

Environmental Technology Verification of Mobile Sources Control Technologies

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turning knowledge into practice

Overview

- Introduction to ETV
- Why verification of Mobile Sources control technologies?
- Mobile sources ETV and OTAQ's Voluntary Diesel Retrofit Program
- Mobile sources ETV and other agencies
- Mobile source technologies included in APCT Center
- Test approach
- Verification process
- Verifications in progress
- Verifications completed
- References and links

Why Verify Heavy Duty Diesel Engine Emissions Reductions?

- Heavy duty diesel engines are significant sources of NOx and fine PM emissions, which contribute to public health problems in the United States
- EPA is setting stringent emission standards for new engines
- Existing fleets may remain in operation for another 20 or 30 years
- Retrofit technologies especially important in the early years of standards implementation

EPA's Environmental Technology Verification Program

- Part of National Environmental Strategy (1995)
- Goal: To improve the environment by accelerating new environmental technologies into the market
- Objective: To *verify* the performance of *commercial-ready* air pollution control technologies using *objective and quality-assured data* resulting in publication of *verification statements* for the technologies
- Voluntary, stakeholder oriented program

Environmental Technology Verification

Office of Research and Development

- Coordinates testing with EPA-OTAQ
- Prepares test/QA plan
- Audits ETV test labs
- Conducts ETV tests
- Issues ETV verification reports and statements (publicly available)

Voluntary Diesel Retrofit Program

Office of Transportation and Air Quality

- Evaluates total application package
- Accepts emissions reductions data from ETV
- Sets emissions reductions for technologies and posts on VDRP website
- Extends applicability to other engines (and adds requirements for additional data)

APCT Center Interaction with Other Agencies

- Texas Environmental Research Consortium/
Houston Advanced Research Center
 - ◆ New Technology Research & Development (NTRD) Program
(new awards)
- Texas Commission on Environmental Quality (TCEQ)
 - ◆ New Technology Research & Development (NTRD) Program
(existing awards)
- California Air Resources Board (CARB)

Technology Groups

■ Devices

- ◆ Diesel Exhaust Catalysts (DECs)
- ◆ PM filters
- ◆ Engine modifications
- ◆ Other devices

■ Fuels

- ◆ Alternative fuels (emulsions, biodiesel)
- ◆ Reformulations
- ◆ Fuel additives
- ◆ Lubricants and lubricant additives

■ Selective Catalytic Reduction

Protocols

- Generic Verification Protocol for Diesel Exhaust Catalysts, Particulate Filters, and Engine Modification Control Technologies for Highway and Nonroad Use Diesel Engines
http://etv.rti.org/apct/pdf/GVP_MS_DevRev07.pdf
- Generic Verification Protocol for Determination of Emissions Reductions from Selective Catalytic Reduction Control Technologies for Highway, Nonroad, and Stationary Use Diesel Engines
http://etv.rti.org/apct/pdf/GVP_MS_SCR_Rev6-2.pdf
- Generic Verification Protocol for Determination of Emissions Reductions Obtained by Use of Alternative or Reformulated Liquid Fuels, Fuel Additives, Fuel Emulsions, and Lubricants for Highway and Nonroad Use Diesel Engines and Light Duty Gasoline Engines and Vehicles
http://etv.rti.org/apct/pdf/GVP_MS_Fuels.pdf

Overview of Approach

- Based on engine dynamometer federal test procedures (FTPs)
 - ◆ Minimum of one cold-start and three hot-starts
 - ◆ Additional tests may be required to detect effect
- Results reported as mean and 95% confidence interval of emission reduction for each pollutant
 - ◆ Statistics computed from multiple hot starts
 - ◆ If confidence interval includes zero reduction, then results cannot be distinguished from zero reduction
- Primary measurements are emissions reduction for NO_x, PM, HC, & CO
- CO₂, fuel consumption, and other operating parameters also measured

Verification Process Step by Step

- The vendor initiates the verification process by submitting an application to the APCT Center and OTAQ.
- The applicant, the APCT Center, and the testing organization discuss the intent of the test and develop a testing outline.
- After the initial discussions have been completed, the APCT Center prepares a contract outlining Terms & Conditions, Statement of Work, and Cost.
- The applicant approves and returns a signed copy of the Terms & Conditions with full payment.
- The APCT Center and its testing organization (with input from the applicant) prepare a test plan addendum, to be approved by EPA, by following the applicable protocol.

Verification Process

Step by Step (continued)

- The applicant provides degreened and aged devices and the engine intended for verification testing to the testing organization.
- Testing is conducted.
- A test report is prepared by the testing organization and submitted to the APCT Center.
- The APCT Center submits a draft verification report and verification statement to EPA.
- EPA approves and signs the verification report and statement.
- The APCT Center releases the verification statements and reports to public via websites.
- Applicant submits data to federal, state, and local agencies.

Verification in Progress

- Paceco, Inc. (Hayward, CA)
 - ◆ Technology: precious metal particulate filter
 - ◆ Application: seaport and dock cranes
 - ◆ Testing completed at SWRI

Verifications Completed

- Donaldson (October 2003)
 - ◆ Oxidation catalyst
 - ◆ Oxidation catalyst (Series 6100) with a closed crankcase filter
 - ◆ Oxidation catalyst (Series 6000) with a closed crankcase filter
- Lubrizol (June 2004)
 - ◆ Particulate filter
- Clean Diesel Technologies
 - ◆ Fuel-borne catalyst with an oxidation catalyst (February 2004)
 - ◆ Fuel-borne catalyst with a wire mesh filter (October 2004)

Verification Results

- PM was the principal targeted pollutant for these verifications
- PM emissions reductions ranged from 21 to 95% or 0.016 to 0.15 g/bhp-hr
- HC emissions reductions ranged from 0 to 100%
- CO emissions reductions ranged from 12 to 87%
- NOx was not controlled by the tested technologies

Confidence Limits

- 95% confidence limits calculated for 15 sets of data
- Confidence interval widths in percent reduction ranged from 3 to 12
- Interval width did not relate to measurement level for these tests
- The size of the confidence interval is likely a function of the inherent variability in emission levels for the test engine.

References and Links

- Air Pollution Control Technology Center:
<http://etv.rti.org/apct/>
- EPA ETV Program website:
<http://www.epa.gov/etv/>
- EPA Voluntary Diesel Retrofit Program:
<http://www.epa.gov/otaq/retrofit/index.htm>
- Code of Federal Regulations:
<http://www.gpoaccess.gov/cfr/index.html>