

NYSDERDA'S CLEAN DIESEL TECHNOLOGY: NON-ROAD FIELD DEMONSTRATION PROGRAM

Tim A. Hansen¹, Stephen Piccot¹, Robert G. Richards¹, Staci Haggis², Barry Liebowitz², Janet Joseph²

¹Southern Research Institute, Research Triangle Park, NC; ²NYSDERDA, Albany, NY

Abstract

NYSDERDA has recently initiated the Clean Diesel Technology: Non-Road Field-Testing Program in collaboration with the New York State Department of Environmental Conservation (NYDEC). The goal of the NYSDERDA program is to provide quality data and information to potential technology end-users, regulators, and others such that implementation of diesel emission control strategies can be encouraged and widely adopted. This will ultimately provide significant reductions in the impacts of diesel emissions in New York State. This project is part of a broader NYSDERDA Clean Diesel Program that was designed to support the development and implementation of new clean diesel technologies in the non-road sector in New York State. As part of its overall clean diesel program, NYSDERDA has also sponsored a statewide Clean Air school bus retrofit program and ferry retrofit program focused on New York Harbor.

The Non-Road Field Testing Program will assess the performance of retrofit emission control technologies through use testing in select non-road diesel powered equipment applications. Non-road emissions inventories will be developed for the State and the 10-county New York City Metropolitan Area (NYCMA) and refined via surveys of equipment owners focusing on the construction/mining equipment (NYCMA) and locomotive (statewide) sectors. Commercially available control technologies, primarily focusing on the control of particulate matter (PM) and oxides of nitrogen (NOx), will be screened from technical, economic, and operational perspectives. Certification of these technologies by the U.S. Environmental Protection Agency (EPA) or California Air Resources Board Control (ARB) will also be a factor in the screening process. Based on the inventory and control technology evaluations, the field testing program will be designed. Prior to implementation of the field testing program, an in-use test protocol will be developed that will be used to provide real-world performance data that will complement the USEPA and ARB engine/control system certification programs. Emission control technologies will be evaluated for emission control (CO, PM, CO₂, CO, THC, fuel consumption, operational (engine power, etc.), maintenance, and economic impacts. Testing will be completed while equipment is in-use, using portable emissions measurement systems (PEMS) and portable dilution sampling systems.

Testing will begin in Spring 2006 with the final report scheduled for release in March 2007.

The project is managed by Southern Research Institute (Southern) with subcontractors:

- Eopoint
- Emissar
- E.H. Pechan & Associates, Inc.
- Environment Canada

Goal

Provide assessments of the in-use performance of commercially available diesel retrofit control technologies to expand energy-efficient diesel emission control technology options for non-road applications in New York State.

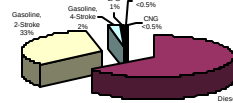
Project Tasks

Task 1: Project Management and Reporting

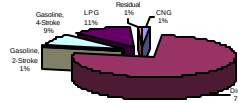
Task 2: Emission & Equipment Inventory, Control Strategy Feasibility Evaluation, and Field Test Matrix Development

- Develop improved emission inventory data for NYS and the NYCMA
 - Baseline inventory with EPA's draft NONROAD2004 model for the 2002 base year.
 - Survey of equipment owners and operators to develop a more accurate inventory of equipment allocation and activity in NYCMA. This allows for development of refined metrics and model inputs for construction activity and equipment allocation for the NYCMA.
 - Develop an up-to-date locomotive emission inventory for NYS based on a survey of 38 freight and 6 passenger/commuter railroads. Collect information regarding fuel use, locomotive activity, miles traveled/day, idling time, and engine inventory (age, size, model, duty).
- Identify opportunities for maximum off-road emission reduction for potential sectors of interest for PM and NOx
 - Collect data and information regarding available retrofit and other control strategies for PM and NOx in sectors of interest
 - Evaluate and rank strategies based on control efficiency, durability, installation/maintenance, acceptability, cost, fuel economy impacts, and verification status.
- Identify and prioritize sectors/applications and emission control technologies warranting field demonstration based on the revised inventory and feasibility evaluation of controls

• Preliminary Results of Emission and Equipment Inventory using NONROAD2004 EPA Model with Default Inputs and County Level Fuel and Temperature Data:



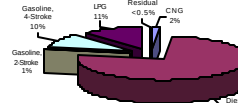
NYS Non-Road PM Emissions by Fuel Type



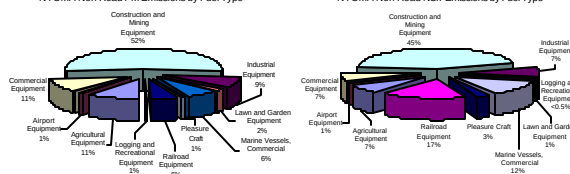
NYS Non-Road NOx Emissions by Fuel Type



NYCMA Non-Road PM Emissions by Fuel Type

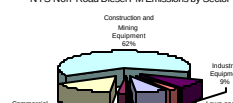


NYCMA Non-Road NOx Emissions by Fuel Type

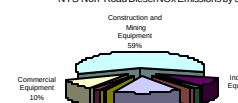


NYS Non-Road Diesel PM Emissions by Sector

NYS Non-Road Diesel NOx Emissions by Sector



NYCMA Non-Road Diesel PM Emissions by Sector



NYCMA Non-Road Diesel NOx Emissions by Sector

Southern developed a list of high priority equipment responsible for a significant portion of emissions using the baseline inventory. The following table lists the top ten equipment types and horsepower ranges for consideration in the field demonstration portion of the project.

Recommended Priority Equipment for Field Demonstration			
Rank	Category	Type	Hp
1	Construction and Mining	Tractors / Loaders / Backhoes	75 - 175
2	Construction and Mining	Roller-Tire Loaders	100 - 600
3	Construction and Mining	Excavators	100 - 300
4	Construction and Mining	Old-Tire Loaders	50 - 100
5	Construction and Mining	Crawler Tractors / Dozers	100 - 600
6	Construction and Mining	Roller-Tire Loaders	100 - 200
7	Construction and Mining	Off-Highway Trucks	1200 - 2000
8	Construction and Mining	Rough-Terrain Forklifts	75 - 175
9	Construction and Mining / Commercial	Generator Sets / Air Compressors	50 - 100
10	Agricultural Equipment	Agricultural Tractors	100 - 600

• Task 3: In-Use Field Testing Protocol Development

Currently, no generic testing protocol exists for non-road equipment. A generic protocol will:

- Provide standardized procedures for tests of varying types of equipment
- Ensure uniformity of data, reporting, and quality
- Allow for direct comparison of data obtained
- Generic protocol considerations:
 - Base on existing protocols, where available (for example, EPA 40 CFR 1065, etc.)
 - Measure: emissions of NOx, CO, THC, CO₂ TPM; may measure PM_{2.5}, speciated PM, and toxics
 - Monitor and record: operational parameters, fuel consumption, exhaust temperature, power output, engine speed, back pressure, etc.
 - Duty cycle: ensure duty cycles are repeatable, representative of real world use, and minimize the influence of operators and other factors
 - Reporting/Analysis: standardizing reporting, evaluation of control system impacts, calculation procedures and statistical analysis of data, and data quality specifications

• Emission Testing Methods



Environment Canada's DOES2 Portable Partial Dilution System
Allows for in-field testing with standard dilution sampling procedures



Portable Emission Monitoring System (PEMS)
Miniaturized analytical benches integrated with sampling system and flow measurement for emissions analysis (NOx, CO, CO₂, THC)

• Task 4: In-Use Field Demonstration

Task 4 will comprise conducting in-use field demonstrations and evaluations of the non-road equipment and emission control technologies selected in Task 2 using the operation and test procedures developed in Task 3.

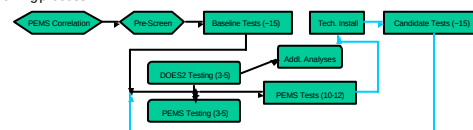
• Currently have support from the following equipment owners:

- NYC Dept. of Sanitation
- W.A. Gross Construction
- NYC Transit / MTA
- DeFoe Corp.
- Yonkers Contracting Co.
- NYS General Contractors Association

• PEMS/DOES2 Correlation and Equipment Prescreen

- Evaluate DOES2 and PEMS units vs. lab and each other using a laboratory dynamometer
- Prescreen candidate equipment prior to initializing test phase

• Phase I Field Testing will evaluate emission control technology performance using the following process:



• Phase II Field Testing will provide information on short-term product durability and feasibility, as well as operation and maintenance requirements. Units will operate over an extended time (~6 months) and the PEMS will be used to complete testing.

• Schedule

- Generic In-Use Test Protocol - Nov 2005
- Locomotive Equipment Profile and Emission Inventory in NYS - Dec 2005
- NYCMA Construction Assessment - Jan 2006
- Specific Field Testing Technology Evaluation Plans - Feb 2006
- Interim Report on Emissions and Surveys - Mar 2006
- Field Testing - Apr to Nov 2006
- In-Use Field Test Reports - Jun 2006 through Jan 2007
- Final Report - Mar 2007