

Evaluation of Diesel Particulate Filter Systems at INCO's  
Stobie Mine  
Study #3  
June 7 – 10, 2004

By  
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## Objective of the Studies

- Determine and provide Inco with the following characteristics as the DPF systems being tested accumulate operating hours
  - Filtration efficiency using various methods
  - Effects on tailpipe gas concentrations

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## Test Methods Employed

- ☀ Filtration efficiency using various methods
  - Carbon particles using the PAS 2000
  - Bosch/Bacharach smoke number
  - Elemental carbon filter samples
  - Particle number and size distributions using the Scanning Mobility Particle Sizer
  - Opacity under snap acceleration
- ☀ Effects of the DPF on gas concentrations
  - CO, NO and NO<sub>2</sub> using electrochemical combustion gas analyzer – ECOM KL (AC)
- ☀ Effects determined by measurement of exhaust gas upstream and downstream of the DPF system

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## Methodology – Test Site

- ☀ The study was conducted in an surface shop at Froid/Stobie Mine complex
- ☀ Tests reported here were conducted in a one-week period in June 2004

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## Systems Tested

Vehicle ID	Use	Engine	System	Element	Regeneration
#111	Sandvik Toro LHD	DDEC 60 285 hp	Arvin Meritor Duel Filters	Corderite	Automatic using Fuel Burner
#213	Wagner ST8B Scoop	DDEC 60	ECS Unikat Combi- filter	Cordierite	Passive Base-metal Catalyst
#820	Wagner ST8B Scoop	Deutz F12L413FW	JMC DPF 201	SiCarbide/ Corderite	Passive- Active Fuel Borne Catalyst On-board Electric
#621	Kubota Utility	Kubota F2803B 40.3 hp	DCL Titan	SiCarbide	Active Off-board Electric
#2180	Kubota Utility	Kubota F2803B 40.3 hp	ECS Combi- Filter	SiCarbide	On-board Electric

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## Particle Instrumentation



Spinning Disk Diluter and PAS 2000



Up and Downstream  
Sampling with PAS



AVL DiSmoke Opacity Instrument



Opacity sampling  
probe

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### Particle Instrumentation



Size distribution and  
Number concentration  
using SMPS  
(TSI EC 3080 & CPC  
3025)



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### Gas & Smoke Instrumentation



ECOM-KL Gas and Smoke Number  
 $O_2$  ( $CO_2$ ), CO, NO,  $NO_2$  ( $NO_x$ )



ECOM Sampling Probe



Example of smoke number obtained from ECOM

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## Results and Discussion

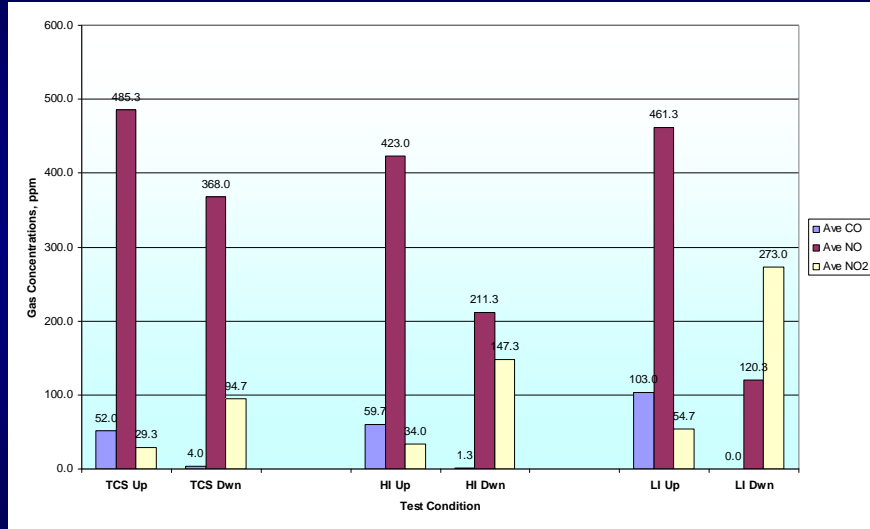
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## Results and Discussion

- ☀ Effects of selected DPF systems on:
  - CO, NO, and NO<sub>2</sub>
  - Soot (carbon particles) – PAS 2000
  - Smoke number
  - Opacity
  - Number concentrations and size distribution of aerosols between 10 and 392 nm

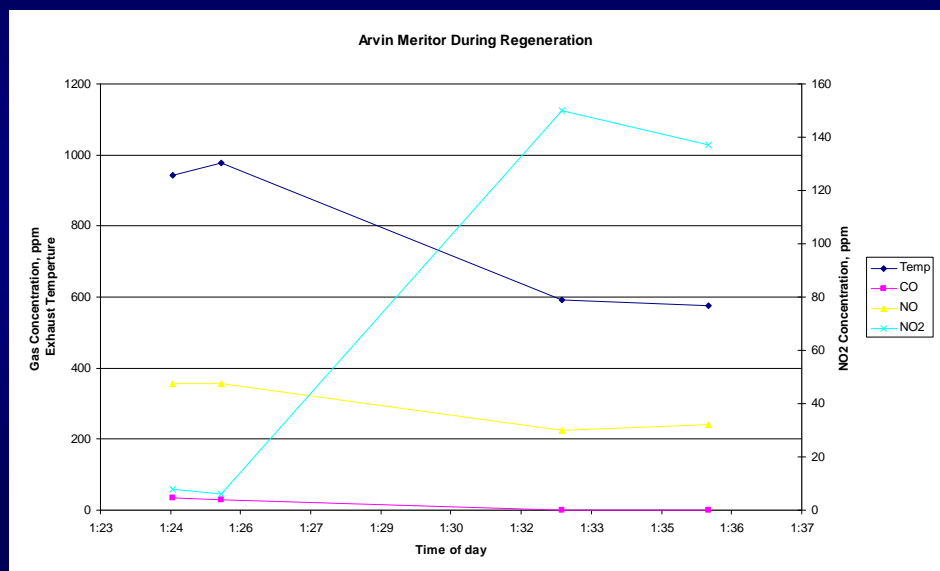
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### Effect of AM DPF System on CO, NO, and NO<sub>2</sub> – Vehicle #111

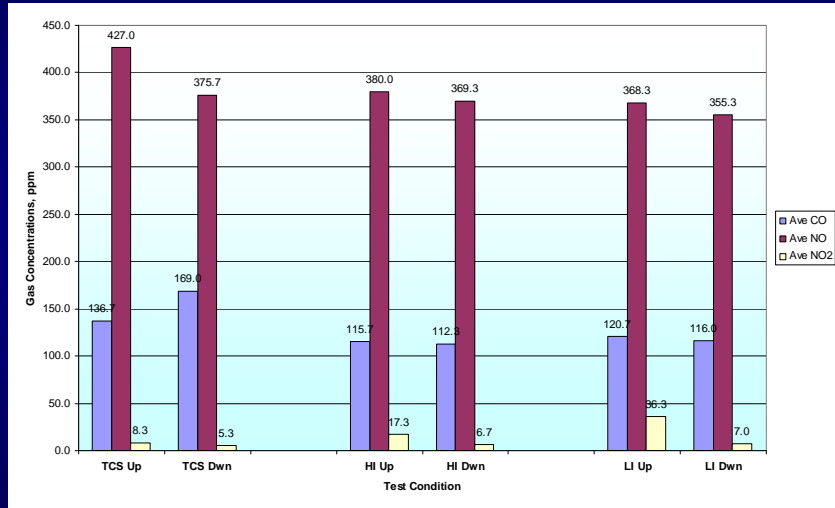


Significant increase in NO<sub>2</sub>

### Effect of Fuel Burner Operation for Regeneration in AM on Exhaust Temp and Gases

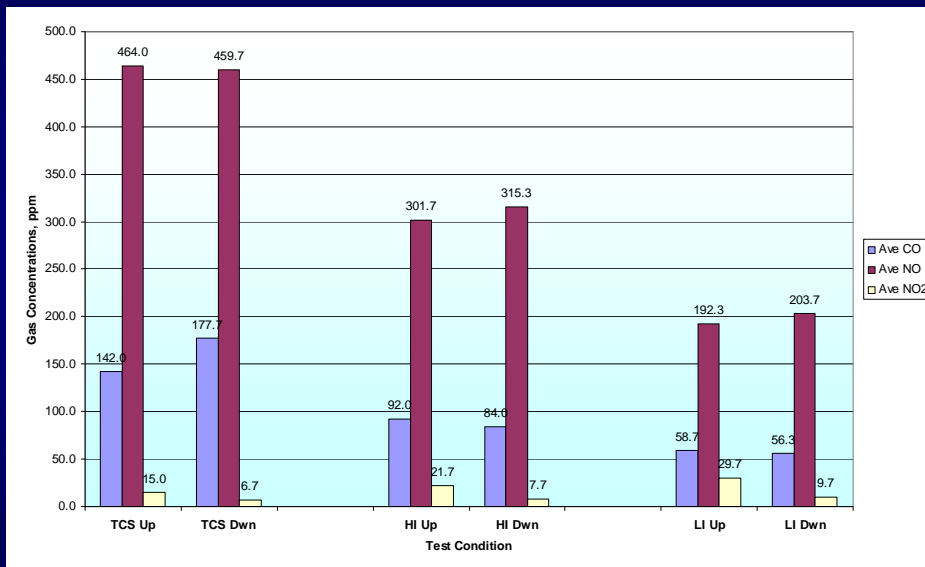


Effects of ECS Combifilter DPF System on CO, NO, and NO<sub>2</sub>  
Vehicle # 213



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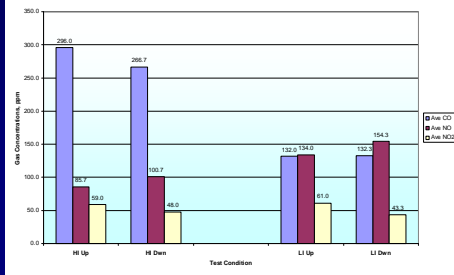
Effects of JM DPF System (Cordierite Substrate) on CO, NO, and NO<sub>2</sub> –  
Vehicle #820



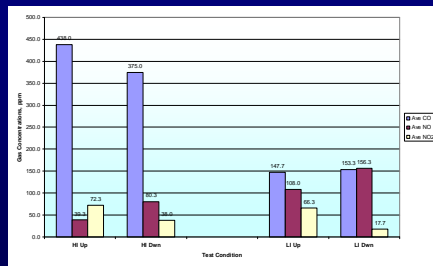
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## Effects of DCL Titan (#621) and ECS Combifilter (#2180) Systems on CO, NO, and NO<sub>2</sub>

### #621 Utility Vehicle

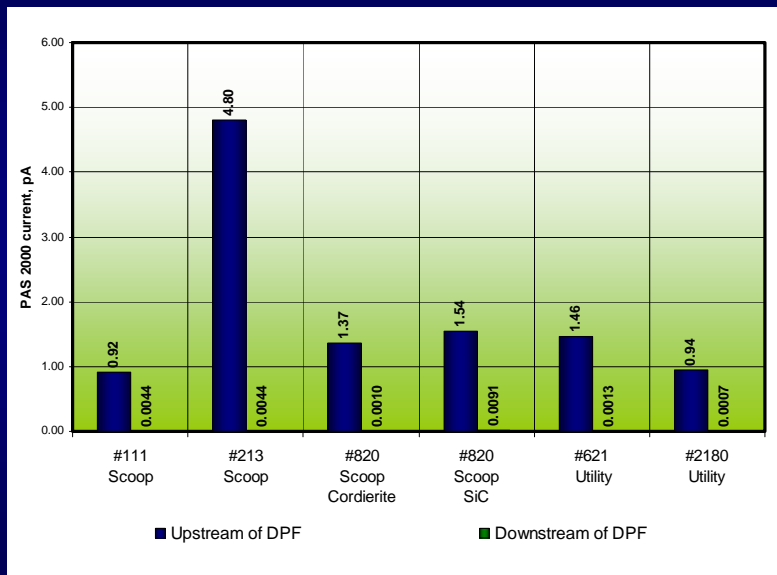


### #2180 Utility Vehicle



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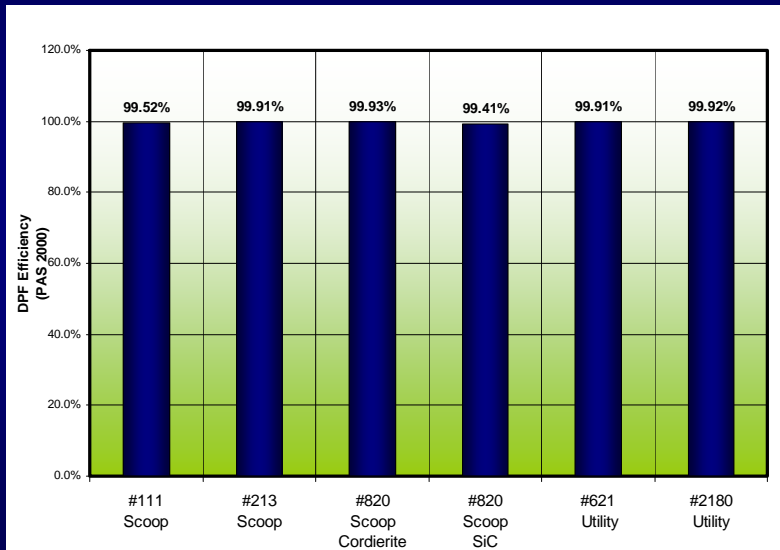
## PAS 2000 Measurements on All Systems



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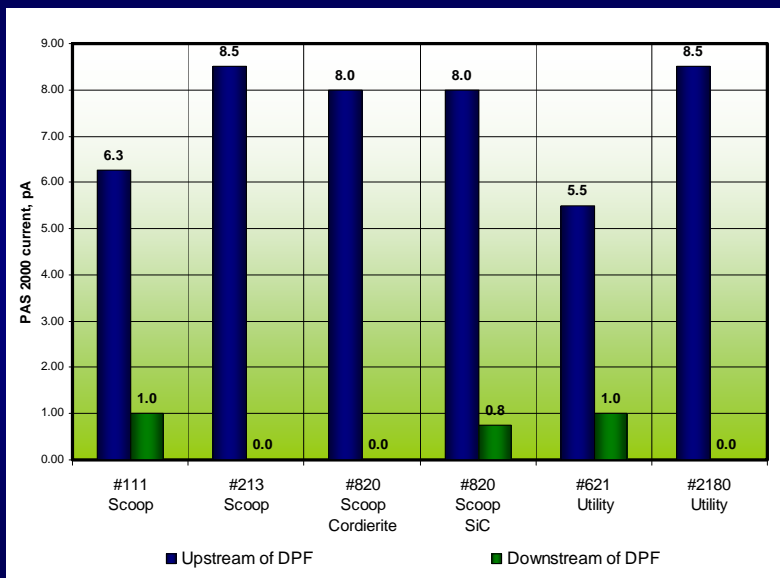


## Efficiencies of All Systems from PAS 2000 Measurements



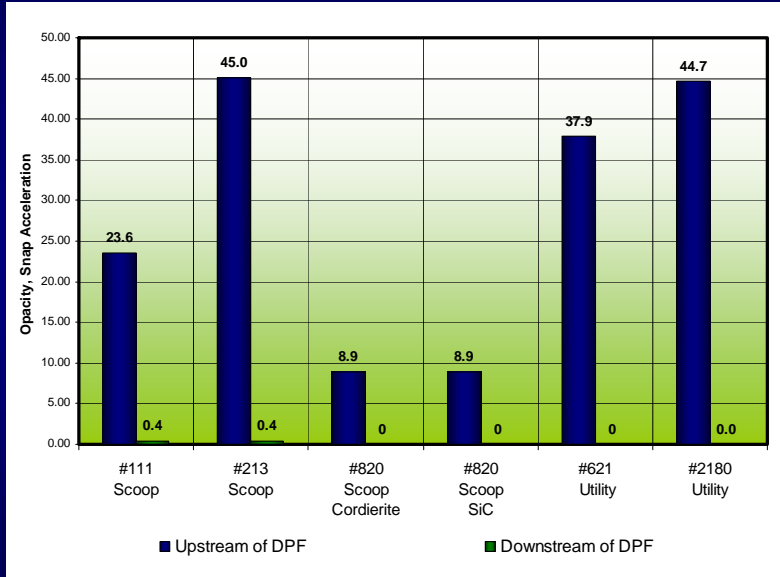
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## Smoke Numbers for All Systems



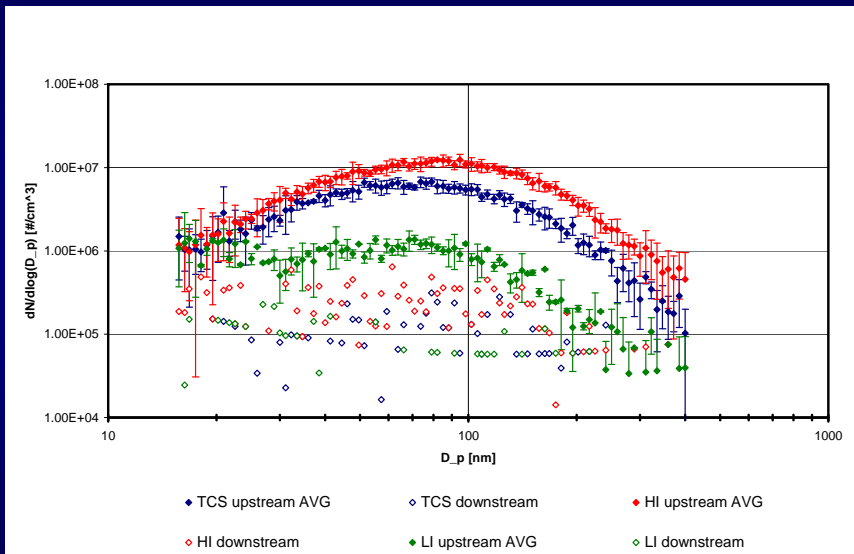
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## Opacity for All Systems



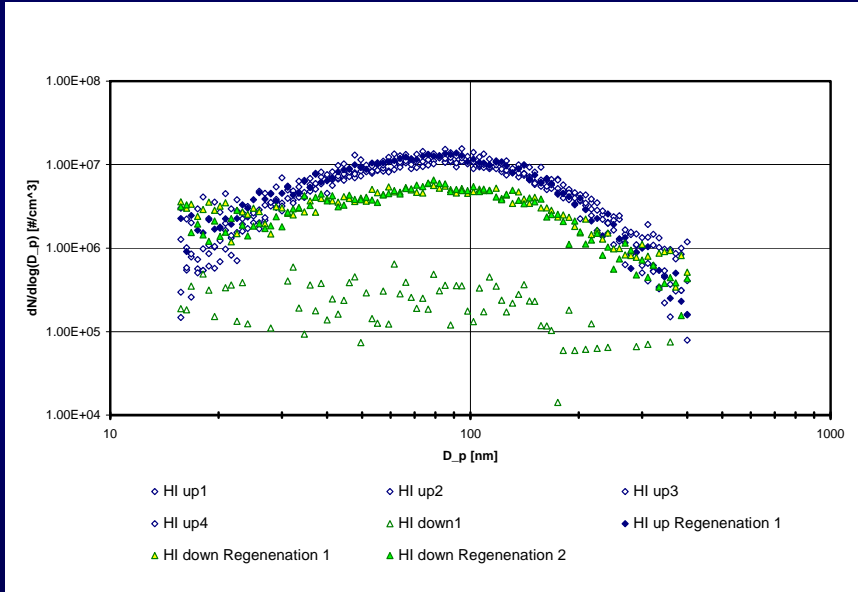
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## Effects of AM DPF System on Number Concentrations and Size Distribution of Aerosols in Exhaust of LHD #111



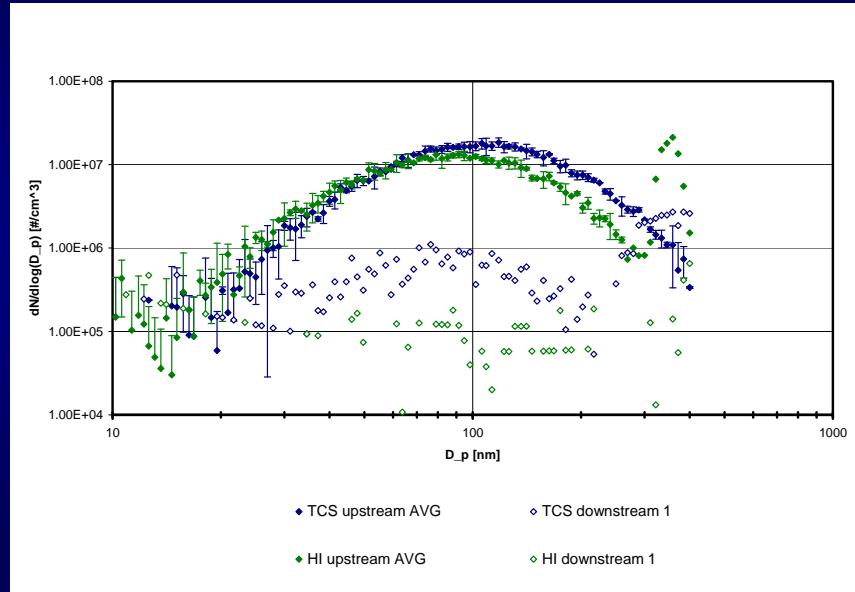
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Effects of AM DPF System on Number Concentrations and Size Distribution of Aerosols in Exhaust of LHD #111



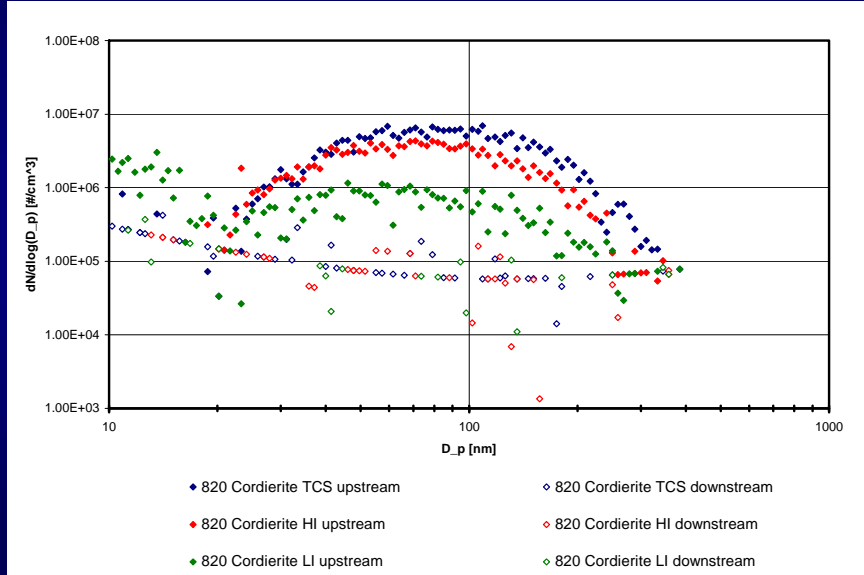
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Effects of ECS Combifilter DPF System on Number Concentrations and Size Distribution of Aerosols in Exhaust of LHD #213



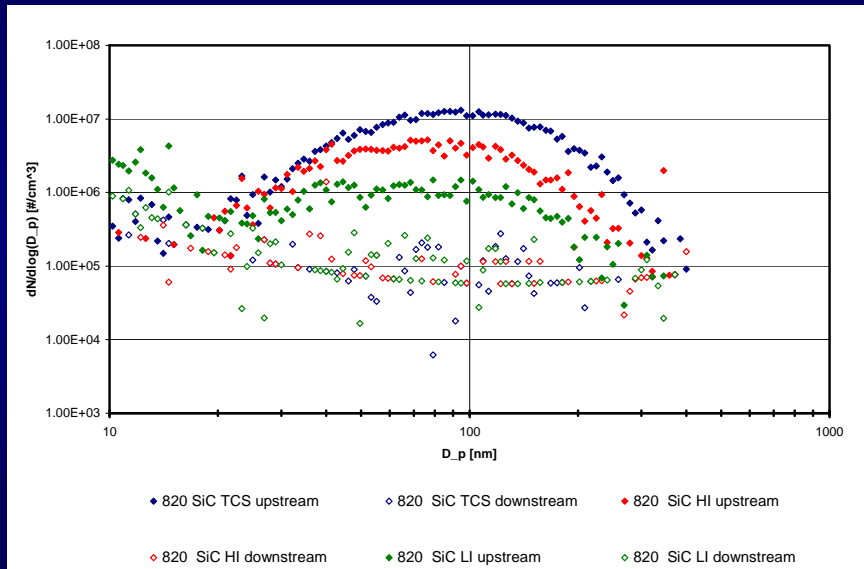
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Effects of JM DPF System (Cordierite Substrate) on Number Concentrations and Size Distribution of Aerosols in Exhaust of LHD 820



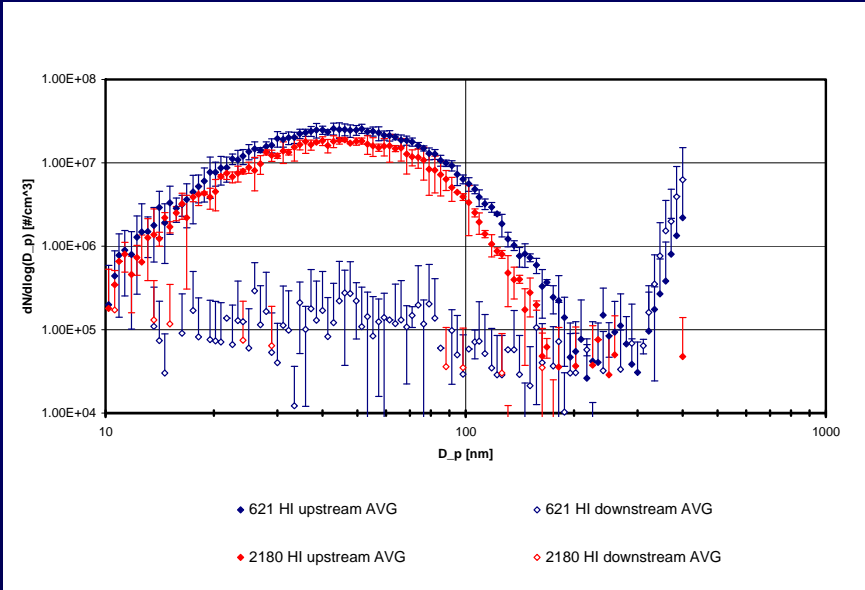
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Effects of JM DPF System (SiC Substrate) on Number Concentrations and Size Distribution of Aerosols in Exhaust of LHD 820



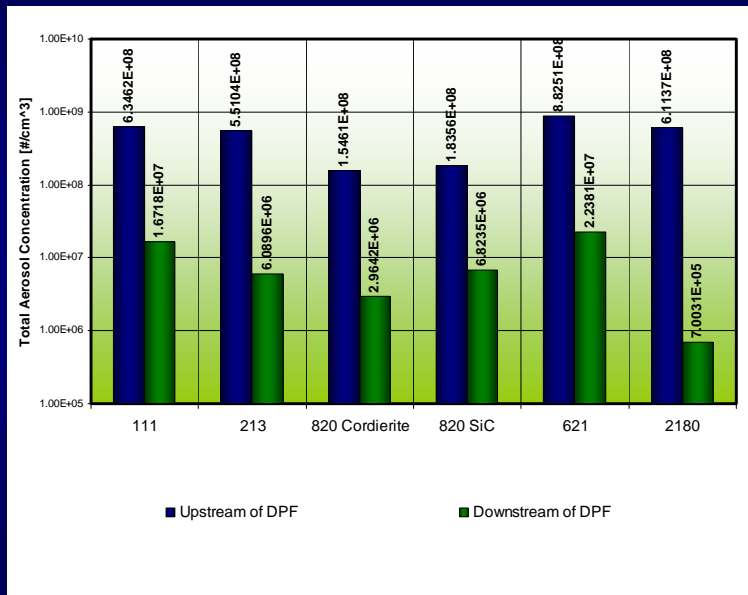
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Effects of DCL Titan (#621) and ECS Combifilter (#2180) Systems on Number Concentrations and Size Distribution of Aerosols in Exhaust



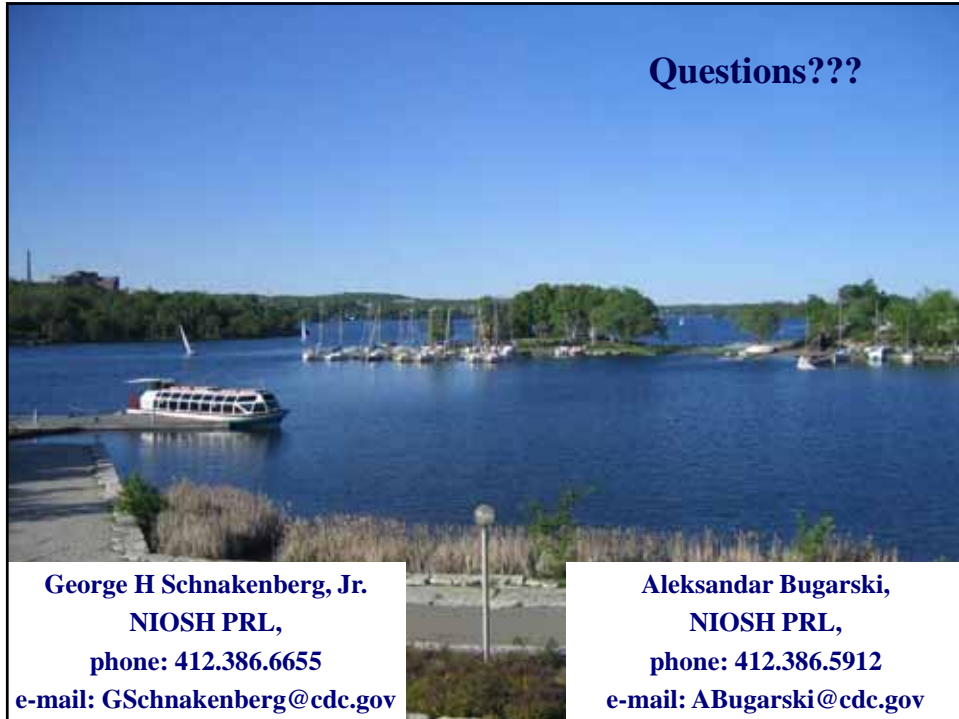
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Effects of Tested DPF Systems on Total Number of Aerosols between 10 and 392 nm in Exhaust



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**Questions???**



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