

## Update on Technology Demonstration Project and Test Method Workgroup



August 26, 2003



California Environmental Protection Agency

Air Resources Board

### Technology Demonstration

## PM Demonstration-Program Overview

- Objectives
- Test matrix
- Test methodology
- Control devices
- Results



## **PM Demonstration-Program Objectives**

- **Combined CEC BUG and ARB Stationary Engine Demonstrations**
- **Demonstrate PM controls targeted to stationary engines**
- **Representative engines from database**
- **Measure baseline and controlled emission levels**
- **Evaluate key operating parameters which affect control technology**

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## **PM Demonstration-Test Methodology**

- **6 Retrofit Control Technologies**
  - ◆ Active and Passive Diesel Particulate Filters
  - ◆ Diesel Oxidation Catalysts
  - ◆ Emulsified Fuel
- **Measurement Methods**
  - ◆ ISO 8178
  - ◆ Test Cycles: ISO 8178 D2 5 Mode
- **Emission Measurements**
  - ◆ Baseline Emissions
  - ◆ Controlled Emissions (Control Efficiency)
  - ◆ Conditional Durability (168 hrs)
  - ◆ Post Durability Controlled Emissions

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## PM Demonstration-Test Matrix

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- **2 Size Ranges**
  - ◆ 15 engines (500 to 750 kW)
  - ◆ 3 engines (1750 to 2000 kW)
- **3 Age Ranges**
  - ◆ Pre 1987
  - ◆ 1987-1996
  - ◆ Post 1996
- **3 Manufacturers**
  - ◆ Caterpillar
  - ◆ Cummins
  - ◆ Detroit Diesel Corporation



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## PM Control Technologies Selected for Demonstration

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- **Emulsified Fuel**
  - ◆ Lubrizol
- **Active Filter**
  - ◆ Engine Control Systems DPF w/Electrical Regeneration
- **Passive Filters**
  - ◆ Johnson Matthey-CRT
  - ◆ Catalytic Exhaust Products- Bare Filter +CDT Fuel Additive
- **Diesel Oxidation Catalysts**
  - ◆ CleanAir Systems DOC+FTF+CDT Fuel Additive
  - ◆ Sud-Chemie DOC



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## Technology Demonstration

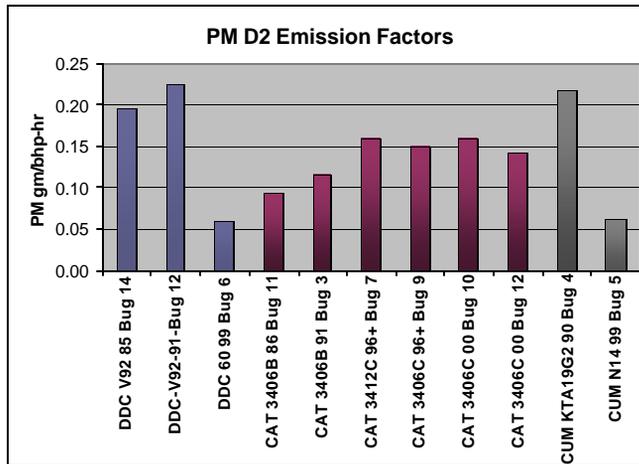
### Test Matrix

Engine	Program ID	Model Year	Control
Detroit Diesel V92	Bug 2	1991	
CAT 3406B	Bug 3	1991	
Cummins KTA19G2	Bug 4	1990	
Cummins N14	Bug 5	1999	
Detroit Diesel Series 60	Bug 6	1999	
CAT 3412C	Bug 7	Post 96	
CAT 3408B	Bug 8	1990	Baseline Planned
CAT 3406C	Bug 12	2000	Passive DPF
CAT 3406C	Bug 10	2000	Active DPF
Detroit Diesel V92	Bug 14	1985	DOC/FBC
CAT 3406C	Bug 10	2000	DOC 1
Detroit Diesel V92	Bug 14	1985	DOC 1
CAT 3406C	Bug 9	Post 96	Emulsified Fuel
CAT 3406B	Bug 11	1986	Emulsified Fuel
CAT 3406C	Bug 10	2000	DPF/FBC

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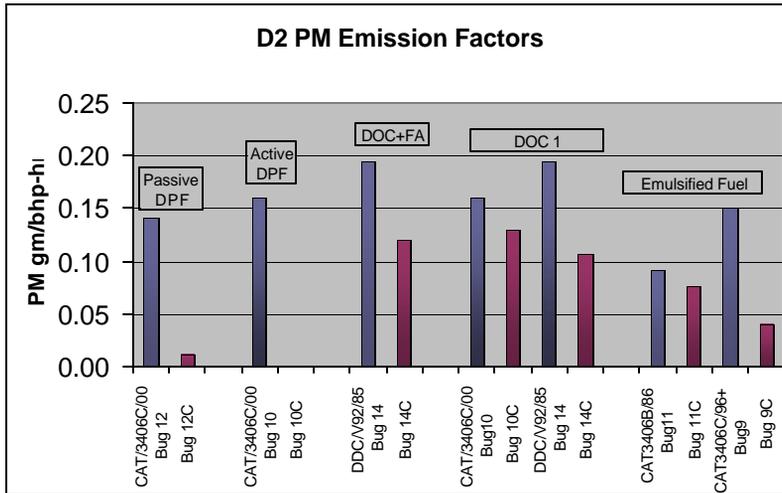
### Baseline D2 Weighted PM Emission Factors



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## Baseline and Controlled PM D2 Weighted Emission Factors



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## Program Status

- Durability in progress for 3 controls
- One more control retrofit planned
- Post durability emission testing planned

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## Summary of Results

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- **Diesel Oxidation Catalysts**
  - ◆ 19 to 45% PM reductions
  - ◆ 38 to 45% for 2 stroke DDC
  - ◆ Reductions in NMHC
  - ◆ Increase in NOx
    - ◆ Continue to evaluate
- **Diesel Particulate Filters**
  - ◆ 91 to 99% PM reductions
  - ◆ Reductions in NMHC
  - ◆ Decrease in NOx
- **Emulsified Fuels**
  - ◆ PM Reductions varied
  - ◆ NOx reductions
  - ◆ NMHC reductions varied

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## Preliminary Conclusions -Stationary Engines

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- **Active and Passive DPF Technology is available for >85% PM control**
- **DOC technology is available for >25% PM control-engines with high PM SOF**
- **Emulsified Fuels are effective, PM control efficiency varies**

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## **Program Contacts**

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