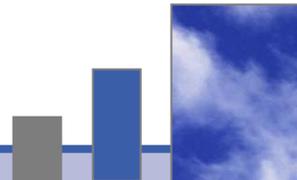


Emission Control Systems and Components for Retrofit, and First-fit Applications

Bradley L. Edgar
Cleaire

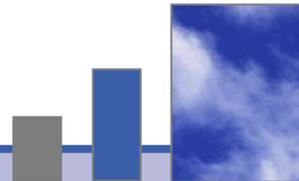
cleaire

ADVANCED EMISSION CONTROLS®



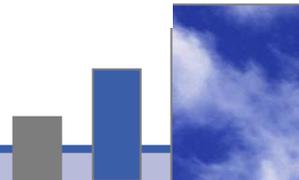
Objectives

- 1) Design a suite of the highest quality components to be assembled into versatile, state-of-the-art aftertreatment systems for retrofit and first-fit applications.
- 2) Develop, verify, and market "Turnkey" diesel retrofit systems that reduce both NOx and PM emissions from in-use diesel engines.

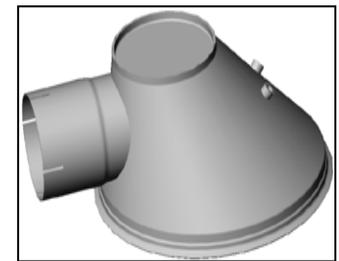
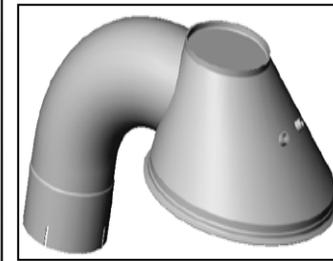
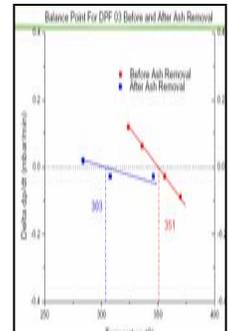
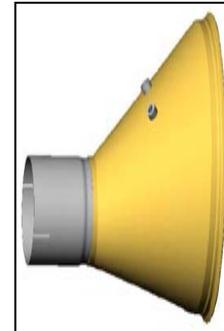
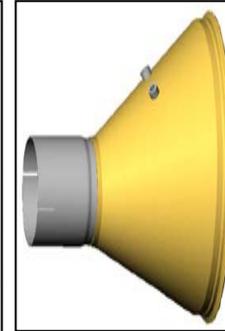


Outline

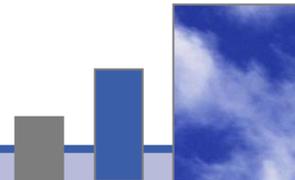
- Components
 - Modular canning system
 - Controls and Sensors
 - HC dosing system
 - NOx Reduction Catalyst (NRC) Module
 - PM Control Module
- Systems
 - Longview®
 - Lonestar™



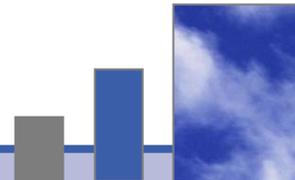
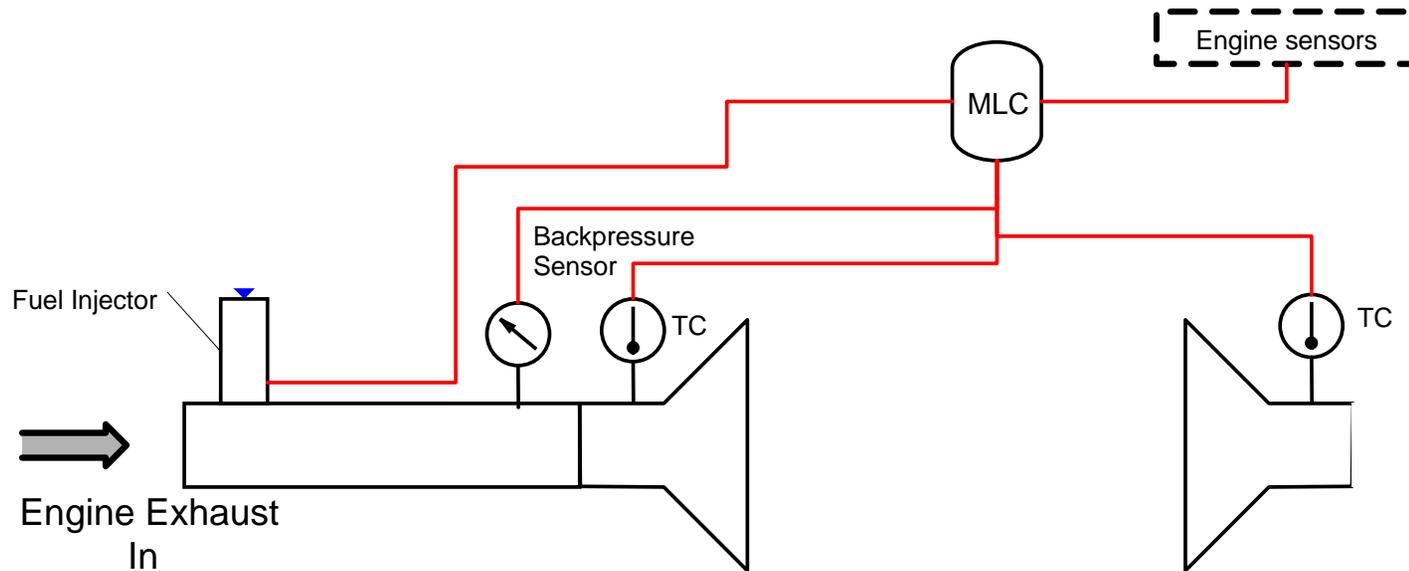
Modular Canning System



- **“Gasketless” clamping design**
- **Reusable sealing rings and clamps**
- **Multiple catalyst configurations**
- **Library of inlet and exit cone designs**



Controls and Sensors



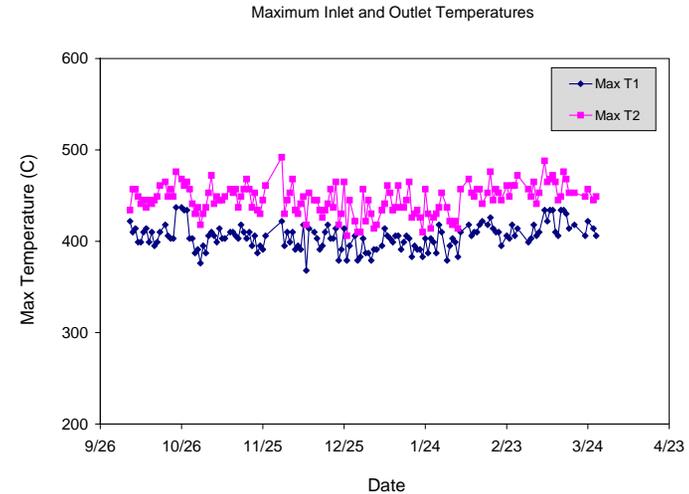
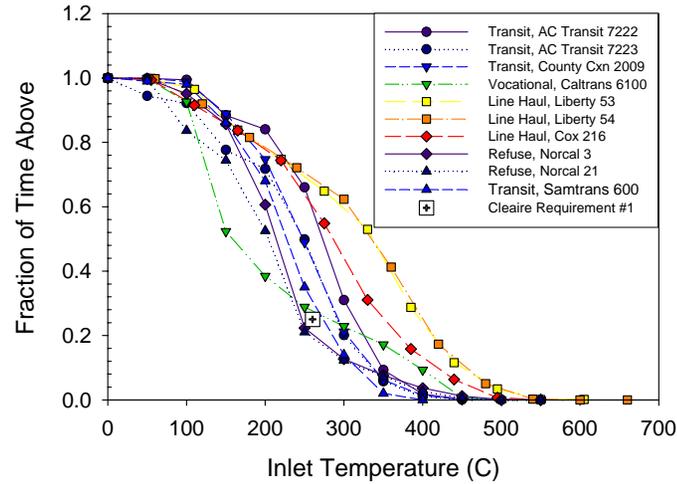
The Cleaire MLC®



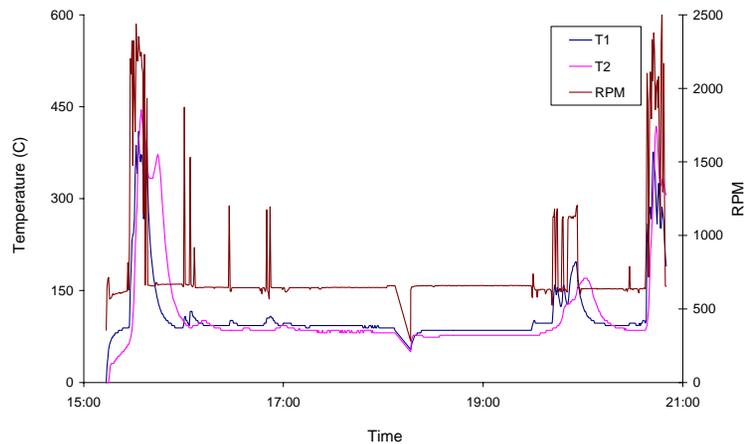
- 8MHz processor
- Multiple Signal Input
 - Thermocouple
 - 0-5V DC
 - Frequency (RPM)
- Multiple Signal Outputs
 - 2 PWM signals
 - LED diagnostics
 - 0-5 V DC
- 8MB on-board FLASH memory
- MLinC™ PC interface



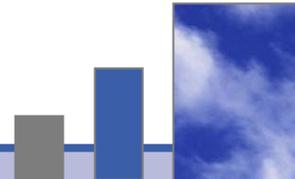
Data Analysis Tools



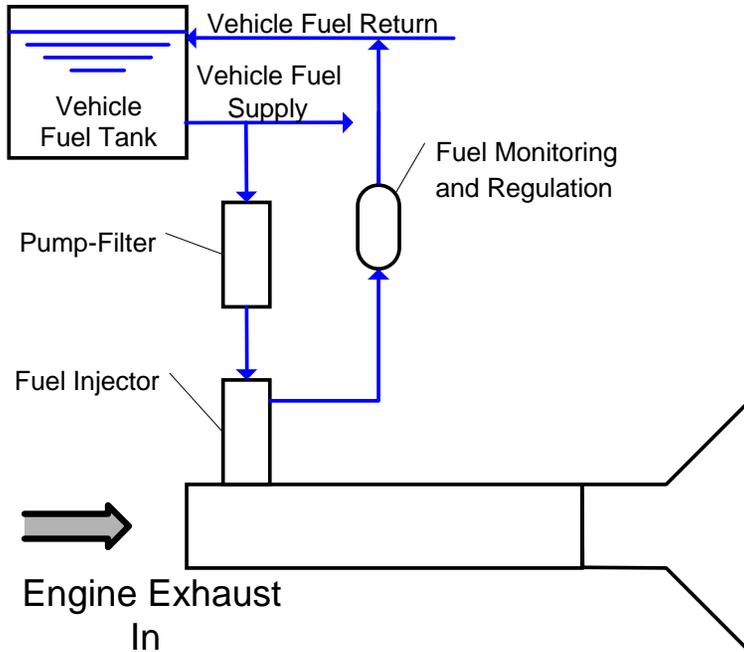
T1 and T2 on 1/27/04



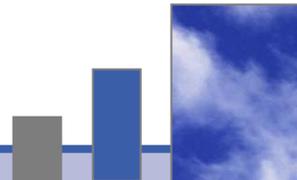
- Temperature profiles
- Duty cycle analysis
- Long term trends
- Warranty analysis



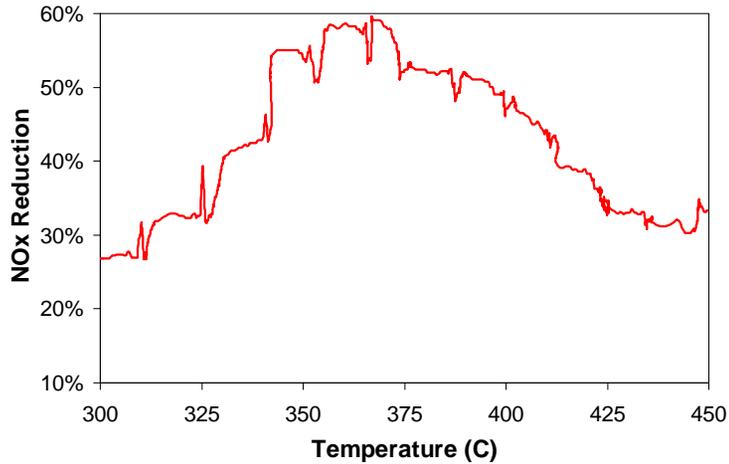
Fuel Injection System



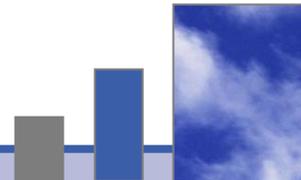
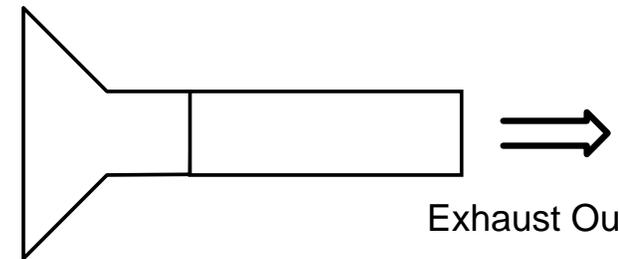
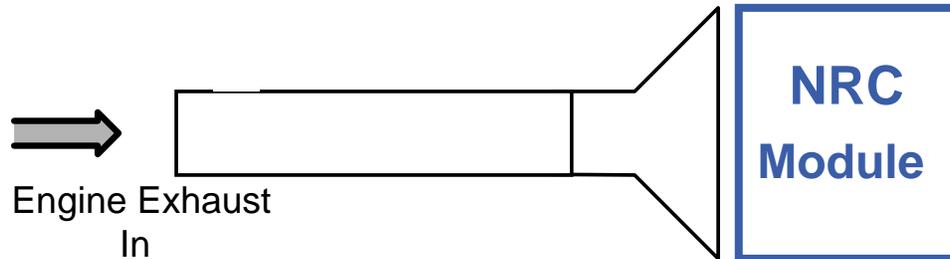
- **Automotive fuel injector**
- **Fuel cooled injector mount**
- **Pulse-width modulated injection**
- **Mixing and flow distribution hardware**



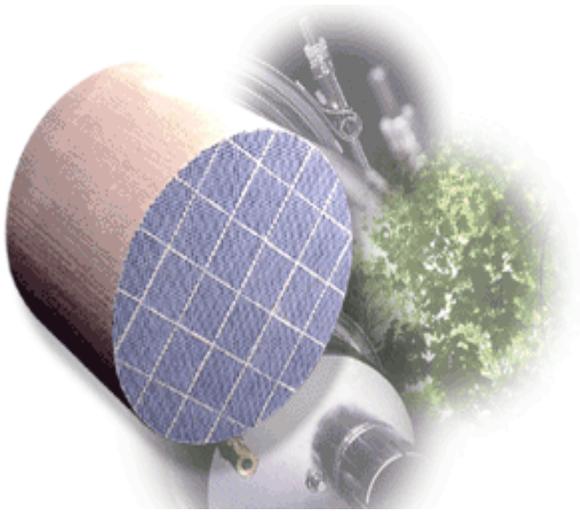
NOx Reduction Catalyst (NRC)



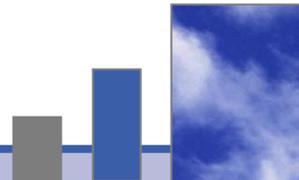
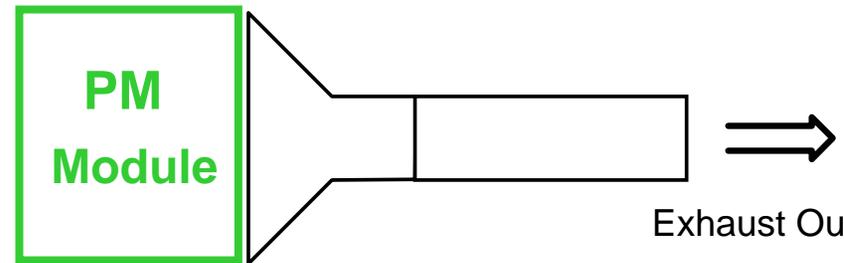
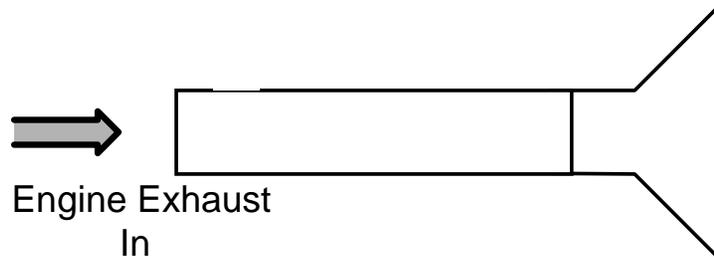
- aka Lean Nox Catalyst, HC-SCR
- High and Low temperature formulations
- Requires active dosing of reagent (diesel fuel)



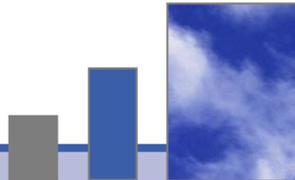
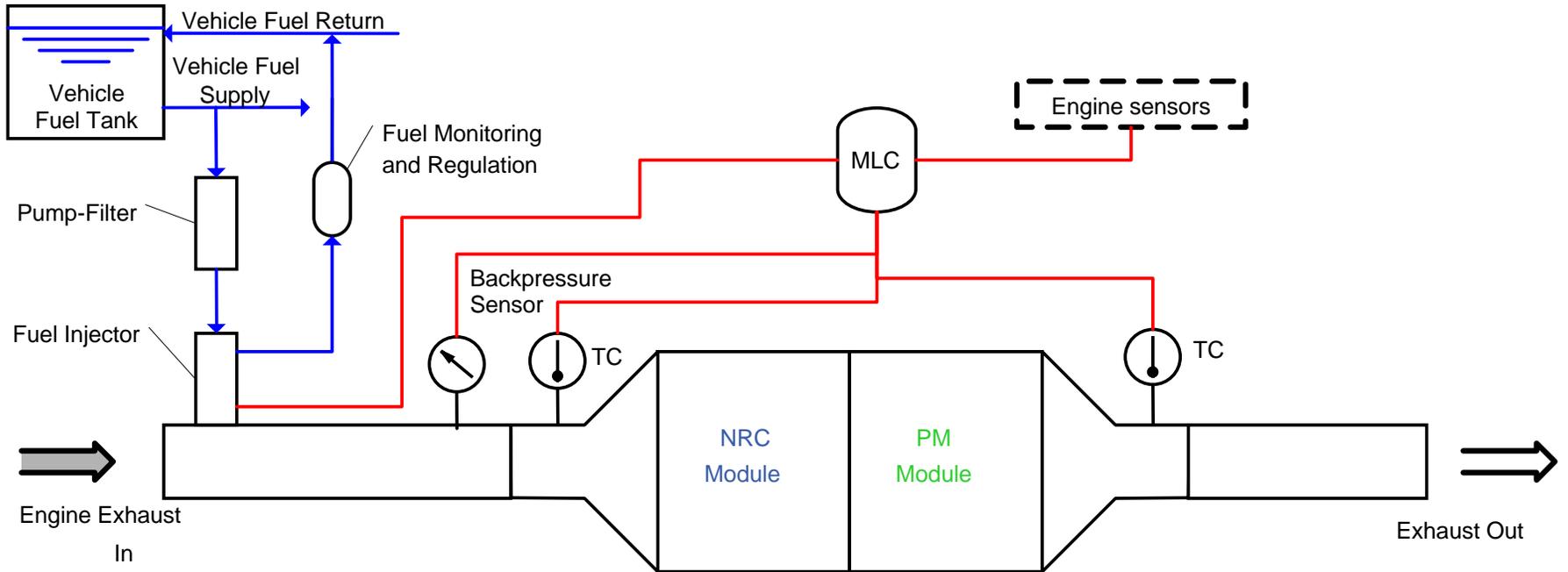
PM Control Module



- Catalyzed DFP, or
- Flow through DOC
- Serves to control HC slip



System Architecture

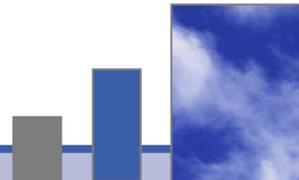


Longview® / Lonestar™



Integrated "Turnkey" Systems

Name	Configuration	NOx Reduction	PM Reduction
 Longview®	NRC + DPF	25-35%	>85% (w/ULSD)
 Lonestar™	NRC + DOC	25-35%	10-50% (fuel dependent)



Longview®

- Cleaire's flagship product
- Proven, solid retrofit platform
- Verified for on-road 1994 – 2002 engines, all makes
 - 5 to 15 L engines
 - ULSD required
- Over 500 in daily service



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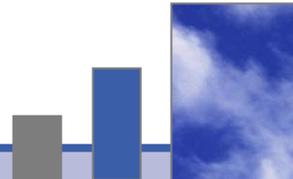
BusinessWire



Cleaire Receives California and EPA Approval of Diesel Emission Reduction Technology for Use on Wide Range of Heavy-Duty Engines

08.17.04, 12:17 PM ET

California and Federal officials have approved the Longview(R) diesel emission retrofit system for use in all 50 states on virtually all on-road heavy-duty diesel engines manufactured between 1994 and 2002, officials of Cleaire Advanced Emission Controls(R), LLC announced today.



Longview Installations



Conclusions

- Components and sub-systems have been developed to support integrated aftertreatment systems, both retrofit and first-fit.
- The Cleaire Longview and Lonestar are examples of integrated aftertreatment systems
- The Longview is now CARB and EPA verified to reduce both Nox and PM emissions from in-use engines.
- Cleaire has over 500 systems installed with many more to come.

