Workshop on Strategies to Evaluate Diesel Emissions in the ACES Project

Emissions Working Group Report

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Recommending a Strategy

For developing the Emissions Research Program for ACES

Objectives

- The objective of the Emissions Working Group is to design a policy relevant research program
- Determine what a representative system is (select cases and prioritize)
- Select conditions and determine how to characterize the emissions for health studies
- Determine what the comparison should/ should not be and relate to earlier studies

Engines and Controls

- High volume 2007 HD on-highway engine
- PM trap and some NOx control - decision to be made within next year on NOx control
- The technology is still evolving -- at least 2 systems 1.SCR and 2.NOx trap (3.EGR, 4.partial HCCI) -- 2 & 3 may switch
- Will obtain integrated system from the manufacturer -- not a lab prototype
- European SCR work is well underway, but we will not test Euro technology

Comparison Engine

- Earlier health studies done on a variety of engines 1950s to 1990s
- Comparison engine for this study should be 1988-1990 (0.6 g PM/bhp-hr)
- Use complete system of the timeframe including matching fuels and lubes

Engine Testing and Break-in

- Use mature full vehicle with exhaust system or complete system in engine test cell
- Need to break-in the engine, lubricant, and aftertreatment system (aged catalyst?)
- Standardized break-in protocol to be developed with mfgs - half useful life?
- Can track chemistry with aging to capture important events

Driving Cycle Strategy

- 2007 testing capability in engine or chassis dynamometer (facilities are limited)
- FTP transient cycle/CA 5-mode cycle? Represent full-use urban. (limited facilities-how to integrate health?)
- Can we attribute health effects to engine mode? (Check chemistry/amount at cold start?)
- Track trap regeneration & desulfation in cycles
- Must have backup for each system tested for long term testing

Fuel Strategy

- Use fuel matched to engine technology
- Get a representative diesel fuel for 2007 (will become easier in near future)
- Use a single test fuel for each technology
- Full speciation of the fuel
- Go outside U.S. for 1990 diesel fuel?

Lubricant Strategy

- Use technology matched lubricants
- Select a single lube matched to the respective technology timeframe
- Full speciation of base oil and additives

Mixture Preparation

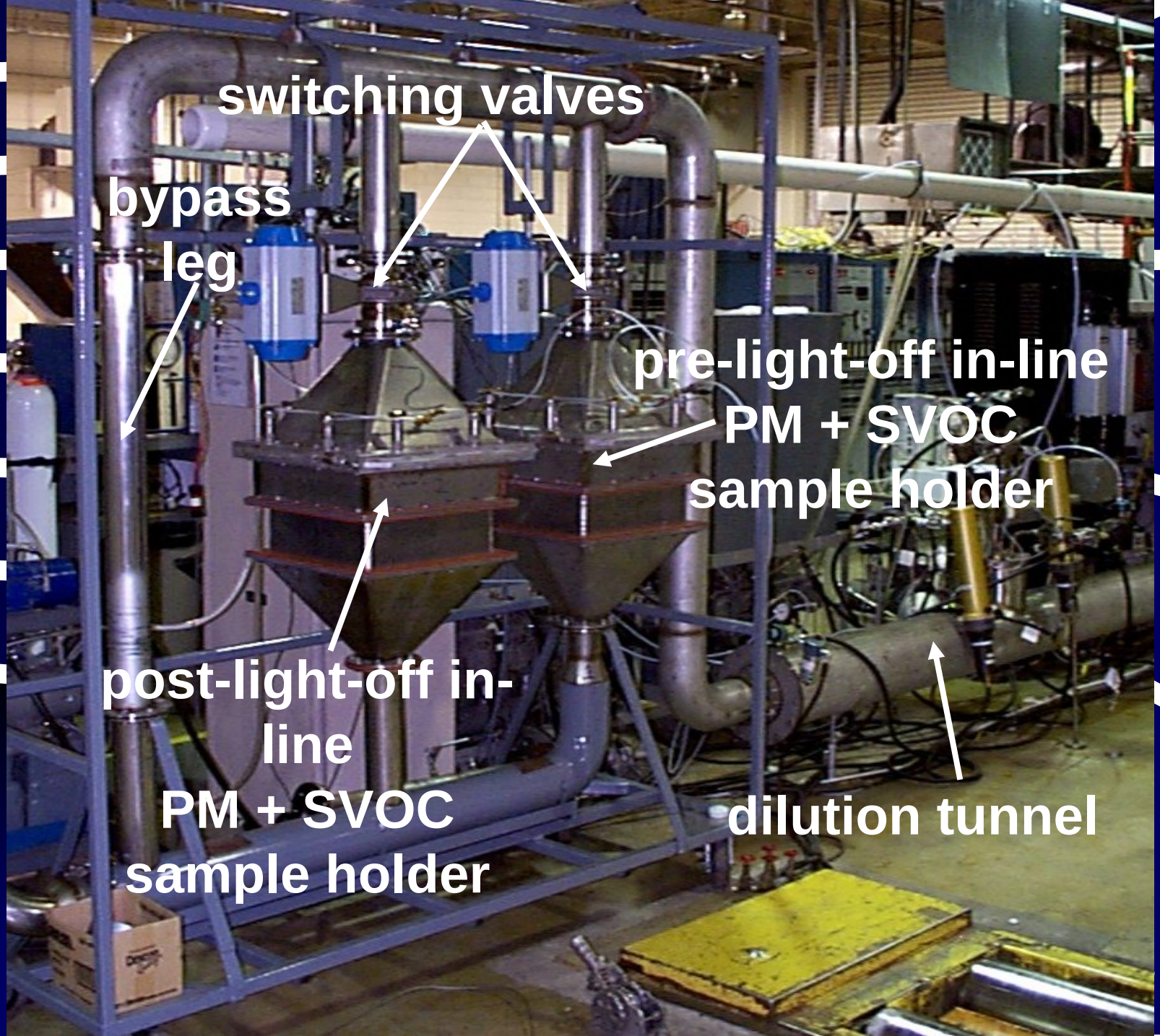
- Need real world mixture to simulate roadside? Near roadside? (look at greatest risk)
- Step up to 100 to 1 dilution? (Double dilution process) Compare at one dilution
- What is realistic and reasonable dilution air to meet project goals? (Standard air or ambient background air?)

Mixture Preparation (cont.)

- Stepwise testing (so ambient air may not be consistent between comparisons)
- Sample in exposure cages with different dilution air (with and without ambient) but use one dilution air for main test program
- Need to dilute as close to end of exhaust as possible -- System designed to consider particle and volatile losses in lines

Sampling Strategy

- Filter sampling for in vitro and chemistry
- Concentrators?
- Extended sampling creates tradeoffs in sample integrity
- Other novel realistic methods for chemistry such as bubblers, aqueous phase, impingers, etc.


switching valves
bypass leg
pre-light-off in-line PM + SVOC sample holder
post-light-off in-line PM + SVOC sample holder
dilution tunnel

Chemical/Physical Characterization Strategy

- Conduct comprehensive gas and solid phase analyses -- list to be determined
- Collect sufficient physical & chemical data for deposition & dosimetry models
- DOE is studying chemistry from new NOx controls and will provide background data
- Changes in potency may be determined from chemistry

Chemical/Physical Characterization Strategy (cont.)

- Collect chemistry data first to assist in selection of health studies
- Particle size, surface area, number, mass, distribution (morphology not as important)
- Chemistry as a function of size

Summary of Recommendations

- 2007 On-highway engine with PM trap and NOx control (SCR and one other)
- 1988-1990 Comparison engine
- Use fuels and lubes matched to technology
- Simulate roadside or near roadside
- Comprehensive physical/chemical analyses