emulsified fuel); five 1986-1987 model year Crown Buses (90 passenger capacity) equipped with Cummins NHHTCC, 300 hp rear-mounted engines (DOC/ULSD); one 1978 model year Crown bus (78 passenger capacity) equipped with a DDC 6-71, 230 hp middle-mounted engine (DOC/ULSD); four 1988 model year Thomas buses (84 passenger capacity) equipped with a Cummins 8.3L, 240 hp rear-mounted engine (DOC/emulsified fuel); and five Bluebird buses (78 passenger capacity) equipped with Caterpillar 3126, 250 hp rear-mounted engines (DPF/ULSD). All buses are owned and operated by CUSD and are used daily on home-to-school bus runs and field trips. The buses on average operate approximately 13,600 miles and 618 hours per year. Data logging was performed, and the exhaust temperatures ranged from 280 to 312C. Ambient temperature ranged from 26 to 107F. Clovis is at an elevation of 257 feet above sea level, but school trips can go from sea level to 7,000 ft.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs (35), in-line DOC (12), and DPFs (5). Forty-one buses are running on emulsified fuels and 12 buses are running on ULSD. The technology manufacturer ran backpressure and exhaust temperature tests for the design of the exhaust control specifications. Extending idling did not impact performance of the technologies.

Emission Performance/Testing – Opacity testing and comparing fuel economy before and after start of program was conducted.

Costs/Warranties -- Hardware cost for the muffler replacement DOC ($2,500); the in-line DOC ($1,100); and the DPF ($5,350 and three hours maintenance annually at $195). Costs included the warranties.

Delivery/Installation/Maintenance – First shipment of retrofit products to be tested was delivered on schedule. The second shipment was delayed for four months because the supplier of the ceramic cores could not deliver the product to the technology manufacturer.

Hardware installation was described as “relatively easy and the parts exchange was completed without problems”. Installation time was 1.5 to 2 hours for the muffler replacement DOC, 2.5 to 4 hours for the in-line DOC, and 7 to 8 hours for the DPF. For the DPFs on the Caterpillar engines, the maximum exhaust temperature was 280C, which was below the 312C temperature needed to operate properly. The manufacturer installed a new type of insulating wrap around the DPF that allowed the temperatures to reach acceptable levels for DPF regeneration. Fuel filters were changed on buses that were operating on emulsified fuels.

DPFs are cleaned every 6,000 miles or 84 days using a DPF cleaning station purchased from the manufacturer. The cleaning device bakes the DPF to remove the ash, which is then caught in a sealed

Clovis Unified School District School Bus Project/Project #84
Retrofit Project Summary

vacuum bag and sent to the CUSD's Haz-Mat handler for proper disposal. CUSD has no special regulation for ash handling.

Training – Emulsified fuel and technology supplier put on a media day that explained all of the products used in the program. Training was also provided for the bus drivers and mechanics specific to their job duties that were related to the new fuel and emission control technologies.

Failures/Repairs/Replacement – The ceramic core of one muffler replacement DOCs came lose and the bus was down for one day to replace the muffler. The manufacturer is sending a replacement.

Impact on Vehicle Performance – During initial operation of DPF-equipped buses, horsepower loss due to filter plugging occurred after about 9,000 miles. The cleaning interval was changed to every 84 days or 6,000 miles and no further problems have occurred. No performance or comments on drivability have been noted on either the DOCs or DPFs. Less smoke from the buses was noted. A power loss was reported because of the 20% reduction in energy content of the emulsified fuel.

FUELS AND LUBRICANTS

Fuel Properties – CUSD reported that the emulsified fuel contains 500 ppm sulfur, 48 cetane and 12% aromatics. CUSD noted that emulsified fuel can be used with ARB diesel fuel and ULSD and that the ULSD contains 15 ppm sulfur, 48 cetane and 12% aromatics. The emulsified diesel fuel was supplied by a local supplier through arrangements with the manufacturer of the emulsion additive. Since the start of project through September 2004, a total of 87,275 gallons of emulsified fuels and 72,823 gallons of ULSD have been used.

Operating Experience – The fuel filters used on the fuel pumps dispensing the emulsified fuel plugged almost daily requiring them to be replaced prematurely. The vendor determined that the existing filters were not compatible with the emulsified fuel and provided different filters. No further problems have been detected.

The fuel/water separator used by the CUSD caused the emulsified fuel to "foam". CUSD and the vendor determined that the fuel/water separator was incompatible with the emulsified fuel; the separator was removed and CUSD primary paper filters were installed to help remove excess water in the fuel system. The problem appears to have been corrected.

Impact on Vehicle Operation – Drivers operating buses using emulsified fuels made mostly positive comments relating primarily to the reduction in visible smoke. Only a few complained about a loss of power. CUSD is currently experiencing a 12% loss in fuel economy using emulsified fuels.

When using emulsified fuel in the winter months, CUSD found the buses were harder to start and some visible white was emitted for a short time after start-up. As result, the cetane levels in the fuel were adjusted during the winter months.

Western Washington School Bus Project/Project #85
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 5, 2005 **Location: Western Washington**

Report based on status of project as of January 6, 2005

Contact Organization: Puget Sound Clean Air Agency (PSCAA)

PROJECT DESIGN

Project Description/Objectives/Outreach/Project Evaluation – The four western Washington regional air quality agencies are working together to implement the Western Washington Clean Buses, Healthy Kids Retrofit project. The purpose of the cooperative project is to begin a pilot project in small, rural school districts. Many of the rural communities have suffered economically as logging, fishing and other traditional industries have experience a sustained downturn. The communities have high percentages of families below the poverty level compared to the state as a whole. The program involves DOC retrofits in four districts and DPF retrofits in two of the districts. Students in these school districts typically have longer rides on older buses than students in urban areas. The use of ULSD is planned for two of the school districts.

Partners -- Northwest Clean Air Agency (NWCAA), Olympic Regional Clean Air Agency, Southwest Clean Air Agency, PSCAA, Sedro-Woolley School District in Skagit County, Aberdeen/Hoquiam School District in Grays Harbor County, Centralia/Chelis School District in Lewis County, and South Kitsap in Kitsap County, Washington Department of Ecology, and the U.S. EPA (funding under the Clean School Bus USA Program).

Status – Technology installations:
Aberdeen-Hoquiam – completed installation of 24 DOCs
Centralia-Chehalis – 28 DOCs installed and an additional 33 planned
Sedro-Woolley – two DOCs installed on 1990 Bluebirds under the EPA Clean School Bus USA Program and seven DOCs on Internationals paid by the Washington Department of Ecology; DPF retrofits on hold until ULSD is available.
South Kitsap – 15 of the 21 DOCs planned have been installed and installation of 12 of 28 DPFs is planned (see also Project #147).

ULSD:
Sedro-Woolley – NWCAA and the school district are exploring locations for an on-site fuel tank to store the ULSD.

Funding – Washington Department of Ecology (several DOCs) and U.S. EPA (DOCs and DPFs). Approximately $89,700 has been expended to date and purchase orders totally $302,204 have been issued.

Major Program Elements – Coordination between the four regional air agencies, the four school districts and the Washington Department of Ecology and obtaining DOCs from the State contractor.

Western Washington School Bus Project/Project #85
Retrofit Project Summary

Voluntary – Washington Department of Ecology and the U.S. EPA funding made the project possible.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Muffler replacement DOCs and DPFs. The application of crankcase emission controls is also being considered for future application.

Emission Performance/Testing – Data logging was performed on the buses to be equipped with DPFs.

FUELS AND LUBRICANTS

Sedro-Woolley and South Kitsap will use ULSD. South Kitsap started using ULSD during the current school year. There remain some logistical issues with bringing ULSD to Sedro-Woolley (establishing a fuel storage facility).

Warwick Public School Bus Program, Project No. 87
Retrofit Project Summary

BACKGROUND INFORMATION

Date: December 21, 2004 **Location:** Warwick, RI

Report based on status of project as of December 12, 2004

Contact: Warwick Public Schools

PROJECT DESIGN

Project Description/Objectives/Partners -- Seventy school buses to be operated on a blended fuel of 80% ULSD and 20% biodiesel and retrofitted with a catalyst-based emission control technology. In conjunction with the program, the school district has implemented a voluntary anti-idling program. The program partners include Warwick Public Schools, First Student Bus Service, engine manufacturers, retrofit technology suppliers, and fuel suppliers. Technical support will be provided by the retrofit technology suppliers, fuel distributors, the engine manufacturers, vehicle maintenance technicians, NREL, the National Biodiesel Board and the U.S. EPA.

Project Status – The project is being implemented. The ULSD/biodiesel blended fuel is being implemented in December 2004. The retrofits are planned for February-May 2005.

Funding -- U.S. EPA ($350,000) and in-kind contributions ($40,000)

Major Program Elements -- Elements of the program include arranging for fuel blending and delivery, exhaust temperature data logging, technology bid specification, selection, and installation. Outreach activities will include interaction with Career Center Automotive Classes, information on alternative fuel/energy sources and air quality, including a brochure on air quality prepared in cooperation with the Rhode Island DEM. Project evaluation will focus on the ease of transitioning into the fuels and retrofit technologies, the costs, the environmental benefits, and other considerations.

Voluntary Program – The school bus fleet was encouraged to participate by providing information on the positive environmental and health impacts on the students, the riders, the drivers and others from reducing emissions from school buses.

VEHICLE/EQUIPMENT FLEET APPLICATION

The 70 buses selected for the program are 1996-2000 model year Blue Bird buses (65-71 student capacity) equipped with IHC T444E, 240 hp front-mounted engines. The fleet also consisted of some IHC 466T model engines that are being phased out. The buses are operated on average of approximately 15,000 miles annually with an average fuel economy in the range of 7-9 mpg. Ambient temperatures range from 15 to 80F and the buses are operated at or near sea level. Data logging was performed to assist in retrofit technology selection. Data logging was performed on the inlet side of the muffler between the turbocharger and the muffler. Data logging became an issue since many of the DPF product vendors were reluctant to provide technical support or perform the actual data logging.

Warwick Public School Bus Program, Project No. 87
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

To date, the particular catalyst-based technology or technologies had not yet been determined. The technology selection will be based in part on the results of the data logging

FUELS AND LUBRICANTS

The fuel used for the program will be an 80% ULSD (<15 ppm sulfur) and 20% biodiesel (soy methyl ester). To date, the ULSD and the biodiesel have been readily available in the Northeast. Warwick reported that the fuel cost were relatively high because only one supplier of ULSD and one supplier of biodiesel were available; the fuel costs were reported as being very high. Warwick noted that some cost efficiencies may be available in the future, and this will be verified at the conclusion of the program. The first delivery of ULSD/biodiesel fuel blend caused the fuel filters in seven of the school buses with IHC T444E engines to be clogged with a globular substance. Possible causes are being evaluated, with resultant information to be provided at a later date. Warwick reported that the biodiesel blend increased the cetane level of the ULSD and added lubricity.

Manchester & Nashua School Bus Project/Project #88
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 8, 2005 **Location:** Manchester & Nashua, NH

Report based on status of project as of December 29, 2004

Contact Organization: New Hampshire Department of Environmental Services (NHDES)

PROJECT DESIGN

Project Description/Objectives/Partners/Outreach/Project Evaluation – A total of up to 45 school buses in Manchester and Nashua will be retrofitted with a DOC/crankcase emission control system. The goal is to reduce overall air contamination from diesel exhaust. Of special concern are children with asthma or other respiratory illnesses. Project partners include NHDES, Asthma Regional Council of New England, Manchester and Nashua School Districts, and the U.S. EPA. Technical assistance is being provided by the technology provider, First Student, and the Manchester Transit Authority (MTA). The project will be evaluated by surveys of school transportation and/or business managers and third party providers. NHDES will investigate the potential for verifying emission reductions through on-road emission testing. A reduced-idling program is part of the project.

Education/Outreach – NHDES sent newsletters out to all school bus providers and school superintendents in August 2004. The newsletters, which were specific for each audience, were sent as a reminder about the reduced idling practices and to provide information on other ways to reduce diesel exhaust from school buses.

Status – Acceptance of the grant award and budget has just been approved by the Governor and Council, which will allow the project to begin. Agreements with partners and participants are being developed.

Funding – U.S. EPA ($100,000), State of New Hampshire ($1,030), Manchester School District ($23,308), and Nashua School District ($10,831).

Major Program Elements – The program elements included identifying partners and evaluating candidate buses, selecting retrofit technology, developing the bid process, and developing the retrofit installation schedule. The program implementing elements include selecting the vendor via a competitive bid process and overseeing the installation of the hardware on the buses. Contract agreements with MTA to retrofit at least 30 buses in Manchester and with First Student to retrofit at least 15 buses for Nashua are being negotiated. Since the five year transportation services between first Student and the Nashua School District will expire in two years, First Student agreed to stipulate that the retrofitted buses must be used in Nashua, unless Nashua subsequently contracts with a different bus provider, in which case First Student will use the retrofitted buses in New Hampshire air quality non-attainment areas.

Voluntary – U.S. EPA funding made the project possible.

Manchester & Nashua School Bus Project/Project #88
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

MTA provides all regular student transportation services for the Manchester School District and First Student provides student transportation for the Nashua School District. The selection of the up to 45 buses that will be retrofitted with the DOC/crankcase emission controls has not been finalized.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The up to 45 school buses will be equipped with DOCs and crankcase emission controls (Manchester up to 30 buses and Nashua up to 15).

Emission Performance/Testing – All school buses in Manchester (75 buses) and in Nashua (45 buses) that will be in service for at least the next seven years were tested for smoke opacity using an opacimeter. All those buses, with and without retrofits, will be tested again at the project completion and the results will be analyzed.

Costs/Warranties – DOC plus crankcase emission control device costs $2,035 per bus; an installation cost of $65 per hour will be part of the agreement.

Delivery/Installation/Maintenance – Installation of the DOC plus crankcase control system is expected to take five hours per bus.

Training – Training will be provided by the technology supplier.

Failures/Repairs/Replacement – No information; technology has not yet been installed.

Impact on Vehicle Performance – No information; technology has not yet been installed.

FUELS AND LUBRICANTS

Conventional highway diesel fuel will be used.

Upper Darby School Bus/Project #91
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 6, 2005 **Location:** Upper Darby, PA

Report based on status of project as of January 11, 2005

Contact Organization: Upper Darby School District

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project will involve 58 school buses being retrofitted with DOCs or DPFs. The District's preference is to use DPFs where possible, and ULSD will be used to fuel the entire fleet of 116 buses. The District was funded for a two-year program by a grant under the U.S. EPA's Clean School Bus USA project. The District is developing a reduced idling policy and has collected model policies from other school districts to assist in developing the policy. The project will be evaluated by tracking developments to determine whether the program objectives are completed.

Public Education and Outreach – In October 2004, the District and the EPA Region 2 Administrator co-sponsored an education session for middle school students interested in engineering on diesel emission reduction.. Also, community members were encouraged to participate on the Advisory Committee. The District used an EPA-produced video on idling as part of an education program for bus drivers and other groups.

Partners – Upper Darby School District (project oversight), EPA (funding and technical support), and technology and fuel suppliers.

Status – Program is in the early stages of implementation. School buses are being data logged to determine candidate buses for DPF retrofit. The DPFs and DOCs will be purchased and installed by summer 2005.

Funding – The U.S. EPA provided a grant for $450,000 and the District provided $27,900 in matching funds.

Major Program Elements – Program planning elements include data logging the school buses, preparing and conducting a bid process for retrofit technology, and working with the fuel consortium to ensure a supply of ULSD. Program implementation elements include installing the DPFs and DOCs, buying and using the ULSD, and implementing policies and practices to reduce idling.

Voluntary – The District made the decision to pursue EPA funding. Data logging will be used to determine which buses are suitable for retrofit with DPFs. All retrofit technologies must be EPA-verified.

Upper Darby School Bus/Project #91
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

The Upper Darby School District's fleet includes 1994-2004 model year buses. The buses include International (72 passenger capacity) equipped with front-mounted DT 466 engines, and Blue Bird (42 & 72 passenger capacity) equipped with Cummins 5.9L and ISB front-mounted engines, Thomas (72 passenger capacity) equipped with front-mounted Cummins ISB engines, Chevrolet (22 passenger capacity) and GMC (21 passenger capacity) equipped with front-mounted GM 6.5L engines and GMC (34 passenger capacity equipped with Caterpillar 3116 front-mounted engines. The school buses are being data logged to determine their suitability for retrofit. Based on initial results of the data logging, DPFs do not appear to be suitable given that the bus routes are short, local runs in dense residential areas. Most of the buses routes are within an eight square mile area. The buses operate two to eight hours per day. The ambient temperatures range from 10 to 100F and the Philadelphia area is about 28 ft. above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – DPFs and DOCs are both being considered. As noted above, the initial data logging indicates that exhaust temperatures are too low due to the type of bus routes to support the use of DPFs.

FUELS AND LUBRICANTS

The program plans to fuel the entire fleet of 116 buses with ULSD.

Hillsborough County School Bus Project/Project #94
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 11, 2005 **Location:** Hillsborough County, FA

Report based on status of project as of December 31, 2004

Contact Organization: Environmental Protection Commission of Hillsborough County (EPCHC)

PROJECT DESIGN

Project Description/Objectives/Outreach/Project Evaluation – The project, which is just getting underway, involves purchasing and installing 170 or more DOCs on the School District of Hillsborough County (SDHC) school buses. The goal is to reduce toxic HCs from the exhaust by as much as 70%. Outreach activities included meetings with the EPCHC and SDHC Boards and media presentations. The project will be evaluated for efficacy by EPCHC in coordination with EPA. SDHC plans to educate their drivers on measures to reduce idling, and EPA has provided reduced idling material to assist in the education efforts**.**

Project Partners -- Partners include EPCHA (project management, coordination, vendor selection and reporting), SDHC (fleet source, installation coordination, driver reduced idling education) and the U.S. EPA (funding and technical assistance).

Status – The project planning phase is almost complete. Upcoming tasks include finalizing the RFP, evaluating the proposals received in response to the RFP, finalizing the performance monitoring plan and developing a marketing/promotional plan.

Funding – The U.S. EPA awarded EPCHC a grant of $200,000. EPCHC also applied for supplemental funding from a local source and is awaiting a decision on that request.

Major Program Elements – Major elements of the program include fleet evaluation and selection, RFP development, selection of the technology vendors, performance monitoring, and meeting reporting obligations.

Voluntary – The availability of funding to cover the cost of the project was important. DOCs were selected as the technology because of their straightforward application and transferability.

VEHICLE/EQUIPMENT FLEET APPLICATION

The fleet from which the buses will be selected for retrofitting range from 1984 to 2003 model year buses and include a variety of bus manufacturers (Thomas, Blue Bird, International, Ward, and Carpenter) and engine models (International DT 360, DT 408, DT 466, DT 466E, and T444E and Caterpillar 3126B). The buses are owned by the school district.

Hillsborough County School Bus Project/Project #94
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

DOCs will be used in the project. Since the project is still in the planning phase, no additional information regarding technology application and operation is available.

FUELS AND LUBRICANTS

Conventional highway diesel fuel (500 ppm sulfur limit) will be used in the project.

Chattanooga-Hamilton County School Bus Project/Project #95
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 10, 2005 **Location:** Hamilton County, TN

Report based on status of project as of December 28, 2004

Contact Organization: Chattanooga-Hamilton County Air Pollution Control Bureau (APCB)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The APCB was awarded $100,000 to retrofit the Hamilton County urban school bus fleet with DOCs. The purpose of the program is to reduce student and community exposure to PM, toxics, VOCs and CO emissions. The project will be evaluated in terms of the success in retrofitting the buses with verified DOCs. There was no reduced idling program conducted in conjunction with the project.

Public Education & Outreach – APCB met and coordinated with First Student, Inc. personnel and had discussions with the Hamilton County Department of Education Staff.

Partners – APCB (manage project, prepare RFP, select winning proposal in consultation with First Student), First Student, Inc., (coordinate with APCB personnel on proposals and select vendors and make buses available for retrofit), U.S. EPA (funding, technical guidance, and review project reports) and technology vendor (technical support).

Status – Project just commencing the implementation stage. The RFPs have been issued and proposals are due at the end of January 2005.

Funding -- EPA awarded a grant of $100,000. In-kind funding of personnel from APCB was $10,228.

Major Program Elements – Elements of the program include: 1) determining the retrofit technology to use, 2) establishing an installation schedule, 3) preparing and issuing the RFP, 4) installing the DOCs on the buses, and 5) completing the required reports.

Voluntary – First Student is voluntarily participating in the program because it recognizes the benefits of the retrofit program. Various technologies were examined and DOCs were selected because they provide significant emission reductions for the least cost. DPFs were not selected because the technology is more expensive than DOCs and because ULSD fuel, which is needed to support the use of DPFs, is not currently available in the region.

VEHICLE/EQUIPMENT FLEET APPLICATION

The buses are owned by First Student, Inc. and are used to transport urban students in Hamilton County, TN. The buses in the fleet range from 1991 to 2005 model year. The buses operate at 685 to 750 ft above sea level and the ambient temperature ranges from 15 to 98F.

Chattanooga-Hamilton County School Bus Project/Project #95
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System -- DOCs

Emission Performance/Testing – No emission testing is planned. Emissions were estimated using EPA's emission calculator.

FUELS AND LUBRICANTS

Commercially available on-road diesel fuel.

Northern Indiana School Bus Project/Project #96
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 22, 2005 **Location:** Northern Indiana

Report based on status of project as of February 8, 2005

Contact Organization: Indiana Department of Environmental Management (IDEM)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project was originally designed to retrofit the entire diesel fleet of the Hammond School District. After inspecting buses it was determined that only 20 buses were suitable for retrofit. The other buses were either too high in mileage and soon would be retired or already were equipped with DOCs. As a result, the remaining funding will be used to cover the cost of DOC retrofits in the Portage Township Community School. The objective of the project is to decrease tailpipe emissions to improve the air quality for children, bus driver, bus technicians and citizens in the area. The project will be evaluated in terms of the acceptance by the bus drivers and mechanics of DOC-equipped school buses. Hammond already had a reduced idling policy in place. IDEM, in cooperation with the School Transportation Association of Indiana (STAI), developed and implemented a voluntary state-wide reduced idling policy. The STAI unanimously passed a resolution supporting the policy at its annual conference in 2004.

Partners – IDEM (project administration and technical support), Hammond and Portage school districts (providing buses for retrofits and performing installations), U.S. EPA (funding), Quantity Purchase Agreement (QPA) vendor (technical support).

Status – The 20 DOC retrofits at Hammond School District have been completed. The DOC retrofits for 25 buses at Portage are planned for spring 2005. IDEM now solicits bids for DOCs using a state QPA. The QPA is an existing contractual agreement between IDEM and the selected vendor.

Funding – U.S. EPA ($50,000)

Major Program Elements – For Hammond, the major planning element was selecting the DOC supplier. For the Portage project, the major planning element was the creation of the state QPA supplier. The implementation element was installing the DOCs.

Voluntary – Funding made the programs at Hammond and Portage possible. DOC technology was selected because ULSD was not available and because the school districts were interested in providing the technology for as many buses as possible.

Overall Comments on the Program – The technology vendors, the equipment, and their staff performed well.

Northern Indiana School Bus Project/Project #96
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

All buses are owned by the two school districts. Hammond buses are 1996-2000 model year Blue Bird models (65-71 passengers) equipped with Caterpillar 3116 or 3126 front-mounted engines. The Portage buses are 1998-2000 Thomas model (65-71 passenger) equipped with International rear-mounted engines. The buses are operated on average approximately 10,000 miles annually. Ambient temperatures range from 14 to 81F and operate at around 590 ft above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System -- DOCs

Emission Performance/Testing – No emission testing is planned. Emission reductions estimates were based on the EPA verified levels.

Costs/Warranties – DOC hardware cost ranged from $1,380 to $1,414. Hammond school bus technicians were paid $32.60 a bus for retrofitting 20 school buses. DOC installation pipe clamps cost $15 per bus.

Installation/Maintenance – Each installation took approximately one hour and was performed by the school district technicians.

Training – School district mechanics received a short training course on the correct installation of the equipment, but driver/operators were not provided any training.

Failures/Repairs/Replacement – No problems reported.

Impact on Vehicle Performance – No adverse impacts reported.

FUELS AND LUBRICANTS

Hammond School is currently using B20 fuel, and there have been no reported problems with using this fuel in combination with DOC technology. Portage School District is researching and taking bids for ULSD and B20.

Ann Arbor School Bus Project/Project #98
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 2, 2005 **Location:** Ann Arbor, MI

Report based on status of project as of February 24, 2005

Contact Organization: Ann Arbor School District

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project is designed to reduce children's exposure to diesel exhaust inside and outside of public school buses. The Ann Arbor Public Schools will retrofit 110 school buses with DOCs and three buses with a DOC/crankcase emission control system. Approximately 30 school buses from nearby Manchester Township will be fueled with biodiesel fuel. Approximately 10% of Ann Arbor's students have asthma. The goal is to provide at least some protection for all students who are bused to school.

Public Education & Outreach – The EPA Administrator came to Ann Arbor to present an award. The project received local newspaper coverage. The Clean Air Task Force prepared a report on the emission testing.

Partners – Ann Arbor Public Schools (program management and fleet participation), Manchester Township Public Schools (fleet participation), U.S. EPA (funding), University of Michigan, the Ann Arbor Transit Authority, and the Clean Air Task Force (funding, technical support and emission testing)

Status – The program has started with the initial work focusing on examining a variety of technologies and fuels. Ann Arbor selected DOCs and DOC/crankcase emission control systems; Manchester Township selected biodiesel. The program is just getting underway.

Funding – U.S. EPA ($95,000) and the Clean Air Task Force (paid for emission testing estimated at approximately $25,000)

Major Program Elements – The major program elements included pre-testing candidate technologies, the selection of technologies, preparing and entering into purchasing arrangements, and implementation.

Voluntary – Funding made the project possible

VEHICLE/EQUIPMENT FLEET APPLICATION

The school buses are owned by the school districts

Ann Arbor School Bus Project/Project #98
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Ann Arbor Public Schools will retrofit 110 of its buses with DOCs. Three of the buses will be equipped with DOC/crankcase emission control systems. The system is not verified. The DOCs for the verified DOC/crankcase emission control system would not fit on the Ann Arbor buses. EPA granted Ann Arbor a waiver to use an unverified crankcase emission control system.

Emission Performance/Testing – Ambient levels of the pollutants both inside and outside a school bus were measured for a variety of strategies including DPFs, DOCs, DOC/crankcase controls and ULSD.

Costs/Warranties – The DOC cost is $800 installed and the crankcase emission control technology is $800 installed.

Installation/Maintenance – Installation time for the DOC was one hour and the installation time for the crankcase emission control technology was three hours.

FUELS AND LUBRICANTS

Ann Arbor Public Schools is using conventional on-road diesel fuel (<500 ppm sulfur). The Manchester Township school district is using B20.

Lansing Area School Bus Project/Project #99
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 14, 2005 **Location:** Lansing Metropolitan Area, MI

Report based on status of project as of January 31, 2005

Contact Organization: Okemos School District

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The goal of the program was to retrofit 78 school buses in the Lansing area with DOCs. The participating school districts included: Okemos, Dewitt, Howell, Leslie, St. Johns, Williamston, Waverly, Lansing, East Lansing, Grand Ledge, and Madison Public School Districts. The project will be evaluated based on the completion of the goals stated in the original proposal for funding. The Okemos School District chief mechanic inspected the DOC installation at all 11 participating school districts. In connection with the program, information was provided to the participating school districts from the Michigan Department of Environmental Quality (MDEQ) on reduced idling procedures.

Public Education & Outreach – Eleven school districts participated. Each school district's school bus department was invited to an orientation/demonstration of an actual retrofit in the Okemos School bus garage.

Partners – MDEQ (technical assistance), Okemos Public Schools (wrote the grant proposal and the Okemos Public School Transportation Department oversaw installation/inspections of the DOCs, area school districts (program participation), U.S. EPA (funding), technology distributor (technical support).

Status – The project was completed in January 2005. The project was delayed for about a month because several DOCs needed to be re-ordered because of a fitting defect.

Funding – The U.S. EPA provided funding under the Clean School Bus USA Program.

Major Program Elements – Program elements included: 1) contacting 15 school districts regarding possible participation in the program, 2) recruiting 10 school districts in addition to Okemos, 3) determining which buses would be retrofitted with DOCs, 4) ordering, installing and inspecting the DOCs,

Voluntary – The incentive for the school districts was receiving the DOCs without costs to the school districts. EPA-verified DOCs were selected through a competitive bid process.

Overall Comments on the Program – A total of 78 buses in Lansing area school districts were successfully retrofitted with DOCs. Okemos School District reports the experience with DOCs has been very good and there have been no complaints about the operation of the DOCs. The project received excellent cooperation from the technology vendor, who took care of problems that arose and made certain that each fitting was correct. Some of the DOCs needed to be "tweaked" to fit certain types of buses.

Lansing Area School Bus Project/Project #99
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

The buses participating in the program were owned by each of the individual participating school districts. The annual mileage of the buses ranged from 12,000 to 25,000 miles. Ambient temperatures ranged from 10 to 85F and the operating altitude range was 790 to 935 ft. The average bus mileage at the time of retrofit was approximately 50,000 miles.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs

Emission Performance/Testing – No emission testing was performed. Estimated emission reductions were based on information provided by the DOC vendor.

Costs/Warranties – The DOC cost was $740 per vehicle if installed by the district and $800 if installed by an Okemos mechanic. A warranty of 3 years/100,000 miles for parts and labor was included at no extra cost. The labor portion of the warranty coverage was only good for those buses that had the DOCs installed by an International approved Okemos Public School bus mechanic.

Delivery – Okemos School District reported that product delivery was delayed for one month due to problems experienced by the product manufacturer.

Installation/Maintenance – No pre-installation maintenance was performed on the buses. The installation time varied depending on whether new muffler hangers were needed. Okemos School District reported that the International buses were the easiest to retrofit (20 to 40 minutes). Some of the Freightliner buses were more difficult to retrofit as a result of a heavier duty transmission and interference of some wire and fuel lines with the front hanger-mounting bracket. The installation time on these buses ranged from 20 minutes to an hour. No maintenance was required. The only problem with the Freightliner buses was that the product was not properly designed for retrofit on them. The second attempt to build the product was successful.

Training – No training was necessary.

Failures/Repairs/Replacement – Other than the issue of obtaining DOCs that would properly fit on the Freightliner buses, no problems have been reported.

Impact on Vehicle Performance – No adverse impacts on vehicle performance were reported. No adverse impacts on fuel consumption were reported or measured.

FUELS AND LUBRICANTS

Participating school districts used conventional on-road diesel fuel. St. John's Public Schools is using biodiesel blended at B20 and possibly lower percentages in cold weather. Emulsions were used in at least one school district but no additional information is available. No fuel-related problems were reported.

Lincoln Public School Project/Project # 101
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 8, 2005 **Location:** Lincoln, NE

Report based on status of project as of December 13, 2004

Contact: Lincoln School District (LSD)

PROJECT DESIGN

Project Description/Objectives//Project Evaluation – The project involves retrofitting 101 buses with DOCs. The goal is to improve the overall air quality of the community with specific attention to children with asthma or other respiratory illnesses. LSD also hopes to decrease elemental carbon from diesel-powered school buses. Partners include: the Lincoln/Lancaster County Health Department (L/LCHD)(conducting before and after ambient air testing of diesel emissions, providing training to service staff on the adverse effects of pollution, and providing ongoing support); Community Asthma Coalition Initiative (providing support for the program); Education Service Unit #18 (evaluation); and U.S. EPA (funding). Technical assistance was provided by the DOC supplier, a technical consultant, and health department personnel.

Status – Funding was awarded in June 2004. The project originally called for retrofitting 118 buses, but as a result of reductions in student transportation services, as well as the need to surplus older buses, the number of buses to be retrofitted was reduced to 106. The number of buses was further reduced to 101 when it was determined that five buses were already equipped with DOCs. Two bids were received in response to the RFP and the lowest bidder was selected. In November LSD met with the DOC provider who suggested accelerating the schedule for the DOC installations. As of December 13, 2004, eight buses have been retrofitted and all remaining retrofits are scheduled to be completed by February 3, 2005.

Funding – EPA provided $150,000 and LSD provided $10,102 in in-kind contributions.

Major Program Elements – During the planning phase, LSD personnel tracked developments relevant to diesel retrofits and consulted with the bus manufacturers, a bus parts manufacturer, and bus parts and services suppliers. LSD noted that working with its product and service vendors was very important in moving forward with the project and understanding the issues involved. The major implementation elements include: conducting the RFP process, selecting the retrofit technology provider, negotiating a contract, and overseeing the installation of the DOCs. The project will be evaluated by conducting ambient emission measurements before and after the retrofits are complete. Also, data will be collected on students with respiratory illnesses and their proximity to bus emissions.

LSD already had reduced idling guidelines in place. All bus drivers are expected to shut the engines off after reaching the school for loading and unloading. Buses are not allowed to idle at a bus stop for more than three minutes before continuing on the route.

Lincoln Public School Project/Project # 101
Retrofit Project Summary

Education/Outreach – LSD is coordinating employee training on EPA's Clean Bus USA initiative and on the environmental impact of emissions from school buses and the benefits of retrofits. L/LCHD personnel also participated in the briefings for LSD employees. LSD has contacted other school districts to assess their interest in seeking EPA funds for retrofit projects and is offering to share experiences gained for the LSD school bus retrofit project. LSD is also exploring sharing its experiences with the Nebraska School Transportation Assoc., the Nebraska School Boards Assoc., the Nebraska Association of School Business Officials and the Nebraska School Transportation Association. LBS hosted an EPA Clean School Bus USA press event in October 2004. Attendees included the EPA Administrator, the EPA Region 7 Administrator, the Governor of Nebraska, and the Mayor of Lincoln. The EPA grant was presented at the event and school students participated. The event was covered by two media outlets and received good exposure.

Voluntary – The positive environmental benefits of the program were emphasized in enlisting the support of the school board, the drivers and other transportation personnel. Local area vendors familiar with the EPA Clean Bus USA program were consulted in selecting the type of retrofit technology. The fact that ULSD will not be available in the area influenced the decision to select DOCs as the retrofit strategy.

Overall Comments on the Program – The project is just getting underway and to date, no problems have been reported. The project has received good press with the community.

VEHICLE/EQUIPMENT FLEET APPLICATION

The model years of the 101 buses retrofitted with DOCs range from 1990 to 2003 and include International, Thomas, FLTR models and the engines include International (DTA360, T444E, 7.3L), Cummins (6BTA210, 6CTA210, ISC250, ISB5.9) and Caterpillar (3208T). All buses are owned by LSD and used to transport school students. The estimated annual fuel consumption ranges from under 500 to as high as 3,200 gallons. The school buses operate at approximately 1,160 ft above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The DOCs are being installed as muffler replacements.

Emission Performance/Testing -- The L/LCHD is purchasing, with EPA funding, a monitoring device (Aethalometer) that will be used to determine the concentration of diesel particulate matter throughout the city-county area. The equipment will be mounted on a small trailer that can take measurements in locations throughout the area. At no costs, L/LCHD will acquire data from LSD buses before and after the retrofits take place.

Costs/Warranties – The cost of the DOCs ranged from $600 to $824 and labor costs were $200 per installation. A five year warranty was included in the cost of the DOCs.

Lincoln Public School Project/Project # 101
Retrofit Project Summary

Delivery/Installation/Maintenance – No pre-installation maintenance was reported. The DOCs were delivered on time. The DOC provider suggested that the schedule for installation be accelerated from the schedule originally proposed in the program plan. The vendor estimates the retrofits will take one to two hours per bus.

Training – The DOC supplier will provide training for vehicle mechanics.

Failures/Repairs/Replacement – The DOCs are currently being installed and consequently there is no operating experience.

Impact on Vehicle Performance – The DOCs are currently being installed and consequently there is no operating experience.

FUELS AND LUBRICANTS

Conventional highway diesel fuel.

Missoula City/County Health Department School Bus Project/Project #103
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 2, 2005 **Location:** Missoula County, Montana

Report based on status of project as of December 16, 2004

Contact: Missoula City/County Health Department (MCCHD)

PROJECT DESIGN

Project Description/Objectives/Partners/Project Evaluation – The project is designed to reduce school children's exposure to diesel pollution. MCCHD will work with partners to increase the use and acceptance of biodiesel fuel. Eight K-12 school buses (four from School District 1 – Missoula City and School District 40 – Frenchtown) will be fueled with biodiesel B20. Project partners include MCCHD (program coordination), the two school districts, U.S. EPA (funds) and the biodiesel fuel distributor and the delivery company (providing technical support). A separate and continuing reduced-idling project exists in Missoula. The project will be evaluated in terms of whether all of the grant funds are used and the responses of the participating fleets to using B20 fuel.

Education & Outreach – MCCHD plans to showcase this pilot project at conferences around Missouri, to develop a website, and to obtain media coverage.

Status – The project is underway and should continue for at least one year.

Funding – Funding was provided by EPA's Clean School Bus USA Program. MCCHD made an in-kind contribution of its staff time and provided funds for a new fuel tank in Frenchtown.

Major Program Elements – The planning phase included recruiting the participating bus fleets and finding a source of B20. The major implementation element was putting in the B20 fuel tank in Frenchtown.

Voluntary – The incentives used to encourage fleet participation included explaining the benefits of B20, environmental, reduced foreign oil imports, and the potential positive impact on the domestic economy. MCCHD selected B20 because it allowed the use of the current infrastructure and would minimize the complications for participating fleets. B20 was also chosen because of its pollution reduction ability and potential long-term domestic economic benefits.

Overall Comments on the Program – At the start of the program, fleet operators still had some concerns that biodiesel will negate engine warranties and that the buses will be damaged by the use of B20.

VEHICLE/EQUIPMENT FLEET APPLICATION

There are eight school buses in two school districts operating on B20. The school buses average three hours per day during the school year and longer for field trips. The buses operate at 3,200 to 4,500 ft above sea level.

Missoula City/County Health Department School Bus Project/Project #103
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

No retrofit technology utilized in the program.

FUELS AND LUBRICANTS

Fuel Properties – Blended fuel is 20% biodiesel and 80% conventional diesel fuel.

Costs – B20 costs approximately $0.35 per gallon when compared to petroleum-only based diesel.

Delivery/Supply – Fuel was delivered on time.

Operating Experience – The program has just started and to date no problems with the fuel supply or its impact on vehicle operation or fuel consumption have been reported.

Littleton School Bus Project/Project #104
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 10, 2005 **Location:** Littleton, CO

Report based on status of project as of January 25, 2005

Contact Organization: Littleton Public Schools (LPS)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The Littleton Public Schools project combines the use of B20 biodiesel fuel and DOC retrofits. The program's objective is to reduce children's exposure to diesel exhaust emissions.

Partners -- LPS is partnering with 12 other school districts in the greater Denver metropolitan area. The Denver Regional Air Quality Council (RAQC) served as the lead in the bid process for both the DOCs and fuel. The RAQC is also providing technical support. EPA is providing funding under its Clean School Bus USA Program and the U.S. Department of Transportation is providing CMAQ funding. The biodiesel supplier and the DOC provider are providing technical support.

Status – The DOCs have been ordered. The LPS has used biodiesel fuel since May 2002.

Funding – U.S. EPA , DOT (CMAQ), and local matching contributions.

Major Program Elements – Elements of the program include, conducting the bidding process, developing specifications for ordering the DOCs, and scheduling the installation of the retrofits between 13 school districts.

Voluntary – The availability of funding was the primary incentive.

VEHICLE/EQUIPMENT FLEET APPLICATION

The approximately 67 buses in the fleet are owned by LPS. Thirty-three 1994-1999 IHC school buses with DT-360, DT-466 or T444E front-mounted engines will be retrofitted with DOCs. The buses average approximately 12,000 miles annually and are used exclusively for student transportation. The buses operate at 5,300 ft above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs.

Emission Performance/Testing – Opacity testing will be performed when license renewal for a bus comes due.

Littleton School Bus Project/Project #104
Retrofit Project Summary

Costs/Warranties – Hardware cost for the DOCs is $860 and the installation cost is $158 per bus. The price includes a five-year warranty.

Delivery – DOCs on order.

Installation/Maintenance – The estimated time for DOC installations is approximately two hours.

Training – DOC installation training for fleet mechanics will be provided by the technology supplier.

FUELS AND LUBRICANTS

Biodiesel Fuel – B20 blended fuel with an anti-gel additive will be used. Problems with plugging have occurred with small volume fuel filters such as those found on ISB Cummins engines under extreme cold weather.

San Diego County Program/Project #106
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 8, 2005 **Location:** San Diego, CA

Report based on status of project as of December 29, 2004

Contact: San Diego County Air Pollution Control District (SDCAPCD)

PROJECT DESIGN

Project Description/Objectives/Partners/Project Evaluation – The project is designed to reduce PM emissions from diesel-powered school buses, street repair vehicles, utility vehicles, and transport vehicles. DPFs meeting ARB-verified Level 3 (85% PM reduction) are being installed on up to 189 vehicles and ULSD is being used. Project partners include SDCAPCD (funding and program administration), ARB (funding), U.S. EPA (funding), City of San Diego (vehicle owner-operator), County of San Diego (vehicle owner-operator), and San Diego Unified School District (vehicle owner-operator). Eight other districts will be participating, but some will only receive two systems. The product suppliers provided technical assistance. The project will be evaluated by opacity testing and visual observation of the exhaust, tailpipes and system components during daily walk around inspections and scheduled maintenance.

The San Diego School District had a reduced idling policy in place prior to the project. Under that policy, no school bus may idle more than five minutes unless safety of students and/or the driver is at risk. Both the city and the county are reviewing reduced idling rules and are considering policies.

Outreach – Direct solicitation of cities and school districts by letter with follow-up phone calls and meetings, as necessary, were used to recruit fleet participation in the program.

Status – There are several projects that are in various stages of planning and implementation.

Funding – U.S. EPA ($355,000), CARB ($800,000) and SDCAPCD ($800,000)

Major Program Elements – During the planning phase, the partners, in cooperation with the vendors, identified eligible vehicles based on model year, duty cycle, and data logging as needed by the vendors. The implementation phase includes ordering the DPFs, partners scheduling rotation of vehicle outages as necessary to allow installation of systems, and vendors installing the devices as they are delivered.

Voluntary – Funding covering system and installation costs provide the incentive to participate. DPFs were chosen because the ARB funded program require Level 3 systems.

Overall Comments on the Program – SDCAPCD reports that the partners have not expressed dissatisfaction with the emission control equipment. The key was to match the proper emission control equipment for a particular vehicle. SDCAPCD continues to gain experience in the program. The timeliness of system delivery was a problem. An extended delay occurred when ARB de-verified two DPF systems. The issue was resolved, but it caused confusion and delay.

San Diego County Program/Project #106
Retrofit Project Summary

SDCAPCD noted that the sense of urgency to obtain and install products was higher from vendors whose primary business was related to DPFs compared to those vendors where the DPF product was a secondary or tertiary product line.

VEHICLE/EQUIPMENT FLEET APPLICATION

The vehicles include 82 model year 2000-2001 International school buses (80 passenger capacity) equipped with rear mounted DT466, 215 HP rear-mounted engines, 107 dump trucks, sewer vacuum trucks, prisoner transport buses and other vehicles under review. The non-school bus vehicles range from 1992 to 2002 model year and include a variety of chassis makes (International, Freightliner, MCI and Ford) and engines (Cummins B 190-205 hp, International DT 466, 225 HP, Cummins N14, International 466E, DDC 8V92 and Caterpillar C10) and include both front and rear-mounted engines. All vehicles are owned by the School District, the City or the County. The annual miles that these vehicles operate is reported to be 10,000 to 25,000 miles. The ambient temperatures range from 30 to 110F and the vehicles operate at altitudes ranging from sea level to 2,500 ft. SDCAPCD reported that the newer vehicles tended to make better candidates for DPF retrofit.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Two different DPF manufacturers provided products. The DPF systems included back pressure monitors with light alarms.

Emission Performance/Testing – No emission testing took place. Estimated results were based on engine certification values under the ARB verification process.

Costs/Warranties – The DPF system costs ranged from $4,000 to $7,000 and the installation costs ranged from $1,000 to $1,500. Warranty for vehicles 14,000 to 33,000 GVW is 5 years or 100,000 miles and for vehicles over 33,000 GVW is 5 years or 150,000 miles and were provided at no extra cost.

Delivery/Installation/Maintenance – No pre-installation maintenance was reported. Installation varied from two to eight hours. SDCAPCD reported that if the DPF systems were specifically designed for a particular model, installations went more quickly because the components are for the most part pre-fabricated. If the components need to be fabricated individually, the installation process takes much longer.

Maintenance includes reversing the filter core once a year. DPFs can also be cleaned with high-pressure air. Ash is captured in a hazardous waste system.

Training – The product suppliers provided tailgate briefing.

Failures/Repairs/Replacement – No problems have been reported to date.

Impact on Vehicle Performance – No adverse impacts have been reported to date.

San Diego County Program/Project #106
Retrofit Project Summary

FUELS AND LUBRICANTS

ULSD (<15 ppm sulfur) is being used for the program. Various suppliers are providing the fuel. No fuel supply problems or other fuel related problems have been reported to date.

Norwich School Bus Project/Project #116
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 15, 2005 **Location:** Norwich, CT

Report based on status of project as of February 4, 2005

Contact Organization: Northeast States for Coordinated Air Use Management (NESCAUM)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project was initiated by the Connecticut Department of Environmental Protection (CTDEP) as a pilot program. Under the program, 41 Norwich School District buses were retrofitted with either DOCs (32) or DPFs (9). The program included in-cabin and tailpipe emission testing. The project was funded by a supplemental environmental project (SEP) resulting from an enforcement action against a Norwich facility. As part of the project evaluation process, First Student (bus contractor) will work with the Connecticut Department of Motor Vehicles (CTDMV) on inspecting the retrofitted buses for safety. The overall project will be evaluated in terms of the number of buses retrofitted, the sustainability of the project, and on-going community support.

CTDEP has worked with the Norwich Board of Education and First Student in posting reduced idling signs around the school yards and the First Student School Bus Depot. Connecticut has a reduced idling policy under which diesel vehicles cannot idle over three minutes. As part of the Norwich School Bus Project, all personnel operating the school buses will go through a reduced idling training workshop.

Public Education & Outreach – NESCAUM and CTDEP worked together in coordinating press events. CTDEP initiated a clean air education curriculum into the Norwich Middle Schools. The curriculum utilizes the retrofit project as a case study for a class science project.

Partners – CTDEP (project oversight and set policy agenda), NESCAUM (project management and technical support), Uncas Health District (local level coordination & communication), First Student (provided buses and installation support), Norwich Public Schools (school system oversight, logistics with First Student management, fuel contracts and logistical support), CTDMV, Norwich Public Utilities (technology review support), and U.S. EPA Region 1 (technical support for fuels and retrofits, as well as public awareness support). The technology supplier and Environment Canada also provided technical support.

Status – The project is complete. A final report is being written.

Funding – The project was funded through a SEP in the amount of $250,000.

Major Program Elements – The major elements included: 1) screening the school bus fleet, 2) recruiting the technology partners, 3) performing exhaust temperature data logging, 4) conducting a retrofit technology assessment, 5) design and engineering of the emission control technologies, 6) arranging for the fuel delivery, 7) addressing safety concerns, and 8) public outreach.

Norwich School Bus Project/Project #116
Retrofit Project Summary

Voluntary – The City of Norwich is interested in reducing the exposure of children to harmful pollutants. NESCAUM, First Student, and the technology supplier assessed and determined the appropriate technologies to be retrofitted on the school buses.

VEHICLE/EQUIPMENT FLEET APPLICATION

The 41 school buses are owned by First Student, a privately owned bus company contracted with the Board of Education to provide student transportation services. The retrofitted buses were 1999 to 2002 Type D Blue Bird Model TC2000 buses (72 to 84 passengers) equipped with Cummins 5.9L ISB transit front-mounted engines. The buses operate at sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Nine DPFs and 32 DOCs were installed on the buses. The technology supplier and the bus contractor worked together to select the appropriate technologies. Data logging was performed on two of the buses to assess exhaust temperature profiles under a "worst case" scenario (routes with slower speeds and lighter loads as well as extensive stop-and-go and idling periods) and a best-case scenario (routes with more sustained higher speed and load operation, often over more suburban or rural routes).

Emission Performance/Testing – NESCAUM and Environment Canada conducted "in-cabin" and tailpipe emission tests using portable testing equipment and a mobile lab.

Costs – The cost of the DPF, including exhaust insulation and the backpressure monitor was $7,500. The cost of the DOC was $2,200.

Installation/Maintenance – Exhaust insulation was installed on the buses equipped with DPFs to help insure that adequate temperatures were maintained to bring about DPF regeneration. NESCAUM reports that the DPFs usually need cleaning once a year or every two years.

Impact on Vehicle Performance – There were no reported adverse impacts on vehicle performance for the buses and no noticeable impacts on fuel economy.

FUELS AND LUBRICANTS

Fuel Properties -- ULSD fuel (lower than 30 ppm sulfur) is being used in the program. Sulfur levels for the fuel used in this program have been measured as low as 7 ppm sulfur.

Delivery and Storage -- The initial delivery of the fuel needed to arrive sufficiently in advance of the DPF retrofits to permit the residual sulfur to be "washed out" of the bulk storage and the bus fuel tanks. Shipments of ULSD came in a quantity of 7,500 gallons at a time. First Student had a 4,000-gallon fuel tank. Mohegan Sun provided $25,000 for an additional tank.

UPROSE UTZ Truck Retrofit Project/Project #117
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 14, 2005 **Location:** Brooklyn, NY

Report based on status of project as of February 2, 2005

Contact Organization: Northeast States for Coordinated Air Use Management (NESCAUM)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The program goal is to retrofit 6 UTZ Potato Chip delivery trucks with emission control technologies in order to reduce PM to the greatest extent possible. The six vehicles operate in the Environmental Justice communities in Brooklyn, NY. Most of the UTZ trucks are older step-van models that emit high levels of PM. Four of the six trucks will be refurbished and two will be repowered with a new engine or replaced with a used vehicle. The project will be evaluated by having a backpressure monitoring device on the dashboard of each truck. The device will alert the drivers to any soot-loading issues. Project evaluation will continue with on-going communication and community participation. NESCAUM and the United Puerto Ricans of Sunset Park (UPROSE) will conduct a workshop that will promote reduced idling initiatives.

Public Education & Outreach – UPROSE held a promotional event celebrating the success of clean air initiatives taking place in Brooklyn, and the UTZ Truck retrofit project was one of the projects highlighted. One of the trucks with a DOC was on display with a decal listing the project partners. UTZ distributed free bags of UTZ potato chips at the event with over 2,000 people attending. As noted above, NESCAUM and UPROSE are planning a maintenance workshop for participating fleet owners covering such topics as the importance of the retrofit program, how to properly maintain their vehicles, and the benefits of reducing idling. As each truck is retrofitted, a decal will be placed on the sides of the truck to promote public awareness.

Partners – Clean Air Communities (provided grant for project and oversees project progress and implementation), NESCAUM (provides technical support and project management), UPROSE (grant recipient and provides project management), Clem's Snacks UTZ Potato Chips (vehicle operator and owner and provides project support), Bruno GMC (technical support), and emission control technology provider (technical support).

Status – Two trucks have been retrofitted with DOCs. The project is about to retrofit a third truck. A decision will need to be made regarding what refurbishing work will be needed to insure that the DOC installed will function effectively.

Funding – UPROSE received a $60,000 grant from Clean Air Communities.

Major Program Elements – Planning elements include: 1) coordinating with Clem Snacks truck vehicle owners on refurbish/retrofit schedule, 2) conducting smoke opacity tests and engine/exhaust diagnosis; 3) determining whether to repower the truck with a new engine or to furbish it; 4) retrofit trucks with DOCs;

UPROSE UTZ Truck Retrofit Project/Project #117
Retrofit Project Summary

and 5) planning education and outreach; and 6) ensuring project team commitment and communication. Implementation elements include refurbishing/replacing the trucks and equipping them with DOCs.

Voluntary -- All project partners are committed to enhance the air quality and the quality of life in Brooklyn neighborhoods. Clem Snacks volunteered to retrofit their fleet to help clean up the air in the neighborhoods in which they deliver products.

Overall Comments on the Program – NESCAUM noted that three necessary aspects are key to making the project successful: 1) project team commitment and cooperation, 2) careful evaluation of emission technologies, and 3) project team coordination and communication. All three of these elements have been present. Community participation has been very important and UPROSE has given great support. NESCAUM has worked closely with the DOC provider to identify a DOC design that is better suited for older vehicles, and project partners have maintained close coordination and communication.

VEHICLE/EQUIPMENT FLEET APPLICATION

The operators of the trucks involved in the program own the vehicles and have contracts with Clem Snacks to deliver UTZ potato chips in Brooklyn. The trucks are one 1983 model year, two 1984 model year, one 1991 model year and one 1996 model year equipped with GM 210 hp engines and a 1983 model year vehicle equipped with a Hercules 195 hp engine. The mileage on the trucks at the time of retrofit averaged about 300,735. The trucks operate an estimated 15,000 to 20,000 miles annually. They are operated at sea level and the ambient temperatures can be as low as -5F.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The DOC design used in the program has a retractable inner core that can be removed in case of soot loading. The DOC system also includes backpressure monitors mounted on the dashboards to alert the drivers to possible backpressure build-up problems.

Emission Performance/Testing – Smoke opacity testing was performed on each truck inspected for this program in order to determine mechanical and operational issues with the engine and exhaust. Each truck tested exceeded 60% or more. All emission reduction estimates for the DOCs are based on the EPA verified technology list on the website.

Costs – The DOCs each cost $1,300 and the backpressure monitors each cost $230. DOC installation took 1.5 hours. There were no major problems with retrofitting the two DOCs. On the second truck the exhaust pipe needed minor cutting to properly fit the DOC to the exhaust.

Delivery – DOCs were delivered on time.

Installation/Maintenance – At a minimum, all trucks will undergo maintenance refurbishing; if necessary, a truck will be repowered with a new engine. The first truck was fitted with a new engine and

UPROSE UTZ Truck Retrofit Project/Project #117
Retrofit Project Summary

DOC. The second truck was refurbished with new fuel injectors, fuel pump overhaul, and a fuel tank cleaning before being retrofitted with a DOC.

Training – Training was provided by an engineer from the DOC manufacturer.

Failures/Repairs/Replacement – As noted above, the first DOC retrofitted on a truck plugged because of the very high soot emissions. This issue was addressed by 1) repowering or refurbishing the engine and 2) using a special design DOC that was better suited for use on older, high emitting vehicles.

Impact on Vehicle Performance – As mentioned above, when the project was first initiated, there was a problem with the soot plugging the DOC. The engine failed to start once the plugging had occurred. To prevent such plugging, additional steps were taken to insure proper operation, including refurbishing or repowering the engine, installing a backpressure monitoring device, and using a DOC designed for easy removal and cleaning.

FUELS AND LUBRICANTS

Conventional on-road diesel fuel was used.

Hartford School Bus Project/Project #118
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 15, 2005 **Location:** Hartford, CT

Report based on status of project as of February 4, 2005

Contact Organization: Northeast States for Coordinated Air Use Management (NESCAUM)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project goal is to retrofit 74 school buses with emission control technologies to reduce PM and other harmful pollutants to the greatest extent possible. All Hartford school buses run on ULSD fuel. This project is funded by a supplemental environmental project (SEP) that was created as a result of an enforcement action against a utility company. The project evaluation will include an inspection of each retrofitted bus for safety and the overall project will be evaluated in terms of the number of buses retrofitted, the sustainability of the project, and on-going community support.

Connecticut Department of Environmental Protection (CTDEP) is working with the Hartford Board of Education, environmental groups and Laidlaw in posting reduced idling signs around the schoolyards and the Laidlaw School Bus Depot. Connecticut has a reduced idling policy under which diesel vehicles cannot idle over 3 minutes. As part of the Hartford School Bus Project, all personnel operating the school buses will go through a reduced idling training workshop.

Public Education & Outreach – NESCAUM and CTDEP are coordinating activities to conduct press events.

Partners – CTDEP (project oversight and technical support), NESCAUM (contracted by CTDEP to mange and implement the he project), Laidlaw (school bus provider and technical project support), Hartford Board of Education (project support and assistance in education and outreach), Connecticut Department of Motor Vehicles (safety oversight for installation of retrofit technologies), Connecticut Dept. of Public Health (advisory capacity on health issues), U.S. EPA (technical support on fuels and emission control technologies and assistance in education and outreach), and other organizations (project support)

Status – The project is underway with exhaust temperature data logging being conducted on the buses. NESCAUM and CTDEP plan to release an RFP to technology providers in the spring of 2005.

Funding – The project is funded through a SEP in the amount of $550,000.

Major Program Elements – Planning elements include data logging three school buses (rear-mounted engines) encompassing the best and worst case scenarios. Two additional buses (front-mounted conventional and front-mounted transit style engines. NESCAUM will work with the technology vendors to assess the appropriate technologies to use on the buses. Implementation elements will include selection of the appropriate retrofit technologies, selecting the vendors, and installing the devices on the buses.

Hartford School Bus Project/Project #118
Retrofit Project Summary

Voluntary – The City of Hartford is interested in reducing PM and children's exposure to harmful pollutants.

VEHICLE/EQUIPMENT FLEET APPLICATION

The school buses are owned by Laidlaw, a privately owned school bus company contracted by the Board of Education to provide student transportation services. Candidate buses for retrofit include 1991-1996 model year Genesis Transit (72 passenger capacity) with front-mounted International DT 466, 195 hp engines and 1998-2002 model year International buses (72 passenger capacity) equipped with either front-mounted or rear-mounted International T444E, 195 hp engines. The buses operate at sea level and the ambient temperatures in the winter can reach as low as -10F.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The technology evaluation and selection process is underway. Both DOCs and DPFs are among the candidate technologies. Exhaust temperature analysis based on data logging indicates that the exhaust temperatures of the school buses with the rear-mounted engines are too low to enable DPFs to be used. Data logging of the buses with front-mounted engines is underway.

Emission Performance/Testing – The project involves extensive data logging of buses with various engine configurations over various routes to determine both the best and worst case exhaust temperature profiles. Worst-case scenarios involve routes with slower speeds and lighter loads as well as extensive stop-and-go and idling periods. The best-case scenarios involve routes with more sustained higher speed and load operation, often over a more suburban or rural route.

FUELS AND LUBRICANTS

ULSD (<15 ppm sulfur) is being used to fuel the Hartford Public School bus fleet.

CALTRAN Retrofit Project/Project #119
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 10, 2005 **Location:** California

Report based on status of project as of January 15, 2005

Contact Organization: California Department of Transportation (CALRTRAN)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – CALTRAN has undertaken a major initiative to retrofit over 290 of its fleet vehicles with DOCs, DPFs or LNC/DPF systems. These vehicles are fueled with ULSD.

Status – To date, approximately 120 vehicles have been retrofitted with LNC/DPF systems and approximately 150 vehicles have been retrofitted with DPFs. These vehicles have been in operation for several years.

VEHICLE/EQUIPMENT FLEET APPLICATION

The CALTRAN fleet vehicles retrofitted ranged from 1994 to 2004 model year and represented a wide variety of vehicle models including dump bodies with spreaders, plows, or plows and spreaders, trucks with cargo bodies and hoists, and trucks with trash compactors to name just a few. Engines included International DT 466, Caterpillar 3116, Cummins M11 and other models.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The technologies that have been retrofitted are DPFs (two suppliers) and LNC/DPF systems. All retrofit systems include backpressure alarms.

Costs/Warranties – The cost of the LNC/DPF systems range from $14,301 to $18,076 and the DPFs range from $6,649 to $6,975. The warranties are based on the requirements for ARB-verified technologies.

Installation/Maintenance – The installation of the LNC/DPFs takes one to two days and the technology supplier performed the installation. The DPFs are cleaned as needed, depending on the usage of the vehicle.

Training – Technology suppliers are providing training for fleet maintenance personnel.

Failures/Repairs/Replacement – CALTRAN reports that the experience with the LNC/DPFs, which have been operating for a couple of years, has been virtually problem free. On one or two of the vehicles, some plugging on the face of the LNC occurred. Similarly, the DPFs have been operating effectively, with only one or two DPFs plugging prematurely. Those filters had to be removed from the vehicles.

CALTRAN Retrofit Project/Project #119
Retrofit Project Summary

Impact on Vehicle Performance – CALTRAN reported the LNC/DPF system had a slight fuel penalty.

FUELS AND LUBRICANTS

California ULSD was used to fuel the CATRAN fleet of vehicles.

Los Angeles Sanitation Department-DPW Project/Project #123
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 23, 2005 **Location:** Los Angeles, CA

Report based on status of project as of: December 10, 2004

Contact Organization: BP (ARCO) and Los Angeles Sanitation Department/Department of Public Works

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – This project was part of the ARCO (Emission Control Diesel) ECD Program. The goal was to evaluate the performance of passive DPFs with ULSD in heavy-duty applications and demonstrate significant emissions reductions.

Partners – Partners included Johnson Matthey, Engelhard, Fleetguard Nelson, Cummins, Corning Incorporated, NGK-Lock, U.C. Riverside, West Virginia University, Desert Research Institute, ARB, SCAQMD, CEC, DOE, NREL, U.S. EPA

Funding – ARB, DOE, in-kind

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Major Program Elements – Implementation included after treatment installation and emission testing as part of the overall program plan to switch the fleet from ARB diesel to ULSD.
No public outreach was involved.

Voluntary – Program was purely voluntary. The effort was in response to California's desire to reduce diesel emissions.

Overall Comments on the Program – The intent was to assess "emissions durability" over a one year period. The program is considered a success. The overall impressions are that the technology was very robust and provided greater than 90-95% reduction of PM, HC and CO with minimal impact on fuel economy. An occasional mis-fueling episode did not impact the retrofit technology

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The retrofit technology was passive diesel particulate filters: Johnson Matthey CRT and the Engelhard DPX.

Emission Performance/Testing – Chassis dynamometer emission testing was performed using the West Virginia University Mobile Laboratory.

Cost/Warranties – Since the retrofits were purchased a significant discount for the program, there was no warranty coverage. However, both Johnson Matthey and Engelhard provided service support for the technology during the program.

Los Angeles Sanitation Department-DPW Project/Project #123
Retrofit Project Summary

Installation/Maintenance – A pre-installation check was performed to make sure the engines were operating properly. Initially, there were some problems related to the brackets that supported the retrofit unit. Those brackets were replaced with stronger one.

Training – None

Impact on Vehicle Performance – No adverse impacts. One operator commented that they did not notice the installed technology from the stand point of engine performance. A 1-3% fuel penalty was observed on some vehicles but it was not statistically significant.

FUELS AND LUBRICANTS

Refer to SAE paper 2002-01-0433

Hertz/Ford Motor Company Project/Project #124
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 24, 2005 **Location:** Los Angeles, CA

Report based on status of project as of: January 10, 2005

Contact Organization: BP (ARCO), Hertz and Ford Motor Company

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – This project was part of the ARCO (Emission Control Diesel) ECD Program. The goal was to evaluate the performance of passive DPFs with ULSD in heavy-duty applications and demonstrate significant emissions reductions.

Public Education & Outreach – None

Partners – Johnson Matthey, Engelhard, Fleetguard Nelson, Corning and NGK-Lock provided for the DPFs, and participated in the testing with Ford Motor Company. Ford also provided expertise on the vehicles. U.C. Riverside performed the dynamometer emission testing. Desert Research Institute performed the chemical analysis of the exhaust. BP (ARCO) provided the ULSD fuel.

Funding – Funded mostly by Ford and DOE through NREL. There was no U.S. EPA funding.
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Major Program Elements – Included getting vehicles dedicated to the project, aftertreatement installation, emissions testing, and switching the fleet from ARB diesel to ULSD.

Voluntary – Program was purely voluntary with no incentives other than potentially having cleaner vehicles.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The retrofit technology was passive diesel particulate filters, specifically the Johnson Matthey CRT, and the Engelhard DPX. Ten of the 19 vehicles were retrofitted with either the CRT or DPX. Nine vehicles were used as control vehicles for testing comparison

Emission Performance/Testing – Testing completed at CE-CERT at U.C. Riverside

Installation/Maintenance – The only pre-installation maintenance done was to make sure that the vehicles were operating properly.

Training – None

Failures/Repairs/Replacement – No failures or repairs reported. One of the vehicles was sold before the testing was complete.

Hertz/Ford Motor Company Project/Project #124
Retrofit Project Summary

FUELS AND LUBRICANTS

The same fuel was used as in the BP (ARCO) ECD program.

New Jersey Transit Retrofit Project/Project #126.1
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 15, 2005 **Location:** New Jersey

Report based on status of project as of January 1, 2005

Contact Organization: New Jersey Department of Transportation/Department of Environmental Protection

PROJECT DESIGN

Project Description/Objectives/Evaluation – The project is designed to retrofit up to 40 NJ Transit Nova B buses with DPFs. The object is to achieve PM reductions in an urban area and develop experience with DPF technology at NJ Transit. The project will be evaluated on the ability of the DPF to remove PM, the durability of the filters with annual cleaning, and road calls resulting from high backpressure incidents. NJ has a reduced idling policy to shut the engine off if the lay over is more than 3 minutes.

Education/Outreach – Training the fleet bus mechanics on installation, monitoring, and services of DPF systems.

Partners – Partners included Cummins, Inc (SEP funding, parts and materials), NESCAUM (project management), NJ DEP (project oversight), DPF supplier, M.J. Bradley & Assocs. and the DPF manufacturer (engineering, design and technical support), parts distributor (technical support, parts, filter cleaning and training), and NJ Transit (buses, installation labor, monitoring and maintenance).

Status – Four prototype DPF installations are in service; retrofitting the remaining buses is scheduled to start in February 2005.

Funding – Cummins (SEP funding for DPFs). NJ Transit is covering the cost of the product installations, service maintenance and the added cost of the ULSD fuel.

Major Program Elements – Program elements included designing the DPF retrofit kit for the Nova B Cummins engine compartment; making design changes to retrofit kits to allow the servicing of the engine and accessory components without having to remove the DPF; and insuring that the kit has all the necessary mounting brackets and materials so the installation can be completed as quickly as possible.

Voluntary – Incentives included project funding, donated equipment, and technical support.

Overall Comments on the Program – Four prototype DPFs have worked properly. A problem area has been the on-board monitoring systems giving false elevated backpressure codes or shutting down.

New Jersey Transit Retrofit Project/Project #126.1
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

Transit buses to be retrofitted with the DPFs are 1999 model year Nova B buses (44 passenger capacity) equipped with Cummins C8.3 ISC, 280 hp rear-mounted engines. The buses are owned by NJ Transit and average an estimated 45,000 miles annually with an average about 6.5 mpg. The range of ambient temperatures in which the buses operate ranges from 24 to 85F.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The DPFs were specially configured to fit in the available space and to allow for quick installation and easy access for engine maintenance. The system comes equipped with a two-light (yellow/red) backpressure alarm system.

Emission Performance/Testing – Opacity testing will be conducted in accordance with NJ regulations

Costs/Warranties – The DPF retrofit kits cost $7,500. A 3 year/150,000 mile warranty is included at no extra cost.

Delivery – As a result of problems with the monitoring systems on the prototypes, installation on the remaining 36 buses was delayed for 120 days.

Installation/Maintenance – Only routine maintenance was performed prior to installation of the DPFs. NJ Transit anticipates that the production DPF retrofit installations will require a two-man team and will take eight hours. The DPFs will be cleaned at 60,000 miles or after 12 months of service, whichever occurs first. The filters will be cleaned by an outside service and the ash is going to be disposed as ID dry industrial waste. The filters will be cleaned in New York and New York State approves of the disposal method for proper ash disposal.

Training – Fleet bus mechanics will receive training in installation, servicing, monitoring and maintenance of the DPFs.

Failures/Repairs/Replacement – A problem with the backpressure monitoring system registering false failures was experienced with the prototype retrofits. Since the project is just getting underway, information was not available on the performance of DPFs.

Impact on Vehicle Performance – Since the project is just getting underway, information on vehicle impacts was not available.

FUELS AND LUBRICANTS

The project will use ULSD (30 ppm sulfur or less). The cetane number is 45. The ULSD fuel specification requires a lubricity of 3100 mg minimum.

New Jersey Transit Retrofit Project/Project #126.2
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 15, 2005 **Location:** New York/New Jersey Metropolitan area

Report based on status of project as of January 1, 2005

Contact Organization: New Jersey Department of Transportation/Department of Environmental Protection

PROJECT DESIGN

Project Description/Objectives/Evaluation – The project is designed to retrofit up to 300 NJ Transit MCI Cruiser buses with DPFs. The object is to achieve PM, HC, and CO reductions in the NY/NJ metropolitan area and to develop experience with DPF technology at NJ Transit. The project will be evaluated on the ability of the DPF to remove PM, the durability of the filters with annual cleaning, and road calls resulting from high backpressure incidents. NJ has a reduced idling policy to shut the engine off if the layover is more than 3 minutes.

Education/Outreach – Training the fleet bus mechanics on installation, monitoring, and services of DPF systems.

Partners – Partners included Virginia Electric & Power Company (VEPCO) (SEP funding, parts and materials), the engine manufacturers (engineering, technical support, parts & materials, NJ DEP (project oversight), DPF manufacturer (engineering, design and technical support), parts distributor (technical support, parts, filter cleaning and training), and NJ Transit (project management, buses, installation labor, monitoring and maintenance).

Status – Developing a retrofit kit meeting the approval of Detroit Diesel, the DPF manufacturer, and NJ Transit. Once the design is approved, four prototype systems will be installed on the MCI Cruiser buses and operated for up to 90 days.

Funding – VEPCO is providing the funding in the form of a SEP for DPFs, related parts, design, engineering, training, and technical support and NJ Transit is providing an in-kind contribution in the form of labor and maintenance.

Major Program Elements – Program elements included designing the DPF retrofit kit for the engine compartment; making design changes to retrofit kits to allow the servicing of the engine and accessory components without having to remove the DPF; and insuring that the kit has all the necessary mounting brackets and materials so the installation can be completed as quickly as possible.

Voluntary – Incentives included project funding, donated equipment, and technical support. NJ DEP proposed using DPFs and EPA approved the selection.

New Jersey Transit Retrofit Project/Project #126.2
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

Transit buses to be retrofitted with the DPFs are 2002-2003 MCI Cruiser buses (42 to 50 passengers) equipped with DDC 12.7L S60, 370 hp rear-mounted engines. The buses are owned by NJ Transit and average an estimated 38,000 miles annual with an average about 3.7 mpg. The range of ambient temperatures in which the buses operate ranges from 24 to 85F.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System -- The DPFs were specially configured to fit in the available space and to allow for quick installation and easy access for engine maintenance. The system comes equipped with a two-light (yellow/red) backpressure alarm system.

Emission Performance/Testing – Opacity testing will be conducted in accordance with NJ regulations

Costs/Warranties – The DPF retrofit kits cost $9,500. A 3 year/150,000 mile warranty is included at no extra cost.

Delivery – DPF specifications are still being developed.

Installation/Maintenance – Only routine maintenance will be performed prior to installation of the DPFs.

Training – Fleet bus mechanics will receive training in installation, servicing, monitoring and maintenance of the DPFs.

Failures/Repairs/Replacement – Retrofit phase has not started.

Impact on Vehicle Performance – Retrofit phase has not started.

FUELS AND LUBRICANTS

The project will use ULSD (30 ppm sulfur or less). The cetane number is 45. The ULSD fuel specification requires a lubricity of 3100 mg minimum.

Cummins SEP Project/Project #131
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 17, 2005 **Location:** New York, NY

Report based on status of project as of December 31, 2004

Contact Organization: Northeast States for Coordinated Air Use Management (NESCAUM)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The New York City Department of Sanitation (NYC DOS) began employing DPFs in the early 1990s. In addition, up to 240 light cars and trucks and 26 refuse trucks in the DOS fleet are fueled with CNG. This project was funded by a Cummins SEP and involved the retrofit of 70 refuse trucks with DPFs and to purchase four street sweepers designed to operate on CNG. ULSD (<30 ppm sulfur) was introduced in 2001 and by 2004, the entire diesel-powered NYC DOS fleet was fueled with ULSD. The project goals were 1) to reduce PM, HC, and CO from HDDEs in local urban neighborhoods, 2) to gain experience with, and access long-term performance of, DPF technology, and 3) to quantify emission reductions achieved. Project evaluation will include both mobile chassis dynamometers and laboratory testing.

The remainder of this project summary focuses on the DPF retrofit portion of the project.

Public Education & Outreach – The NYC DOS DPF retrofit program was featured as part of a NYC "Heavy-Duty Clean Vehicle Technology Conference that showcased a number of the City's programs to reduce pollution. The event received media attention and was attended by the EPA Administrator.

Partners – NYC DOC (provided vehicles/equipment and project support), Cummins (funding and technical support), NESCAUM (project management and technical support), M.J. Bradley & Associates (project management assistance and retrofit oversight), the technology providers (technical assistance), West Virginia University (emission testing), and the local Cummins distributor (technical assistance)

Status – The original plan was to retrofit 260 trucks with DPFs. However, a number of candidate trucks were retired early and as a result the program was changed to retrofitting 70 trucks with DPFs and purchasing 4 street sweepers powered with CNG (completed). The retrofitting of the trucks began in 2002 and was completed in 2003.

Funding – Cummins Inc. as part of a SEP provided funding.

Voluntary – NYC DOS has an established commitment to evaluating and using clean technologies. The SEP funding made this project possible. EPA-verified DPF technology was selected because it provided the greatest overall reductions of PM, HC, and CO.

Cummins SEP Project/Project #131
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

The candidate refuse trucks for the DPF retrofits were 1997and later model year Cummins engines on trucks with Crane Carrier bodies. The vehicles are owned by NYC DOS and operate in the Manhattan and Bronx boroughs of New York. They operate approximately 10,000 miles a year.

NESCAUM noted that retrofitting the NYC DOS refuse trucks with DPFs presented challenges because: 1) the vehicles operate at low speed with frequent stops, 2) loads vary, and 3) winter ambient temperatures are low. Extensive data logging was performed during the process of selecting vehicles (and operating routes) for DPF retrofit. The data logging indicated that the routes in Manhattan (some high speed operation on expressways) would allow vehicles equipped with DPFs to generate exhaust temperatures to bring about filter regeneration, but the routes in the Bronx (more low-speed, frequent stop-and-go) were marginal. Consequently, a pilot program was conducted for the DPF-equipped vehicles operating in the Bronx. The pilot program demonstrated that DPFs could be used on vehicles in the Bronx as well.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DPFs equipped with backpressure monitors/alarm (yellow light/red light). Two different DPF designs provided by two different technology suppliers were evaluated during the pilot portion of the program that began in 2001 and involved four vehicles. The DPFs in the pilot program performed without any reported problems. Prior to the full-scale retrofit phase, two DPFs underwent a complete tear down and inspection. For the full-scale program, one technology design was selected for the remainder of the retrofits. The selection was based in large part on the fact that the DPF selected had a system that continuously monitors and records exhaust backpressure and temperature and can store data for up to three months.

Emission Performance/Testing – The program will include both testing on a mobile HDE chassis dynamometer and laboratory emission testing. West Virginia University conducted the initial testing on one of its transportable HDE testing laboratories. DPF-equipped trucks were baseline and emission tested on two test cycles: the New York Garbage Truck Cycle and the Orange County Garbage Truck Cycle. Multiple test runs were performed. Based on this testing, the DPF-equipped trucks compared to the trucks operating only on ULSD achieved an average emission reduction of 88% for PM, 83% for CO, and 85% for HC. Average NOx emissions were 4-5% lower on average compared to trucks with the standard mufflers on a low average speed cycle, with a negligible to a very slight increase on the higher average speed cycles. The laboratory testing portion of the program is now underway.

Warranties – With regard to warranties, the DPF manufacturers provided a warranty on the DPFs that covered consequential damages attributable to the DPF, with Cummins administering the warranties. In the case of an engine failure due to a problem not related to the DPF, the engine warranty will apply. For example, if the engine is damaged due to an outside factor that might cause the DPF to fail, such as a failure of the turbo unit, which could result in oil plugging the DPF, the DPF supplier is not liable.

Cummins SEP Project/Project #131
Retrofit Project Summary

Installation/Maintenance – The first few installations took four to eight hours to complete. After a few retrofits were completed, the installation time was cut to two to four hours. Flexible woven insulating material was used to help reduce the loss in exhaust temperature upstream of the DPF. Given the type of operation, the DPF-equipped trucks are expected to require cleaning once or year or after 10,000 miles of operation. The local Cummins dealer is performing filter cleaning. The filter must be removed for cleaning. The cleaning machine operates by forcing compressed air through the DPF, which dislodges the accumulated soot and ash and deposits it in a special bag. The cleaning bag is porous enough to let the air through, but not the soot and ash. After the cleaning, the filters were reversed and reinstalled. The New York State Department of Conservation (DEC) was contacted to determine whether the ash was a hazardous waste. DEC advised the project partners that under its regulations, residues from burning fossil fuels are excluded from being considered hazardous waste and the transportation of the ash, in limited quantities (<500 lbs.) can be considered regular solid waste.

Training – Training provided by technology providers and Cummins local distributor.

Failures/Repairs/Replacement – After approximately two years of operation, there are no reported problems.

Impact on Vehicle Performance – No problems with adverse impact on vehicle performance reported. The DPFs did not have an impact on fuel consumption.

FUELS AND LUBRICANTS

Fuel Properties -- The refuse trucks are fueled with ULSD (<30 ppm sulfur).

Delivery/Supply – NYC DOS was able to find a fuel supplier because several other New York City fleet were using ULSD (e.g., the Department of Transportation and the Metropolitan Transit Authority). The program started with one dedicated fuel tank at one depot in Manhattan. After several months, NYC DOS began the process of switching all of the Manhattan and Bronx depots to ULSD. Some delays were experienced in deploying ULSD fuel to all Manhattan depots because of a change in the City's ULSD fuel supplier. This delay caused some logistical issues in which vehicles operating out of one depot having to re-fuel at a different depot. These issues were resolved once the City's original fuel supplier began providing fuel again. During July 2004, NYC DOS switched all depots city-wide to ULSD. This has allowed much simpler fuel tracking and has allowed NYC to move vehicles from depot to depot without concerns about fuel issues.

Fuel Cost – The current cost differential for ULSD is approximately $0.15 per gallon.

Cummins SEP Project/Project #131
Retrofit Project Summary

Maintaining Fuel Quality and Preventing Misfueling – To insure fuel quality (e.g., sulfur levels <30 ppm), the fuel tanks that were used to store the ULSD were purged of excess sulfur by filling the tanks several times with ULSD fuel before the fueling of the DPF-equipped refuse trucks commenced. Also, the fuel contract specified that all ULSD fuel must be stored and transported in dedicated tanks. Finally, NYC DOS conducts periodic spot analyses of the fuel from random deliveries.

To guard against misfueling, signage was installed on the DPF-equipped vehicles indicating that only ULSD should be used and locks were installed on the vehicle fuel cap fillers.

Impacts on Vehicle Performance – Test data taken at various intervals throughout the project on vehicles with and without DPFs indicate that ULSD on average contains approximately 4% less energy than on-road diesel fuel (<500 ppm). However, testing on vehicles with and without DPFs indicates a minimal increase (approximately 0.15%) in fuel consumption over the different test cycles.

Mack SEP Project/Project # 132
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 14, 2005 **Location: Northeast States**

Report based on status of project as of February 28, 2005

Contact Organization: Northeast States for Coordinated Air Use Management (NESCAUM)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project was designed to retrofit up to 150 refuse trucks with DOCs, up to 30 refuse trucks with DPFs, five long haul trucks with SCR, three long haul trucks (class 8 tractors) with DPF/SCR systems and two refuse trucks with DPF/SCR systems. The project goals included reducing PM, NOx, HC and CO emissions in non-attainment areas, assessing the capabilities of the technologies over a long period of time, quantifying emission reductions from the program, demonstrating prototype emission measuring devices that gather continuous data on NOx emissions, assessing the effectiveness of the SCR/DPF systems to control secondary emissions such as N2O and NH3 to minimal levels, and developing a understanding of the practical considerations in installing SCR technology and an urea infrastructure. Emission testing will be part of the project evaluation, and a final report discussing all aspects of the program will be prepared. The New York City Department of Sanitation (DOS) was one of the participating fleets in the program. Project #66 discusses in more detail the DOS aspects of the program.

Partners A large number of partners participated in the program including Mack Trucks, Inc. (funding, program support and technical support), NESCAUM (program and technical support), M.J. Bradley & Assoc. (program and technical support), the emission technology and urea providers (technical support, and the participating fleets (NYC DOS, Waste Management, and UPS).

Status – The DOC and SCR portions of the project were largely completed by the end of 2002. The filter portion of the program was moved over to the NYC DOS (See Project #66) since the refuse trucks operating by Waste Management were determined not to be appropriate for DPFs.

Funding – Mack contributed $1,382,000 for the SCR portion of the project and $1,310,000 for the DPF/DOC portion of the project.

Major Program Elements – Major elements included: 1) developing a detailed project plan and goals, 2) conducting surveys of candidate fleets and procuring of trucks for participation in the project, 3) performing hardware design and fabrication, 4) conducting emission testing and 5) documenting the results.

Voluntary – Fleets volunteered to participate in the program; available funding to pay the cost of the retrofit helped provide an incentive to participate.

Mack SEP Project/Project # 132
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

All vehicles participating in the program were fleet-owned. For the DOC retrofits, both LE and MR refuse trucks were used (NYC DOS). For the DPF retrofits, 1994 and newer MY refuse trucks were used. Originally both Waste Management and NYC DOS fleets were included, but all DPF installations were switched to DOS when it was determined that the Waste Management refuse trucks were not suitable candidates for DPFs. For the SCR and SCR/DPFs new Mack engines were used and the vehicles included eight long haul (class 8) delivery trucks (UPS) and two refuse trucks (NYC DOS). The UPS long haul trucks operate on average approximately 2,000 miles a week. The refuse trucks at NYC DOS operate approximately 11,000 miles per year.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The technologies used in this program were muffler replacement DOCs, DPFs, SCR, and SCR/DPF systems. The DPF systems included a backpressure monitor that had a two-light warning system. The yellow light is designed to illuminate after 15 seconds of high backpressure and the orange light is designed to illuminate after 60 seconds of high backpressure. Fleet operators are advised to remove and clean the filter and/or if the yellow light appears several times during a day. If both the yellow and orange lights are illuminated, drivers are advised to take the truck back to the maintenance facility to have the filter removed and cleaned. The SCR systems are equipped with two indicator lights on the dashboard, a yellow and green light. If the yellow light is illuminated, it indicates that a urea dosing problem has occurred, which can include a sensor failure, dosing control unit (DCU) communication problems, or DCU component failures. The green light on the dashboard indicates that the on-board urea tank is low. Urea consumption vs. mileage is tracked and if a change occurs, it suggests that something is wrong with the urea dispensing system. The UPS SCR-equipped vehicles have an on-board 27-gallon urea storage tank and the refuse trucks have an on-board 13-gallon urea tank.

Emission Performance/Testing – Both chassis dynamometer and over-the-road testing is planned for the SCR and SCR/DPF-equipped vehicles. Over the U.S. FTP test cycle, NOx reductions of over 80% were achieved. Emission testing of the DOCs and DPFs is planned after the units have been in operation for several thousand miles. The DPF technology manufacturer had specified the following minimum duty-cycle temperature requirements: peak temperature over 350C and duration of the exhaust temperature over 300C at least 30%. As originally designed, the program planned to use diesel fuel with <350 ppm sulfur rather than ULSD and consequently, higher exhaust temperatures were required for regeneration. Data logging was performed and a number of vehicles were rejected because they did not achieve the minimum exhaust temperatures specified. Engine mapping of the engines to be equipped with SCR systems were performed at various speeds and loads to help determine the best calibrations for urea injection to maximize NOx reductions and minimize any ammonia slip. Finally, a "bump test" was performed prior to installation of the technologies that simulated the stresses on a truck over a 10-year period.

Installation/Maintenance –

DOC – Installations of the DOCs at NYC DOS proceeded on schedule. The DOC retrofits for the Waste Management fleets were delayed due to several factors.

Mack SEP Project/Project # 132
Retrofit Project Summary

First, a need arose to design and manufacture new stanchions (muffler supports) for all MT trucks. A second issue was that not all of the originally designated trucks could be fitted with the redesigned stanchions and those trucks had to be replaced with different trucks. Finally, employee layoffs at several Waste Management fleets impacted the attention that could be paid to completing the retrofits. Installation of the DOCs was performed by fleet personal after training from the technology provider. Initially, four DOCs were installed as a pilot program.

DPFs – As was the case with DOCs, special installation hardware was used with the DPFs because they weighed more than the conventional muffler they replaced. Installation of the DPFs was delayed because of difficulties finding vehicles that had suitable exhaust temperature profiles that would support the use of DPFs. The retrofits were installed by local Mack dealers. Again, an initial installation of a few DPFs was performed as a pilot test. The DPF manufacturer recommended filter cleaning at least every 12 months or 60,000 miles and provided a recommended cleaning procedure. In New York, limited quantities (<500 pounds) of ash can be disposed of with regular solid waste.

SCR – The SCR systems were installed on new engines at the Mack truck assembly plant. Mack personnel installed the SCR systems under supervision from the technology provider. Special installation hardware was used. Both the UPS and NYC DOS fleet yards have 250-gallon urea storage containers. Plans are to fill the UPS storage facility ("tote") four times a year and the DOS facility once a year.

Training – Mack and the technology suppliers provided technical training and/or support.

Failures/Repairs/Replacement – Limited operational experience information was available. Several of the DPF-equipped vehicles participating in the pilot phase experienced premature increased backpressure problems.

Impact on Vehicle Performance – No information available.

FUELS AND LUBRICANTS

As originally planned, diesel fuel with a sulfur content of <350 ppm sulfur was planned for use by all vehicles.

World Trade Center Diesel Emission Reduction Project/Project #133
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 1, 2005 **Location:** New York, NY

Report based on status of project as of February 28, 2005

Contact Organization: The Seven World Trade Center (WTC) Project/Northeast States for Coordinated Air Use Management (NESCAUM)

Overview – This project summary covers two initiatives: The Seven World Trade Center (WTC) Diesel Emissions Reduction Project and the New York City Local Law #77 that was an outgrowth of the public private cooperative initiative to reduce diesel emissions from rebuilding of the World Trade Center.

PROJECT DESIGN

Project Description -- The WTC Project is designed to be a model for demonstrating clean construction through the use of less polluting ULSD fuel and emission control technologies. The goal is to retrofit eight pieces of construction equipment with technologies to reduce PM or NOx emissions. Local law #77, which was signed into law in December 2003, requires the phase-in of ULSD and "Best Available Technology" (BAT) for emission control use in all diesel-powered off-road equipment used construction projects in NYC. NYC is currently developing a definition of what constitutes BAT. The requirements apply to all diesel nonroad engines rated at 50 hp or greater that are owned by, operated by or on behalf of, or leased by a city agency. Some exemptions are provided in the law. The requirements are being phased in with all city-owned and operated, or leased nonroad heavy-duty vehicles in Lower Manhattan covered in the first phase that took effect in June 19, 2004. The provisions of the law will be fully effective as of December 19, 2005. An approved list of products will be used for selecting BAT with preference being given to technologies that reduce PM (NOx is considered of secondary importance). The program will be enforced with penalties of up to $20,000 plus twice the amount of money saved by failing to comply with the requirements or making false claims. To date, no equipment has been retrofitted under New York Local Law #77.

Public Education & Outreach – Project partners conducted stakeholder meetings, forums, and media events. A website was developed.

Partners -- The Clean Air Communities (CAC) Partnership (New York State Department of Environmental Conservation, the Natural Resources Defense Council, Con Edison, Northeast States Clean Air Foundation, NESCAUM, construction companies, technology suppliers and the fuel supplier.

Status – To date, two excavators have been equipped with DOCs, one generator has been equipped with a flow-through filter, two tower cranes have been equipped with flow-through filters, and one concrete pumper has been equipped with a LNC/DPF system.

Funding – CAC provided $300,000 in funding.

World Trade Center Diesel Emission Reduction Project/Project #133
Retrofit Project Summary

Voluntary – The CAC partnership has initiated the project through the establishment of memoranda of understanding between each participant. As a project partner, the selected construction company receives CAC technology funding and the full complement of technical resources. No costs above those incurred during routine operations are born by the construction partner. A major incentive for construction companies to participate in the WTC project was the opportunity to capitalize on zero-cost participation in a program that ultimately would establish mandatory requirements for the same type of controls on construction equipment in New York City (Local Law #77).

VEHICLE/EQUIPMENT FLEET APPLICATION

Candidate equipment included drill rigs, excavators, loaders, tower cranes, compressors, contract loaders, and generators. The two tower cranes retrofitted with flow-through filters are powered by a Cummins 16L or a refurbished DDC 12VC, 2-cycle. The concrete pumper that will be equipped with a LNC/DPF system is powered by a Caterpillar 3406, 520 hp engine.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Retrofit technologies include DOCs, flow-through filters and LNC/DPF systems

Emission Performance/Testing – Portable emission monitoring systems (PEMS) are being employed to record and measure real-time, tailpipe emissions.

FUELS AND LUBRICANTS

The fuel used in the project initially had a sulfur content of <30 ppm. The fuel was designed to meet or exceed the engine manufacturers' specification for lubricity. There are no fuel-related problems reported.

At the start of the program the cost differential for ULSD was in the range of $0.10 to $0.20.

NYSERDA Private Ferries Project/Project #134
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 12, 2005 **Location:** New York, NY

Report based on status of project as of March 6, 2005

Contact Organization: Northeast States for Coordinated Air Use Management (NESCAUM)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project objective is to assist the New York Energy Research and Development Authority (NYSERDA) and the NY DOT in the development of an incentive program that will ultimately provide a significant reduction in diesel exhaust emissions from the mostly unregulated New York City (NYC) harbor private ferry fleet. The plan is to retrofit emission control technology(s) on a selected vessel from one of the four operating fleets in NYC. The goal is to reduce NOx emissions by 30% and PM emissions by 50%. NYSERDA, Federal Transit Administration, and NYC officials will evaluate the project. The evaluation will include whether the retrofits are successful, an evaluation of the emission data collected, and other elements to be determined.

An anti-idling policy was not included in the project, nor was another "best practices" programs included because the ferries operate on tight schedules and the owners are concerned about possible impacts of such programs on the operating and profit margins. Additionally, significant changes in operations would have to be cleared with the Coast Guard.

Partners – The project partners include NYSERDA (funding), FTA (funding), Seaworthy Systems, Inc (overall project management, liaison with the ferry operators, and vessel non-emission data collection), NESCAUM (technical and managerial support), ESI (technical support) and Environment Canada (on-site and dynamometer testing).

Status – The project is underway with the completion of the pilot phase in Summer 2005. Delays have been caused by one of the four fleets filing for bankruptcy. In addition, there has been inconclusive data results (still being evaluated) from a back-to-back comparison of ULSD (<30 ppm sulfur) with LSD (<500 ppm sulfur), the latter being the specification used for the NYC ferry fleet.

Funding -- $950,000 from NYSERDA and FTA.

Major Program Elements – Project elements include: 1) develop an available, initial inventory of private ferries operating in the NYC harbor characterizing engine types, operating profiles, space constraints and other factors affecting the applicability of various emission control options, 2) conduct a technology study of commercially available emission control technology options for diesel-powered ferries, 3) conduct a technology analysis comparison and selection process to develop a ranked list of the most appropriate technologies, 4) conduct a demonstration of up to three selected technologies or combination of technologies on ferries operating in the NYC harbor.

Voluntary – There has been an issue in gaining ferry owner/operator support.

NYSERDA Private Ferries Project/Project #134
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

The candidate vessels included in the program include the following:

Name	Year Built	Hull Type (1=monohull; 2=catamaran)	Max Speed (knots)	Duty Cycle (hoursr/day)	Crew Size	Passenger Capacity	Drive (1=direct mechanical; 2=indirect hydraulic)	Rated HP (for all engines)	Propulsion Engine	# Engines	Est. Fuel Usage (g/hr)
Vessel A	2003	2	24	12.5	3	75	1	600	DDC Series 60	2	28
Vessel B	2001	1	30	16	2	97	2	1800	Caterpillar 3406E	3	150
Vessel C	2003	1	15	16	3	492	1	1440	Caterpillar 3412E	2	60
Vessel D	not avail	2	42	15	6	400	1	7000	Cummins KTA50-M2	4	350

All candidate vessels are owned by, and carry passengers in the waterways in and around NYC, and between New York and New Jersey. Temperatures in the NYC area range from 10 to 80F and the vessels operate at sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The technology evaluation and selection process is still underway. NESCAUM notes that in selecting an emission reduction strategy, a number of factors must be considered including: 1) vessel operation is paramount and disruptions such as significant vessel downtime are unacceptable to the vessel owners/operators, 2) installation of any sizable emission control technologies will incur weight penalties that may affect vessel stability and will require a Coast Guard evaluation.

Emission Performance/Testing -- Emission testing will include dynamometer testing according to EPA specifications with full dilution for fuel effects. The program will also include on-site testing using the following techniques: 1) Non-Dispersive Infrared Detection (CO and CO2), 2) Chemiluminescence Detection (NO and NOx), 3) Heat Flame Ionization Detection (FID) (total HC), 4) Gravimetric Procedure with cyclone separators for PM10/PM2.5 split (PM), 5) Ion Chromatography (Ammonia), 6) Infrared and Electrochemical Sensors (Raw HC, CO, CO2, NOx, and O2), and 7) Light Transmittance (Opacity).

Training – Training by the technology provider will be provided to fleet personnel

FUELS AND LUBRICANTS

Some evaluations have taken place using LSD (<500 ppm sulfur) and ULSD (<30 ppm sulfur). The final fuel specifications for the test program are still being developed. Fuel-borne catalysts are one strategies being considered.

Indianapolis Refuse Truck Project/Project #137
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 4, 2005 **Location:** Indianapolis, IN

Report based on status of project as of February 2, 2005

Contact Organization: Office of Environmental Services, City of Indianapolis Department of Public Works (IDPW)

PROJECT DESIGN

Project Description/Objectives/Outreach/Project Evaluation – The project involves retrofitting at least 38 DPW refuse trucks and nine nonroad engines with DOCs. The vehicles and equipment are fueled by conventional highway diesel fuel. In the future, B20 may be introduced. The objective of the project is to improve the air quality of the Indianapolis urban area. The Indiana Department of Environmental Management (IDEM) has completed a competitive procurement process on behalf of public entities. The resulting Quantity Purchase Agreement (QPA) is for the purchase of DOC retrofit equipment for trucks and nonroad equipment. A DOC vendor was selected through a competitive process to supply the DOCs. The Indianapolis DPW is one of the first public entities to utilize the QPA process.

As part of the project, IDPW will develop a reduced idling plan that can be used by IDPW and other city fleets. Project evaluation will be conducted by tracking the miles and hours the vehicles are operated, recording any problems that arise, and identifying any lessons learned.

Outreach and Public Education -- The City of Indianapolis worked with EPA Region 5 to develop outreach materials for DPW employees that were distributed in conjunction with the initial round of DOC installations. On-going communications with DPW personnel will occur in conjunction with the Great Cities/Midwest Diesel Imitative media event. The Mayor has been invited to speak at a media event planned for early June 2005. Following the media event, outreach activities will target other diesel fleet owners/operators and the Indian Trucking Association.

Partners – Partners include: IDPW (project management, providing the fleet vehicles and performing the DOCs installation in Phase 2), IDEM (QPA process), EPA Region 5 (funding and project support) and the technology supplier (technical support and training).

Status – The first round of DOCs were delivered in November 2004 and were installed on nine trucks. Twenty-seven DOCs have been ordered for installation on additional trucks. Nine DOCs will be installed on nonroad equipment. If funds are available after installation of the planned retrofits, a decision will be made regarding how to spend the funds, which may be used to retrofit additional vehicles and/or equipment.

Funding – EPA Region 5 provided a $100,000 grant. The technology supplier provided training on DOC installation, and IDPW will provide in-kind contributions including performing the installation of DOCs.

Indianapolis Refuse Truck Project/Project #137
Retrofit Project Summary

Major Program Elements -- Program elements involve the close coordination between EPA Region 5, IDEM, and IDPW (both the Office of Environmental Services and the fleet personnel).

Voluntary – The primary motivation for undertaking the project was to improve the quality of the air in the Indianapolis urban area.

Overall Comments on the Program – IDPW reports that the project is just getting underway, but to date no problems have been reported. IDPW stressed the importance of early communication between air policy personnel and the fleet personnel to explain the purpose and scope of the program and to give the fleet personnel a sense of ownership in the process.

VEHICLE/EQUIPMENT FLEET APPLICATION

The refuse trucks retrofitted with DOCs to date include Sterling vehicles equipped with Caterpillar 3126E, 7.2L or Cummins 8.3L engines, Autocar trucks with Cummins 8.3L engines, Loadal trucks with Caterpillar 3126E, 7.2L engines, and Volvo trucks with VE D7 275 engines. The nonroad equipment targeted for retrofit include a 2002 model year John Deere road grader, six 2002 model year John Deere front-end loaders, and one 2002 model year John Deere dozer.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The technology is a muffler replacement DOC.

Emission Performance/Testing – No emission testing is planned. IDPW will use the EPA model for calculating emissions reductions.

Costs – The DOCs cost is $840 plus $325 to cover installation and training on the installation of the initial nine DOCs.

Delivery – The DOCs were delivered on time.

Installation/Maintenance – Three hours were set aside for installation, but installation actually takes far less time (in the range of 40 minutes)

Training – The technology provider provided training during the installation of the initial nine DOCs. IDPW personnel will install the DOC in future phases of the project.

Failures/Repairs/Replacement – No problems reported.

Impact on Vehicle Performance – No problems reported.

FUELS AND LUBRICANTS

The trucks and nonroad equipment will be fueled with conventional highway diesel fuel. At a later date the project may introduce the use of B20 fuel.

MASSPORT Biodiesel Project/Project #143
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 6, 2005 **Location:** Boston, MA

Report based on status of project as of January 3, 2005

Contact Organization: MASSPORT

PROJECT DESIGN

Project Description/Objectives/Partners/Outreach/Project Evaluation – MASSPORT fueled its diesel buses with biodiesel (B20) fuel from 1993 to 1999. The program was implemented as a strategy to reduce diesel exhaust emissions during a period that MASSPORT was transitioning from diesel buses to CNG buses. Beginning in the early 1990s, Massachusetts state law required vehicles to idling no more than 15 minutes.

Education/Outreach – Conducted a project launch event that included MASSPORT, federal, state, and local officials, as well as others. The event received press and TV coverage. Some additional media coverage occurred during the course of the project.

Status – Project completed; all diesel buses retired.

Funding – MASSPORT paid for the incremental cost of using B20 fuel. Estimated annual costs were approximately $250,000.

Major Program Elements – Program elements included arranging for B20 fuel supply, cleaning the fuel tanks on the buses, replacing engine fuel filters, and emission testing.

Voluntary – MASSPORT undertook the program as part of an overall effort to have an environmentally responsible operation.

Overall Comments on the Program – Initially problems occurred with obtaining B20 fuel that was properly mixed. Also, the biodiesel acted as a solvent that caused sediment to be released in the fuel tank which plugged engine fuel filters. These problems were addressed and overall the program was successful. MASSPORT personnel characterized the types of issues that arose and were addressed as being of similar magnitude to issues that arise whenever a new technology bus or new fuel (e.g., CNG) is introduced. MASSPORT indicated that a key element proved to be dedicated mechanics who worked through a number of technical issues and who were involved in every stage of the project. The individuals involved in the program indicated that they would not hesitate to undertake a similar program in the future.

MASSPORT Biodiesel Project/Project #143
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

Thirty-Two 1980 to 1988 model year TMC airport transit buses (passenger and airport employees) equipped with DDEC or 6V92 engines were fueled with B20 fuel. The buses operated on average about 5,000 miles per month. The buses were owned by a contractor who was very cooperative during the project. The original bus contract did not include the use of B20 fuel, but MASSPORT worked with the contractor to address such issues as unanticipated additional bus outages that might occur initially as a result of using the B20 fuel. The ambient operating temperatures ranged from sub-zero to over 90F and the buses operated at sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

The program did not include any retrofit technology.

FUELS AND LUBRICANTS

Fuel Properties – B20 biodiesel. Initially, there was an issue regarding the proper mixing of the fuel, but this issue was addressed.

Emission Performance/Testing – In the late 1990s, an emission testing program was conducted comparing diesel buses fueled with conventional diesel, biodiesel and CNG-powered buses. Testing results indicated that the use of biodiesel reduced PM by a measurable amounts over the multi-year use on the 32 buses, which translated into tons of PM emission reduced.

Costs – The 20% fraction of biodiesel blend cost approximately $3.50 per gallon, which translated into a near doubling of the cost of biodiesel fuel compared to conventional diesel (diesel ranged from $0.65 to $0.90/gal.).

Impact on Vehicle Performance/ Problems/Solutions – The biodiesel acted as a solvent which caused the sediment in the tanks of older buses to be released and caused plugging of the engine fuel filters. The fuel tanks were cleaned and fuel filters that were compatible with biodiesel were identified and installed. After these remedial actions were complete, no further problems were reported. Since the fuel storage tank used to store the biodiesel was new, no problems with the fuel dispense filters occurred.

MASSPORT Conley Container Terminal Project/Project #144
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 8, 2005 **Location:** Boston, MA

Report based on status of project as of February 7, 2005

Contact Organization – MASSPORT

PROJECT DESIGN

Project Description/Objectives/Outreach/Project Evaluation – As part of its 2003 ISO 14,001 ISO certification, MASSPORT has developed an Environmental Management System (EMS) to identify strategies to address environmental issues. Under the EMS, MASSPORT has initiated several program elements designed to reduce emissions from diesel engines operated at its marine port. Program elements include: 1) retrofitting DOCs on 20 trucks making deliveries at the Conley Container Terminal; 2) retrofitting DOCs on nonroad equipment owned by the port including five reach stackers, four rubber tire gantry cranes, and 12 tractors; and 3) fueling MASSPORT vehicles and equipment operating at Conley with ULSD.

Partners – MASSPORT (project management and funding), U.S. EPA (funding), Northeast States for Coordinated Air Use Management (NESCAUM, technical support), participating truck companies (providing trucks to be retrofitted) and the Conley Container Terminal.

Status – MASSPORT has been using ULSD at the Conley site since early 2004. The DOC retrofit project for the stackers and cranes is just getting underway as is the process of selecting the freight delivery trucks for DOC retrofit. DOCs have been installed on 12 Kalmar tractors.

Funding – The U.S. EPA provided a grant of $82,000 for the freight trucks, gantry cranes and reach stackers DOC retrofits. MASSPORT is making an in-kind contribution for the project and is covering the costs of the DOC retrofits on the other nonroad equipment and is paying for the ULSD.

Major Program Elements – Developing programs under the EMS, obtaining a grant from the U.S. EPA for the DOC retrofits on the gantry cranes and reach stackers, recruiting trucks to be retrofitted with DOCs, retrofitting the DOCs on the vehicles and equipment, and obtaining the ULSD fuel.

Voluntary – The programs were under MASSPORT's EMS that was adopted as a requirement to receive ISO 14,001 certification. The incentive for the freight delivery truck companies is an opportunity to participate in a program designed to improve air quality. Also, the DOCs will be installed without cost to the truck companies.

VEHICLE/EQUIPMENT FLEET APPLICATION

The 20 trucks being retrofitted with DOCs are freight trucks owned by the trucking companies. The five reach stackers, four rubber tire gantry cranes, and 12 tractors being equipped with DOCs are owned by MASSPORT.

MASSPORT Conley Container Terminal Project/Project #144
Retrofit Project Summary

The 12 tractors are Kalmar PT-122 tractors equipped with Cummins QSB5.9-44 engines.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – DOCs were selected for retrofit on the freight delivery trucks and the nonroad equipment. DPFs were considered, but MASSPORT was concerned that the exhaust temperatures of the targeted nonroad equipment and delivery trucks was inadequate to support the use of this technology.

Installation/Operation/Impact on Vehicle Performance – No installation or operational problems and no adverse impacts on equipment performance have been reported for the 12 tractors retrofitted with DOCs.

FUELS AND LUBRICANTS

ULSD has been used at the port facility since early 2004. Two dedicated tanks are used to store the fuel at the facility. No problems have been reported concerning obtaining the necessary supply of ULSD or operational problems on vehicles and equipment fueled with ULSD.

Bainbridge School Bus Project/Project # 146
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 8, 2004 **Location:** Bainbridge Island, WA

Report based on status of project as of December 28, 2004

Contact: Puget Sound Clean Air Agency (PSCAA)

PROJECT DESIGN

Project Description/Objectives/Partners/Project Evaluation – The project combines retrofitting DOCs and DPFs on school buses and operating the buses on ULSD. This is the first school bus program funded under the State School Bus Program that will involve the use of DPFs. Under the program, 15 buses have been equipped with DOCs and 11 buses are being equipped with DPFs. An additional five mini-buses are expected to be retrofitted with DOCs. The program is designed to insure that every student will be transported by a clean bus to help ensure program support by all parents. Partners include the State of Washington (funding), PSCAA (project administrative support, bid process, contracts, payment), the Bainbridge Island School District, and the DPF and DOC suppliers. The State has a voluntary reduced idling program, but Bainbridge Island is not currently participating. The project will be evaluated by periodic examination of the retrofitted buses.

Education/Outreach -- PSCAA met with school district officials. A local paper published an article on the program after the DOCs were installed and a media event is planned once the buses are retrofitted with the DPFs.

Status – The DOCs were installed in March 2004 and the DPFs are being installed during the last week of December 2004.

Funding – The State of Washington funded the costs of the technology and is reimbursing the school district for a portion of the cost differential of the ULSD fuel.

Major Program Elements – Selection of candidate buses to be retrofitted, conducting the RFP process, selecting the contractors, and overseeing the installation of the retrofit technologies.

Voluntary – State funding for the program was the key to the project going forward.

VEHICLE/EQUIPMENT FLEET APPLICATION

The 15 buses retrofitted with DOCs were equipped with 1988 to 1995 model year Cummins 8.3L engines. The DPFs are being installed on Amtram buses equipped with International DT 466E 2000 model year engines. Four buses were data logged to assess the suitability of DPF technology. The buses are owned by the school district. Routes selected for the data logging were those with the lowest passenger loads, the flattest terrain, and/or the shortest distance, the "worst-case" for achieving the exhaust temperatures necessary to insure DPF regeneration. Bainbridge Island school buses operate in the range of sea level to 300 ft and the ambient temperatures range from 25 to 85F.

Bainbridge School Bus Project/Project # 146
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Both the DOCs and DPFs were installed as muffler replacements. The DPF system included an on-board backpressure monitor with the added capability to generate continuous temperature profiles that can be downloaded for diagnostic purposes. The monitor included an alarm in the form of a yellow/red light system. The lights can also flash in sequence to help in diagnosing the problem. The alarm was mounted at the rear of the bus and not visible to the driver. The alarm will be checked daily as part of a bus maintenance checklist.

Emission Performance/Testing – No emission testing is planned, although the exhaust systems will be checked periodically for leaks.

Costs/Warranties – The installed cost of the DOCs ranged from $1,571 to $2,182 and came with a 12 month/20,000 mile warranty. The installed cost of the DPFs was $5,989 and the monitoring system cost $670. The DPFs came with a 5 year/100,000 mile warranty.

Delivery/Installation/Maintenance –

DOC – The delivery of the DOCs was delayed for two months due to a shortage of supply. Originally, 17 DOCs were to be installed, but the devices did not fit on two of the vehicles. Installation of the DOCs was made with the bus on a lift and took approximately three hours. The DOCs have not required any maintenance. The supplier inspected the DOCs for mechanical integrity after the buses had been placed into service. No problems were discovered.

DPF – The DPFs were delivered on time and are being installed with the bus on the ground by two workers. The installation takes approximately two hours (four men/hour). After approximately three months of operation, the DPF supplier will examine the filter on at least one bus to assess ash accumulation, temperature profiles and back pressure. Based on the results, a cleaning cycle and procedure will be established. The technology supplier will work with the fleet mechanics to demonstrate how diagnostic checks can be performed with the monitoring system.

Training – Training consisted of informal sessions with the bus fleet personnel.

Failures/Repairs/Replacement – For the DOC-equipped buses, no problems have been reported. The DPFs are in the process of being installed and currently have no operating experience.

Impact on Vehicle Performance – For the DOC-equipped buses, no problems have been reported. The DPFs are in the process of being installed and currently have no operating experience.

FUELS AND LUBRICANTS

The Bainbridge Island school buses have been operating on ULSD since Fall 2003. No fuel related supply or performance problems have been reported.

South Kitsap School Bus Program/Project #147
Retrofit Project Summary

BACKGROUND INFORMATION

Date: December 31, 2004 **Location:** South Kitsap, WA

Report based on status of project as of December 28, 2004

Contact: Puget Sound Clean Air Agency (PSCAA)

PROJECT DESIGN

Project Description/Objectives/Partners/Outreach/Project Evaluation – The project involves retrofitting up to 49 buses with emission control technology (21 DOC-equipped buses and 28 DPF-equipped buses). ULSD has been used since September 2004. The project partners include: PSCAA (project administrative support); the State of Washington (funding); the U.S. EPA (funding); the technology providers; and the fuel supplier. The State of Washington has a voluntary idle reduction policy. South Kitsap does not currently participate in that program.

Education and Outreach – An article in a national trade magazine featured the South Kitsap school bus program. A media event is planned once the installation of the DPFs is complete.

Status: Fifteen of the 21 DOCs have been installed and the first phase installation of the DPFs commenced during the last week of 2004.

Funding – Funding for the project is being provided by the U.S. EPA ($138,000) and the State of Washington ($121,000).

Major Program Elements – Program elements include recruiting the school district, obtaining funding for the project, selecting the technologies, conducting the RFP process, overseeing installation of the technologies, and establishing a filter cleaning program for the DPFs. Separate contracts for the DOCs and DPFs were issued. Also, the DPF retrofit program is divided into two phases. If it is determined that none of the buses identified for the Phase 1 DPFs retrofits have adequate temperatures for DPF regeneration, PSCAA has reserved the right to allow the DPF provider who originally awarded the contract to proceed with the Phase 2 DPF retrofits or to re-issue the RFP. The program calls for periodic status reports.

Voluntary – State and federal funding provided the incentive for the program.

VEHICLE/EQUIPMENT FLEET APPLICATION

The 21school buses being equipped with DOCs include: 1989-1990 Thomas buses equipped with Caterpillar 3208, 250 hp engines; 1993 Thomas buses equipped with Cummins 8.3L, 250 hp engines; and 1994 Carpenter buses equipped with Cummins 8.3L, 250 hp engines. All of these buses have an 84 passenger capacity. The 12 buses for the Phase 1 DPF retrofits are 2004 model year International buses (78 passenger capacity) equipped with International DT466, 250 hp engines.

South Kitsap School Bus Program/Project #147
Retrofit Project Summary

The 16 buses for the Phase 2 DPF retrofit include are 2000, 2001, and 2003 model year Blue Bird buses (78 passenger capacity) equipped with Cummins ISC, 250 hp engines. The buses operate from sea level to approximately 400 ft with ambient temperatures ranging from 25 to 85F.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Both the DOCs and DPFs are being installed as muffler replacements. The DPFs come with a back pressure monitor, a continuous temperature monitor, and a two-light (yellow/red) alarm system. The alarm is to be located in the cab in a location specified by the fleet manager. For the DPFs, data logging was performed on select candidate buses operating under the worst case scenarios for exhaust temperatures (routes, loading, usage, etc.). The 2004 International buses had low exhaust temperatures and it was determined that only two EPA-verified DPF technologies had potential application. PSCAA reported that one of the DPF products was significantly more expensive than the other. The lower cost DPF was selected.

Emission Performance/Testing – No emission testing is planned. The exhaust systems will be checked for leaks after the retrofit installations are complete.

Costs/Warranties -- The price of the DOCs and the warranty coverage was determined by the state contract under the State of Washington school bus program (5 years/100,000 miles)**.** Up to $96,500 was provided to cover the costs of the Phase 1 DPF retrofits and up to $126,500 for the Phase 2 DPF retrofits. The warranty on the DPF is 5 years/100,000 miles.

Delivery/Installation/Maintenance –

DOCs – The delivery of the DOCs by the state contract supplier was delayed. The devices were ordered in May 2004 and as of mid-December 2004, six DOCs have yet to be delivered. Installation of the DOCs took between 2 and 3 hours. There were no reported problems with the installation and no special maintenance for the DOC-equipped buses is planned.

DPFs – The DPFs were delivered on schedule and are now being installed on the Phase 1 buses. The installation on the first bus took four days due to the fact that the technology provider's two-person team was being trained by the filter manufacturer's representative. The second installation took two days. The DPF kit was described as being more complex than the DPF kit used on the Bainbridge school buses. After the DPF-equipped buses have operated for three to four months, the DPF provider will inspect the DPF on at least one bus to evaluate the ash build-up in the filter, the back pressure and the temperature profile. Based on this evaluation, a maintenance regime will be recommended. Under the contract, the DPF provider was required to provide two spare DPFs. The project participants are currently evaluating the option of receiving only one spare DPF and applying the funds for the other spare DPF towards purchasing a cleaning device (oven-type).

Training – Informal discussions took place between the technology suppliers and the bus fleet personnel. The DPF supplier will train fleet personnel to download information from the monitoring system. Once the filter cleaning regime is selected, the DPF provider will work with fleet personnel to implement the procedure.

South Kitsap School Bus Program/Project #147
Retrofit Project Summary

Failures/Repairs/Replacement – No DOC failures or problems have been reported. The DPFs are in the process of being installed and currently there is no operating experience.

Impact on Vehicle Performance – There have been no reported adverse impacts on vehicle performance from the DOCs.

Impact of extended Idling – During the data logging phase of the project, one bus used for extra curricular activities experience extended idling (several hours) and as result the bus had an extended period of low temperature. To avoid potential problems with the DPFs from extended idling, the school district placed a time limit on idling for the DPF-equipped buses.

FUELS AND LUBRICANTS

ULSD (<15 ppm sulfur) has been used since September 2004. No supply or performance-related problems have been reported.

Redmond/Kirkland Solid Waste Retrofit Project/Project #149
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 12, 2005 **Location:** Redmond/Kirkland, WA

Report based on status of project as of February 17, 2005

Contact Organization: Waste Management, Inc.

PROJECT DESIGN

Project Description – The project involved retrofitting 12 DPFs on refuse collection vehicles serving the communities of Redmond and Kirkland, Washington.

Partners – Cities of Kirkland and Redmond (funding), Waste Management, Inc. (provided vehicles), and technology supplier (technical support)

Status – DPFs installed on 12 refuse collection vehicles.

Funding – The Cities of Redmond and Kirkland provided the funding

Voluntary – Redmond and Kirkland provided the funding for the project and Waste Management agreed to participate.

Overall Comments on the Program – Local Waste Management representative commented that he was not convinced that the technology is fully proven and/or reliable at this time.

VEHICLE/EQUIPMENT FLEET APPLICATION

The DPFs were installed on Freightliner Condor/McNeilus refuse collection vehicles equipped with ISL 330 engines. The retrofits began in February 2004 and completed in November 2004.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – DPFs equipped with a backpressure monitoring system.

Costs/Warranties – The DPFs cost approximately $9,000 per unit installed.

Delivery – Delivery was made approximately six months after the order was placed.

Installation/Maintenance – The DPFs were installed by the technology provider.

Failures/Repairs/Replacement – Premature plugging of the filters required servicing of the units. Also, several backpressure monitor sensors failed.

Redmond/Kirkland Solid Waste Retrofit Project/Project #149
Retrofit Project Summary

FUELS AND LUBRICANTS

The refuse collection vehicles were fueled with ULSD (<15 ppm sulfur).

Port of Tacoma Project/Project #156
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 22, 2005 **Location:** Tacoma, WA

Report based on status of project as of February 9, 2005

Contact Organization: Port of Tacoma

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The program will involve retrofitting DOCs on 30 Port of Seattle straddle carriers. The straddle carriers are used to move cargo containers to and from ocean-going vessels. The Port of Tacoma estimates that after installation, PM emissions will be reduced by at least 20%. In addition, the Port has begun using ULSD in port-operated equipment and estimates that DOCs plus ULSD will provide up to a 50% reduction in PM emissions from the straddle carriers. A reduced idling policy is in place permitting engines to idle for only three minutes before automatically shutting down.

Public Education & Outreach – The Port will document project information and share it with other ports, equipment fleet owners, and those organizations that may be planning to perform retrofits

Partners – Port of Tacoma (project management and funding), U.S. EPA (funding and technical support), and Puget Sound Clean Air Agency (PSCAA, technical support and funding)

Status – The RFP for the DOCs has been issued.

Funding – U.S. EPA ($75,000), PSCAA ($40,000), and Port of Tacoma ($14,000 for changeover to ULSD)

Voluntary – The Port of Tacoma is committed to reducing emissions from diesel engines operating at the Port.

VEHICLE/EQUIPMENT FLEET APPLICATION

The Port of Tacoma owns the 30 straddle carriers, each of which has two engines. This equipment is powered by Cummins (6CT 8.3L/CTAA 8.3 L), Volvo (TD610M/TD730VE) or Mercedes (OM442 engines). The straddle carriers operate approximately 3,000 hrs/yr. At the time of retrofit, the carriers had been operated from 3,000 to 30,000 hrs. The carriers consume anywhere from 30,000 to 200,000 gal/yr.

Port of Tacoma Project/Project #156
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System -- DOCs

FUELS AND LUBRICANTS

ULSD (<15 ppm sulfur)

Community Transit Project/Project #158
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 14, 2005 **Location:** Sequim, WA

Report based on status of project as of January 5, 2005

Contact: Puget Sound Clean Air Agency (PSCAA)

PROJECT DESIGN

Project Description/Objectives/Partners/Outreach/Project Evaluation – The project is designed to retrofit up **to** 138 Community Transit buses with DPFs and to fuel the buses with ULSD. Partners included Diesel Solutions, a public private partnership (program support), PSCAA (funding and help in facilitating the project), Community Transit (operating and maintaining the DPF-equipped buses and provided funding), and the DPF supplier (technical support).

Status – Approximately 65 of the 138 total buses have been retrofitted with DPFs.

Funding – Community Transit provided 90% of the funding and PSCAA provided 10%.

Major Program Elements – Program elements included building the partnership among participants, selecting the type of retrofit technology, acquiring, installing, and maintaining the DPFs.

Voluntary – The state and local government, as well as Community Transit and the private sector have a strong commitment to reduce emissions from diesel-powered vehicles.

VEHICLE/EQUIPMENT FLEET APPLICATION

The Community Transit bus routes are a mix of stop-and-go routes and routes that are longer than the typical urban transit route.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DPFs with backpressure monitoring and a two-light (yellow/red) alarm system. The alarm system is visible to the driver.

Emission Performance/Testing – Data logging was performed by the DPF supplier prior to installation of the DPFs. To date, no emission testing has been performed.

Delivery/Installation/Maintenance – The DPFs were delivered on schedule. No pre-installation maintenance was reported. The DPF supplier performed the installations. The DPFs are shipped out to the supplier to be cleaned. The transit maintenance staff has been very committed to making the program a success and overcoming problems when they arise.

Training – DPF supplier provided training to the fleet personnel.

Community Transit Project/Project #158
Retrofit Project Summary

Failures/Repairs/Replacement – The first 17 DPFs installed on buses operated without problems. However, the 48 DPFs installed on the DDC Series 50 engines with EGR have had problems with filter plugging. PSCAA reports that there also have been problems with installation and service from the vendor.

FUELS AND LUBRICANTS

ULSD (<15 ppm) fuel is used. No supply or performance problems reported. The fuel was purchased from the existing fuel distributor used by the transit company.

King County Metro Transit Project/Project #159
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 5, 2005 **Location:** King County, WA

Report based on status of project as of February 4, 2005

Contact Organization: Diesel Solutions/Puget Sound Clean Air Agency (PSCAA)

PROJECT DESIGN

Project Description/Objectives/Partners/Outreach/Project Evaluation – The project, which started in 2001, is designed to retrofit up to 369 King County Metro Transit (Metro) buses with DPFs and to fuel the buses with ULSD. Partners included Diesel Solutions, a public/private partnership (program support), PSCAA (funding and help in facilitating the project), King County Metro (operating and maintaining the DPF-equipped buses and provided funding), and the DPF supplier (technical support).

Status – Approximately 310 of the 369 buses have been retrofitted with DPFs.

Funding -- Metro provided 90% of the funding and PSCAA provided 10%.

Major Program Elements – Program elements included building the partnership among participants, selecting the type of retrofit technology, acquiring, installing, and maintaining the DPFs.

Voluntary – The state and local governments, as well as Metro and the private sector, have a strong commitment to reducing emissions from diesel-powered vehicles.

VEHICLE/EQUIPMENT FLEET APPLICATION

Buses retrofitted with DPFs include 60-foot articulated buses equipped with 1988 and 1999 model year Cummins ISM 11L engines and 30-foot buses equipped with 1999 model year Cummins C8.3L engines. The Metro transit has a number of routes with frequent stop-and-go operation. Also, it is not unusual for buses to idle for extended periods.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DPFs with backpressure monitoring and a two-light (yellow/red) alarm system. Initially, the alarm system was visible to the driver. However, at the initial phase of the program, some monitoring systems malfunctioned and the light came on even though there was no backpressure problem; this was a distraction to the drivers. As a result, the lights were moved to the engine compartment at the end of the bus. The lights are checked as part of the daily maintenance regime.

Emission Performance/Testing – Data logging was performed by the DPF supplier prior to installation of the DPFs. To date, no emission testing has been performed.

King County Metro Transit Project/Project #159
Retrofit Project Summary

Costs/Warranties – The DPFs for the 30-foot buses cost approximately $6,400 and for the articulated buses approximately $8,000 to $9,000. Metro has incurred substantial operating costs as the need for more frequent cleaning and replacement of failed DPFs components. In 2004, Metro estimated it spent approximately $64,000 on the 30-foot buses and $250,000 on the articulated buses in DPF-related maintenance and part replacement. Another $100,000 in costs during that period was covered under the warranty.

Delivery – The DPFs were delivered on schedule. No pre-installation maintenance was reported. The DPF supplier performed the installations.

Installation – Installation was challenging given the engine and muffler locations. As discussed below, the DPFs had to be cleaned frequently. The Metro fleet personnel made some modifications to the engine compartment that made it easier to remove and re-install the DPFs.

Maintenance – Premature plugging of the DPFs has been a major maintenance issue. Originally, Metro anticipated that the DPFs would require cleaning after about 100,000 to 150,000 miles of operation (about once a year). As a result of DPFs plugging, a number of DPFs have required cleaning every 35,000 miles (and in some cases more frequently). The DPFs are sent to the DPF supplier for cleaning (bake and air blow). The cost of cleaning is approximately $300-400 per DPF. In some instances, the supplier indicated that the DPF filter component could not be cleaned and would need to be replaced. Metro indicated that often the warranty would not cover the cost of the filter component replacement. Metro is exploring the possibility of purchasing its own DPF cleaning equipment. Metro estimates it will need three DPF cleaning units and one full-time employee to conduct the cleaning procedures. The estimated cost of the cleaning equipment is $15,000 per machine. Metro hopes to receive some funding from PSCAA to help cover the costs of purchasing the equipment.

Training – DPF supplier provided training to the fleet personnel.

Failures/Repairs/Replacement – As noted above, two problems have occurred. First, the DPFs need to be cleaned about every 35,000 miles, more frequently than had been anticipated. Some of the DPF filter units could not be cleaned and had to be replaced. The excessive build-up of soot occurred on both types of buses. The problems occurred on routes that involve low-load stop-and-go driving and where there was excessive idling.

The second problem was the backpressure alarms, in some instances, malfunctioning with the warning light coming on even though there is no backpressure problem. The problem seems to be related to malfunction of the probe in the exhaust pipe that may have been caused by severe vibration in the exhaust pipe. The DPF system provider has worked on correcting the problem and Metro personnel indicated that they thought the issue has now been addressed. The technology provider developed a design change to correct the problem that seems to have addressed the problem.

Impact on Vehicle Performance – Metro reports that there have been some road-calls related to DPF backpressure issues. Also, the frequent DPF cleaning intervals have resulted in buses being taken out of service.

King County Metro Transit Project/Project #159
Retrofit Project Summary

FUELS AND LUBRICANTS

ULSD (<15 ppm) fuel is used. No supply or performance problems reported.

City of Seattle Retrofit Project/Project #161
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 14, 2005 **Location:** Seattle, WA

Report based on status of project as of January 31, 2005

Contact Organization: Puget Sound Clean Air Agency (PSCAA)

PROJECT DESIGN

Project Description/Objectives/Outreach/Project Evaluation – The project started about 3.5 years ago. The original goal of the program was to retrofit a mix of DOCs and DPFs on 300 vehicles in the City of Seattle fleet, including utility vehicles and dump trucks. The plan called for 95% of the vehicles to be equipped with DOCs and 5% with DPFs. The operating exhaust temperatures of the fleet vehicles were found to be, for the most part, inadequate to allow the use of passive DPFs. The vehicle fleet is being fueled with ULSD/B20 fuel. The objective of the program is to reduce the severe air pollution within the City of Seattle.

All 5,000 city vehicles are quipped with an automatic shutdown after 10 minutes of idling. The city estimates that a typical city diesel vehicle idling causes approximately $36,000 in engine wear costs.

Partners – Diesel Solutions, PSCAA, U.S. EPA, and the City of Seattle and the DOC and DPF vendors (technical support).

Status – DOCs have been installed on 215 vehicles, but only 10 DPFs have been installed. The City does not plan to retrofit any more vehicles with DPFs and is reconsidering the number of vehicles to be retrofitted with DPFs.

Funding – U.S. EPA contributed $125,000 for the original pilot program. Follow-up program activity is being funded by the City of Seattle.

Voluntary – The incentives were to make a contribution to improving the air quality of the City of Seattle.

VEHICLE/EQUIPMENT FLEET APPLICATION

All types of city fleet vehicles are being retrofitted including dump trucks and utility vehicles.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The DPFs and DOCs were installed as muffler replacements. Since there are many railroad crossings and intersections in Seattle, each DOC and DPF retrofitted vehicle was equipped with a malfunction warning system and a system that would allow a ramp down of the vehicle operation so that the vehicle could "limp" off the road.

City of Seattle Retrofit Project/Project #161
Retrofit Project Summary

Emission Performance/Testing – Data logging was performed. It indicated that the exhaust temperature profiles for many of the city vehicles were inadequate to support the use of DPFs. As a result, the number of vehicles equipped with DPFs was reduced from the number originally planned.

Costs/Warranties – The system costs, including installation, for the DOCs were $5,200 and for the DPFs were $8,200.

Failures/Repairs/Replacement – A few of the DOCs installed on the older (1986-1988) Caterpillar 3208 engines plugged.

FUELS AND LUBRICANTS

The project started with ULSD and then switched to a ULSD/B20 fuel. When the B20 was first introduced, it acted like solvent and loosened sediment from the tank. The sediment caused the fuel dispensing filters to clog. Once the sediment was removed and the filters changed, no further problems have been reported.

Seattle School Bus Project/Project #164
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 7, 2005 **Location:** Seattle, WA

Report based on status of project as of January 6, 2005

Sponsor: Diesel Solutions/Puget Sound Clean Air Agency (PSCAA)

PROJECT DESIGN

Project Description/Objectives/Partners/Project Evaluation – The project is designed to retrofit 52 Seattle School District school buses with DOCs, to retrofit 15 buses with DPFs, and to operate a portion of the bus fleet on ULSD fuel. Program partners included Diesel Solutions, a private/public partnership to promote reducing emissions from diesel-powered vehicles (program support), PSCAA (administrative support and funding), State of Washington (funding), the bus contractor, the engine manufacturer, and the technology providers. The Seattle School District has a reduced idling program. Program evaluation includes periodic inspection of the DOCs and DPFs.

Education and Outreach – Two press events were held: one at the school district and one at the state legislature.

Status – All of the DOCs and DPFs have been installed. Currently 200 to 300 buses are operating on ULSD.

Funding – The DOC portion of the project was funded by the State of Washington School Bus Program. One DPF was donated by the engine manufacturer and funds from a local SEP were used to pay for the other 14 DPFs and the incremental costs of the ULSD for approximately two years (2004-2006).

Major Program Elements – Program elements include recruiting the partners, obtaining funding, selecting and purchasing the technology and fuel, installing the devices and operating the DPF- and DOC-equipped buses in service.

Voluntary – Funding availability allowed the program to go forward. The school district had a strong commitment to the environment.

Overall Comments on the Program – To date, the program has been very successful and the only problems reported were with the backpressure alarm systems on the DPF-equipped buses. A special contract provision had to be included to insure that if the bus provider's contract was not renewed with the Seattle School District, the retrofitted buses would operate in other districts in Washington for a specified time or the contractor would provide reimbursement. There was a delay in receiving delivery of the DOCs because the state contracted DOC provider could not keep up with the statewide demand for DOCs. The school district has been very committed to the project. The project helped build support for funding the Washington State School Bus Program.

Seattle School Bus Project/Project #164
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

The DPFs were installed on 15 Navistar IC 2002 model year buses equipped with ICH T444E engines. The DOCs were installed on 1994-1998 International buses (65 to 75 passenger capacity) equipped with ICH T444E, DT466E, DT466 or DT408 engines. The buses operate on average around 15,000 miles annually. The buses operate at or near sea level and ambient temperatures range from 25 to 85F.

The buses are owned by a bus contractor. One issue that needed to be addressed under the State's Gift of Public Funds Act was to insure that if the contractor's contract with the Seattle School District was not renewed, the retrofitted buses would continue to be used in other school districts in Washington for a designated period or the contractor would be required to make a re-imbursement. This issue was handled in the contract to purchase the retrofit technology.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The DOCs and DPFs were installed as muffler replacements. The DPF system included a backpressure monitoring/two light (yellow/red) alarm system.

Emission Performance/Testing – Data logging was performed by the vendor on the buses to be retrofitted with the DPFs. No emission testing is planned.

Costs/Warranties – Under the Washington State contract the DOCs cost $1,100 to $1,200 installed and with a 5 year/100,000 mile warranty.

Delivery/Installation/Maintenance –

DOCs – The delivery of the DOCs was delayed due to the fact that the state contractor could not keep pace with the statewide demand for DOCs. The DOCs were installed by the contractor. The DOCs have not required any maintenance.

DPFs – The DPFs were delivered and installed by the supplier on scheduled. The DPFs are expected to require periodic filter cleaning. PSCAA noted that, ideally, the filter cleaning would take place annually, if needed, during the summer months.

Training – The DOC and DPF providers provided training for the fleet operators.

Failures/Repairs/Replacement –

DOCs – No problems were reported with the DOCs.

DPFs – The only problem reported with the DPFs was that the backpressure alarm system malfunctioned. The yellow light would come on, sometimes almost immediately, even though there was no backpressure problem. The technology supplier is working to solve this problem. No other problems with the DPFs were reported.

Seattle School Bus Project/Project #164
Retrofit Project Summary

Impact on Vehicle Performance – No adverse impacts on vehicle performance or fuel consumption were reported for either the DOCs or the DPFs.

FUELS AND LUBRICANTS

ULSD is being used to fuel approximately 200-300 school buses. Once funding was obtained to cover the incremental cost of the ULSD, no problems occurred in obtaining a supply of ULSD. There have been no reported performance problems related to the use of ULSD.

SCAQMD School Bus Project/Project #169
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 11, 2005 **Location:** Los Angeles Metropolitan Area, CA

Report based on status of project as of February 14, 2005

Contact Organization: South Coast Air Quality Management District (SCAQMD)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project involved retrofitting DPFs on school buses owned by private operators and school districts in the SCAQMD. These buses are being fueled with ULSD.

Public Education & Outreach

Partners – SCAQMD (project administration, technical assistance, and funding), local school districts and private school bus contractors (provided buses to be retrofitted), and the DPF suppliers (technical support).

Status – As of September 4, 2004, 1,273 DPFs have been installed by the private bus contractors and the school districts.

Funding – The SCAQMD provided the funds to cover the costs of the DPFs and the incremental additional cost of using ULSD.

Voluntary – The incentives were the funding and participating in a program to reduce school children's exposure to diesel exhaust emissions.

VEHICLE/EQUIPMENT FLEET APPLICATION

The buses retrofitted with DPFs were 1994 and later model years.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Two different technology manufacturers supplied DPF technology for the project.

Costs/Warranties – SCAQMD paid approximately $7,000 for each retrofit, which covered the purchase, installation, and sales tax for each DPF. Also included in the $7,000 amount was $500 to cover the incremental cost of the ULSD used by each bus. SCAQMD subsequently purchased insulation blankets at a cost of $250 to help attain sufficient exhaust temperatures to insure DPF regeneration.

Operational Experience – On some school bus routes (i.e., routes with frequent stop-and-go driving), the exhaust temperatures have not been sufficiently hot enough to insure proper regeneration. As a result,

SCAQMD School Bus Project/Project #169
Retrofit Project Summary

some DPFs have failed or plugged prematurely. To address this problem, SCAQMD plans to purchase insulation blankets and give them to the bus operators.

FUELS AND LUBRICANTS

ULSD (<15 ppm sulfur) fuel is being used in this project.

Sound Transit Project/Project #170
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 14, 2005 **Location:** Snohomish, WA

Report based on status of project as of January 5, 2005

Contact Organization: Puget Sound Clean Air Agency (PSCAA)

PROJECT DESIGN

Project Description/Objectives/Partners/Outreach/Project Evaluation – The project is designed to retrofit up 391 Sound Transit buses with DPFs and to fuel the buses with ULSD. Partners included Diesel Solutions, a public/private partnership (program support), PSCAA (funding and help in facilitating the project), Sound Transit (operating and maintaining the DPF-equipped buses and provided funding), and the DPF supplier (technical support).

Status – Approximately 64 of the 391 total buses have been retrofitted with DPFs.

Funding -- Sound Transit provided 90% of the funding and PSCAA provided 10%.

Major Program Elements – Program elements included building the partnership among participants, selecting the type of retrofit technology, acquiring, installing, and maintaining the DPFs.

Voluntary – The state and local government, as well as Sound Transit and the private sector have a strong commitment to reduce emissions from diesel-powered vehicles.

VEHICLE/EQUIPMENT FLEET APPLICATION

The Sound Transit bus routes are longer than the typical urban transit routes and include some freeway travel.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DPFs with backpressure monitoring and a two-light (yellow/red) alarm system. The alarm system is visible to the driver.

Emission Performance/Testing – Data logging was performed by the DPF supplier prior to installation of the DPFs. To date, no emission testing has been performed.

Costs/Warranties – The purchase contract had an escalator clause and the cost of the DPFs have risen by about $1,000 due to the increased price of precious metals. Sound Transit is in the process of re-negotiating the contract.

Delivery/Installation/Maintenance – The DPFs were delivered on schedule. No pre-installation maintenance was reported. The DPF supplier performed the installations. The DPFs are shipped out to

the supplier to be cleaned. The transit maintenance staff has been very committed to making the program a success.

Training – DPF supplier provided training to the fleet personnel.

Failures/Repairs/Replacement – No problems or failures have been reported.

Impact on Vehicle Performance – No adverse impacts on vehicle performance or fuel consumption reported.

FUELS AND LUBRICANTS

ULSD (<15 ppm) fuel is used. No supply or performance problems reported. The transit company purchased from its regular fuel distributor.

Spokane County School Bus Project/Project #171
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 14, 2005 **Location:** Spokane County, WA

Report based on status of project as of February 4, 2005

Contact Organization: Spokane County Air Pollution Control Agency (SCAPCA)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The objective of the program is to retrofit all district-owned school buses serving Spokane County with DOCs or DPFs and crankcase emission control devices. DPFs will not be installed until such time as ULSD is available. The Washington DOE is required to report annually to the state legislature on the statewide progress to retrofit school buses. Washington Department of Ecology (DOE) reports on the number of buses retrofitted, the costs, and estimated emission reductions. A reduced idling policy was not a specific element of the program, but the State of Washington has a separate program to address idling.

Public Education & Outreach – Initially, SCAPCA met with the transportation supervisors from the various school districts at a meeting organized by Educational Service District 101. Follow-up contacts were made primarily by telephone or e-mail.

Partners – Ten of 14 school districts serving Spokane County (providing vehicles for installation of retrofit technology); the Office of the Superintendent of Public Instruction (liaison with the school districts); Education Service District 101 (liaison with the school districts); Washington DOE (overseeing the state equipment purchase contract and providing technical and policy guidance); and SCAPCA (working with the individual school districts and administering the state funds for the project). The technology vendor, a technical consultant, and agency technical experts are providing technical assistance. SCAPCA notes that the primary source of technical support is the staff from the Washington DOE.

Status – The project is on-going with the current focus on retrofitting 200 and older buses with DOCs. Crankcase emission controls have been installed on buses in one school district as a pilot project. Further installations of crankcase emission controls are on hold until more EPA or ARB-verified technologies are available.

Funding -- The major source of funding is from the Washington State School Bus Program in which SCAPCA will receive approximately $435,000 a year for five years. In addition, one project (Central Valley School District) was funded in the amount of $198,000 through a Supplemental Environmental Project (SEP) as part of a settlement with a local utility.

Major Program Elements – SCAPCA used a Resource Manual developed by the Washington DOE to guide local air agencies in their administration of the program. Under this guidance, the participation school districts submitted a two-page application to the SCAPCA. The SCAPCA makes initial contact

Spokane County School Bus Project/Project #171
Retrofit Project Summary

with the state contractor or issues an RFP. The vendor then works with the school district to retrofit the buses and bills SCAPCA.

Voluntary – Funding to cover the costs of the retrofit technology provided the incentive to participate in the program. Under the Washington program, a statewide steering committee was established to identify technologies and strategies. Puget Sound Clean Air Agency provided technical input for the committee.

Overall Comments on the Program – SCAPCA noted that the project was "surprisingly simple" to implement and everything has gone very smoothly with no significant problems encountered to date.

VEHICLE/EQUIPMENT FLEET APPLICATION

The school buses participating in the program are owned by the individual school districts. Up to 219 buses are currently scheduled to be retrofitted with DOCs. The buses range from model years 1981 to 2000. There are a variety of chassis make/models including Ford, IHT, Carpenter, Amtran, Blue Bird, IHC, Cummins, Genesis, Thomas, TC 2000, LaFance, and Pierce. Engine models include IHC DT466, DT408, DTA360, 7.3L and 6.9L; Cummins 5.9L and 8.3L; Ford 478 and 7.8L; and others. An additional 61 1984-1994 model year buses in the Mead School District are scheduled to be retrofitted with a DOC/crankcase emission control system. Ambient temperatures in which the buses operate range from 0 to 100F and the buses operate at 2,000 to 3,000 ft. above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – DOCs and DOC/crankcase emission control systems are being retrofitted on school buses. If ULSD fuel becomes available, DPFs will be considered for retrofit on 2001 and later model year school buses. One school district (Central Valley) had backpressure monitors installed as part of the DOC system.

Emission Performance/Testing – Emission reduction projects are based on the EPA or ARB- verified emission levels.

Costs/Warranties – Costs and warranties are in accordance with the Washington State School Bus Program contract.

Delivery – SCAPCA noted that delivery took anywhere from a few weeks to a few months because of an apparent high demand for DOCs nationwide.

Installation/Maintenance/Operation/Impacts on Vehicle Performance – No specific information available.

FUELS AND LUBRICANTS

All participating school districts are using conventional on-road diesel fuel. The Central Valley School District is using a B20 blend of biodiesel.

Skagit Transit Project/Project #172
Retrofit Project Summary

BACKGROUND INFORMATION

Date: January 14, 2005 **Location:** Skagit County, WA

Report based on status of project as of January 6, 2004

Contact Organization: Northwest Clean Air Agency (NWCAA)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation -- The project involved retrofitting 18 Skagit Transit buses with DPFs and using ULSD fuel (maximum 30 ppm sulfur/average 15 ppm sulfur). Local SEP funding was used to cover the cost of the retrofits, the cost differential for the ULSD, and the installation of a fuel storage and delivery system for the ULSD. The project is being evaluated by NWCAA with periodic discussions with Skagit Transit personnel.

Education/Outreach – A fact sheet was developed for general circulation and a press conference was held in the spring of 2002 to demonstrate the effectiveness of the retrofit program and to educate the media on the benefits of reducing diesel emissions.

Partners – Project partners included Skagit Transit (provided the vehicles), Shell Oil Company Puget Sound Refinery (SEP funding), NWCAA (identified projects and liaison between partners), EPA Region 10 (oversight and approval of SEP project) and project vendor (technical support).

Status – Project completed on time in Fall 2002. Eleven buses are currently operating with DPFs. Five of the DPF-equipped buses were sold to a neighboring transit authority.

Funding – SEP funding totaled $250,000

Major Program Elements – Program elements included identifying the project, reaching agreement between Shell and Skagit Transit, providing funding, selecting the vendor, performing the data logging, training the fleet personnel, retrofitting the DPFs and arranging for ULSD fuel delivery and storage.

Voluntary – SEP funding made the project possible. DPF technology was selected based on recent successes in the Seattle area with diesel retrofits. NWCAA and Skagit Transit concluded that DPFs would be a good technology fit for the transit fleet.

Overall Comments on the Program – NWCAA noted that no program of the magnitude of the Skagit Transit project is failsafe. There were two filter failures and there were computer system failures (electronic feedback modules). However, the overall impression from Skagit Transit was very positive. The transit personnel appreciated the dramatic reduction in diesel odor and smoke from the tailpipes. NWCAA reported that the downtime has been about what was expected.

Skagit Transit Project/Project #172
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

A total of 16 of the original 18 buses equipped with DPFs are still in operation. Thirteen of the transit buses retrofitted with DPFs are 1993-2001 model year Gillig buses (56 passenger capacity) equipped with rear-mounted Cummins 8.3L mechanical 280 hp engines. The other three DPFs were installed on Gillig buses (56-72 passenger capacity) equipped either with a rear-mounted Cummins M-11 (280 hp), a rear-mounted Cummins C plus (260 hp), or a rear-mounted Cummins ISM (280 hp) engine. The buses are owned by Skagit Transit and they operate an average of about 30,000 miles annually. Data logging was performed on all of the buses by the DPF vendor. There were two classes of buses; the average exhaust for the smaller buses was 375C and for the larger buses 408C. The range of ambient temperatures was 20 to 95F and the buses operated at about 300 feet above sea level. At the time of retrofit, one bus had only 20,000 miles, while the other buses had mileage ranging from 152,000 to 288,000 miles.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The technology used was a muffler replacement DPF equipped an electronic feedback module.

Emission Performance/Testing – No emission testing.

Costs/Warranties – The DPFs cost $5,000 plus approximately $300 for installation. An annual fee of $600 per bus is charged for filter cleaning.

Delivery – The DPFs were delivered on time.

Installation/Maintenance – No pre-installation maintenance was performed. The installation took about five hours per bus. The only problems were fitting the retrofits into a tight space and the need for additional brackets to support the filters.

Training – The DPF vendor provided training on filter installation and on installation of the electronic feedback monitor.

Failures/Repairs/Replacement – Two of the DPFs failed. One failure was caused by a blown compressor and the cause of the other DPF failure was not determined.

Impact on Vehicle Performance – No adverse impacts were noted on vehicle performance when the systems were running properly. No adverse impacts on fuel consumption were reported.

FUELS AND LUBRICANTS

The fuel used in the program had a sulfur content of a maximum of 30 ppm and an average of 15 ppm. Cetane number was a minimum of 41. A lubricity additive was added to the fuel at the refinery. The fuel dispensing filters needed to be replaced periodically for proper sediment and water control.

Bellingham School Bus Project/Project #173
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 6, 2005 **Location:** Bellingham, WA

Report based on status of project as of January 18, 2005

Contact Organization: Northwest Air Pollution Authority (NWAPA)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project resulted from an administrative order issued on March 31, 2001, requiring Georgia-Pacific to submit a plan to mitigate the PM contribution of diesel generators. The plan included retrofitting DPFs on 10 school buses. The program did not include a reduced idling plan.

Public Education and Outreach – A press release was issued by Georgia-Pacific, and an article was written in the *Bellingham Herald* about the project.

Partners – Partners included NWAPA (program support), Washington Department of Ecology (program support), Georgia-Pacific (funding), the technology provider (technical support), and the Bellingham School District (providing the buses to be retrofitted).

Status – Ten buses have been retrofitted with wire mesh flow-through DPFs.

Funding – Georgia-Pacific provided the funding to cover the cost of retrofitting 10 school buses

Voluntary – The funding for the project was the result of an administrative order that included a requirement to provide funding for a school bus retrofit. Georgia-Pacific selected the technology based on the vendor's specifications.

Overall Comments on the Program – NWAPA reported that the entire project was easy from the perspective of the Bellingham School District and that there were no delays. Also, NWAPA noted that the buses were noticeably cleaner and that there were no problems with the retrofit.

VEHICLE/EQUIPMENT FLEET APPLICATION

Ten buses, owned by the school district, were retrofitted with wire mesh partial flow DPFs. Five buses were 1986-1988 model year Thomas buses (72-78 passengers) equipped with rear-mounted DDC 8.2L engines, and five buses were 1992-1993 model year Thomas buses (72-78 passengers) equipped with rear-mounted Caterpillar 3116 engines. The buses average approximately 15,000 miles annually and have an average fuel economy of 5.5 mpg. The buses operate at about 800 ft above sea level with ambient temperatures ranging from 10 to 95F.

Bellingham School Bus Project/Project #173
Retrofit Project Summary

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Wire mesh partial-flow DPFs. No backpressure monitors/alarms were installed

Emission Performance/Testing – No data logging or emission testing was performed.

Costs/Warranties – The wire mesh partial-flow DPFs cost $3,000 per bus. No warranty was included.

Delivery – The retrofit technology was delivered on time.

Installation/Maintenance – No pre-installation maintenance was performed. Installation took approximately one hour per bus.

Training – No training was provided.

Failures/Repairs/Replacement – No reported problems.

Impact on Vehicle Performance – No reported adverse impacts on vehicle performance or fuel economy.

FUELS AND LUBRICANTS

Regular on-road diesel (<500 ppm sulfur).

ORCAA School Bus Project/Project #174
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 12, 2005 **Location:** Olympic Area, WA

Report based on status of project as of February 17, 2005

Contact Organization: Olympic Region Clean Air Agency (ORCAA)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project was designed to retrofit 24 school buses in the Aberdeen and Hoquiam School Districts with DOCs to reduce diesel emissions. An idling program was not included as part of the program, but the State of Washington has a reduced idling policy.

Public Education & Outreach – ORCAA provided photos of the installation process and buses on actual routes, along with detailed press releases to all area media (e.g., TV, radio, newspapers, magazines, and business journals). Information was also provided on the ORCAA website.

Partners – U.S. EPA (funding), ORCAA (program support), Hoquiam School District (provided buses), Aberdeen School District (provided buses), and the technology supplier (technical support).

Status – Project largely completed on time with 86% of the diesel buses in the two school districts retrofitted with DOCs.

Funding – EPA provided the funding.

Voluntary – The incentives were the opportunity to equip the buses with DOCs without charge to the school districts in order to improve student and community health. The fleet managers were very supportive of the project.

VEHICLE/EQUIPMENT FLEET APPLICATION

All the buses are owned by the individual school districts and are used for regular school transit and for extracurricular events. The buses included 1984-1998 model year Thomas buses (72-84 passengers) equipped with Caterpillar 3208 and 3126 front-mounted engines, 1987-1998 model year Blue Bird buses (22-78 passengers) equipped with Caterpillar 3208 and Cummins 5.9L front-mounted engines, a 1990 model year Carpenter bus (78 passengers) equipped with a Caterpillar 3208 front-mounted engine, and a 1995 model year Wayne bus (16 passenger) equipped with a Cummins 5.9L front-mounted engine. The buses operate an average of 15,000 miles annually on routes ranging form sea level to 1,000 ft.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Muffler replacement DOCs.

ORCAA School Bus Project/Project #174
Retrofit Project Summary

Costs/Warranties – The cost of the DOCs ranged from $920 to $1,500 per retrofit with labor and installation costs of $300 on average.

Installation/Maintenance – Installations took place during the summer and were completed within a week by the technology supplier.

Failures/Repairs/Replacement – No problems were reported.

Impact on Vehicle Performance – No adverse impacts were reported.

FUELS AND LUBRICANTS

Conventional diesel fuel (<500 ppm sulfur) was used to fuel the school buses.

Port of Seattle Project/Project #176
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 1, 2005 **Location:** Seattle, WA

Report based on status of project as of February 15, 2005

Contact Organization: Port of Seattle

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The Port of Seattle Emissions Reduction Project is designed to reduce PM, NOx, CO, SO2, and HC from the Port of Seattle seaport operation through the use of emission reduction controls, cleaner fuel, and public outreach. Reductions will be achieved through the use of technologies such as DOCs and operator/driver outreach activities such as reduced idling education. Equipment being considered for inclusion in the program includes cargo handling equipment (CHE), on-road trucks and heavy-duty equipment. Fleet selections will be made based on recommendations from the Puget Sound Clean Air Agency (PSCAA). The Port of Seattle is also working with PSCAA on a pilot project to retrofit marine terminal cargo-handling equipment at the Port.

The Port also encourages the use of alternative fuels such as biodiesel and ULSD. Currently, a biodiesel B20 blend can be purchased at the Port's Shilshole Bay Marine fuel dock, one of two marinas in the Puget Sound area that offer biodiesel. All diesel equipment owned and operated by the Port of Seattle is fueled with ULSD.

In another project, the Port of Seattle, Princess Cruise Lines, the U.S. EPA and Seattle City Light are engaged in the Port of Seattle Princess Shore Power Project. The Project involves building a shore side power facility that will allow the Sapphire and Diamond Princess cruise ships to turn off their engines and "plug in" while docked at Terminal 30 in Seattle beginning in Summer 2005. The cost of this project is approximately $2.8 million ($1.8 million for the power facilities and $500,000 per ship. The Port of Seattle reported that the project is expected to eliminate the use of 35 metric tons of turbine engine fuel per ship call, for a total of 1,400 tons over the summer season. Estimated seasonal reductions from this project are 7.7 tons of PM and 203.5 tons of SOx emissions.

The information discussed below only pertains to the Port of Seattle Emissions Reduction Project.

Public Education & Outreach – The project will include operator/driver outreach activities such as reduced idling education.

Partners – The Port of Seattle and PSCAA will provide monetary, in-kind contributions of staff time, technical expertise, and installation and maintenance of the emission controls.

Status – The project is currently in the planning stages.

Port of Seattle Project/Project #176
Retrofit Project Summary

Funding – The Port of Seattle ($40,000 and in-kind contributions) and PSCAA ($30,000 and in-kind contribution). In addition, the Port has applied for a $50,000 grant from the U.S. EPA under the Region 10 Regional Geographic Initiative grant.

Major Program Elements -- Program elements include selecting the equipment to be included in the program based on factors such as equipment age, engine type, duty cycle, and compatibility of emissions control technologies.

Voluntary – The project is encouraging the use of cleaner fuels, retrofit technology, and reduced idling strategies by providing technical and financial assistance to port tenants and employees. Technologies will be selected based on recommendations from PSCAA and based on the factors discussed above.

VEHICLE/EQUIPMENT FLEET APPLICATION

Candidate vehicles are cargo handling equipment, on-road trucks, and heavy-duty equipment

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology selection has not yet begun, but DOC technology is one of the leading candidates.

FUELS AND LUBRICANTS

All equipment owned and operated by the Port of Seattle is fueled with ULSD. B20 biodiesel can be purchased at the Port's Shilshole Bay Marina fuel dock. The Port also encourages the use of alternative fuels.

Port of Seattle, Sea-Tac International Airport Project/Project #177
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 9, 2005 **Location:** Seattle, WA

Report based on status of project as of February 3, 2005

Contact Organization: Port of Seattle, Seatlle-Tacoma International Airport (Sea-Tac)

PROJECT DESIGN

Project Description/Objectives/Outreach/Project Evaluation – The project involved strategies to reduce NOx emissions from construction activities on Sea-Tac's Runway Three. The regulatory driver was a conformity commitment to keep NOx emissions resulting from the construction project to less than 100 tons per year. The project involved several phases. Phase 1, which took place in 2001, involved a pilot program using emulsified fuels on three dual-bed dump trucks. The pilot program lasted less than a week because of difficulties using the emulsified fuel on the vehicles selected. In 2002, a pilot program was initiated fueling on-road and nonroad vehicles with ULSD. The program was a success, and in February 2004, all vehicles and equipment used in the construction of Runway Three started being fueled with ULSD. A new phase is being planned involving the retrofit of up to 10 or more nonroad engines with DOCs.

Partners – Partners included Sea-Tac (program management and fuel costs), Puget Sound Clean Air Agency (PSCAA, program support and funding), and the emulsified fuel supplier (technical support)

Status – The emulsified fuel pilot program was terminated in 2001. Vehicles and equipment used in the Runway Three construction project are being fueled with ULSD. A DOC retrofit project involving nonroad engines is in the planning stage.

Funding – Sea-Tac paid for the emulsified fuel used in the 2001 pilot program. The airport and PSCAA split the incremental cost of the ULSD used in the 2002 pilot program. The cost of the ULSD now being used is covered as part of the contract agreement with the construction contractors. PSCAA will be providing a grant in the range of $50,000 to $100,000 to cover the costs of the planned DOC retrofit project.

Major Program Elements – Coordination between Sea-Tac, PSCAA, the runway construction project contractors, the emulsified fuel supplier and the ULSD suppliers.

Mandatory – The program is mandatory in the sense that the Sea-Tac had a conformity commitment not to exceed greater than 100 tons of NOx annually in connection with the Runway Three construction project.

Port of Seattle, Sea-Tac International Airport Project/Project #177
Retrofit Project Summary

Overall Comments on the Program –

Emulsified Fuel Pilot Program – Several issues contributed to the termination of the pilot program. First, while the construction contractor was totally supportive of the project; there were perceptions of problems with emulsified fuels; the milky consistency of the emulsified fuel did not look like diesel fuel. When a problem developed with the operation of one of the vehicles, even though the cause was not determined, it contributed to the contractor's diminished support for the pilot program. Second, the dual-bed dump trucks were required to climb a steep grade requiring full power and there was concern about a loss of power on the trucks using the emulsified fuel. The supplier of the emulsified fuel was very cooperative and offered to adjust the engines to improve performance, but that suggestion was not well-received by the construction contractor.

ULSD Fuel – No problems were reported with either the ULSD pilot or the subsequent conversion to ULSD fuel. The requirement to use ULSD in the construction contracts was straight-forward. The Port of Seattle has received positive feed-back from its efforts to reduce NOx emissions.

VEHICLE/EQUIPMENT FLEET APPLICATION

Three large tandem trucks (400-460 hp) that haul about 31 tons per load were used for the 2001 emulsified fuel pilot program. All construction vehicles used on the Runway Three construction project are using ULSD. Nonroad engines will be targeted for the planned DOC retrofits. At least one of the retrofits will be on a large scrapper.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Muffler replacement DOCs, rather than DPFs, are planned for the retrofit portion of the project because some of the candidate pieces of equipment are high PM soot emitters. Backpressure monitors will be installed. Since this phase of the project is at the planning stage, no additional information was available.

FUELS AND LUBRICANTS

Emulsified Fuels – The pilot program involved fueling four dual-bed dump trucks with emulsified fuels and was terminated after less than a week. As noted above, several issues contributed to the termination of the pilot program. The incremental cost increase of the emulsified fuel was about $1 per gallon and the quantity used was less than 2,000 gallons.

ULSD – Both the 2002 ULSD pilot program and the conversion to ULSD in 2004 for all construction vehicles and equipment have taken place without any problems reported. For the pilot program, the incremental cost increase was about $0.26 per gallon with PSCAA covering $0.16 and the airport covering the remaining $0.10. Construction contracts now require the use of ULSD fuel. The individual contractors are responsible for making arrangement for the ULSD.

Sacramento Metropolitan Utility District Project/Project #187
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 21, 2005 **Location:** Sacramento, CA

Report based on status of project as of February 8, 2005

Contact Organization: Sacramento Metropolitan Utility District (SMUD)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project's objective is to install the most effective ARB-verified emission control technology on SMUD fleet vehicles to reduce NOx, PM, HC, and CO emissions. Thirty utility vehicles have been equipped with LNC/DPF systems. A reduced idling ordinance was already in place in Sacramento. The project will be measured in terms of the annual percentage of vehicles retrofitted.

Public Education & Outreach – Report to upper management on programs being made to reduce fleet emissions.

Partners – SMUD (project implementation and funding) and technology supplier (technical support).

Status – The first three phases are complete. Each phase involves purchasing and installing 10 LNC/DPF systems per year.

Funding -- SMUD

Major Program Elements – Elements included: 1) identifying areas where emission improvements are available, 2) identifying the available technologies, 3) evaluating benefits, 4) obtaining SMUD Board of Directors approval, 5) purchasing and installing the equipment, and 6) testing, if necessary, for certification/verification.

Voluntary – The incentive is to reduce emissions and to begin early compliance with future regulations. ARB plans to establish emission reduction requirements for municipal fleets. SMUD decided to be proactive and began installing retrofit technology on its vehicles. The LNC/DPF system was selected because it had the best overall emission reduction performance (NOx, PM, HC, and CO) of the technologies verified by ARB.

Overall Comments on the Program – SMUD reports that the overall experience has been favorable. The program experience with new technologies has led to an understanding that there will be problems along the way, but the final environmental results are worth the effort. SMUD recognizes that, in most cases, it is necessary for someone to take the risk in using new technology to advance the technology.

Sacramento Metropolitan Utility District Project/Project #187
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

SMUD owns its fleet vehicles. The vehicles retrofitted with the LNC/DPF ranged from 1996 to 2002 model year and included dump trucks, service trucks, line trucks, and chipper dump trucks. The vehicle's annual mileage ranges from 5,000 to 13,000 miles. The fuel economy of the vehicles ranges from 4.5 to 7.0 mi/gal. Data logging of the target vehicles indicated that the duty-cycle temperature profile was greater than 260C at least 25% of the time. Ambient temperatures range form 20 to 110F and the vehicles operate at approximately 25 to 300 ft above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – LNC/DPF system equipped with a backpressure monitor/alarm. An ECM monitors the system. Warning lights are installed on the dash of the vehicles to indicate a power failure, excessive backpressure, or a complete system failure. SMUD reports that the monitoring/alarm system has proved useful.

Emission Performance/Testing -- Emission reductions were calculated based on the vendor's product information and the ARB verification levels.

Costs/Warranties -- The installed retrofit cost is $18,000 to $22,000 per vehicle. Warranties are 5 years/100,000 miles for vehicles <33,000 lbs GVWR and 5 years/150,000 miles for vehicles over 33,000 lbs GVWR. Maintenance costs have been minimal to date since most servicing has been provided under warranty. Future maintenance costs include a recommended servicing/cleaning of the filters at $400 per unit.

Delivery – On time.

Installation/Maintenance – Installations took two to three days for vehicles with horizontal exhausts. For vehicles with vertical exhaust, the retrofit took a week. The technology provider is currently cleaning the filter and disposing of the ash and soot. SMUD is considering purchasing filter cleaning equipment.

Training -- The technology supplier provided training for the fleet mechanics.

Failures/Repairs/Replacement – Problems included two exhaust fuel injectors failing and several cases of the front face of the catalyst section plugging. The technology manufacturer and supplier made changes to the software on this system to try to correct these issues. There are still several cases of face plugging of the catalysts, most notably on vehicles with the Intl. T444E engine. Three DPFs have plugged and have required unscheduled cleaning, which typically resulted in down time of less than one day. The plugging has been a problem on vehicles that use the engine to power auxiliary equipment such as aerial lifts and cranes/derricks. Extended idling will cause the DPFs to plug.

Impact on Vehicle Performance – When the filters plugged, a loss in power resulted. Most operators did not notice the difference. The system uses a fuel injector and sensors to keep exhaust temperatures at the operating temperature needed. This causes a minor reduction in fuel economy that SMUD has not been able to track.

Sacramento Metropolitan Utility District Project/Project #187
Retrofit Project Summary

FUELS AND LUBRICANTS

California ULSD (<15 ppm sulfur).

City of Houston Fleet Retrofit/Project #188.1
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 28, 2005 **Location:** Houston, TX

Report based on status of project as of February 18, 2005

Contact Organization: City of Houston

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – This project was part of the City of Houston's Emission Reduction Plan and grew out of a field demonstration program in which a number of NOx reduction strategies were evaluated, including emission testing by Environment Canada. As a result of that field program, SCR was selected as one of the technologies to be used on City fleet equipment. The project involves retrofitting 33 rubber tire excavators with SCR. Also, one SCR system was installed on a 2003 model year dump truck. The City also has retrofitted approximately 30 to 40 nonroad engines such as backhoes and water pumps with DOCs and plans to retrofit up to 63 refuse trucks with low-pressure EGR/DPF systems (see Project #188.2). A portion of the City of Houston fleet is now operating on ULSD fuel. The program includes emission testing at the University of Houston's testing facility (chassis dynamometer) to evaluate the emission reductions achieved with the retrofit technologies.

Public Education & Outreach – The EPA regional administrator toured the University of Houston testing facility that will be used to test some of vehicles equipped with retrofit technology. Decals will be placed on the excavators equipped with retrofitted technology. The City of Houston personnel have met with other agencies in the state to discuss the Houston program.

Partners – City of Houston (program administration and implementation), Texas Commission on Environmental Quality (TCEQ, funding), Houston-Galveston Area Council (funding), Environment Canada (emission testing during the pilot program), the University of Houston Diesel Vehicle Emissions Research Laboratory (testing) and the technology supplier (product installation and technical support).

Status – All 33 ditch excavators are equipped with an initial design SCR system and the SCR system will be upgraded on these pieces of equipment in the future to increase the level of emission reductions.

Funding – Funding was provided by the TCEQ (TERP funds) and the Houston-Galveston Area Council (CMAQ funds) in the amount of $500,000 for the SCR systems. The City of Houston also provided nearly $4 million to the University of Houston to help fund its testing facility that will be used for this and other projects, and the University provided an additional $689,000 for building construction and manpower.

Major Program Elements – Elements of the program included: 1) conducting the pilot program to evaluate NOx emission reduction strategies; 2) selecting the NOx control technologies to use in the program; and 3) designing and installing the retrofit technologies.

City of Houston Fleet Retrofit/Project #188.1
Retrofit Project Summary

Voluntary – The incentives for the program included the City of Houston's commitment to reduce emissions from its fleet vehicles to help improve the region's air quality and a desire to reduce NOx emissions to help meet the NAAQS for ozone. SCR was selected as one of the technologies to equip on fleet vehicles because the technology demonstrated excellent NOx emission reduction capability in the pilot program.

Overall Comments on the Program – The City of Houston has actively sought to evaluate and help demonstrate emerging emission control technologies. Data from the program was used to help obtain ARB verification for the SCR system. The City noted that, as with any retrofit project, it has been a learning process for the partners. Challenges have occurred, but the partners have worked together to resolve any issues that have arisen. Close coordination and communication with the fleet personnel was beneficial in retaining their active support for the program.

To date, the SCR systems have operated without any reported major problems. The City of Houston hopes to use the University of Houston testing facility to evaluate emerging technologies and to conduct in-use verification testing. Houston's desire to retrofit additional fleet vehicles/equipment has been limited by the fact that the TERP funding can no longer be used to pay for retrofit technologies that have not been verified. The City of Houston noted that there was a shortage of verified technologies for nonroad engines. Houston stated that it is essential to get more verified products and products verified for more applications to expand the clean-up of existing diesel engines and to achieve the NOx reduction needed to meet the NAAQS for ozone. Houston suggested accelerating the verification process and/or permitting conditional verifications in some cases.

VEHICLE/EQUIPMENT FLEET APPLICATION

All fleet vehicles and equipment are owned by the City of Houston. The Gradall rubber-tire excavators retrofitted with the SCR systems are all powered by 1994 to 2000 MY Cummins 5.9L 190 hp engines. Also, an SCR system was retrofitted on a 2003 MY dump truck powered by a Cummins ISC 315 330 hp engine. DOCs, which were not directly part of this program, were retrofitted on nonroad equipment such as backhoes and water pumps.The excavators operate on average 400-600 hours annually. Ambient temperatures range from 50 to 100F and the equipment operates at 60 to 100 ft above sea level.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The SCR system included a DOC and a warning signal to indicate when the ammonia supply was getting low. The signal is in the engine compartment and is checked by the fleet maintenance personnel. At the time the SCR systems were installed, the technology had not been verified. The Houston program helped provide data for the eventual ARB verification of the SCR for use on nonroad 1991-1995 Cummins 5.9L from 150 to 200 hp engines. The manufacturer will shortly commence upgrading the SCR systems currently installed on the excavators with an enhanced SCR system that will include a hybrid DPF and will be designed to be used with ULSD. The new system will achieve greater PM emission control.

City of Houston Fleet Retrofit/Project #188.1
Retrofit Project Summary

Emission Performance/Testing – Data logging, opacity testing and emission testing (chassis dynamometer) were employed during the pilot phase of the program. Additional emission testing on a chassis dynamometer at the University of Houston is being conducted. The test cycle used was the modified EPA UDDS drive cycle developed for use in testing the rubber tire excavators.

Costs/Warranties – The installed cost for the SCR system was approximately $15,000 per unit. A five-year warranty covering parts and service was included in the product cost.

Installation/Maintenance – No pre-installation maintenance was performed on vehicles that were in proper running condition at the time of installation. The SCR systems had to be configured for application on the excavators. The product distributor performed the installation which took about one day for each unit. No maintenance was required on the SCR/DOC system currently installed on the excavators other than insuring the supply of ammonia (the reductant) was replenished.

Failures/Repairs/Replacement – The SCR systems have now been in operation for up to three years and no major problems have been reported. There was one case where an operator reported the smell of ammonia. The cause was traced to ammonia slip due to the wrong software setting being input into the control module. Once an adjustment was made to the software, there were no further issues with ammonia odor.

Impact on Vehicle Performance – No adverse impacts on vehicle performance were reported with regard to either of the SCR systems. The fuel economy was not measured, but during dynamometer testing, there appeared to be a slight increase in fuel use.

FUELS AND LUBRICANTS

The excavators currently operate on conventional on-road diesel fuel. By June 2006, the City of Houston plans to have ULSD fuel available for all of its fleet vehicles. Initially, Houston had difficulty obtaining the ULSD fuel because there was only one ULSD supplier serving the region. The current cost differential for ULSD is about $0.20 per gallon. The City estimates that about two-thirds of that cost differential is due to delivery costs.

City of Houston Fleet Retrofit/Project #188.2
Retrofit Project Summary

BACKGROUND INFORMATION

Date: February 28, 2005 **Location:** Houston, TX

Report based on status of project as of February 18, 2005

Contact Organization: City of Houston

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project involves retrofitting up to 63 refuse trucks with low-pressure EGR/DPF systems. As an initial step, a pilot program was conducted to develop operating test cycles and to evaluate a variety of NOx reduction strategies. Based on the results of this pilot program, low-pressure EGR/DPF and SCR (see Project #188.1) systems were selected for use by the fleet. The City also retrofitted approximately 30 to 40 nonroad engines such as backhoes and water pumps with DOCs. A portion of the City of Houston fleet is now operating on ULSD fuel. The City of Houston plans to include emission testing at the University of Houston's testing facility (chassis dynamometer) to evaluate the emission reductions achieved with the retrofit technologies.

Public Education & Outreach – The EPA regional administrator toured the University of Houston testing facility that will be used to test some of vehicles equipped with retrofit technology. Decals will be placed on the refuse trucks equipped with retrofitted technology. The City of Houston personnel have met with other agencies in the state to discuss the Houston program.

Partners – City of Houston (program administration and implementation), Texas Commission on Environmental Quality (TCEQ, funding), Houston-Galveston Area Council (funding), Environment Canada (emission testing during the pilot program) the University of Houston (testing) and the technology suppliers (product installation and technical support).

Status – Fourteen of the 63 refuse trucks have been equipped with EGR/DPF systems.

Funding – Funding was provided by the TCEQ (TERP funds) and the Houston-Galveston Area Council (CMAQ funds) in the amount of $850,000 for the EGR/DPF systems. The City of Houston also provided nearly $4 million to the University of Houston to help fund its testing facility that will be used for this and other projects and the University contributed $689,000 for building construction and manpower.

Major Program Elements – Elements of the program included: 1) conducting the pilot program to evaluate NOx emission reduction strategies; 2) selecting the NOx control technologies to use in the program; and 3) designing and installing the retrofit technologies.

Voluntary – The incentives for the program included the City if Houston's commitment to reduce emissions from its fleet vehicles to help improve the region's air quality and a desire to reduce NOx emissions to help meet the NAAQS for ozone. The low-pressure EGR/DPF system was one of the technologies selected for this project because it demonstrated significant NOx emission reductions in the pilot program

City of Houston Fleet Retrofit/Project #188.2
Retrofit Project Summary

Overall Comments on the Program – The City of Houston has actively sought to evaluate and help demonstrate emerging emission control technologies. The City of Houston noted that, as with any retrofit project, it has been a learning process for the partners. Challenges have occurred, but the partners have worked together to resolve any issues that have arisen. For example, modifications to the EGR/DPF system at the installation phase proved necessary to achieve a proper fit resulting in some delays. Also, there was a delay in obtaining a supply of the ULSD fuel. Close coordination and communication with the fleet personnel was beneficial in retaining their active support for the program.

To date, the low-pressure EGR/DPF systems have operated without any reported problems. The City of Houston plans to use the University of Houston testing facility to evaluate emerging technologies and to conduct in-use verification testing. Houston's desire to retrofit additional fleet vehicles/equipment has been limited by the fact that the TERP funding can no longer be used to pay for retrofit technologies that have not been verified. The City of Houston noted that accelerating the verification process for NOx control technologies for both on-road and nonroad engines to make more retrofit products available is essential to expanding the clean-up of existing diesel engines and achieving the NOx reduction needed to meet the NAAQS for ozone.

VEHICLE/EQUIPMENT FLEET APPLICATION

All fleet vehicles and equipment are owned by the City of Houston. The refuse trucks retrofitted with the EGR/DPF systems are 2000-2002 or 2004 model year vehicles powered with either a Volvo VED7 or Caterpillar 3126 engine. DOCs, which were not part of this program, were retrofitted on nonroad equipment such as backhoes and water pumps.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The low-pressure EGR/DPF system is equipped with a backpressure monitor/alarm system visible to the driver.

Emission Performance/Testing – Data logging, opacity testing and emission testing have been employed during the pilot phase of the program. Additional emission testing at the University of Houston is planned.

Costs/Warranties – The installed cost of the low-pressure EGR/DPF systems was $18,200 per unit.

Installation/Maintenance – The EGR/DPFs were originally configured using data supplied by the City. When the systems arrived, they did not fit because the data used to design the systems did not correctly show the actual vehicle configuration. As a result, the EGR/DPF system needed to be reconfigured to properly fit on the vehicles. This resulted in some delays. The EGR/DPF manufacturer had to train the distributor on how to properly install the system, which resulted in some extra time needed to complete the retrofits on the first few vehicles. Once the training was complete, the retrofits took approximately 16 hours per vehicle to complete.

Failures/Repairs/Replacement – No reported problems with the EGR/DPF systems.

City of Houston Fleet Retrofit/Project #188.2
Retrofit Project Summary

Impact on Vehicle Performance – No adverse impacts on vehicle performance were reported with regard to the EGR/DPF systems.

FUELS AND LUBRICANTS

ULSD (<15 ppm) is now available at all solid waste sites. By June 2006, the City of Houston plans to have the fuel available for all of its fleet vehicles. Initially, Houston had difficulty obtaining the ULSD fuel because there was only one ULSD supplier serving the region. The current cost differential for ULSD is about $0.20 per gallon. The City estimates that about two-thirds of that cost differential is due to delivery costs.

Houston METRO Transit Project/Project #189
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 15, 2005 **Location:** Houston, TX

Report based on status of project as of February 10, 2005

Contact Organization: Houston Metro Transit Authority (METRO)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project involved retrofitting EGR/DPF systems on up to 543 transit and commuter buses, repowering a number of buses with lower NOx emitting engines, and repowering five LNG buses with Allison hybrid electric powertrains. Also, the entire fleet of METRO buses (approximately 1,600) is fueled with ULSD. METRO estimates that the project will result in over 520 tons of reduced NOx emissions.

Partners – Houston METRO (project management, funding, fleet technical support), Texas Commission on Environmental Quality (program support and funding), U.S. Department of Transportation (funding), and technology providers (technical support).

Status – ULSD is being used by the entire Houston transit fleet (1,600 buses). EGR/DPFs systems have been retrofitted on approximately 350 buses to date.

Funding – Texas Commission on Environmental Quality ($11.2 million), U.S. DOT CMAQ funds ($12.3 million), and METRO ($884,000)

Major Program Elements – Coordination between partners, obtaining the funding necessary, obtaining the ULSD fuel, identifying and selecting the technologies to be employed

Voluntary – The Houston Metro Transit Authority is committed to applying and evaluating new transit bus technologies and to help improve the air quality of the Houston metropolitan area. The availability of funding was critical to the project going forward.

VEHICLE/EQUIPMENT FLEET APPLICATION

All buses are owned by the Houston Metro Transit Authority. The low-pressure EGR/DPF systems are being retrofitted on 386 New Flyer (40-foot) buses equipped with Cummins ISC engines (336 2001 model year and 50 2000 model year). Also, 157 Neoplan (60-foot) 1996-1999 model year buses that are being repowered with Cummins ISL engines that will include a low pressure EGR/DPF system.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – Low pressure EGR/DPF systems that include a backpressure two-light alarm.

Houston METRO Transit Project/Project #189
Retrofit Project Summary

Emission Performance/Testing – Emission testing is being performed by Environment Canada. Metro officials reported that the retrofit low-pressure EGR system reduced NOx emissions by approximately 40%.

Costs/Warranties – The low-pressure EGR/DPF systems for the New Flyer buses cost $18,000 which included installation and a three-year warranty. The Cummins ISL repower, which included a low-pressure EGR/DPF system, costs approximate $57,000, which included installation and the engine and EGR/DPF warranty.

Delivery – There were no reported problems in delivery of the retrofit technology.

Installation/Maintenance – Installation was performed by the retrofit technology supplier. METRO had anticipated that "Level 1" cleaning of the filter (pressurized air flow) would be needed on average about once a year. Experience to date has been that the filters require cleaning more frequently due to PM build-up and that a more rigorous cleaning method may be necessary. Houston has also found that the engine fuel injectors begin to leak fuel into the cylinder combustion chambers after about 100,000 to 150,000 miles, which in turn, creates elevated levels of PM that collect on the filters causing backpressure build-up and illumination of the backpressure yellow light alarm. METRO officials believe the build-up of PM occurs because the exhaust temperatures are not always adequate to insure proper DPF regeneration. METRO officials are working with the retrofit system supplier to explore ways to address this issue.

Training – The technology supplier provided training for the METRO fleet mechanics. Metro noted that training was excellent and exceeded contract specifications.

Operating Issues – A pilot program from February to September 2003 involving a limited number of EGR/DPF retrofits, was completed without incident. Full-scale installation of the EGR/DPF systems began in September 2003.

Elevated levels of condensation in the exhaust system **–** After about 220 systems had been installed, METRO began to detect elevated levels of aluminum and chromium in the engine oil. Elevated levels of condensation, likely caused by the EGR system, mixed with the sulfur in the exhaust to form sulfuric acid that resulted in etching of the exhaust pipes. METRO noted that the increased condensation issue has not been a problem in Dallas where these retrofit systems are also being used. METRO officials indicated that perhaps Houston's extremely high ambient humidity might have been a contributing factor to the elevated condensation. It was thought that the condensation problems occurred primarily during fast idle. A software change was introduced that shut down the EGR function during fast idle. However, METRO reports that the problem of elevated condensation remains an issue. The technology provider has been working with METRO to resolve this issue.

Engine fuel injectors – METRO determined that after about 100,000 to 150,000 miles, the engine fuel injectors begin to leak fuel into the cylinder combustion chambers causing excess PM to collect on the filter and increase backpressure causing the backpressure monitor to illuminate. METRO is now replacing injectors before the problem occurs.

Houston METRO Transit Project/Project #189
Retrofit Project Summary

Backpressure monitor alarm – In some cases the backpressure alarm (i.e. the yellow light) was triggered even though the backpressure had not reached the level where action was required. The technology supplier is making software changes to address this issue.

Filter maintenance – As noted above, the DPFs on the METRO buses are requiring filter cleaning more frequently than METRO originally anticipated. The accumulation of PM on the filter is the likely result of the exhaust temperatures on some routes not being high enough to insure regeneration of the filter. The technology supplier is working with METRO to address this issue.

FUELS AND LUBRICANTS

Fuel Properties – The ULSD specification calls for a sulfur content of <15 ppm, but the actual level of sulfur in the fuel is typically <7 ppm.

Fuel Supply and Cost –There is only one supplier of ULSD available to service the Houston transit fleet. The ULSD has a $0.196 per gallon incremental cost. Through the end of February 2005, the Texas Commission on Environmental Quality is paying the price differential. After that, the Houston Metro Transit Authority will have to bear the full cost of the price differential. Houston Metro does not expect any price relief until the Texas and/or federal ULSD fuel requirements go into effect, creating more competition in the marketplace.

Bay Area Transportation Authority Project/Project #193
Retrofit Project Summary

BACKGROUND INFORMATION

Date: March 2, 2005 **Location:** Traverse City, MI

Report based on status of project as of February 14, 2005

Contact Organization: Bay Area Transportation Authority (BATA)

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project is designed to reduce odor and PM from municipal transit buses in the two-county area around Traverse City, MI by retrofitting a total of eight transit buses with PM emission control technology. The technology falls in the category of flow-through filter technology.

Public Education & Outreach – Newspaper coverage and TV interviews.

Partners – BATA (funding and project management), the technology supplier (technical support) and an independent engineer (technical support).

Status – One transit bus has been retrofitted and an additional seven retrofits are planned.

Funding – BATA will pay for the emission control technology used in the program.

Voluntary – BATA undertook the project to reduce diesel emissions in order to be responsive to complaints from local residents. BATA's engineering manager researched possible technology options and concluded that the technology selected was the only PM control equipment that could operate effectively under the operating temperatures of the BATA transit buses.

Overall Comments on the Program – BATA reports that the technology selected for the program is ideal for BATA's application; it can operate effectively on conventional on-road diesel fuel and its PM removal efficiency improves with decreasing temperature.

VEHICLE/EQUIPMENT FLEET APPLICATION

The transit buses are owned by BATA. A Blue Bird transit bus with a 2000 model year Cummins ISB 5.9L engine was retrofitted with the PM control technology. The installation took place in July 2004, and the bus has logged approximately 1,000 hrs. The ambient temperatures range from -15 to 90F.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – The technology is composed of three elements: a wire mesh filter media, an air pulsation system and a soot reclamation/incineration system. The wire mesh media consists of layers of various compactness augmented with screens of various mesh sizes. This system agglomerates particulate matter of submicron and nano-size into dendrites. As these dendrites grow in size, they break off and are collected on additional filter screens. The wire mesh media is then regenerated through pulsation of

Bay Area Transportation Authority Project/Project #193
Retrofit Project Summary

compressed air and subsequent collection in an external "collection bag." The device fits on the Bluebird transit buses but is too large for BATA's smaller buses.

Emission Performance/Testing – No emission testing is planned.

Costs/Warranties – The PM filter costs $8,000 and the pulsation platform costs $3,000. Pipes and clamps added about $500 to the total costs.

Installation/Maintenance – The installation was performed by BATA personnel and took about four hours to complete. No pre-installation was performed on the vehicle. About every 3,000 miles, the filter must be pulsed. This takes about one to two minutes and can be performed during routine maintenance.

Failures/Repairs/Replacement – No problems reported. BATA reported that the system "worked great."

Impact on Vehicle Performance – No adverse impacts on vehicle or on fuel consumption were reported.

FUELS AND LUBRICANTS

Conventional No. 2 diesel fuel was used.

American Lung Association of Missouri, City of St. Louis
Refuse Truck Retrofit Project/Project #204
Retrofit Project Summary

BACKGROUND INFORMATION

Date: June 21, 2005 **Location**: St. Louis, Missouri

Report based on status of project as of June 30, 2005

Contact Organization: American Lung Association of Missouri

PROJECT DESIGN

Project Description/Objectives/Project Evaluation – The project is designed to reduce the risk factors for sensitive populations living in the City of St. Louis by reducing harmful emissions from refuse trucks operating in densely populated urban neighborhoods in St. Louis. In this project, the U.S. EPA has provided a grant to the American Lung Association of Missouri (ALAM) to support the retrofit of 44 City of St. Louis refuse trucks with EPA-verified diesel oxidation catalysts (DOCs) plus closed crankcase ventilation (CCV) systems. The vehicles to be retrofitted represent nearly half of the City's refuse truck fleet. The refuse trucks to be retrofitted are model year 2000 Crane Carrier "Impact" units equipped with Cummins ISC 8.3L 250 HP diesel engines. All of the trucks are identical in their configuration, thus allowing for common retrofit product configurations and installation techniques on all vehicles.

Public Education & Outreach – The EPA Administrator chose St. Louis and this project to initiate and announce the EPA's National Clean Diesel Campaign. The press event resulted in extensive newspaper/ TV coverage and interviews.

Partners – ALAM is the recipient of the EPA grant and administers the program. Emissions Advantage, LLC (EA) provides program assistance to support technology evaluation and provides assistance in the program to help ensure the successful technical application of the retrofit products for the City's refuse truck fleet. EA personnel have extensive hands-on experience with the development and implementation of diesel engine retrofit programs. Fleetessentials, LLC, a provider of technology-based products and services to fleets of all types, is the supplier of the DOC/CCV systems and related installation hardware, and provides local technical support for installation assistance. The St. Louis Association of Community Organizations (SLACO) provides strong support, outreach and education services aimed at the local community and businesses in the affected areas.

Status – An initial DOC and CCV system was acquired to accomplish a trial fit on one of the refuse trucks, as a guide to developing the installation requirements for the remaining vehicles to be retrofitted.

Funding – The project is being funded by a $125,000 grant from EPA, with additional in-kind contributions of nearly $40,000 from project partners.

Voluntary – This is voluntary project.

Overall Comments on the Program – To date, the bulk of the effort for the project has been devoted to addressing retrofit product installation and configuration issues. EA recommended that all of these issues be resolved with a trial fit approach, before proceeding with installations on the remainder of the fleet.

American Lung Association of Missouri, City of St. Louis
Refuse Truck Retrofit Project/Project #204
Retrofit Project Summary

VEHICLE/EQUIPMENT FLEET APPLICATION

All of the City of St. Louis refuse truck vehicles to be retrofitted are model year 2000 Crane Carrier Corporation "Impact" models with Cummins ISC 8.3L 250 HP diesel engines. Engine and refuse equipment packaging on these vehicles are very tight, thus, significant time and effort was spent on developing product configurations and installation options that would work with this vehicle application.

RETROFIT TECHNOLOGY CHARACTERISTICS & PERFORMANCE

Technology/System – EPA-verified DOC plus CCV systems have been selected for the project.

Emission Performance/Testing – Emissions Advantage developed a detailed inventory of emissions for the affected fleet in the project, and will develop estimates of the emission reductions attributable to the DOC retrofits. Limited emission testing is planned to be performed on several of the refuse trucks, to confirm the emission reduction effectiveness of the DOCs.

Costs/Warranties – The EPA-verified DOC/CCV systems were acquired at a cost of $1260 each and with a 5-year or 150,000 mile warranty.

Delivery – Delivery of final retrofit products has not been established as of the time of this report.

Installation/Maintenance – The DOC product manufacturer did not have a muffler replacement product that could be used for the Crane Carrier refuse truck application without modification or the need for using exhaust pipe adapters. After discussion with the DOC product manufacturer, however, the manufacturer agreed to develop a muffler replacement configuration that could be used without the need for exhaust pipe adapters, thus allowing the installation to be completed with less time and fewer exhaust pipe connections. The operational requirements of the CCV system dictated a specific mounting arrangement that after a full day of addressing vehicle installation options, resulted in no really good location on the vehicle. Subsequent discussion by EA and Fleetessentials technical personnel with the Cummins Engine Company engineering staff also yielded no really good alternative for installing the CCV system. The only practical mounting configuration would require removal of several engine/vehicle components, fabrication and installation of special mounting brackets, use of 6-foot lengths of connecting hoses to the CCV system, and was estimated to require two technicians approximately 6 hours for each vehicle installation, or over 500 manhours to install the CCV systems in the vehicles selected for the project. The City fleet maintenance staff is considering if this level of installation time commitment can be accommodated, and if not, other options for eliminating the use of CCVs and substituting the use of additional DOCs on other City vehicle/equipment.

Failures/Repairs/Replacement – Installations have not been completed as of the time of this report.

Impact on Vehicle Performance – Installations have not been completed as of the time of this report.

FUELS AND LUBRICANTS

ULSD is not available in the St. Louis area. Conventional No. 2 highway diesel fuel used in City diesel fleet vehicles.