



Case Study – Maryland School Bus Retrofit Project

SUMMARY

Clean Diesel Technologies, Inc.'s (CDTI) wholly-owned subsidiary, Engine Control Systems (ECS), helped reduce the emissions of 230 school buses by 85% through the Maryland Department of the Environment (MDE) School Bus Retrofit Technology Assistance Program, funded by the United States Environmental Protection Agency (EPA) National Clean Diesel Funding Assistance Program.

By providing unique training for installation accuracy, high-quality customer support, and verified products to meet specific device-requirements, the ECS retrofits helped Montgomery and Prince George Counties reduce over 150 tons of carbon monoxide, 57 tons of hydrocarbon and 6 tons of particulate matter within six months in 2009.

THE CHALLENGE

According to the National Resources Defense Council (NRD), “levels of diesel exhaust inside a school bus can be four times higher than those found in passenger cars driving just ahead of the bus.” In addition, “out of every million children that ride a school bus an hour or two each day during the school year, 23 to 46 of them may eventually develop cancer from the excess diesel exhaust they inhale on their way to and from school.”

With growing lungs and frequent bus riding, the NRD suggests that children are more susceptible than adults to diesel exhaust particles aggravating emphysema and bronchitis. Also, early exposures to these pollutants can cause chronic health problems as they age.

“MDE developed the School Bus Retrofit Technology Assistance Program to reduce harmful pollutants emitted from diesel engines and provide a cleaner and healthier commute for students who ride buses everyday,” states MDE Secretary Kendi P. Philbrick in the press release about the project. “Local air quality will benefit from this action as well.”

With an award of nearly \$300,000 from the MDE in Rockville, Maryland, the Montgomery County Public Schools began research to find specific products meeting stringent, verified reduction-requirements for pre-2007 engines without emission control devices (such as 2003, 2004 and 2005 Thomas Pushers with Cat 3126 engines).

The products necessary for the retrofits included diesel particulate filter (DPF) level 3 emission control devices verified by CARB and the EPA to reduce particulate matter (“PM” or “soot”) by 85% or greater and a Back Pressure Monitoring system (BPM).

With installations beginning in September 2009, no corners were to be cut, and the job needed to be scheduled around bus activity taking students to and from school. To meet these requirements, the MDE sent out bid requests to the marketplace for the work.



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THE SOLUTION

Provide Training.

K. Neal International, an ECS distributor in Hyattsville, Maryland, won the bid in August 2009 to provide the retrofit products. This included 72 ECS Purifilters[®], five spare center bodies and one, ECS CombiClean[®] DPF cleaning machine along with complete system installation. However, this was K. Neal's first DPF project, and they needed unique training prior to starting the installations.

After receiving the orders from K. Neal International, Engine Control Systems created a comprehensive, instruction process to give the inexperienced technicians an understanding of how and why it was important to install the devices correctly. This unique process included three to four hours of classroom training with an actual installation on several buses delivered by Montgomery County.

ECS taught K. Neal installers:

- The do's and don'ts of installing the product;
- What to watch out for;
- How to safely install the product;
- How to service the filter once it's on the vehicle; and
- Other installation-requirements.

"So that the Maryland School Bus Retrofit Project would be a success, our technicians spent a couple of days at the K. Neal facility training inexperienced installers, answering questions and providing much-needed support," states Darrell Trueman, ECS Regional Sales Manager – NE.

Upon completion of the training, and when they felt comfortable doing the installations correctly, the students at K. Neal International became authorized technicians for the ECS products.

Offer Installation Accuracy with Qualified Technicians.

With the technicians trained correctly, the installation process began. To start, ECS reviewed a fleet list to see which buses were compatible with the products. Then, they narrowed this list down to the buses that could be retrofit.

At this point, K. Neal's newly-authorized technicians installed the data loggers at the inlet of the OE muffler to monitor and record the exhaust gas temperature, time and date on a sampling of buses (all the buses involved in the project were Thomas buses with Cat 3126 engines).

It took approximately 30 minutes to install the data logger on each bus, and the buses were done in groups of five when they weren't being used. The data logger remained on each vehicle approximately three to five days to record the required data identified above.

This information was then downloaded from the data loggers, and sent to ECS for analysis to determine a suitable DPF system. Under ECS' direction, the trained technicians at K. Neal International took



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measurements, assigned part numbers and made drawings. ECS analyzed this information for each bus to see the configurations needed. The product was then ordered and shipped shortly thereafter.

“The product lead time and data logging response time were exceptional on this project,” states Ian MacDonald, ECS V.P. of Sales and Marketing. “Unlike our competition, who took ten weeks or more to ship products, we turned filters around in approximately four weeks and this was unheard of at that time.” The initial bus-installation was completed in the service bay at K. Neal International during the training process with ECS technicians on hand to ensure everything went smoothly. Then, the remaining installations were done at the actual maintenance facilities for the buses in Montgomery and Prince George Counties.

“Unlike other dealers, K. Neal International provided mobile installations on a flexible schedule so that the fleet managers could keep as many buses in service as possible,” states Trueman. “This avoided the need to shuttle buses back and forth, added convenience, and helped the fleet managers save time and money.”

ECS originally created the training process to help K. Neal employees learn how to install the ECS products correctly and to recognize the fact that the distributors had been factory-trained. But the training process went so well that it turned into a certificate program for all ECS distributors.

“It serves our product and end-user customers much better when authorized technicians perform the installations,” states Trueman. “Because of the experience at K. Neal International, we now have an official training-program which provides authorized installer certificates upon graduation. Most competitors do not take this extra step and allow an actual end-user do the installations as opposed to having their distributors do them directly. We just felt that it was a positive thing to promote all technical employees who were actually trained by ECS and give them the recognition they deserved.”

And this initial, training process was just the beginning. Installers at K. Neal International also received follow-up instruction as needed and detailed training on the ECS CombiClean® diesel filter cleaning machine that Montgomery County had purchased.

In addition, the ECS team helped the MDE resolve a cleaning issue.

“During the project, we noticed that some of the buses required filter cleaning earlier than we anticipated and were right on the borderline of the required heat needed for the DPFs to regenerate and burn the soot into ash,” states Laurence F. Richmond Jr., Maryland Department of the Environment Senior Regulatory & Compliance Engineer, Emissions Control & Program Development. “Further investigation revealed that the engine duty cycle had changed since the initial exhaust temperatures were taken as a result of changes to assigned bus routes and due to different driving characteristics of the drivers.”

“We developed a solution using a thermal blanket which helped to retain the temperature in the heat range for the DPFs to regenerate,” states Richmond. “Darrell Trueman at ECS helped us locate a manufacturer for these thermal blankets. K. Neal installed the blankets, and our early, cleaning issues were resolved quickly and cost-effectively.”



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After the buses in Montgomery County were finished, installations began on the fleet for the Prince George County public schools following the same process.

Provide High-Quality Products.

The ECS Purifilter® was the first, U.S. EPA-verified passively regenerating diesel particulate filter to offer 90% diesel particulate reduction and meet strict California Air Resources Board Level (CARB) 3+ NO₂ limits. It uses a silicon carbide wall flow filter substrate and advanced precious and base metal catalyst system to passively regenerate using exhaust heat.

"CDTI's ECS Purifilter® was chosen for this project because it was verified by the regulatory programs and met the program requirements for a Level 3 device, or one that reduces particulate matter ("PM" or "soot") by 85% or greater," states MacDonald.

Purifilter® Plus employs a passive, Purifilter® Diesel Particulate Filter (DPF) which was the first to attain an industry-leading 90% particulate emissions reduction value from the US EPA (see <http://www.epa.gov/cleandiesel/verification/techlist-ecs.htm#ecs6>).

It combines this technology with electrical heating elements. These elements can be engaged when needed to perform thorough DPF regeneration – maximizing vehicle uptime across a variety of highway and urban, drive-cycle-applications.

Verified by CARB as a Level 3+ reduction technology, Purifilter® Plus gives fleet managers the ability to readily maintain optimum, vehicle performance and uptime while minimizing DPF maintenance. This system is ideal for centrally-located fleets and fleets where buses have access to off-board, regeneration control panels.

In addition, the ECS CombiClean® is a device dedicated to cleaning ECS and competitor diesel particulate filters. It is an economical, safe and environmentally-friendly technology developed to clean diesel filters, whether it is a passive or active filter made of cordierite or silicon carbide. The cleaning process uses a gradual, temperature increase with a constant air supply during the regeneration process in order to ensure no damage to the catalytic coating or substrate material. The cleaning process consists of a heat cycle, a vacuum cycle, and a high pressure blow cycle.

By using the ECS CombiClean®, the bus fleet managers can now clean a DPF within two to six hours at their own maintenance facility without having to send filters out for cleaning elsewhere. With costs of external cleaning anywhere from \$300.00 to \$500.00 per filter, this in-house cleaning system saves fleet managers time, money and effort.

RESULTS: CLEANER AIR FOR CHILDREN AND THE COMMUNITY

85% of Toxins Are Eliminated.

After retrofitting 230 school buses in Montgomery County and Prince George County, ECS helped to reduce toxins in the air for children riding the buses and the local community.



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According to the Maryland Department of the Environment, the entire Maryland School Bus Retrofit Project reduced the lifetime sum of emissions of:

- Carbon monoxide by 150.08 tons
- Hydrocarbon by 47.76 tons
- Particulate matter by 6.53 tons

"ECS gave a lot of support, and their local distributor, K. Neal International, was instrumental in making the project a success," states Richmond. "When I received feedback from the fleet managers after the installations, they could tell right away that the air was cleaner because it didn't have that telltale odor of strong, diesel fumes."

Now, young children who are susceptible to respiratory illnesses related to poor air quality, and potentially cancer, can breathe cleaner air in this region.

Increase Quality Training and the Number of ECS Authorized Technicians.

In addition to providing cleaner air in Maryland, ECS established a detailed training process for their technicians from this project. Now, all ECS products are installed by certified ECS technicians. This improves the accuracy of installations and provides support to fleet managers who want to save time, money and effort.

"ECS and K. Neal International were great to work with," says Richmond. "They were helpful and accessible, either in person or via conference calls, when necessary to resolve any technical or delivery problems."

ECS continues to give its distributors extensive training. This enables technicians to hone their skills and provide high quality installations and service to customers. More importantly, this allows CDTI to obtain first-hand feedback that helps them update their products and services to fit the needs of their customers and provide value as cost-effectively as possible.

About Clean Diesel Technologies, Inc.

Clean Diesel is a vertically integrated global manufacturer and distributor of emissions control systems and products, focused on the heavy duty diesel and light duty vehicle markets. Clean Diesel utilizes its proprietary patented Mixed Phase Catalyst (MPC[®]) technology, as well as its ARIS[®] selective catalytic reduction, Platinum Plus[®] fuel-borne catalyst, and other technologies to provide high-value sustainable solutions to reduce emissions and lower the carbon intensity of on- and off-road engine applications. Clean Diesel is headquartered in Ventura, California and currently has operations in the U.S., Canada, U.K., France, Japan and Sweden. For more information, please visit www.cdti.com.



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Sources:

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