DECSE PM EMISSIONS

Robert A. Gorse, Jr. Ford Motor

Diesel Emissions Control-Sulfur Effects (DECSE): Summary of PM Results and Data

DECSE PM EMISSIONS

DECSE OBJECTIVE

Determine the impact of fuel sulfur levels on emission control systems that could be implemented to lower emissions of NO_x and PM from on-highway trucks in the 2002-2004 time frame.

DECSE PM EMISSIONS

- Emission Control Systems
  - Diesel particle filters
  - Diesel oxidation catalysts
  - Lean-NO_x catalysts
  - NO_x adsorbers
- Fuel Sulfur Levels: 3, 16, 30, 150, 350 ppm
- Engines: modern, production engines as source of exhaust
- Study Aging, Regeneration & Desulfurzation

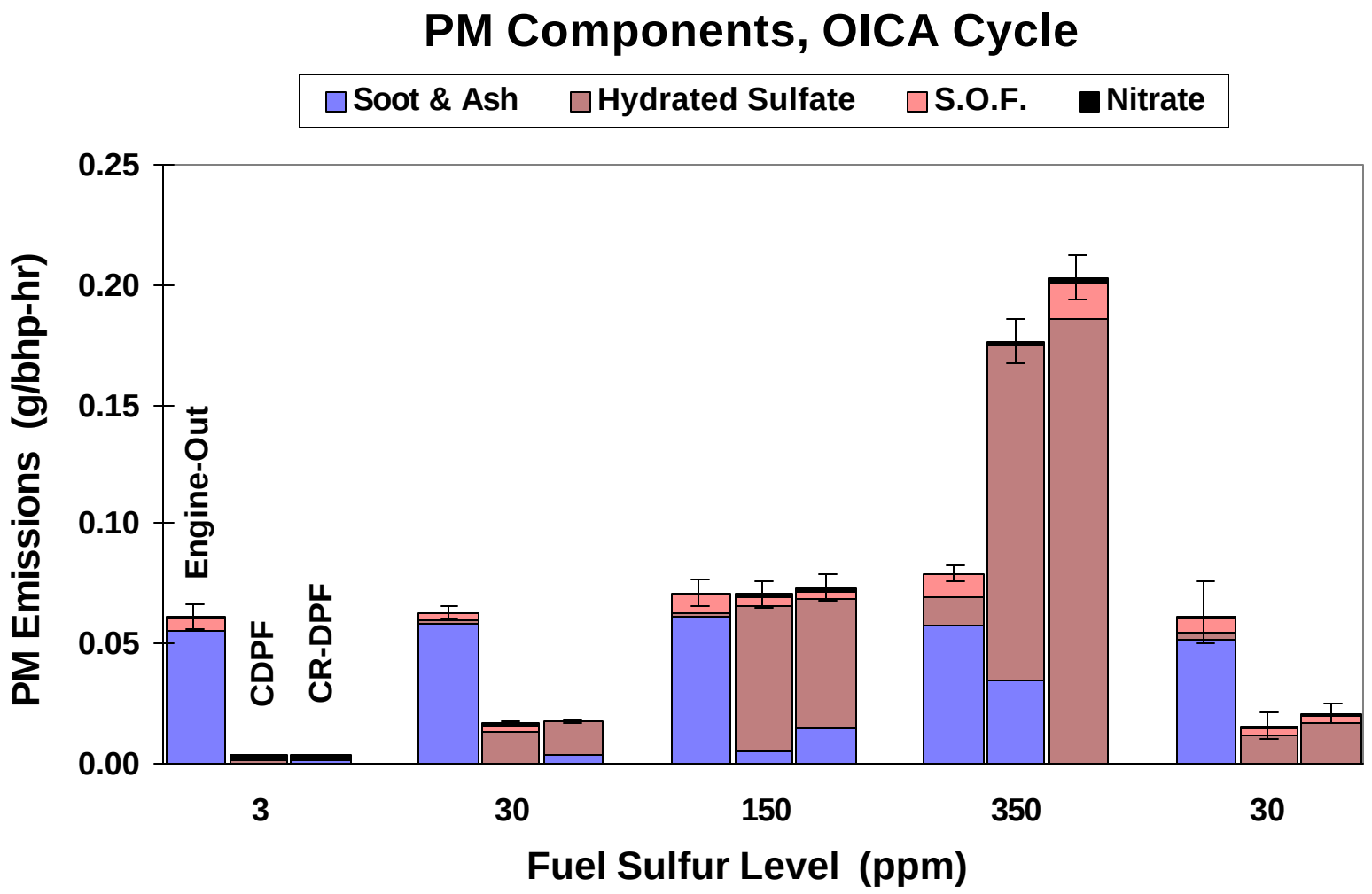
DECSE PM EMISSIONS

- Diesel Particulate Filters - ETS
  - Test Program/Report Completed January 2000
- NO_x Adsorbers - FEV
  - Phase I (Sulfur Effects) Completed October 1999
  - Phase II (Desulfurization) Underway February 2000, Reported at DEER 2000
- Diesel Oxidation Catalysts/Lean-NO_x Catalysts

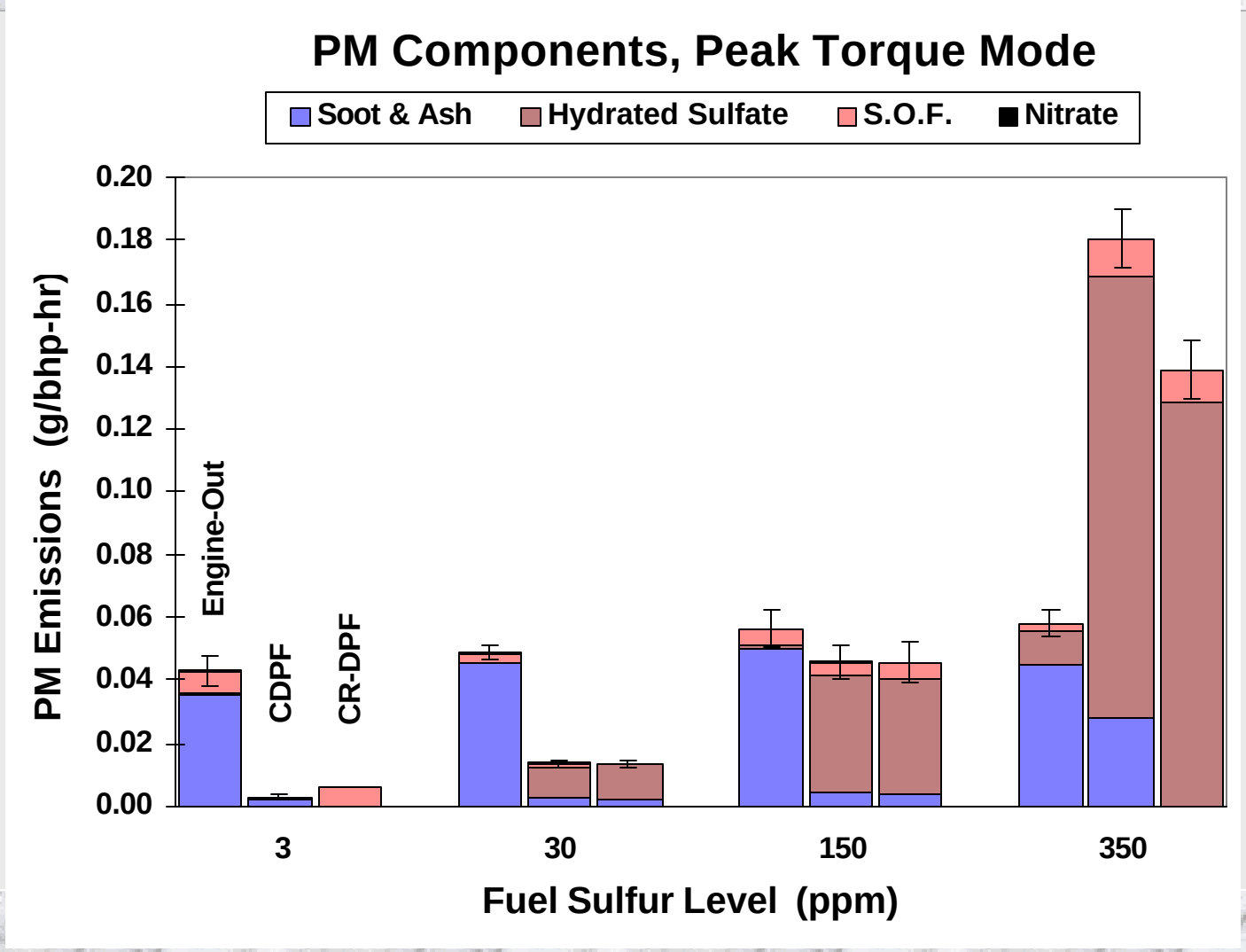
- WVU
  - Testing to continue through Summer 2000
  - Reported at DEER 2000

DECSE Web-Site: http\\www.ott.doe.gov

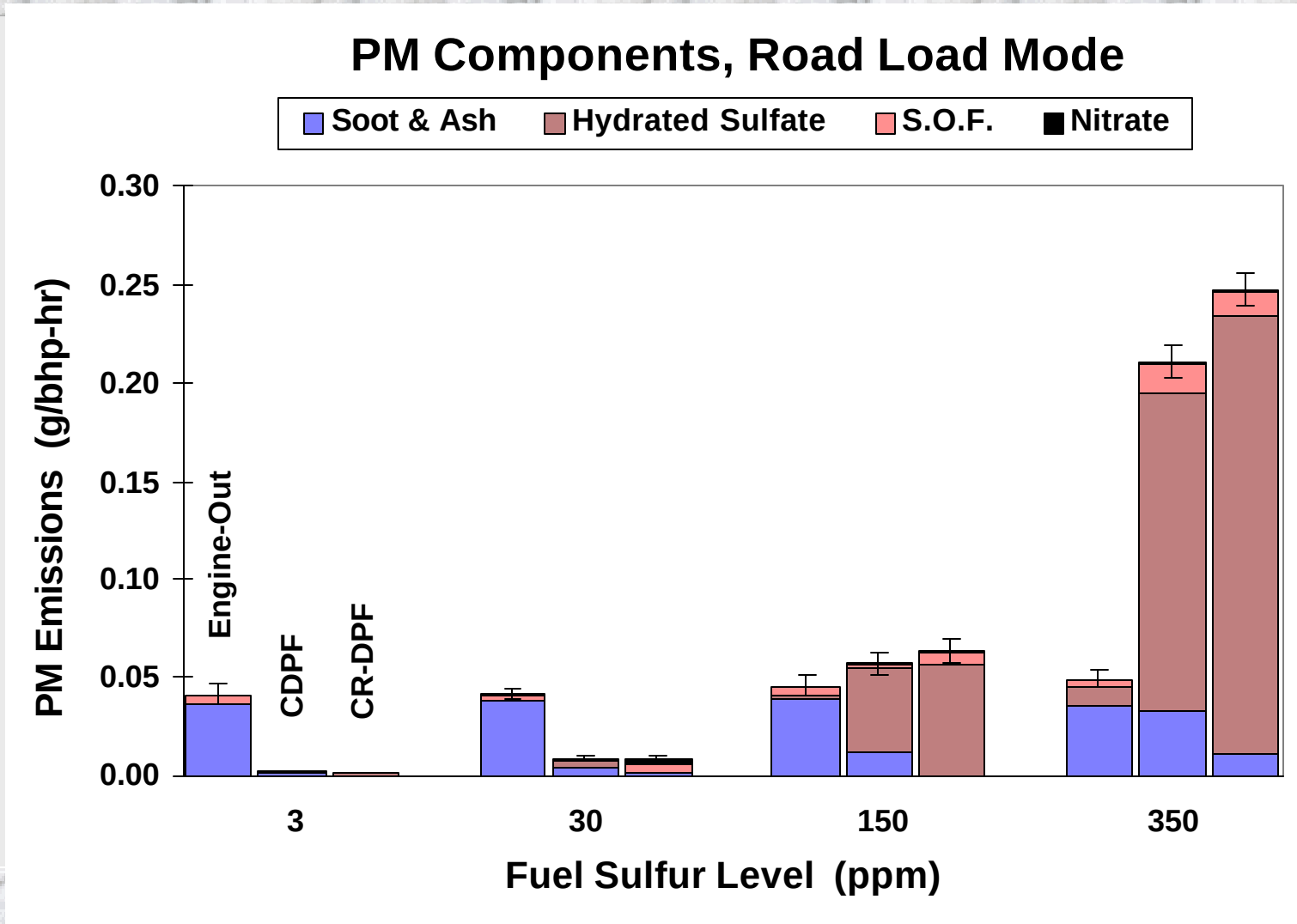
DECSE PM EMISSIONS
Diesel Particulate Filters



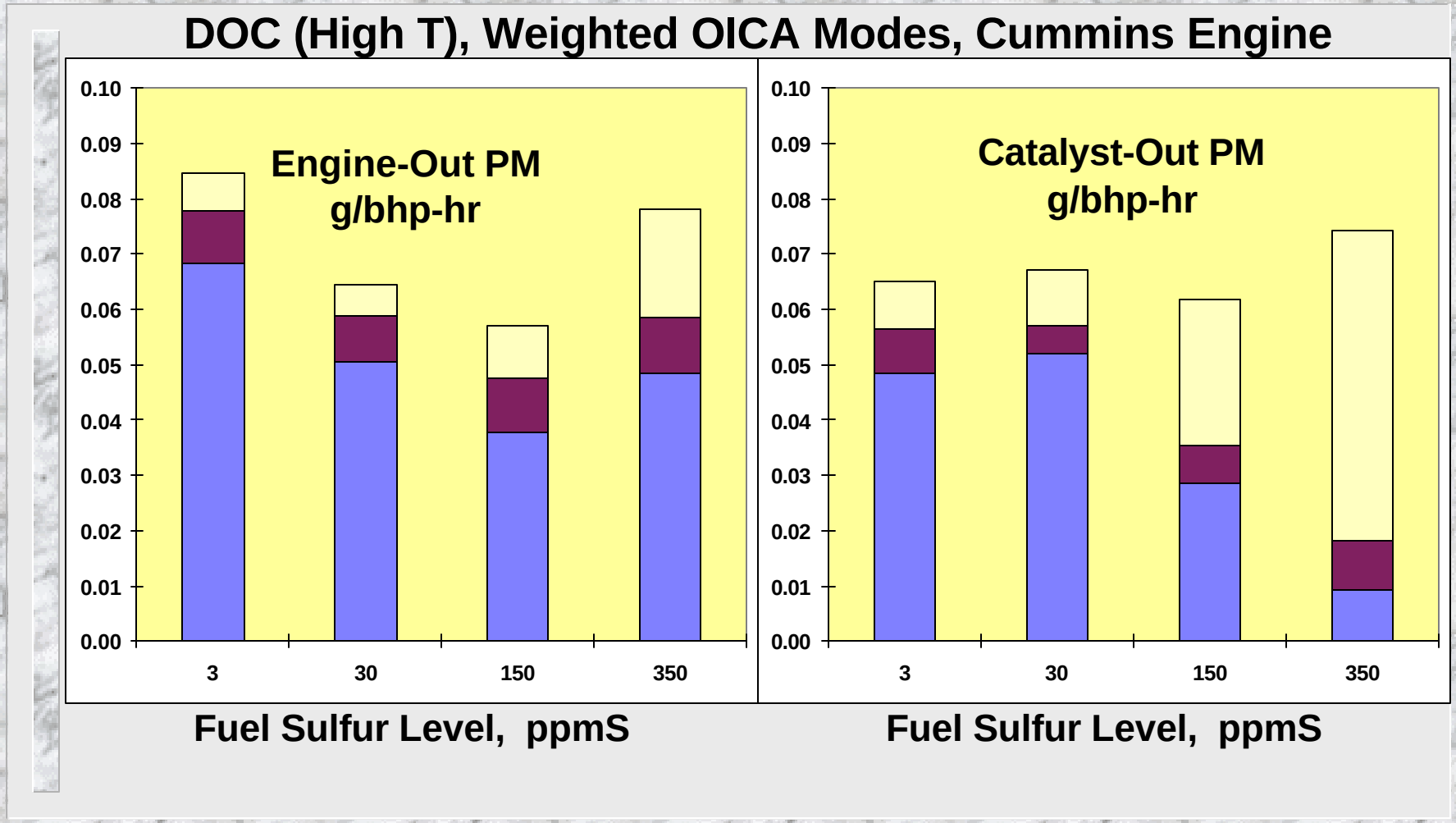
DECSE PM EMISSIONS
Diesel Particulate Filters



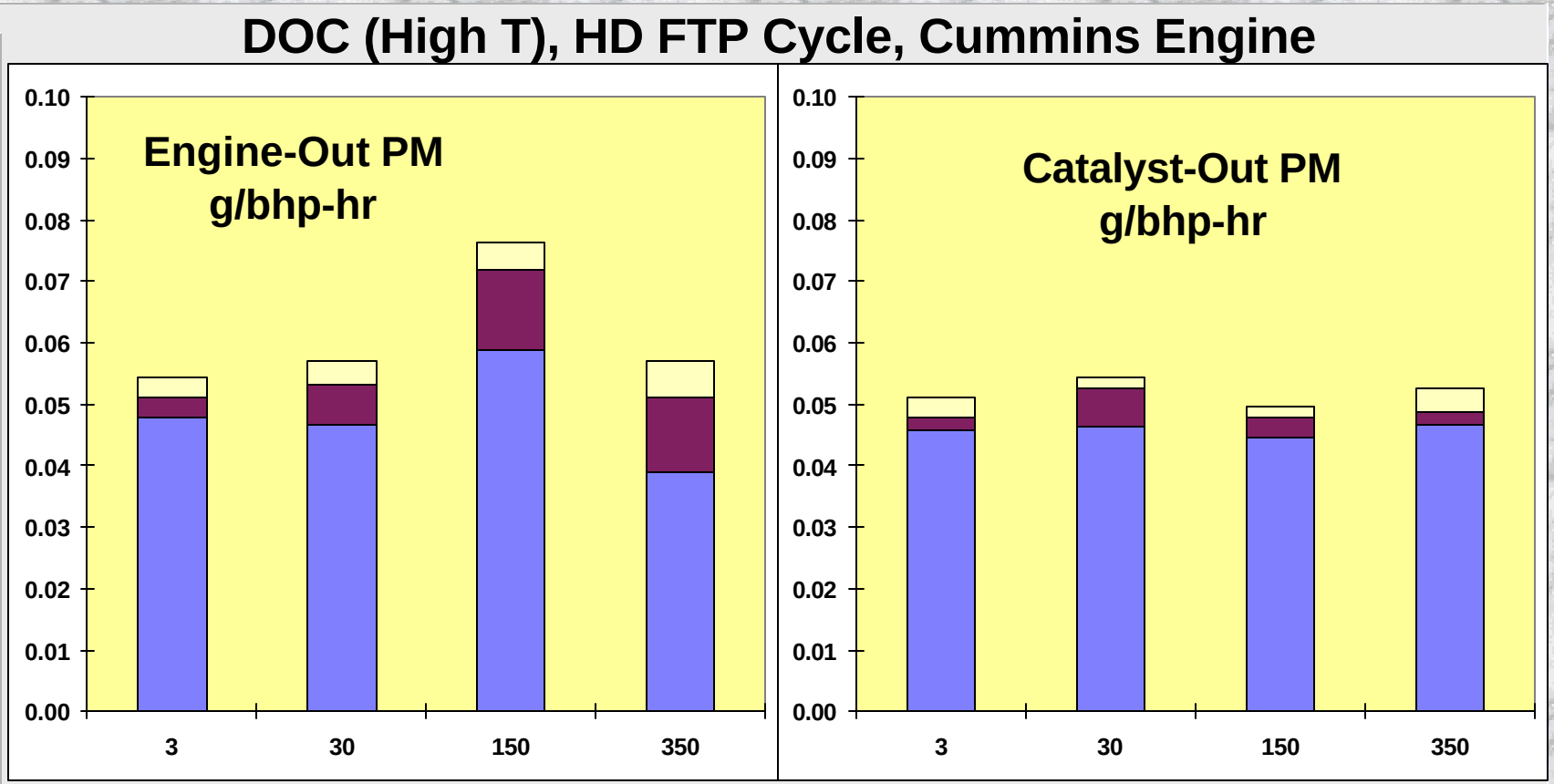
DECSE PM EMISSIONS
Diesel Particulate Filters



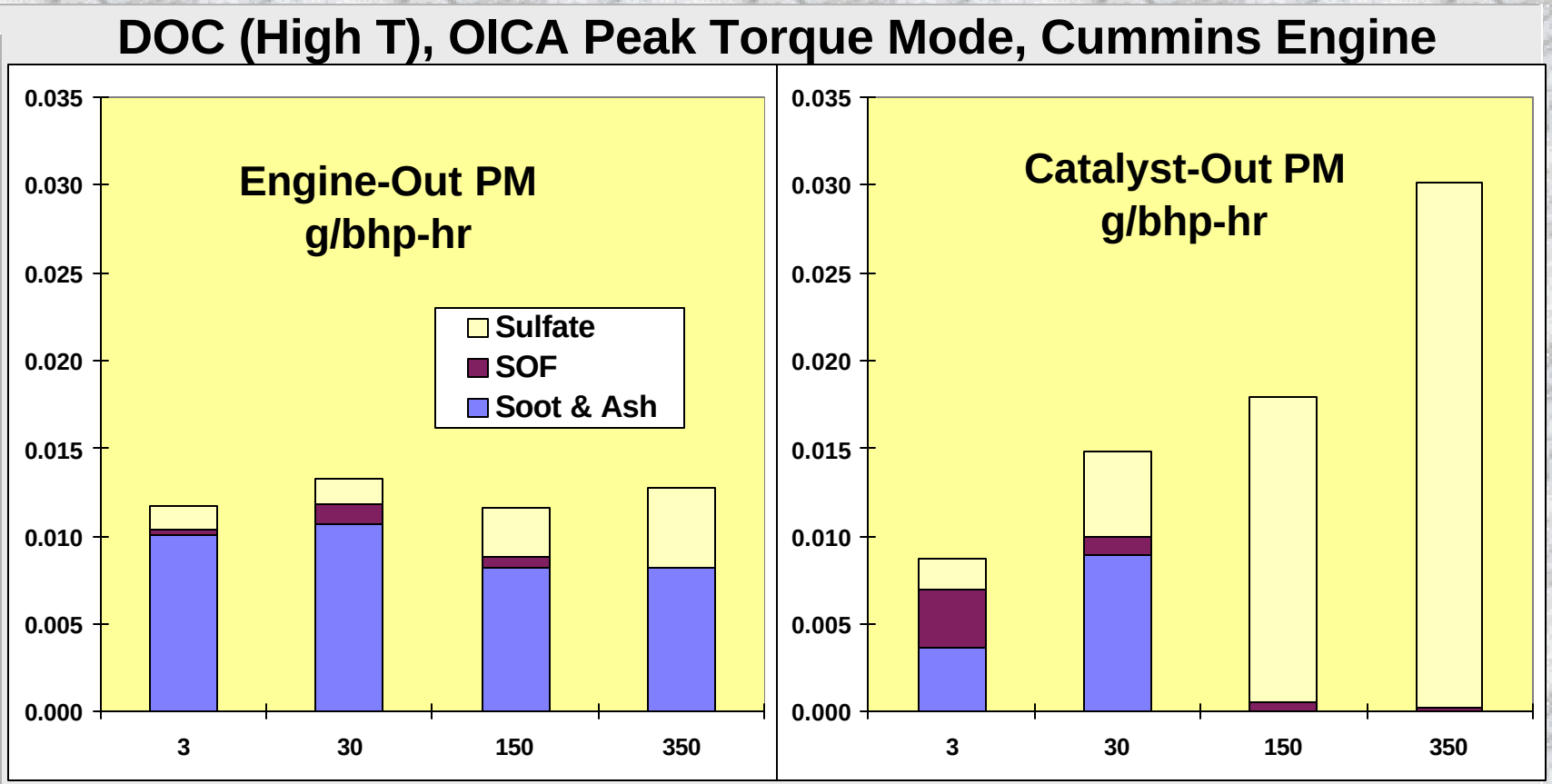
DECSE PM EMISSIONS
DOC



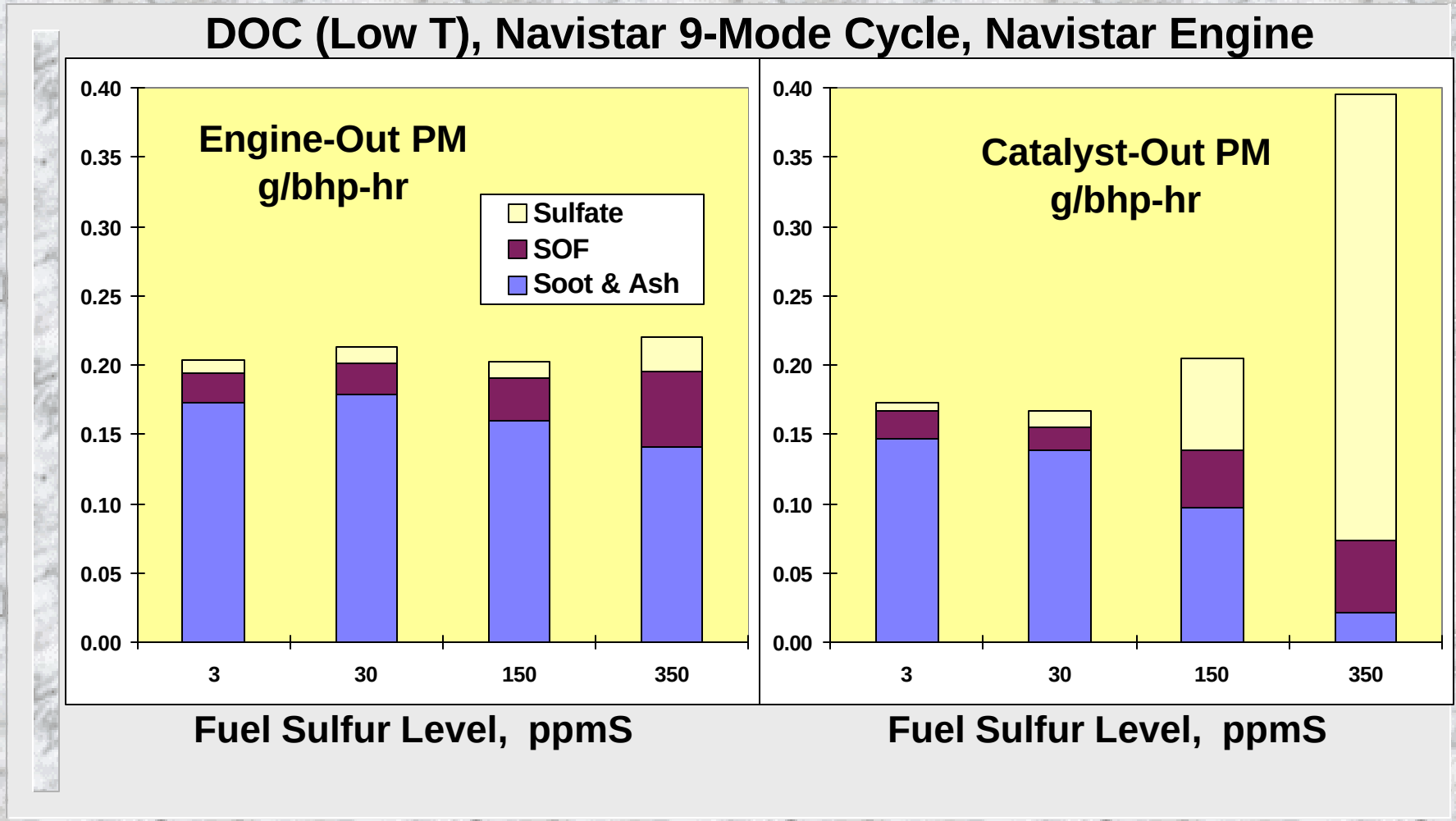
DECSE PM EMISSIONS
DOC



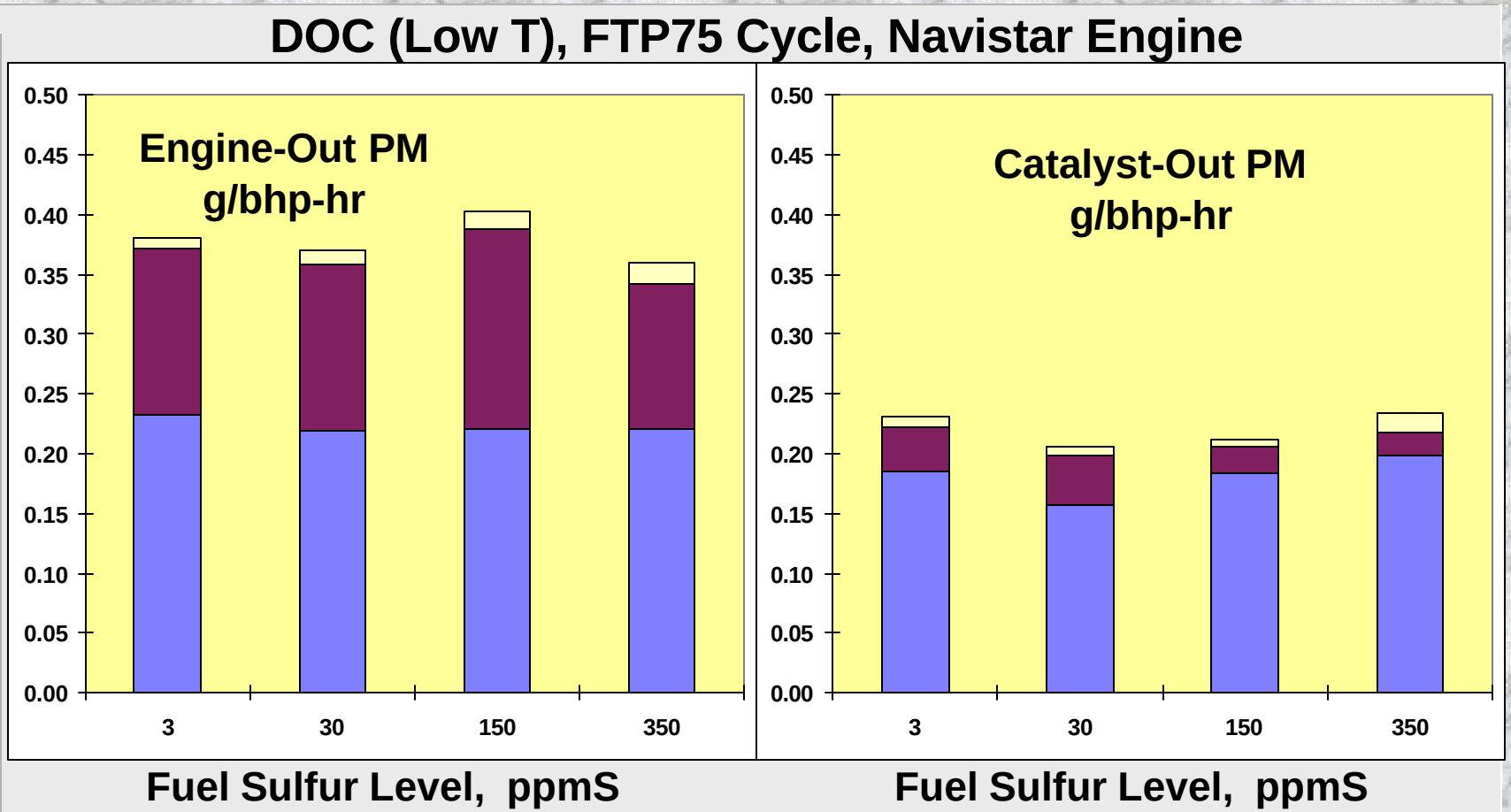
DECSE PM EMISSIONS
DOC



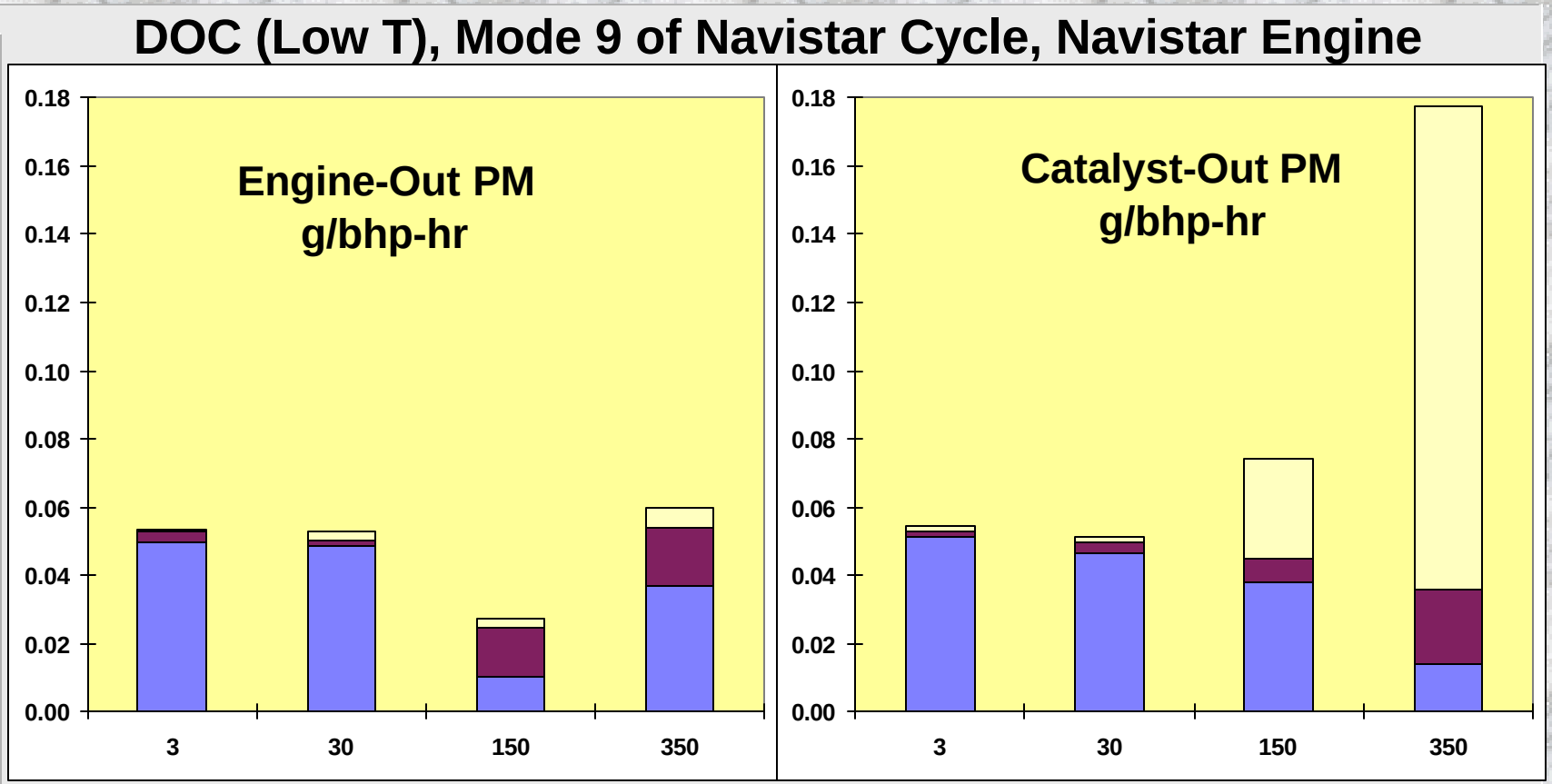
DECSE PM EMISSIONS
DOC



DECSE PM EMISSIONS
DOC

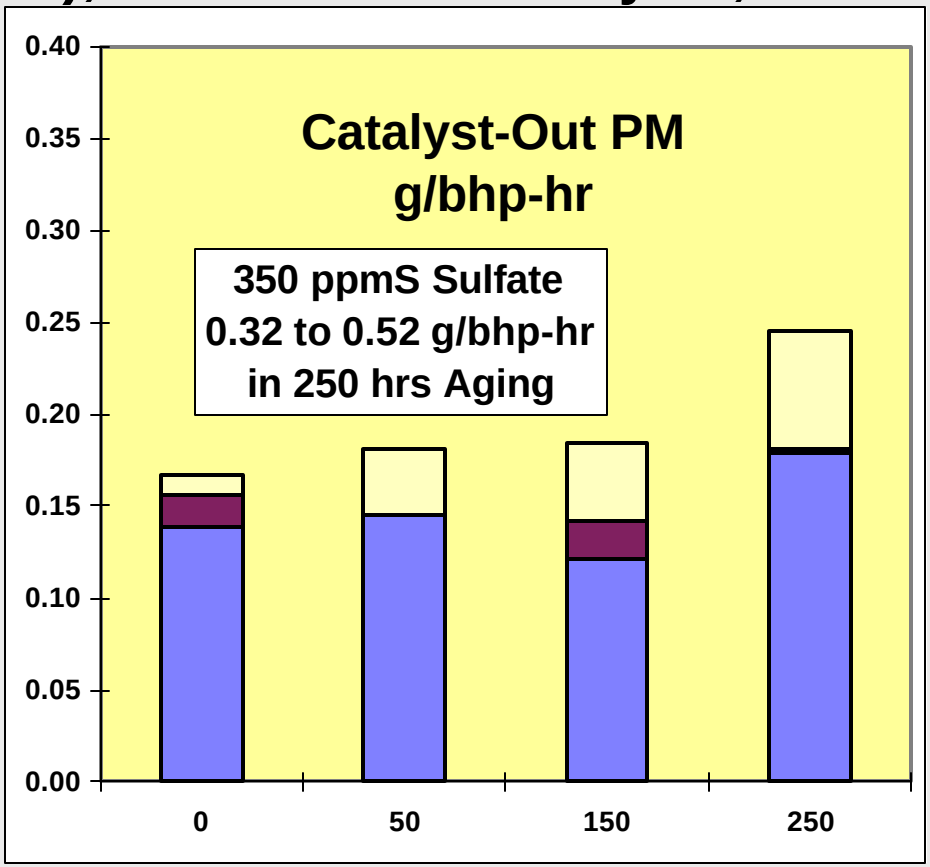


DECSE PM EMISSIONS
DOC



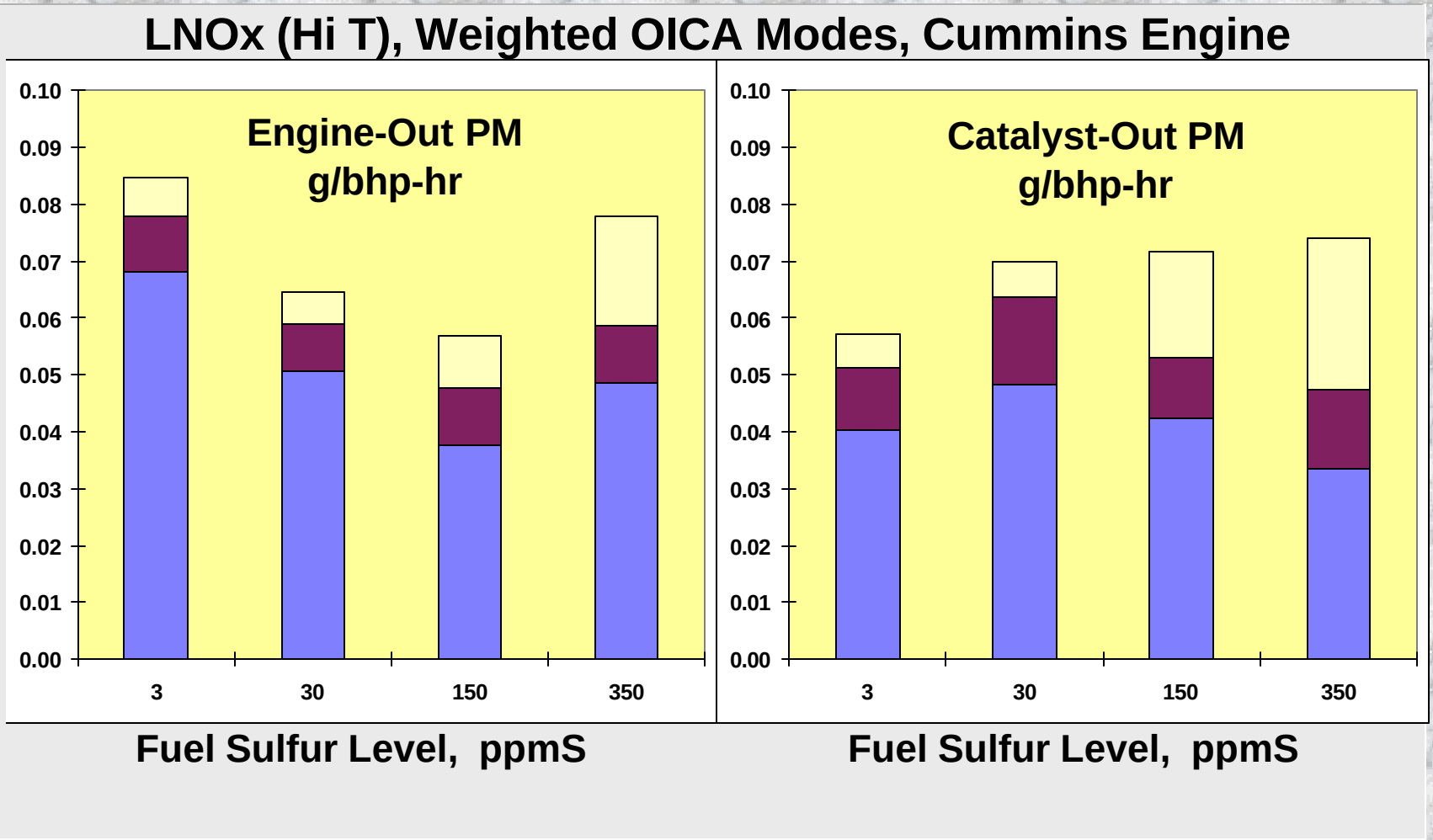
DECSE PM EMISSIONS
DOC

DOC (Low T), Navistar 9-Mode Cycle, Navistar Engine

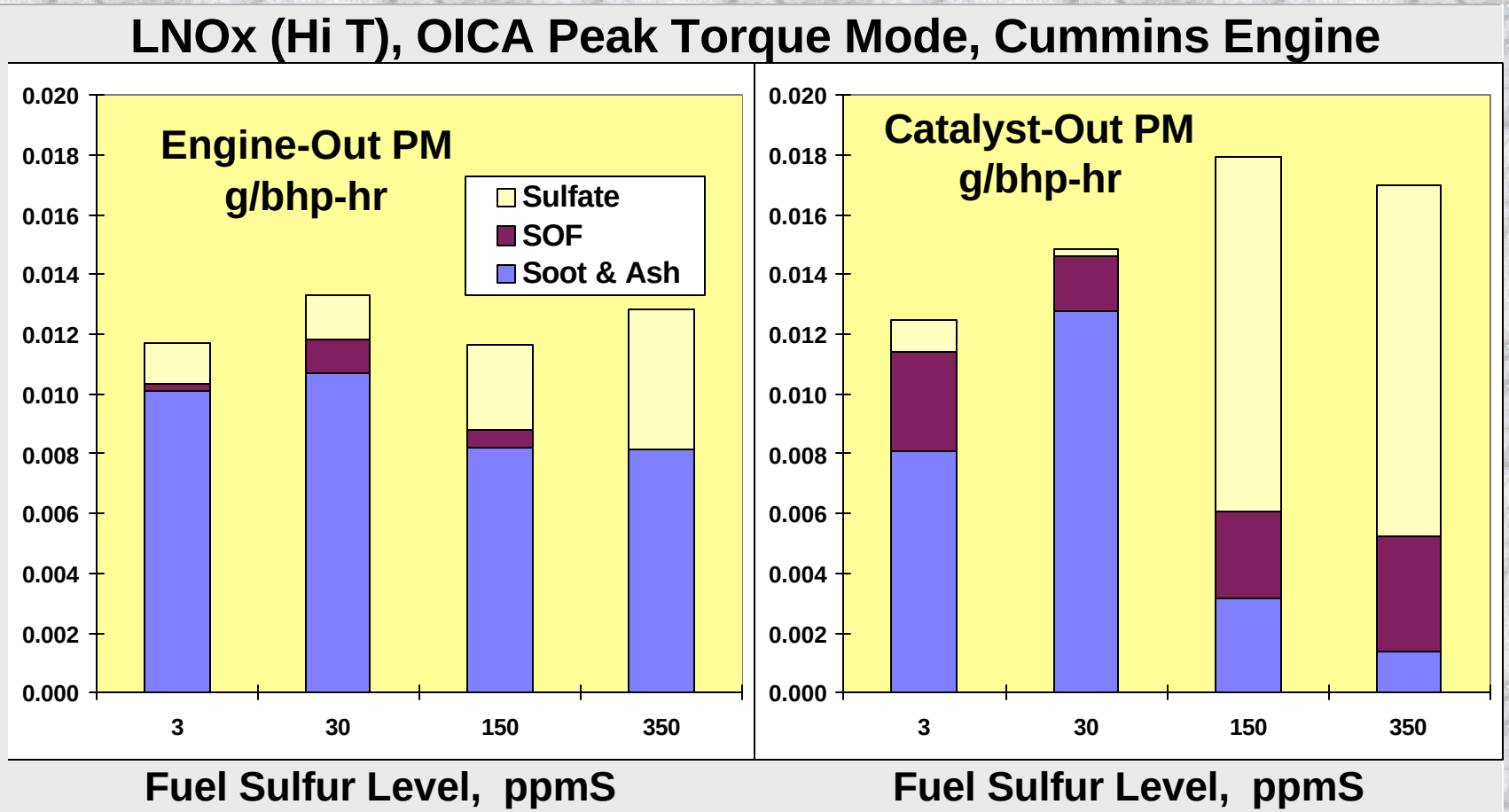


Aging Hours with 30 ppmS Fuel

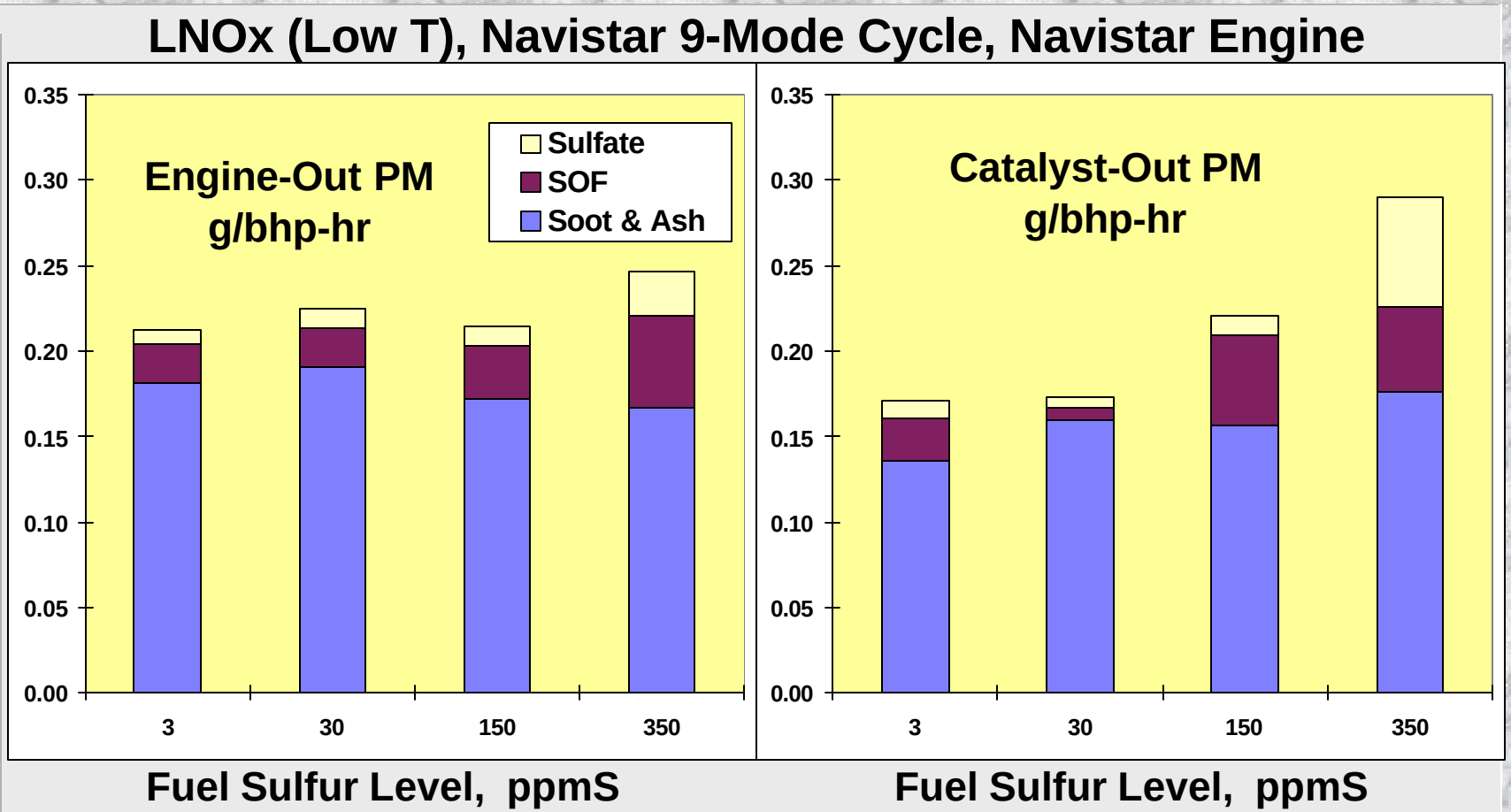
DECSE PM EMISSIONS
LNOx



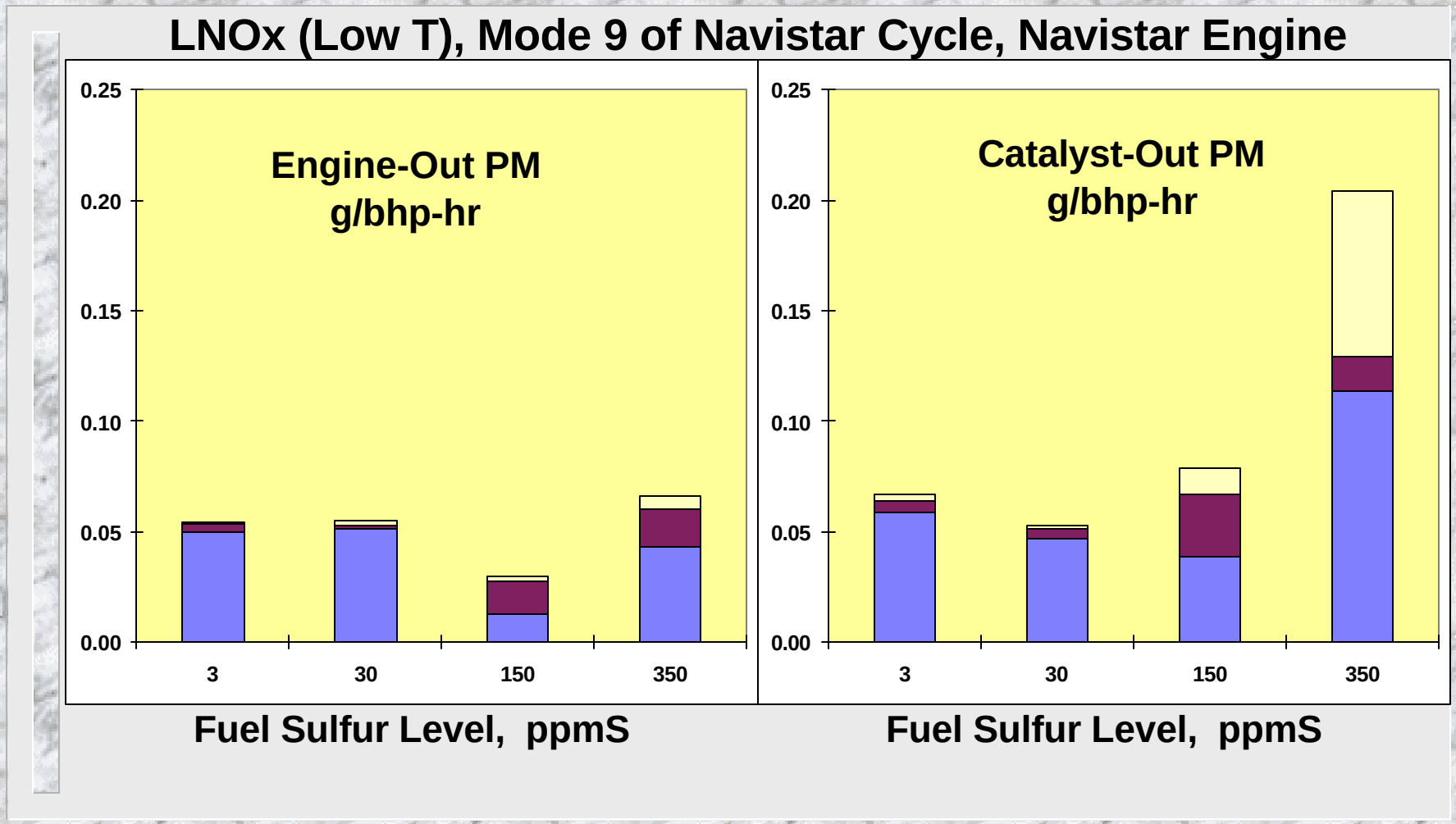
DECSE PM EMISSIONS
LNOx



DECSE PM EMISSIONS
LNOx

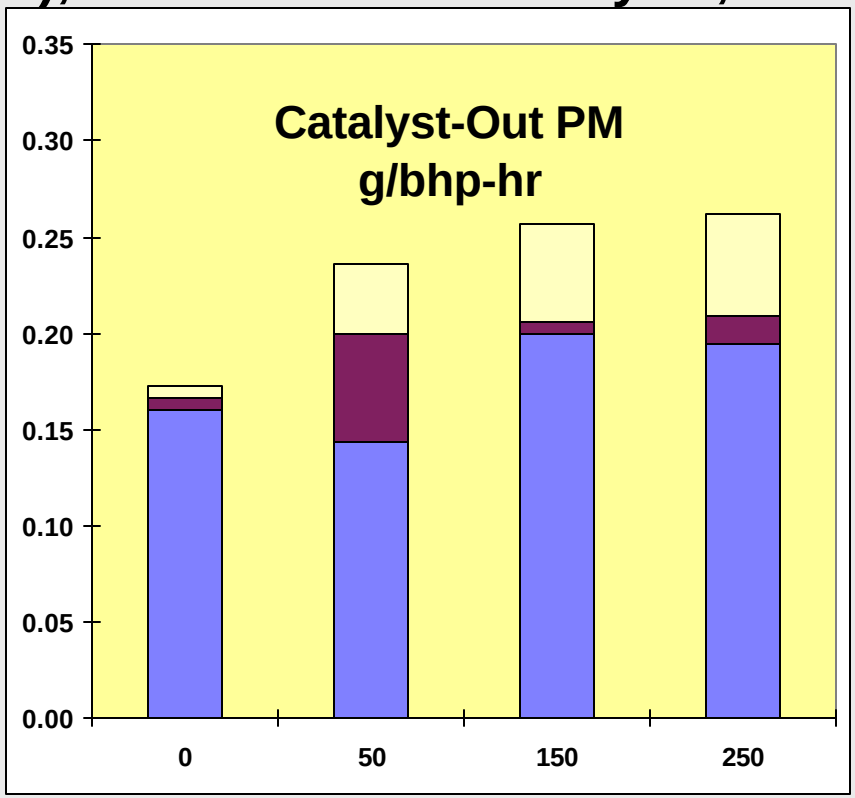


DECSE PM EMISSIONS
LNOx

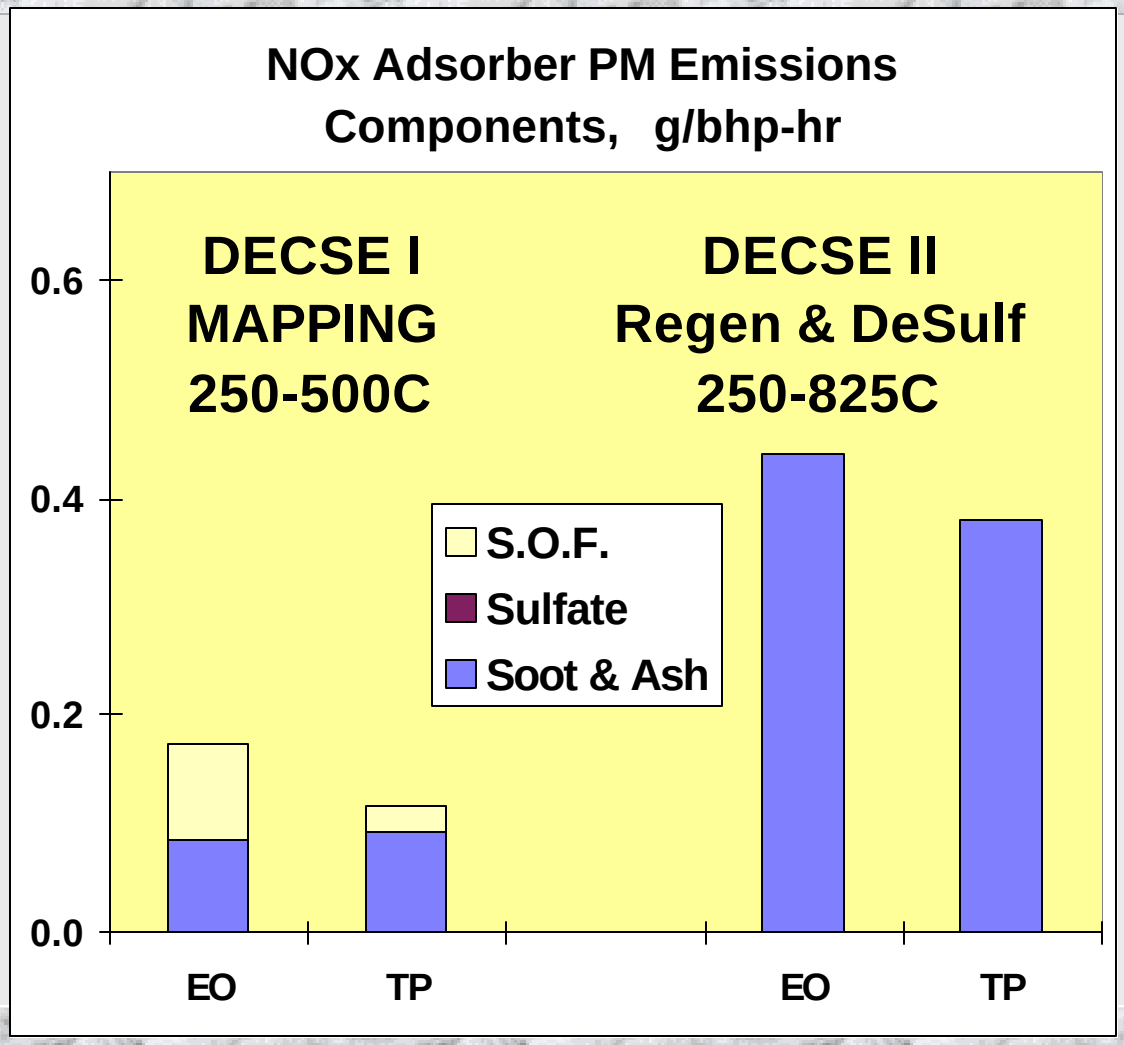


DECSE PM EMISSIONS
LNOx

LNOx (Low T), Mode 9 of Navistar Cycle, Navistar Engine



DECSE PM EMISSIONS
NOx Adsorber



DECSE PM EMISSIONS
DPF Conclusions

- **DPF Technology is 95% Effective at Reducing Particulate Matter with 3-ppm Sulfur Fuel - Removing Soot & SOF**
- **Engine-out PM Emissions Increased By 30% with 350-ppm Sulfur Fuel**
- **Exhaust Temperatures Required to Regenerate DPF Increased By More than 25 Degrees (C) at Higher (≥ 30 ppm) Fuel Sulfur Levels**

DECSE PM EMISSIONS
DOC & LNOx Conclusions

- **DOC and LNOx Catalysts Reduce Some of S.O.F. BUT Are Sensitive To Elevated Fuel Sulfur, Making Sulfates**
- **Post-Catalyst Emissions of PM Increase with Higher Fuel Sulfur Level - Especially Under Peak Torque Conditions**
- **Aging Tests (to 400 hours) with 3-, 30-, 150-, and 350-ppm sulfur fuel continue, showing some additional sulfate increases**

DECSE PM EMISSIONS
NOx Adsorber Conclusions

- **Fresh NOx Adsorbers Can Reduce NO_x Emissions By 80% to 95% With Exhaust Temperatures of 300 to 500 Degrees C. (Fuel economy penalty less than 4%)**
- **NO_x Conversion Efficiency Declines with Catalyst Age, Elevated Fuel Sulfur And Desulfurization Temperature Extremes**
- **NOx Adsorbers Reduce S.O.F. And Show No Propensity To Produce Sulfate**