Development and Deployment of Advanced Emission Controls for the Retrofit Market

DEER Meeting
August, 2003

Brad Edgar
Marc Rumminger
Michael Streichsbier
Cleaire Advanced Emission Controls
San Leandro, CA 94605
Outline

• Introduction
• Phase I – Product Development
• Phase II - Deployment
Cummins West, Cleaire, and CaTTS

- Cummins West (CWI) is the regional distributor of Cummins engines and Komatsu Heavy Equipment
  - > 350 employees
  - $100 M Revenue
- Cleaire is a division of Cummins West, Inc.
  - Headquartered in San Leandro, CA
  - Manufacturing facility in San Diego
- CaTTS (California Truck Testing Services) is a division of Cummins West
  - Located in Richmond, CA
  - 1 of 6 HD Chassis dynamometer labs in North America
  - Development and verification testing
Motivation - Why is Retrofit Important?

- If we wait for fleet turnover to take effect, we will give up on two generations of breathers.
- Significant reductions in NOx and PM can be achieved NOW.
- Retrofit is a tool for planners and regulators to meet near term Ozone and Air Toxics requirements.
Development - System Components

- Modular packaging system
- Integrated NOx and PM control catalysts/filters
- Device for monitoring, logging, and control of system (MLC®)
- Fuel injection (Hydrocarbon dosing) system for NOx reduction and filter heating
Development - NOx Reduction Catalyst

• A.K.A.
  – Hydrocarbon Selective Catalytic Reduction (HC-SCR)
  – Lean NOx Catalyst (LNC)
• Diesel fuel (HC) is the reducing reagent
• No secondary reagent storage tank required
• No ammonia slip issues
• HC slip is addressed with catalyzed DPF or DOC
NOx reduction vs. temperature
Cleaire Longview™

Vehicle Fuel Tank → Vehicle Fuel Supply → Vehicle Fuel Return

Pump-Filter

Fuel Injector

Fuel Monitoring and Regulation → Backpressure Sensor

MLC

NRC Module → DPF Module

Engine Exhaust In → Exhaust Out

Engine sensors

TC

TC
Performance and Verification Testing

Vehicle
- Cummins M11/ISM, ISC, ISX
- International DT-466

Test Cycles
- Transient (UDDS, NYCB), Steady (4-5-6)

Fuels
- CARB #2 Diesel
- ULSD
Emission Reductions with Longview and ULSD Fuel

Engine: 1997 Cummins M11
Development - Field experience

• Field test and early demonstrations
  – ~90 systems operating in the field
  – Used in transit, refuse, line haul vocational, and non-road applications.

• Product success
  – Over 1,800 installations committed over the next 18 months.
Development - Longview Verification

- CARB verified in April, 2003
- Some Cummins and ITEC engines, others to follow
  - 25% NOx reduction
  - >85% PM reduction
- Verified for use with ULSD fuel
New Product - Lonestar

- Product specification
  - 40% NOx Reduction
  - Cost effective ($/ton NOx)
  - Fuel tolerant (EPA, CARB, ULSD, GTL)
  - Does not require ULSD
  - No filter maintenance
  - Targeted at non-urban bus market
- Shares modular Longview platform
- EPA verification in progress
- Systems are available now
Longview and Lonestar Systems

**Longview™**
- Modular Design
- Computer controlled HC dosing system
- NOx Reduction Catalyst (NRC)
- Catalyzed Diesel Particulate Filter (DPF)
- 25% NOx reduction
- > 85% PM reduction

**Lonestar™**
- Modular Design
- Computer controlled HC dosing system
- NOx Reduction Catalyst (NRC)
- Diesel Oxidation Catalyst (DOC)
- 40% NOx reduction
- up to 25% PM reduction
Longview and Lonestar Requirements

**Longview™**
- 4 stroke engines
- CARB or ULSD fuel
- >260 °C for 25% of duty cycle
- Back pressure monitor
- Data logging

**Lonestar™**
- 4 stroke engines
- EPA, CARB or ULSD fuel (< 500 ppmS)
Cleaire Systems are Broadly Applied
Phase II – Deployment Model

Verified Systems
NOx & PM
Broadly Applied

Technology Development

Program Development

Customer/End User (Hosts)

NOx & PM Funding
Public & private program
Regulation vs. Incentive

Market intelligence
Customer relationships
Service and Support
Installation
Service packages
Leasing packages
Phase II - Distribution Network

Cummins, Inc

FES

CWI

2

3

... ...

22

OEM First-fit and Neofit Markets

Cummins Distribution Network

Cleaire
Phase II - Deployment

- **Partner with Fleetguard Emission Solutions**
  - Manufacturing
  - Distribution
  - Training
  - Warranty administration
  - Program management

- **Leverage Cummins Distribution Network**
  - Sales and Marketing
  - Installation
  - Service
  - Lease and maintenance agreements
Summary

Development - Cleaire has developed novel, state of the art retrofit systems to provide immediate emissions benefits to existing engines with no major engine or infrastructure changes.

Deployment - Fleetguard Emission Solutions and the Cummins Distribution Network is well positioned to support the widespread deployment of these technologies today.
Closing Statement

The potential for massive reductions in NOx and PM is possible through widespread deployment of “retrofit” and “neofit” technologies in on-road and non-road applications.