

**STATE OF RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES**

*Opportunities to Achieve Maximum PM Reductions from
Diesel Powered Heavy Duty Vehicles*

submitted to

THE HONORABLE GOVERNOR, DONALD L. CARCIERI

and

THE RHODE ISLAND GENERAL ASSEMBLY

in compliance with

The Diesel Emissions Reduction Act

December 2007

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In order to achieve the pressing public health and environmental goals outlined in the Diesel Emissions Reduction Act - Public Laws 07177 (H 5574A) and 07219 (S 0566A), (The Act), DEM was required to "... identify opportunities to achieve maximum PM reductions from diesel powered heavy duty vehicles or equipment that is owned by, operated by, or on behalf of, or leased by, or operating under a contract to a state agency or state or regional public authority (except vehicles that are specifically equipped for emergency response) and diesel powered waste collection and recycling vehicles that are owned, leased, or contracted to perform the removal or transfer of municipal, commercial or residential waste, or recycling services."

The Act further requires that: "... no later than January 1, 2008, DEM shall present a report to the general assembly, governor, house committee on environment and natural resources, and the senate committee on environment and agriculture on such opportunities to maximize PM reductions from the aforementioned fleets including legislative changes, regulatory changes, funding sources, contract requirements, procurement requirements, and other mechanisms that will bring about maximum PM reductions from these two priority fleets."

This report has been prepared to present the results of DEM's activities in identifying opportunities to meet these goals.

Background

Diesel engines emit a highly complex mixture of gaseous and particulate air pollutants. These pollutants include particulate matter, nitrogen oxides, volatile organic compounds and carbon monoxide. Of particular concern is diesel particulate matter (DPM), which is emitted as very small particles that can travel deep into the respiratory system. DPM consists of an elemental carbon core embedded with a variety of organic and inorganic substances, many of which are highly toxic. The Environmental Protection Agency (EPA), the National Toxicology Program, and other international, federal and state organizations have determined that diesel particulate matter is a potent air toxic, causing both cancer and non-cancer health effects.

Exposure to elevated levels of DPM has been linked to a variety of health effects, including respiratory symptoms, chronic bronchitis, aggravation of asthma, increased respiratory and cardiovascular-related hospital admissions and emergency room visits, and premature death. Those most vulnerable to these effects include children, whose lungs are still developing, the elderly and people with chronic heart or lung diseases whose lungs are already compromised. Children are at particular risk because they can be frequently exposed to elevated levels of DPM.

FLEET INVENTORIES

Inventory of State Owned or controlled diesel vehicles

The following table presents the number of diesel powered vehicles owned by the state, as of December 2007, as reported by the Department of Administration and the referenced state commissions and authorities. The fleet of on-road vehicles range in age between model years 1964 through 2007.

| Agency/Fleet | Heavy and light -duty diesel trucks/Buses | Non-road diesel powered Equipment |
|-------------------------------|---|-----------------------------------|
| State Fleet | 620 | 129 |
| Resource Recovery Corporation | 6 | 96 |
| Airport Corporation | 73 | 71 |
| Public Transit Authority | 241 (Full-size buses)*, 135 (Small transit buses) | 1 |
| Narragansett Bay Commission | 15 | 9 |

* 25 previously retrofitted and 36 have factory installed controls.

In addition to these vehicles, the state contracts for various services, such as snow removal and construction projects, and those contractors use diesel powered vehicles. The number of heavy-duty diesel powered vehicles that might be included in this category is unknown. The Division of Motor Vehicles (DMV) Motor Vehicle Registration Database (Database) indicates that 9,963 Class Seven (Diesel-powered trucks over 8,500 pounds gross vehicle weight [GVW]) were registered in Rhode Island as of December 5, 2007. Unfortunately, this data is known to be an under-estimate in that many diesel-powered vehicles are incorrectly classified in the Database as gasoline-powered (Class Four – gasoline-powered trucks over 8,500 pounds GVW). The Database indicates that the number of Class Four vehicles, some of which may actually be diesel vehicles, registered as of December 5, 2007, was 32,679. Additionally, many vehicles owned by the state and municipalities, as well as many school buses, are included in the Database with GVWs of 0 pounds. Therefore, there may be many heavy-duty diesel vehicles actually categorized in lower weight classes in the Database.

The number of non-road diesel-powered equipment used in state-contracted projects is also unknown. A reasonable approximation of the number of individual pieces of diesel powered non-road construction equipment in Rhode Island can be calculated using EPA model estimates based on a population factor. In 2002, EPA estimated that 4,245 pieces of non-road diesel equipment were located in Rhode Island. Examples include pavers, rollers, scrapers, backhoes, air compressors, etc. It can be assumed that many of these pieces of equipment might be used at one time or another on a project contracted by the State or a State Authority.

Inventory of diesel powered waste collection and recycling vehicles

Based on reporting from the municipalities, the fleet of refuse vehicles owned by these cities and towns is presented in the following table. These vehicles range in age between model years 1984 through 2007.

| Municipality | Number of Diesel Waste/Recycle Vehicles |
|---------------|---|
| Barrington | 8 |
| Bristol | 6 |
| Central Falls | 6 |
| Coventry | 12 |
| Glocester | 2 |
| Lincoln | 9 |
| Pawtucket | 24 |
| Providence | 3 |
| Tiverton | 2 |
| Warwick | 26 |

In addition to these 98 municipal-owned vehicles, these and the other municipalities contract for refuse or recycled waste collection or transfer services. The DMV Database indicates that an additional 447 commercial vehicles, ranging in age between model years 1975 through 2007, are registered to businesses known to be in the refuse industry. As indicated above, this number may be a low estimate due to the diesel/gasoline discrepancies identified in the Database as well as the probable existence of unrecognized businesses using vehicles to haul refuse/recycled waste. It might be possible to obtain additional information from the Resource Recovery Corporation based on records of vehicles accessing to their landfill and recycling facilities. This approach may also be problematic in that vehicles other than typical refuse collection and transfer vehicles access these facilities to dispose of waste.

CONTROL STRATEGIES

Common control measures to reduce diesel emissions fall under one of five categories: reduce idling, engine repair, engine/vehicle replacement, retrofit or re-fuel. These approaches, along with a corrective program concerning on road diesel engine controls, are discussed below and will be considered in the development of a strategy for Rhode Island.

Anti-Idling (reduce idling)

The Rhode Island Diesel Engine Anti-idling Act became law in 2006 and DEM promulgated Anti-idling regulations in June of 2007. An aggressive outreach effort with an active enforcement program will be necessary to maximize vehicle operator compliance and assure a reduction in emissions from regulated vehicles and equipment.

Even idling for driver comfort, deemed necessary and therefore allowed under the program, can be further minimized through the use of externally powered heating and cooling equipment at layover truck stops or the use of fuel-efficient, truck mounted auxiliary power units to provide cab heating, cooling and power. Anti-idling is the one control strategy that can be applied to almost all diesel equipment operating in Rhode Island that provides direct reductions in all types of diesel emissions. It also provides a benefit in fuel savings.

Inspection and Maintenance programs for diesel vehicles (repair)

Mandatory periodic inspection and maintenance regulations help minimize excessive emissions from malfunctioning diesel vehicles. Rhode Island now has the authority to require a diesel exhaust opacity test for Rhode Island registered heavy-duty diesel vehicles. The implementation of an inspection/maintenance (I/M) program for heavy-duty diesel vehicles through the existing contract for light-duty vehicle emissions testing is in the process of being developed. The Rhode Island State Police continue to conduct road-side checks and issue penalties for vehicles failing the field opacity test. Several states are now in the process of considering lowering the opacity standards for both their road-side testing and periodic I/M programs.

Fleet Turnover (engine/vehicle replacement)

Stringent federal engine design standards governing the amounts of NO_x and DPM that model year 2007 and later heavy duty diesel engines can emit are in place and will require further emissions controls for model year 2010. These federal standards will improve emissions from new diesel engines installed in new or existing equipment. However, the federal government cannot mandate any new controls on existing vehicles or engines or their operation (such as anti-idling requirements or mandatory pollution equipment retrofits). State governments may also be precluded from requiring the installation of new controls on existing engines.

Programs to encourage the retirement of older equipment and replacement with newer, less polluting equipment can result in significant reductions of emissions. Additionally, newer diesel engines that have been designed and manufactured to lower emissions can be installed in older equipment to reduce overall emissions.

Retrofit

Various emissions-reducing equipment is available that can be retrofitted on existing diesel equipment to control emissions. Available technologies to address particulate matter (PM_{2.5}) along with two re-fuel options (discussed below) are detailed in the following tables.

| Technology | PM _{2.5} Reduction | NO _x Reduction | Cost (per typical vehicle) |
|---------------------------------|-----------------------------|---------------------------|----------------------------|
| Diesel oxidation catalyst (DOC) | 10%-30% | No reduction | \$1,000-\$2,000 |
| Diesel particulate filter (DPF) | 80%-90% | No reduction | \$5,000-\$10,000 |
| Flow-through filter (FTF) | 50%-76% | No reduction | \$3,000-\$4,000 |

Source: *Controlling Fine Particulate Matter Under the Clean Air Act, A Menu of Options*, March 2006, STAPPA

Retrofit devices should be either EPA or California Air Resources Board certified to ensure that the retrofit will actually achieve the desired emissions reductions. The certification requires extensive device and engine-specific testing that results in application-specific certification. This certification process is time consuming and expensive so equipment manufacturers are careful to select diesel engine applications that will result in high potential sales to recover their certification investments. Only a few non-road engine applications have been certified to date, however, certified devices are available for most on-road engine applications.

Re-Fuel

Different fuels can be used to reduce emissions including ultra low sulfur diesel (ULSD) which is now mandatory for on-road use in MY 2007 and newer diesel vehicles, bio-diesel, compressed natural gas (CNG), and electricity. Additionally, the use of ULSD in pre-MY 2007 engines and non-road equipment not only reduces direct emissions of pollutants but also allows for the use of various retrofit technologies to further reduce emissions. ULSD fuel will be completely phased in for highway use by 2010, and will also be required for non-road equipment (except marine and locomotive uses). ULSD will be required for all uses in 2014. The use of bio-diesel blends, also reduces the emissions of PM and, because they are produced from renewable resources, results in the net reduction of greenhouse gases. Questions remain on the possible slight increase of NO_x emissions from vehicles burning bio-diesel. Results of different methods of testing ranged from no measured increases to slight NO_x increases. Proprietary fuel additives and fuel processing (e.g. emulsified diesel fuel) can lower the emissions from equipment using these fuels. However, mandating the use of special formulations of fuel may be problematic due to unknown formulations of additives and federal restrictions on fuel formulations.

| Fuel | PM _{2.5} Reduction | NO _x Reduction | Cost |
|------------------------------|-----------------------------|---------------------------|--|
| Bio-diesel fuel | 0%-50% | Increase 0%-10% | 1.5-2.0 X diesel fuel cost. (B20 - \$.05-\$.10/gal increase over 100% diesel fuel) |
| Emulsified diesel fuel (EDF) | 20%-50% | 5%-30% | \$.01-\$.10/gal increase over 100% diesel fuel |

Source: *Controlling Fine Particulate Matter Under the Clean Air Act, A Menu of Options*, March 2006, STAPPA

OPPORTUNITIES TO MAXIMIZE EMISSION REDUCTIONS

Various methods might be considered to help achieve maximum reductions of emissions from the State-controlled and refuse vehicle priority fleets discussed above. Methods to be considered under The Act include: “ ... *legislative changes, regulatory changes, funding sources, contract requirements, procurement requirements, and other mechanisms ..*”.

Legislative and regulatory changes

Unfortunately, State governments may be pre-empted through various federal laws from mandating the retrofitting of existing privately owned diesel powered vehicles. However, diesel retrofits and fueling options can be mandated by the State for State-owned equipment as well as equipment used through contracted services. As far as the equipment used under contracted services, the costs associated with these emissions-reduction options must be covered either as part of the contract cost or be covered by the owners of the equipment. Ultimately, these costs will come from the proceeds of contract work, either as reimbursable costs or from the profits generated from contracted work. Care must be exercised in mandating retrofitted equipment under contracts to protect small businesses that may not be able to finance the installation of retrofit devices on their own and therefore may be precluded from bidding projects requiring retrofitted equipment.

Funding sources

The costs associated with retrofitting the fleet of state-owned vehicles will have to be borne by the state, either through the General Fund or through some other mechanism. Surcharges on the registrations of motor vehicles or perhaps diesel-powered vehicles could be considered. Additionally, taxes on the proceeds associated with buying or selling used diesel equipment could be considered with the added benefit of providing an incentive for the purchase of newer, less-polluting equipment.

Publicly owned vehicles, including transit and school buses, refuse trucks, construction and maintenance equipment can be retrofitted through the use of grant monies and even penalties collected from regulated parties under other environmental actions (often called 'supplementary environmental programs', or SEPs). It has been determined that the most cost-effective approach to retrofit projects is to concentrate on the newer legacy vehicles to maximize the effective life of the retrofitted equipment, while also considering that any older diesel vehicle retrofitted with the appropriate equipment will result in lower pollutant emissions.

Grants that might be used to purchase and install retrofitting equipment might be obtained through federal programs such as the Congestion Mitigation and Air Quality (CMAQ) program offered by the US DOT and the Diesel Emissions Reduction Act (DERA) program. Currently, Rhode Island is using funds from CMAQ to begin the process of retrofitting school buses as required by The Act. Additional funds for continuing school bus retrofitting and possibly retrofitting other vehicles from these two additional priority fleets will be requested during the next round of CMAQ project grants to be solicited in 2008. DERA funding has yet to be approved by the federal government but Rhode Island will take advantage of this funding source should funds be made available in the future. It appears that as of this time, the Federal Budget for fiscal year 2008 may contain \$49.2 million in the DERA program, of which 30% will be available for state projects. It should be noted that DERA funds may not be available to finance retrofit projects that are mandated by law.

Construction project funds, such as transportation projects or major facility construction projects can be used to finance the retrofitting of diesel-powered equipment used on the project. The retrofitting requirements can be presented as part of the project's specifications as discussed below. The cost of retrofitting all of the diesel equipment on a major construction project, based on experience in Connecticut, may be on the order of 0.15% of the overall project cost.

Contract and procurement requirements

Several states and government entities have been successful in mandating that contractors working on government-funded construction projects adhere to emissions specifications developed to control diesel emissions from construction equipment. DEM has been working with other members of the North East Diesel Collaborative to develop a model set of contract specifications that could be used in future state-funded (and privately funded) construction projects, as well as various service contracts offered by the State. These specifications dictate technical retrofit requirements to reduce diesel emissions from diesel equipment used under the scope of the contract.

Rhode Island could consider using this approach for all state-funded contracts by requiring, through legislation or other mandate, that the state purchasing program address diesel emissions reductions.