

# Application of the Longview<sup>®</sup> HC-SCR System to Off-road Construction Equipment

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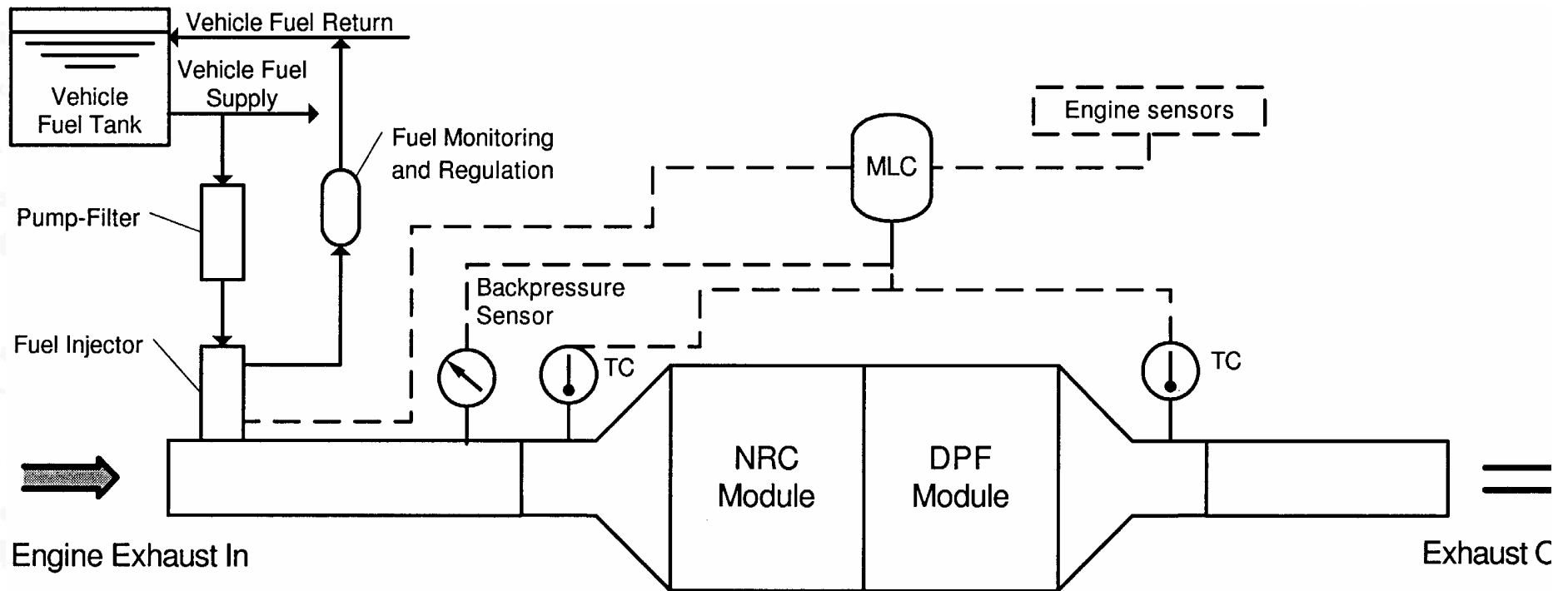
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# The Longview System

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- HC-SCR is “HydroCarbon Selective Catalytic Reduction”
- Diesel fuel is the reducing agent, pulled from the engine’s fuel tank
- HC-SCR components reduce NOx
- Catalyzed DPF reduces PM, CO, and HC
- The Longview integrates the HC-SCR and DPF functions.

# The Longview System



# The Longview System

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# Longview Experience

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- Initially developed for the on-road heavy duty markets
- Over 3000 retrofit applications in California including transit bus, refuse truck, and line-haul vehicles since 2002.
  - >10 million hours / 175 million kilometers
  - Good experience with ruggedness and durability
- Off-road field tests in progress on a variety of equipment

# Longview On-Road Verification

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- Verified by CARB for on-road mobile applications in 2003
  - 5 to 15 L diesel engines.
  - Requires exhaust temperatures of 260 °C for 25% of time.
  - 5 year/150,000 mile warranty
  - Annual warranty reports required

# Longview Design Features



**Modular design**



**Advanced diagnostics and controls**



**Rugged materials and proven packaging**



**Variety of inlet and exit cone options**

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# Test Objectives

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- Investigate emission performance of Longview system
  - Off-road engine
  - Off-road test cycle
  - Benchmark against on-road test performance



# Test Setup

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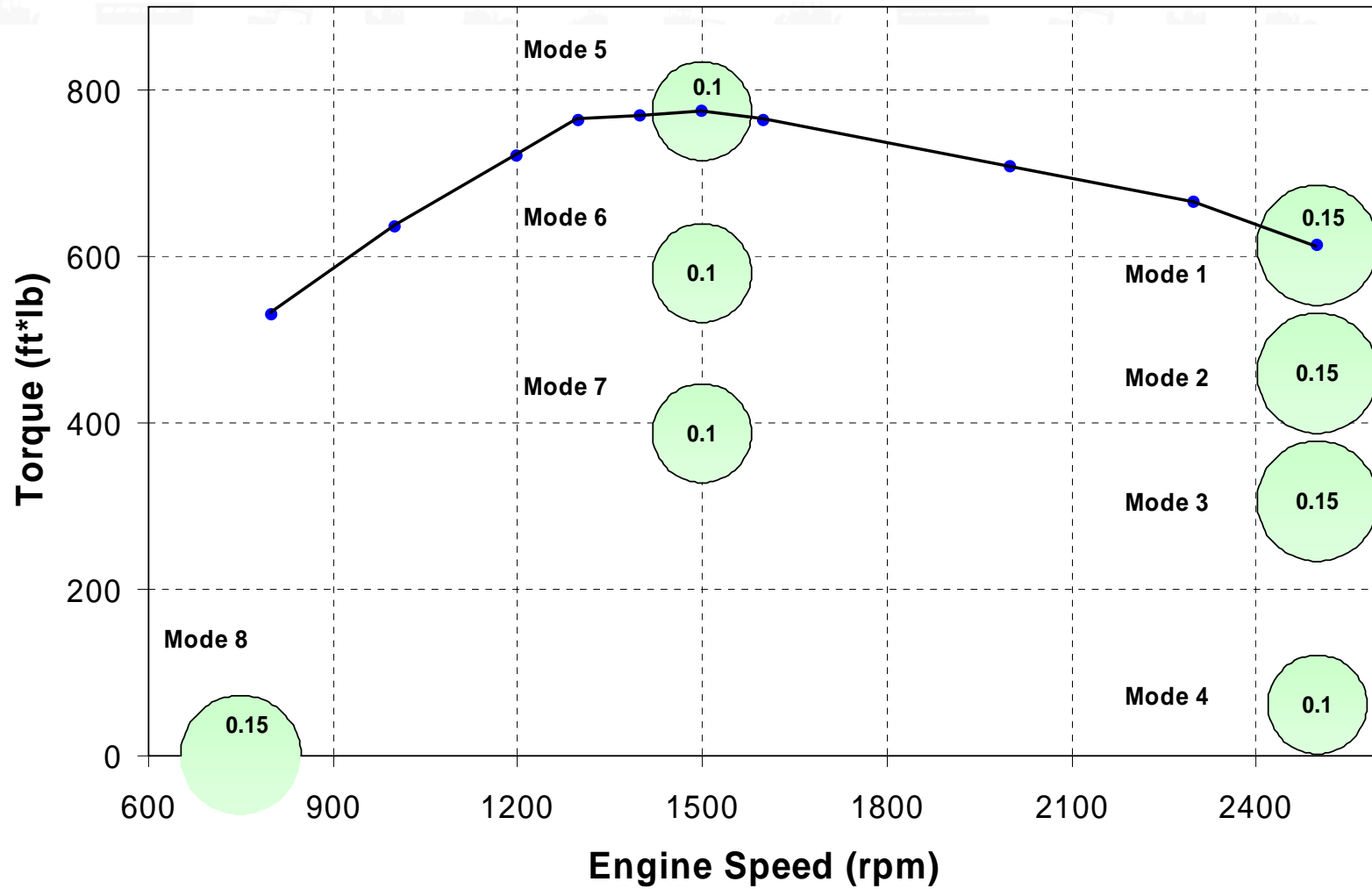
- Cummins Test Laboratory in Rocky Mount, NC
- Engine
  - MY 2005 Cummins QSB Tier III engine
  - 6.7 L, 285 hp
- Fuel: EPA ULSD (<15 ppm S)
- Raw emissions sampling of
  - NO and NO<sub>x</sub> (NO<sub>2</sub> inferred by subtraction)
  - CO
  - CO<sub>2</sub>
- PM not measured

# Test Plan

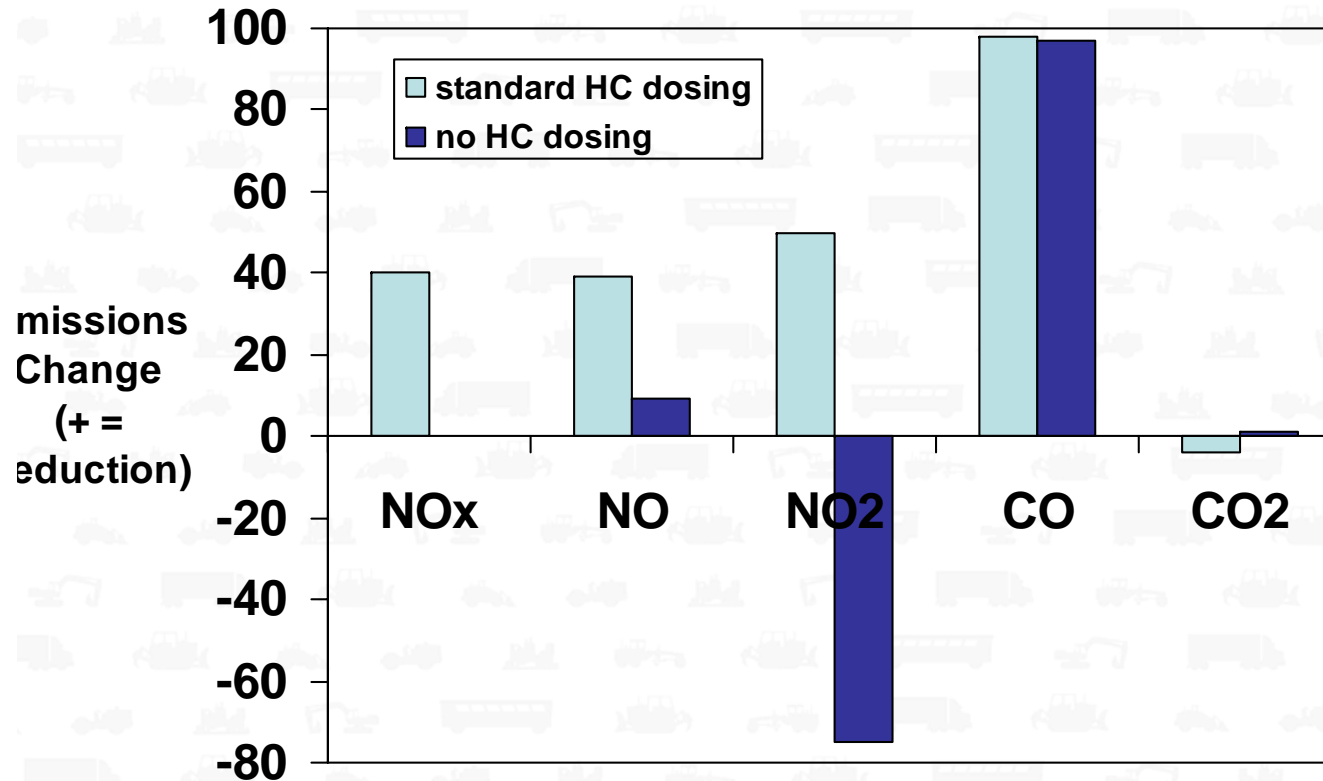
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- ISO 8178 D1 8-Mode Test Cycle
- Baseline Emissions
- Longview
  - Standard commercial configuration

# Test Cycle: ISO 8178 C1 8-Mode



# Cycle averaged emissions with and without HC dosing



HC dosing has a dramatic impact on NOx and NO2, and little on CO and CO2 emissions

# Longview Performance

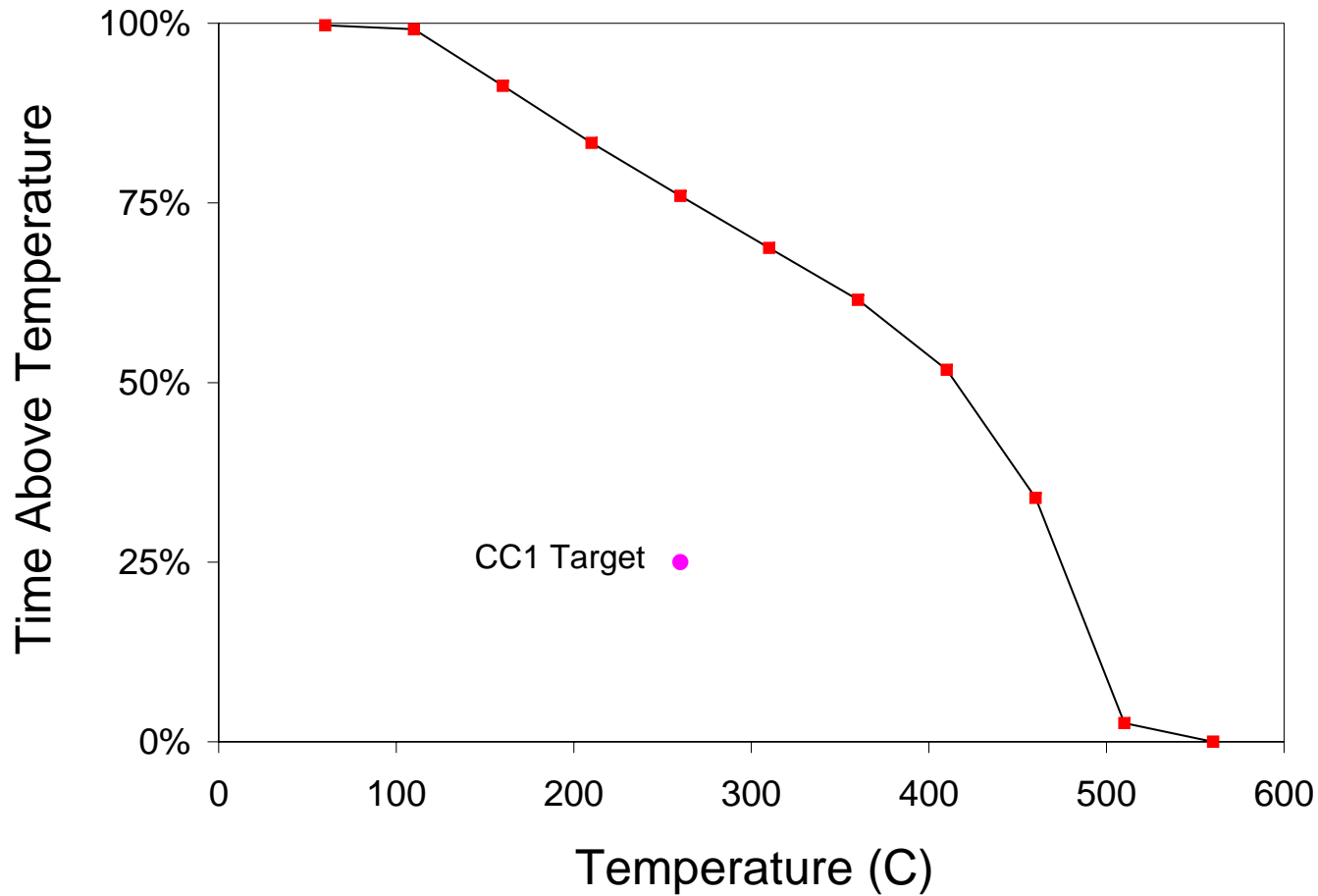
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- Cycle averaged emissions
  - NO<sub>x</sub> reduction of 40%
  - NO<sub>2</sub> reduction of 50%
  - CO reduction of >95%
- PM reduction has been shown to be >85% in many other test campaigns

# Excavator



# Cumulative Temperature Distribution for Excavator



# Scraper





# Longview “Off-Road” Examples



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# Grader



# Summary of Longview HC-SCR/DPF System

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- Over 3000 successful on-road applications, can be applied to off-road applications
- Capable of >40% NO<sub>x</sub> reduction and Level 3+ PM performance
- Diesel fuel is the reductant; no secondary reagent required making Longview a very practical solution
- Currently under field test in many applications
- CARB verification being pursued