

Advanced Petroleum Based Fuels- Diesel Emission Control (ABPF-DEC) Update

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Advanced Petroleum Based Fuels – Diesel Emission Control Study

Government/Industry Sponsorship



Participating Companies/Organizations

Automobile:

DaimlerChrysler
Ford
GM
Toyota

Government:

CARB/SCAQMD
DOE
EPA
NREL
ORNL

Emission Control:

Argillon
ArvinMeritor
Benteler
Clean Diesel Tech.
Corning
Delphi
Donaldson Co.
Engelhard
Johnson Matthey
MECA
NGK
Rhodia
Robert Bosch Corp.
STT Emtec AB
Tenneco Automotive
3M
Umicore

Energy/ Additives:

American Chemistry
Council
API
BP
Castrol
Chevron Oronite
ChevronTexaco
Ciba
Conoco-Phillips
Crompton
Ergon
Ethyl
ExxonMobil
Infineum
Lubrizol
Marathon Ashland
Motiva
NPRA
Pennzoil-Quaker State
Shell Global Solutions
Valvoline

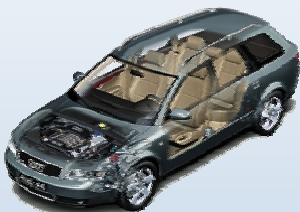
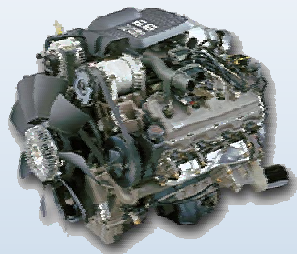
Engines:

Caterpillar
Cummins
Detroit Diesel
EMA
International Truck
& Engine
John Deere
Mack Trucks

Technology:

Battelle

APBF-DEC Projects

NO _x Adsorber/DPF		SCR/DPF		Lubes
				
FEV	SwRI	Ricardo	SwRI	AEI
1.9L TDI	6.6L Isuzu Duramax	15L Cummins ISX	Caterpillar C12	Cummins ISB
Audi A4 Avant	Chevrolet Silverado	<i>No vehicle</i>		

Project Summaries

NO_x Adsorber/DPF Passenger Car Platform

- FEV Engine Technologies
- Vehicle: Audi A4 Avant
- Engine: 1.9L TDI
- Catalyst aging study completed
 - 2200 hour aging
 - Final report: Summer 2005
 - Evaluation of criteria and unregulated pollutants and air toxins



Project Objective

TIER 1:

after 100,000 miles

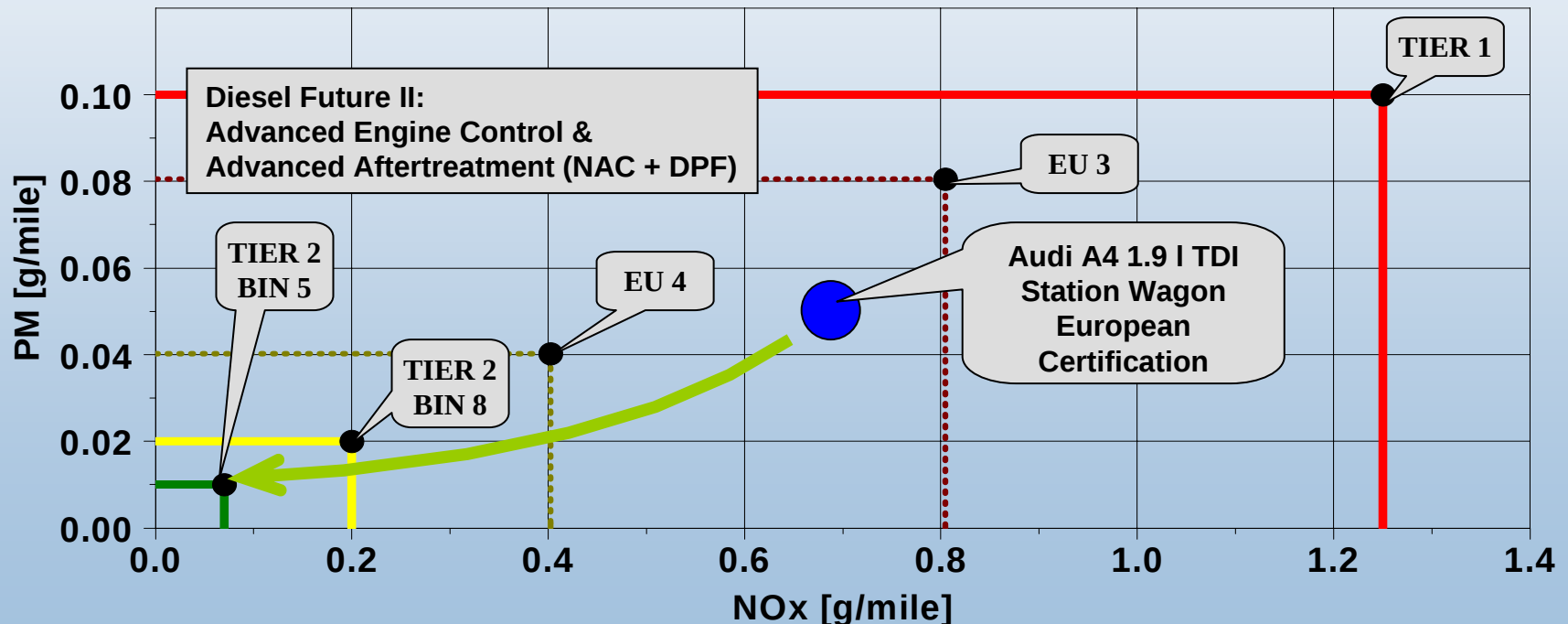
- ▶ NOx 1.25 g/miles
- ▶ PM 0.1 g/mile



TIER 2 BIN 5:

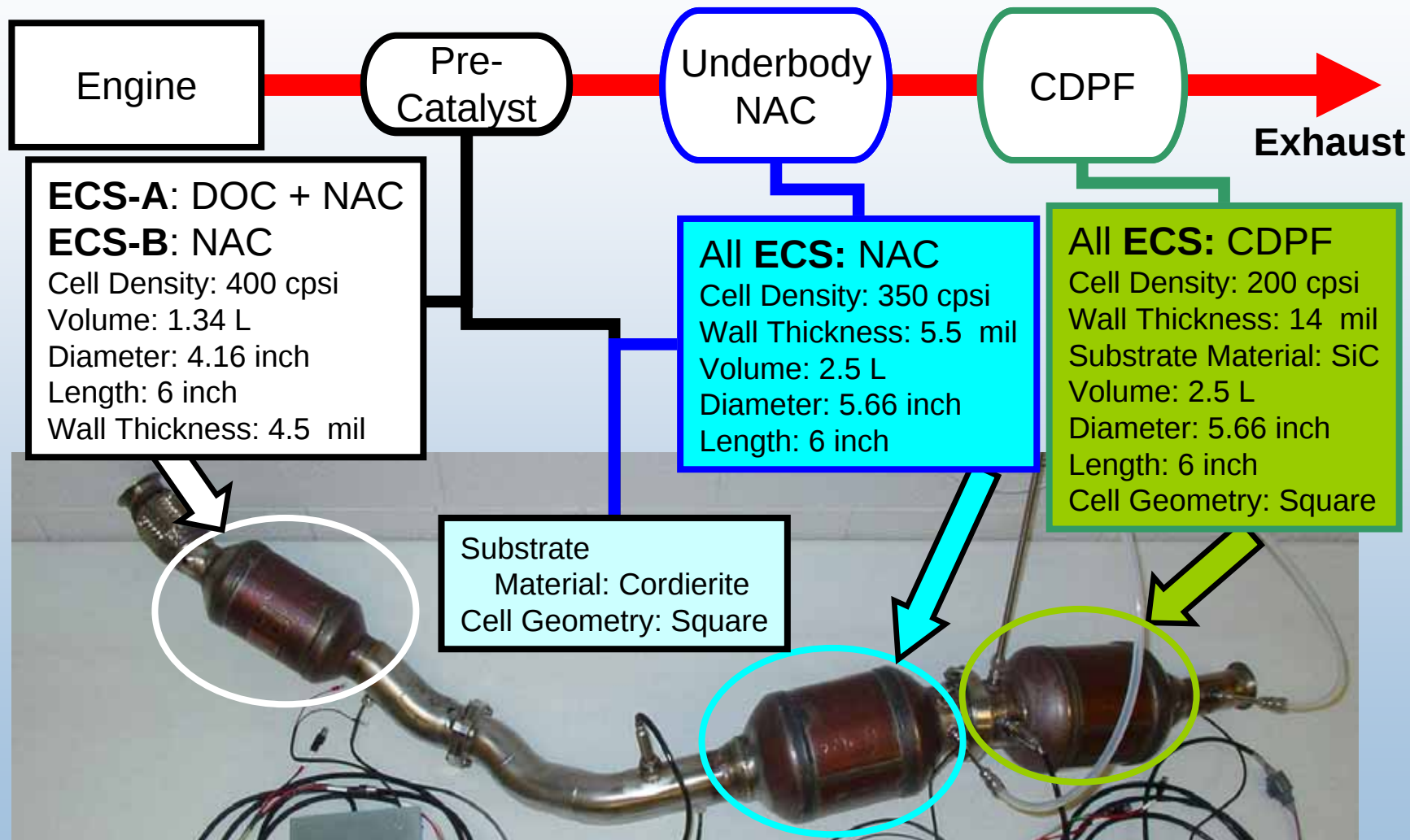
after 120,000 miles

- ▶ NOx 0.07 g/miles
- ▶ PM 0.01 g/mile



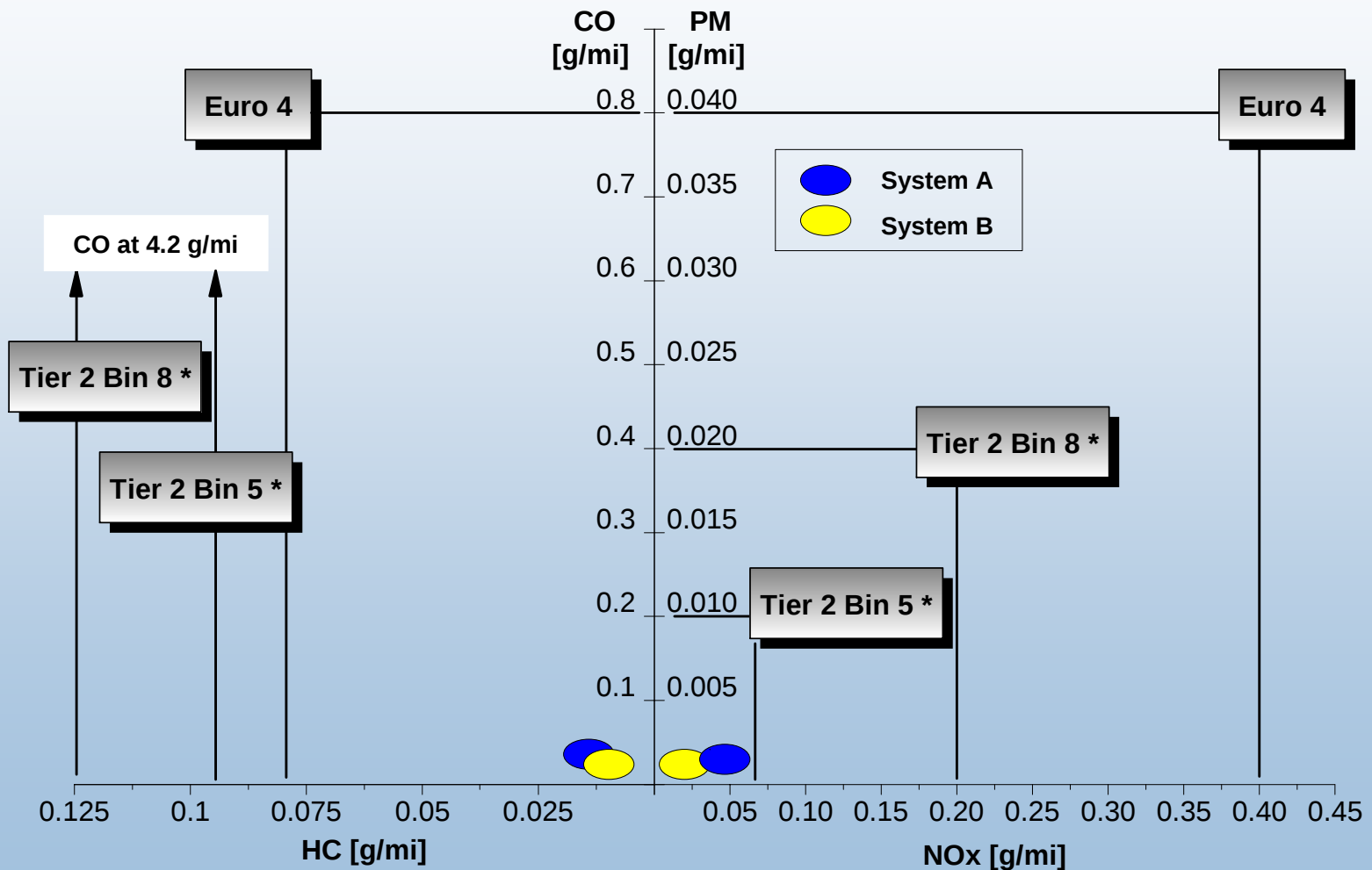
Emission Control System

Development Catalyst Configuration and Specifications



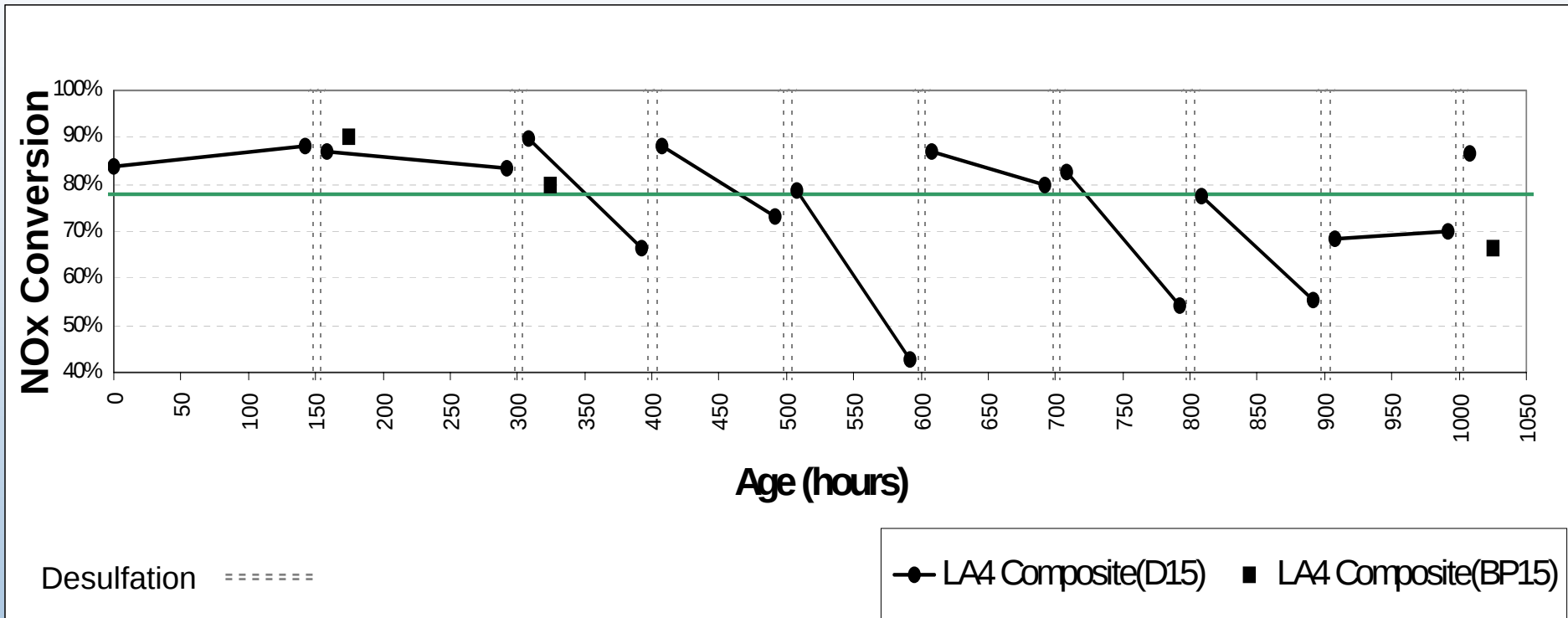
Test Cell Emission Performance

FTP Cycle (Un-aged System)



* EMISSION LIMITS AFTER 120,000 MILES

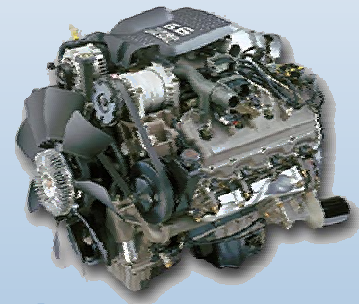
Passenger Car Platform – Aging Results (LA4 Composite)



More details: SAE 2005-01-1755

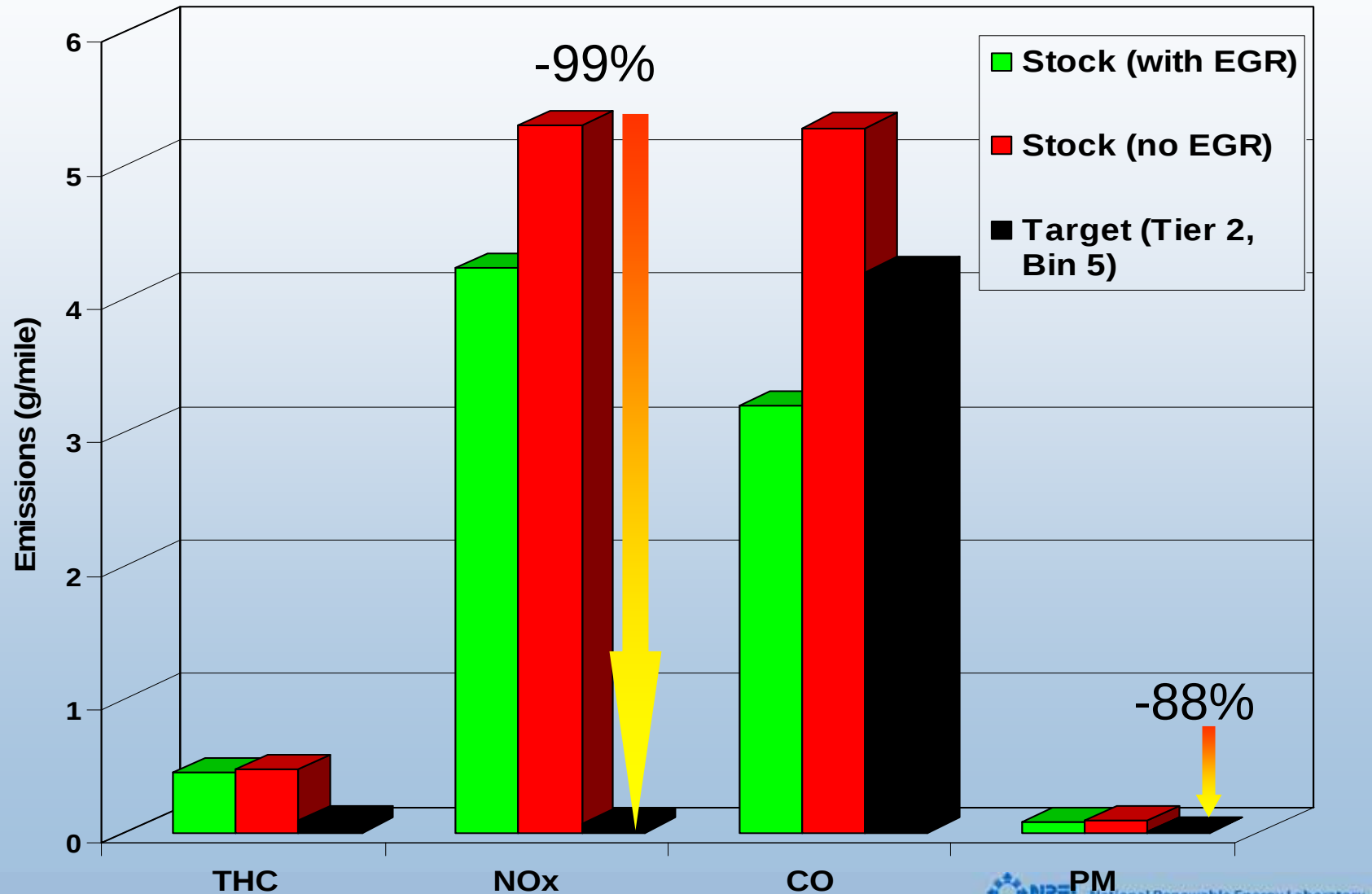
NO_x Adsorber/DPF SUV Platform

- Southwest Research Institute
- Vehicle: 2002 Chevrolet Silverado
- Engine: 2002 Isuzu Duramax 6.6L
- Catalyst aging study completed
 - 2000 hours
 - Final Report: Summer 2005
 - Evaluation of criteria and unregulated pollutants and air toxics

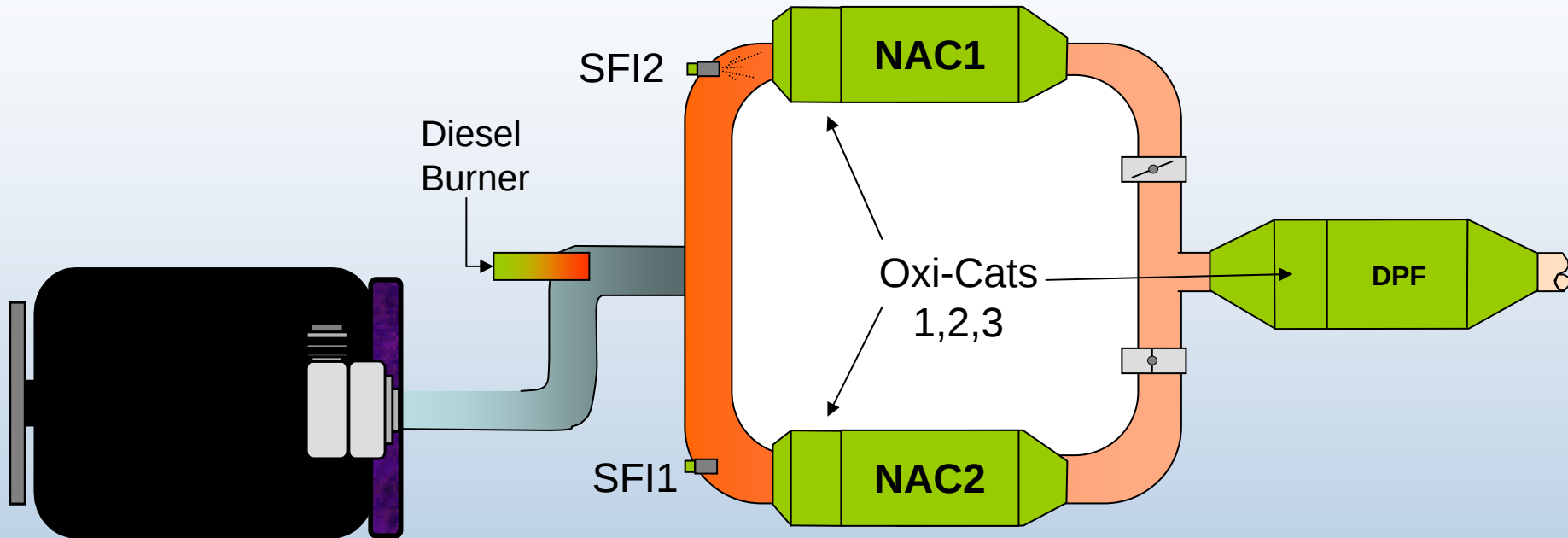


Project Objective

FTP Drive Cycle Only



Emissions Control System



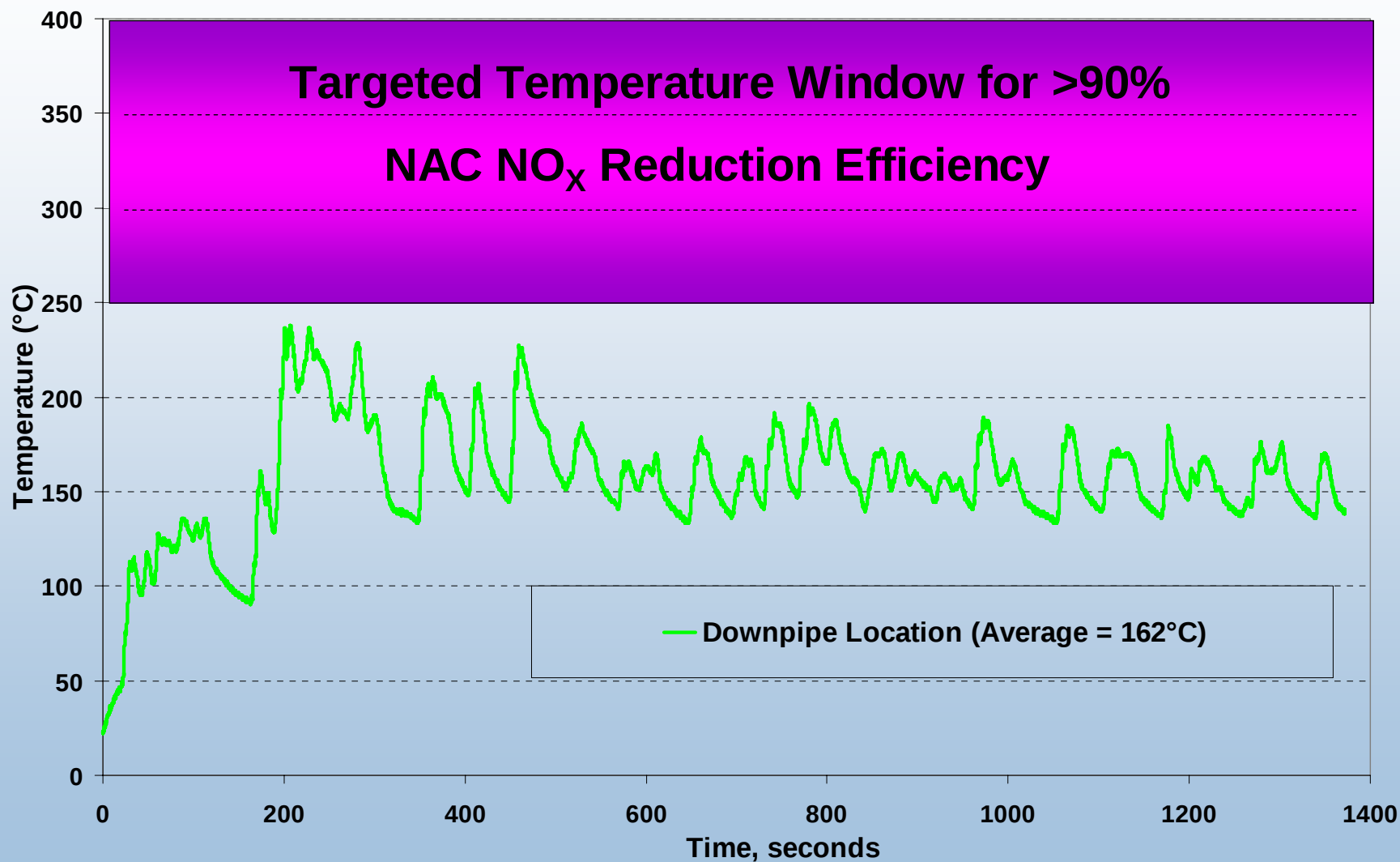
Volume (2nd Generation System):

$$\begin{array}{ccccccc} 3.5\text{L} \times 2 & + & 7\text{L} \times 2 & + & 3.5\text{L} & + & 12.5\text{L} & = & 37.0\text{L} \\ \text{Front Oxi} & & \text{NAC} & & \text{Rear Oxi} & & \text{DPF} & & \end{array}$$

$$\text{ECS : Eng} = 5.6:1$$

$$\text{NAC : Eng} = 2.1:1$$

Measured Exhaust Temperature - On-Vehicle



Supplemental Energy-Diesel Burner



Diesel Burner Details

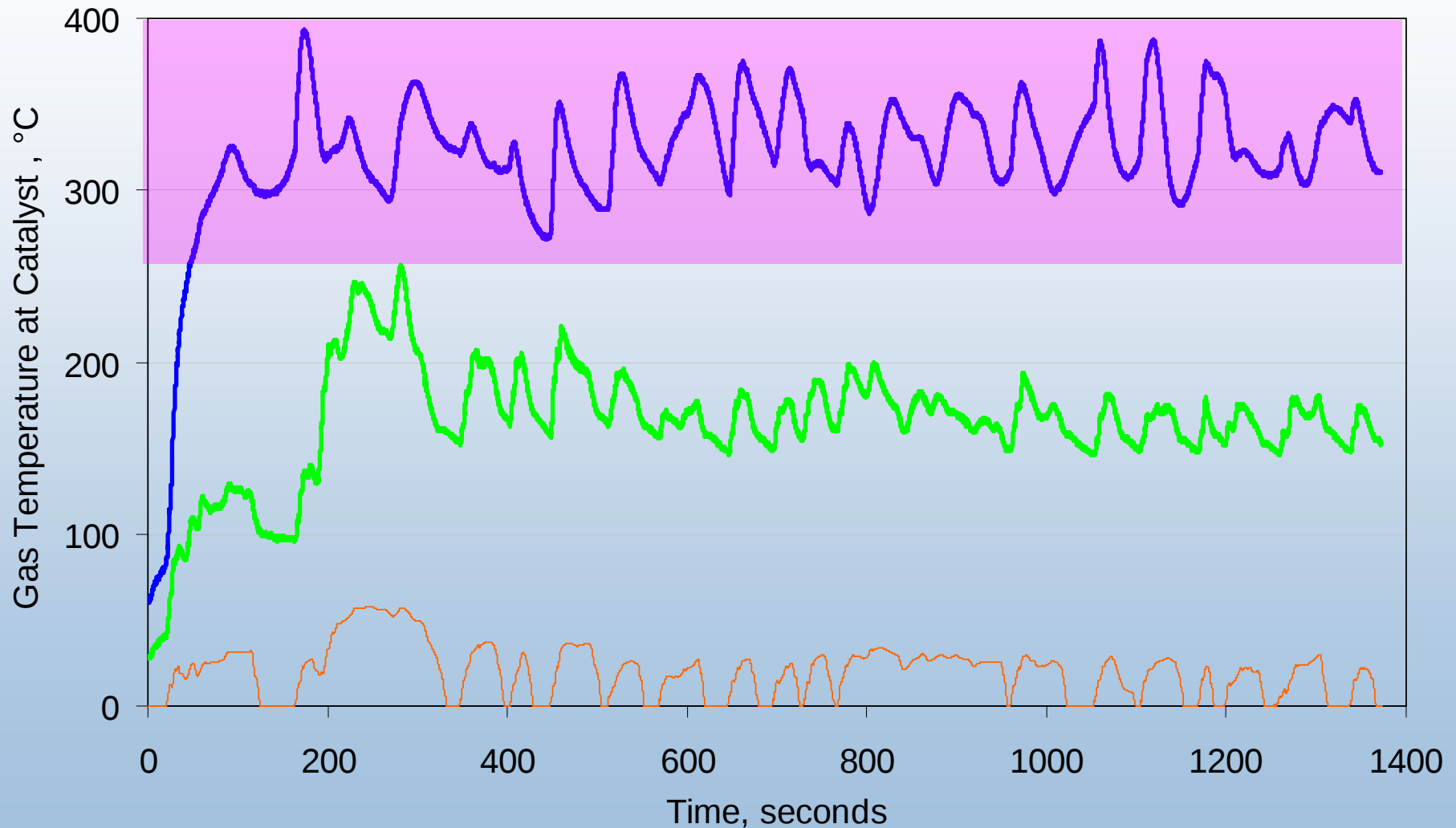
Engine Exhaust In



Burner Head



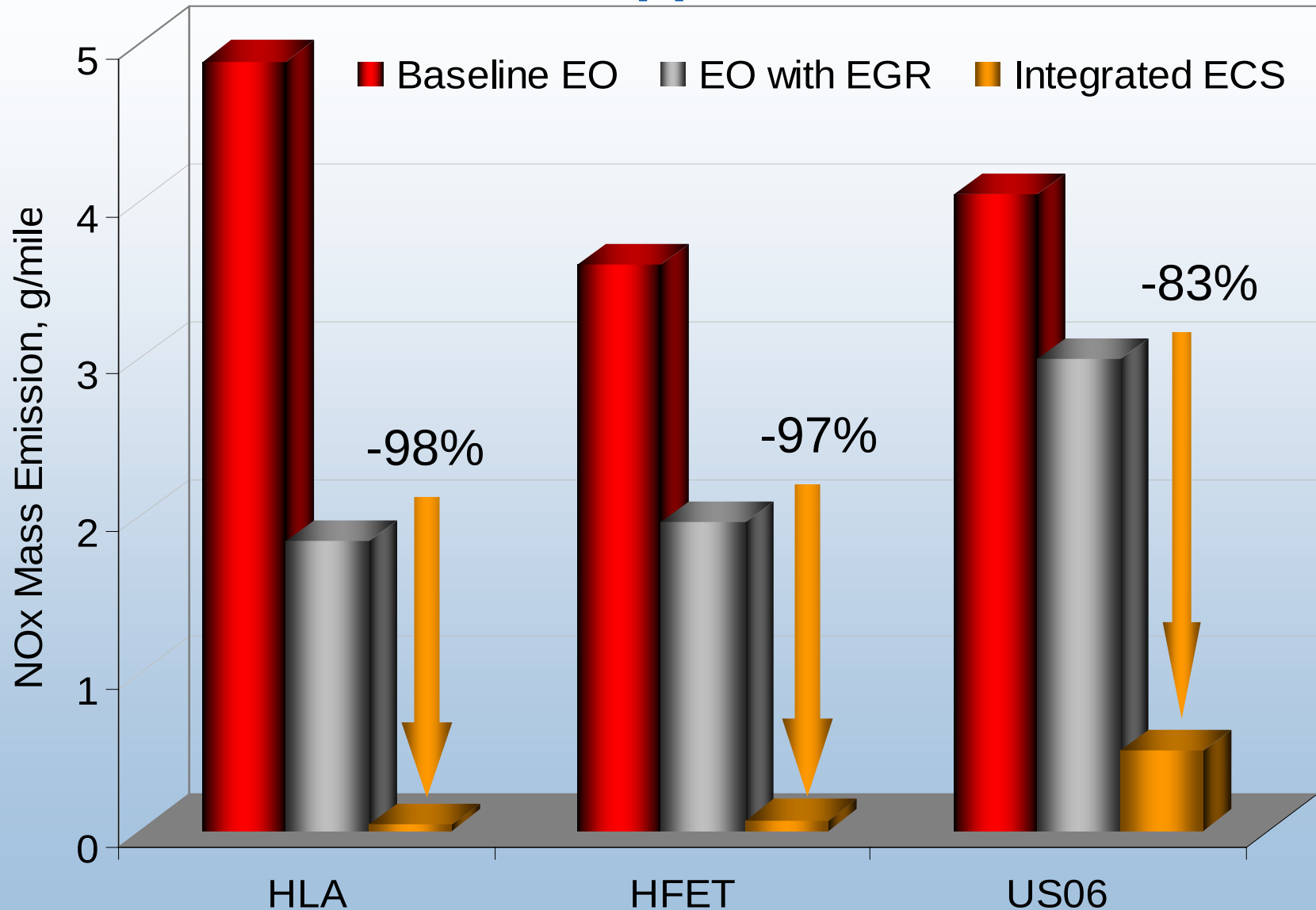
Diesel Burner Management



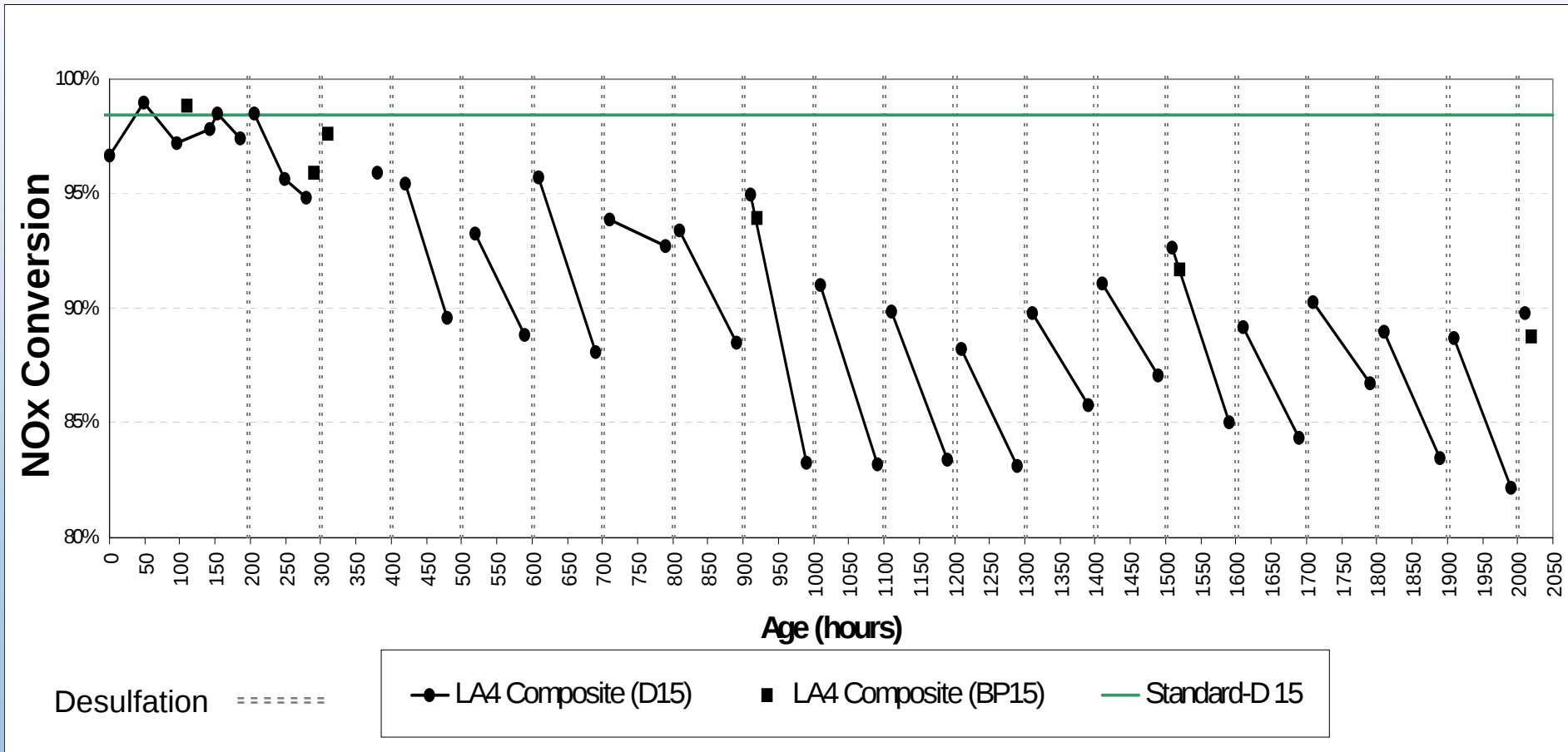
More details: [SAE 2004-01-0584](#)

Program Achievements

Low Hours, <1ppmS DECSE Fuel



SUV Platform – Aging Results (LA4 Composite)



NO_x Adsorber/DPF Heavy-Duty Platform

- Ricardo, Inc (Chicago)
- Vehicle: None
- Engine: 2002 Cummins ISX 15L
- Catalyst aging study completed
 - 2000 hours
 - Final report in progress



Project Scope

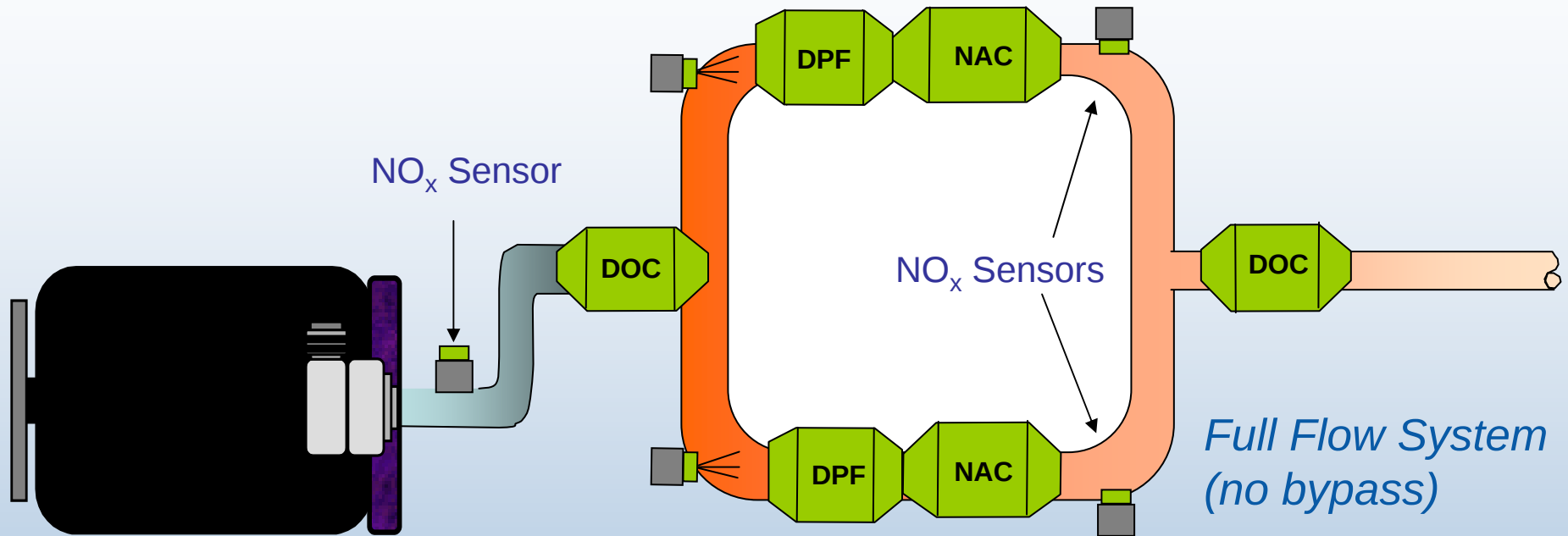
- Develop system capable of meeting 2010 emissions standards:
 - 0.20 g/bhp.h NO_x and 0.01 g/bhp.h PM
- Develop sulfur management strategy
- Conduct 2000 hour catalyst aging test
 - Transient and steady-state evaluations of:
 - Regulated emissions
 - Currently unregulated emissions

Test Engine

- Cummins ISX 15L
- 475 hp Rating
- DOHC 4V central EUI
- Cooled EGR, VGT
- Advanced electronic controls
- 2002/2004 Base engine out emissions (pre-production)

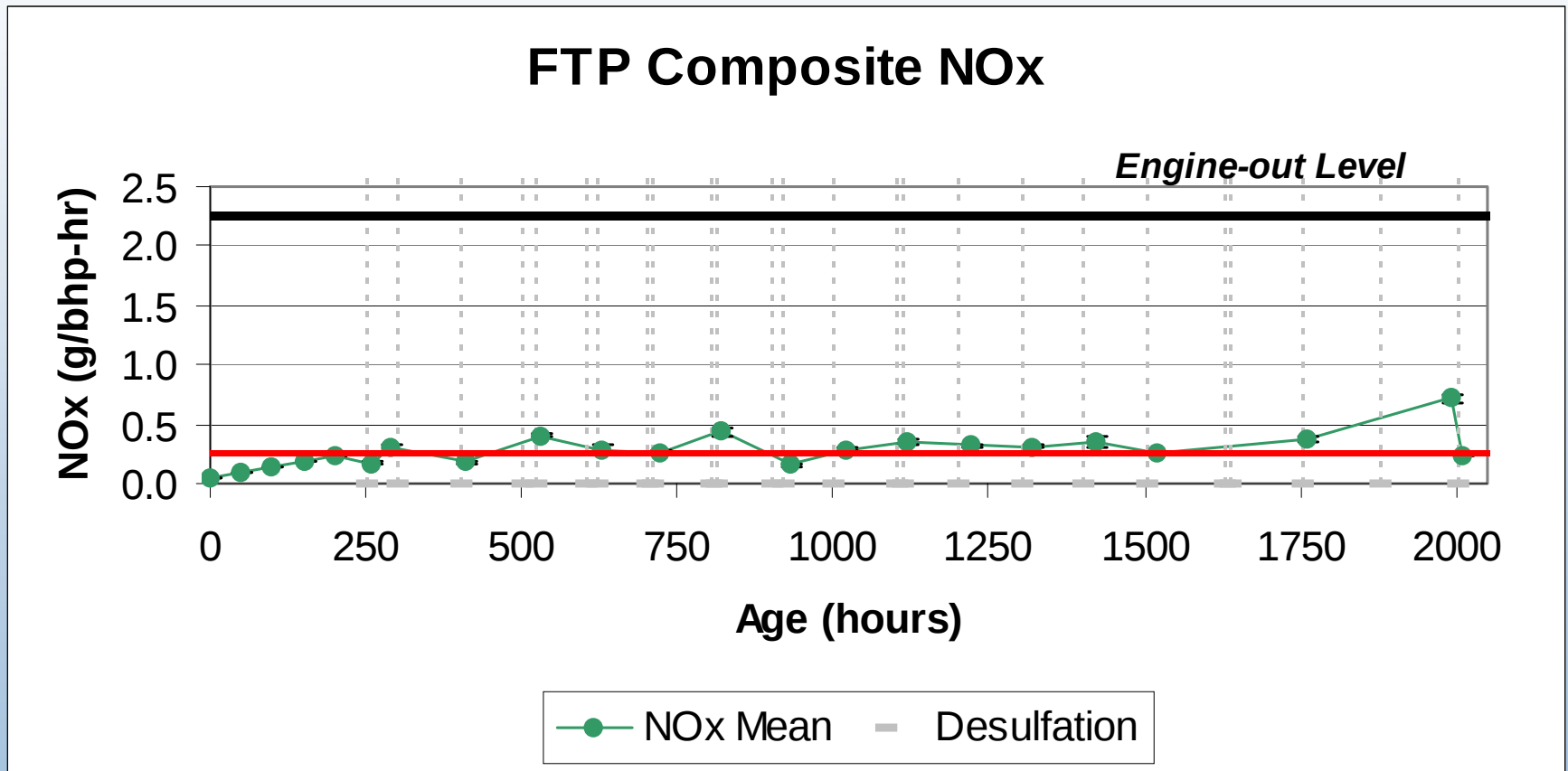


Emission Control System



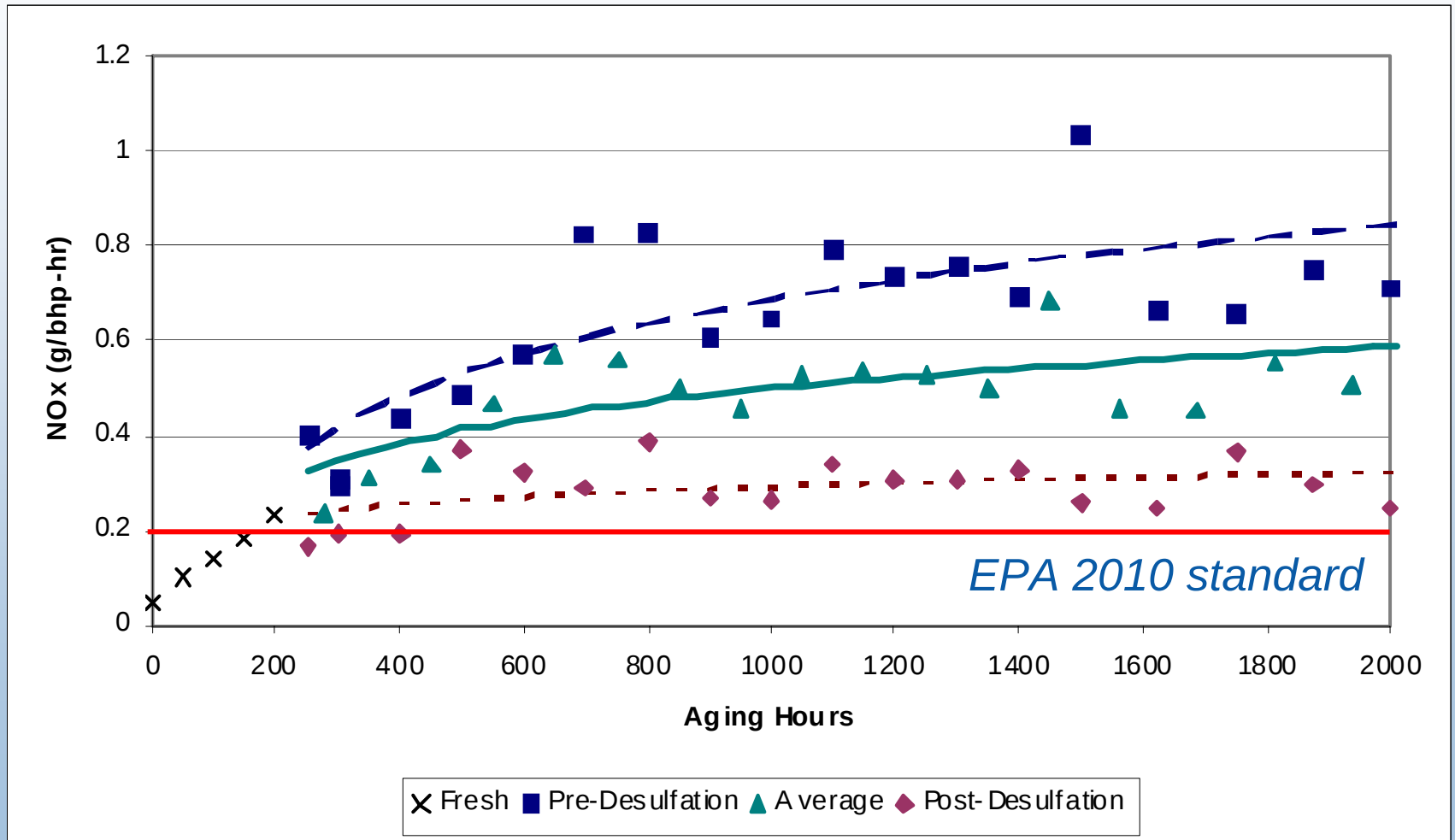
Device	Dimensions (Diameter x Length)	Volume
Upstream DOC	12" x 6"	11.1 L
DPF (x2)	12" x 14"	25.9 L (51.8 L total)
NO _x Adsorber Catalyst (x2)	12" x 12"	22.2 L (44.4 L total)
Clean-up DOC	12" x 6"	11.1 L
Total Volume:		118 L

Aging Results - NO_x



More details: SAE 2005-01-1760

Trends Analysis - NO_x



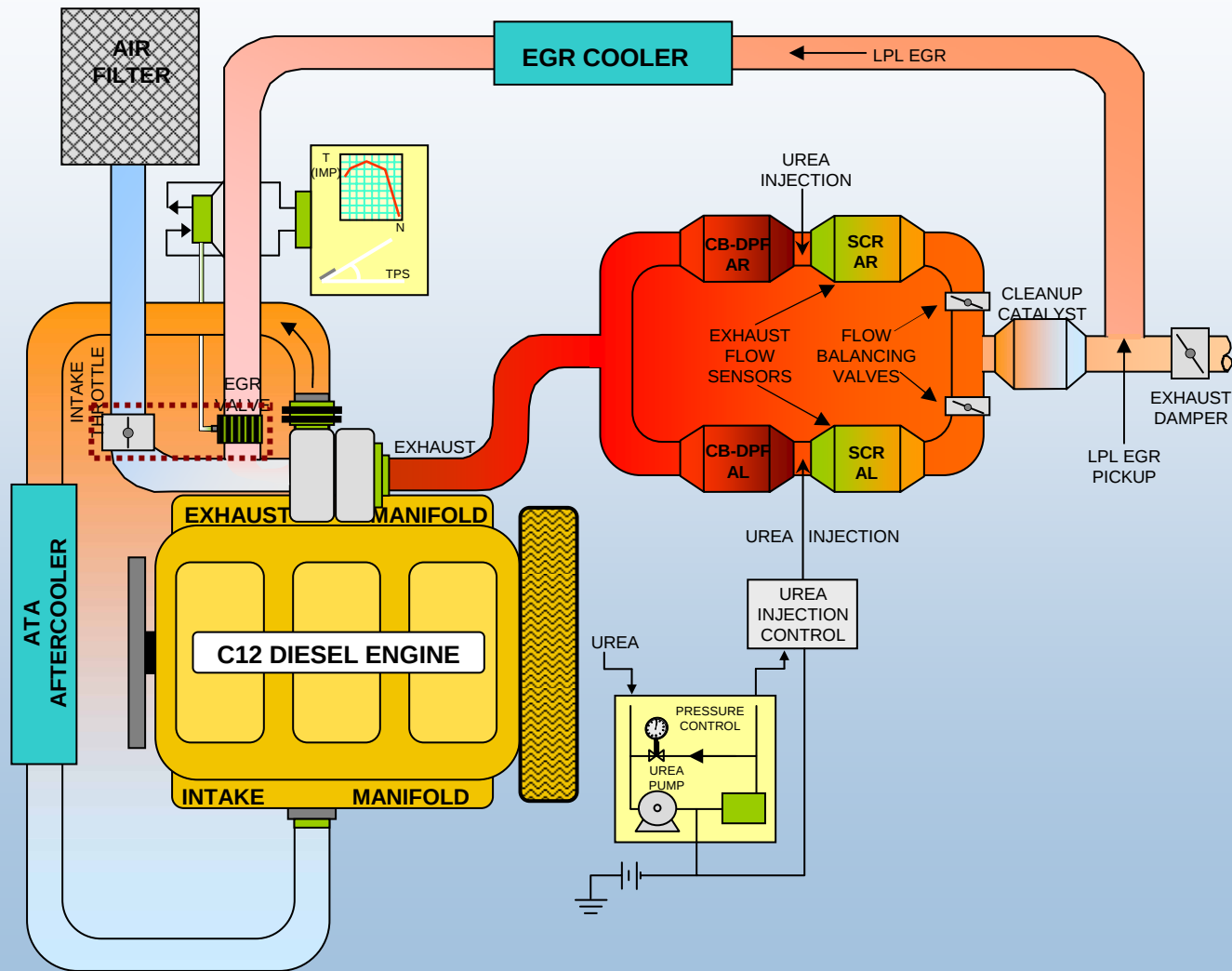
Heavy-duty SCR/DPF

(Southwest Research Institute)

- Vehicle: none
- Engine: Caterpillar C12 w/ LPL EGR
- Two systems evaluated:
 - System A: 6000 out of 6000 hours
 - System B: 6000 out of 6000 hours
 - Also testing NO_x sensor durability



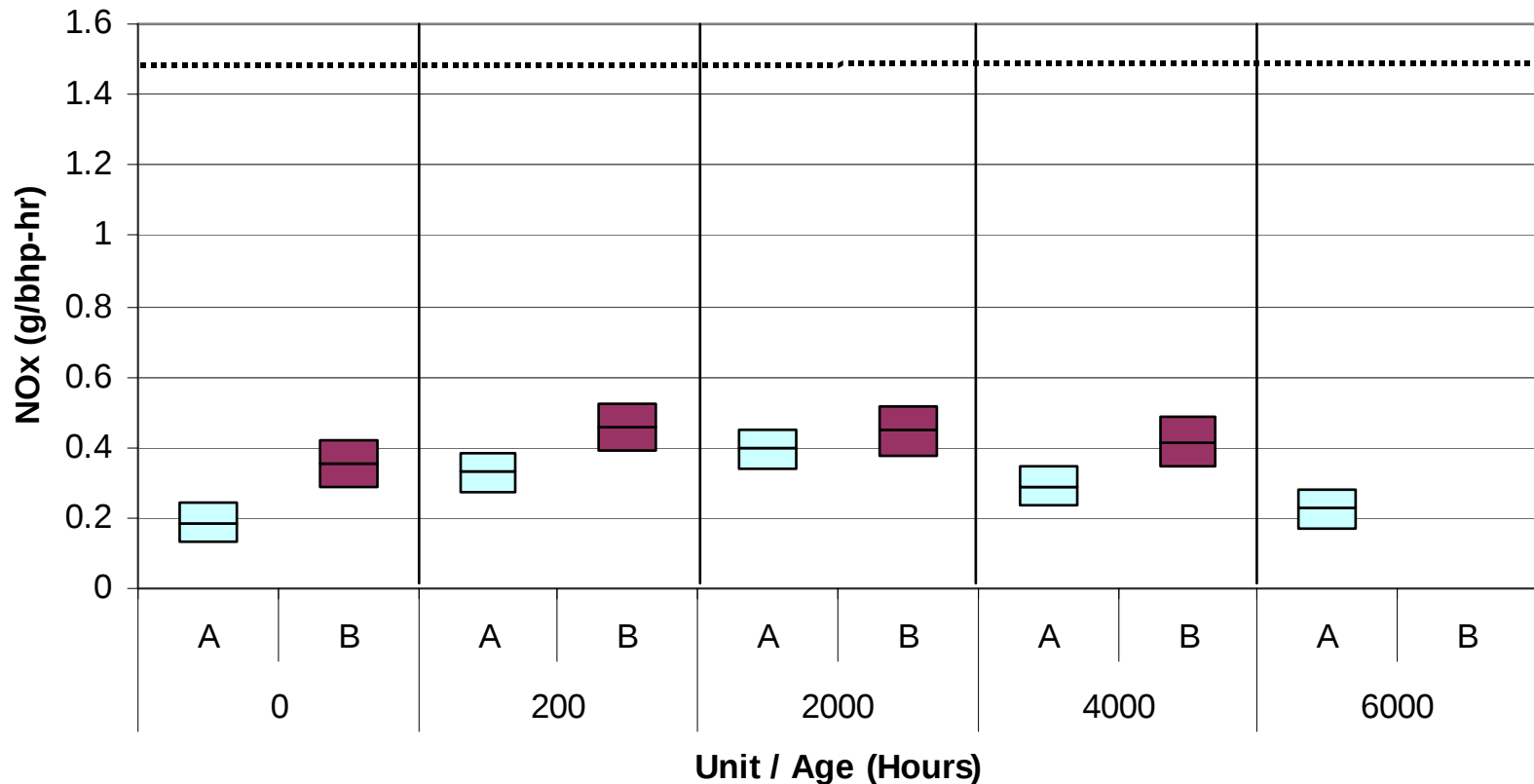
SCR - System Design



Heavy-duty SCR/DPF Aging Study

(HD FTP Composite NO_x 8-ppm S fuel)

Effects of Aging on NO_x (Composite)
(Mean and 95% Prediction Interval)



Lubricants Project



Determine the impact of lubricant properties and composition on engine-out/catalyst-in emissions



Determine if lubricant formulation impacts the performance and durability of NO_x adsorber catalysts

Lubricants Project Status

- Phase I Completed in 2003
- Final Report available
- Phase II Testing completed Aug 2004
- Final reporting underway
- **Detailed results to be presented in later session**

Future Direction

- APBF-DEC projects to wrap up in 2005
- At present time, no formal plans to continue the activity
- Anticipate future collaborative activities in fuels and lubricants research:
 - Fuels for advanced combustion
 - Non-petroleum based fuels
 - Lubricant impact on PM