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06-1-06

Public Meeting to Consider an Update on Implementation of ARB/Railroad Statewide Agreement and to take Action as Appropriate

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UP/BNSF/SWRI Summary of Current DPF Technology for Locomotives

- Address Part 8, Agreement to Evaluate other, Medium and Long-Term Alternatives
- Summarize Experience in Europe
- DPF retrofits on existing high-horsepower locomotive are not investigated in US because **no sufficient space** and **oxycat retrofits** will be tested.

- Booz Allen Hamilton "Locomotive Emission Study" for CARB (1990)
- Engine, Fuel, and Emissions Engineering "Controlling Locomotive Emissions in California" for CARB (1994)

Recommend Locomotive Retrofit Devices including **DPF** and **SCR** with Space Consideration

GasRail USA LaCHIP LNG Technology Development

- LaCHIP Late-Cycle High-Injection Pressure
- Applies to GM EMD two-cycle engines
- Dual Fuel – uses LNG and diesel fuel (20:1)
- Diesel fuel injected to initiate combustion
- High pressure NG injected into combustion
- NOx reduced 75% - diesel-like fuel economy and power

GasRail USA – Develop Low-NOx LNG Locomotive

1992 GasRail USA starts - SwRI contractor sponsors: DOE, EPA, CARB, others
1996 LaCHIP selected to develop / demo
1997 Bench Test Results show feasibility of achieving 2.8 g/bph
1998 CARB-RR sign South Coast NOx MOU
1999 EPA adopts locomotive standards
1999 GM-EMD withdraws from GasRail
2000 GasRail concluded - no LaCHIP demo
AQMD spent $1.75M, Others $6.6M

"California Emission Program (CEP) PM Reduction from EMD Locomotives"

- Set-up test engine laboratory
- Select lube-oil control technologies
  - Power assemblies (piston, cyl, rings)
  - Crankcase blow-by
  - Valve stem seals
- Laboratory engine durability testing of 3 selected technologies
- Locomotive demonstration

"California Emission Program (CEP) PM Reduction from EMD Locomotives"

2000 CARB-RR agreement - RRs to spend **$5M** to reduce PM from EMD switchers
2001 SwRI starts CEP - contracts with AAR
2004 Lube oil studies completed
2005 Three control technologies selected
2 Diesel Oxidation Cats, 1 DPF
12-31-05 MOU deadline, only **$1.5M** spent

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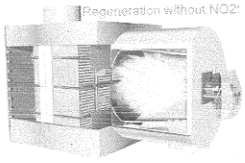
SOOT PARTICLE FILTER SYSTEMS
for mobile diesel engines with power outputs from 150 to 3'000 kW



- modular system for engines between 150 and 3'000 kW
- filter elements made of SiC (Silicon Carbide)
- active regeneration burner, also for low exhaust temperatures
- excellent sound absorption (replaces silencer) for cramped places
- very recommended for:
  - locomotives
  - railway construction machines
  - mobile power plants
  - peak load
  - special applications

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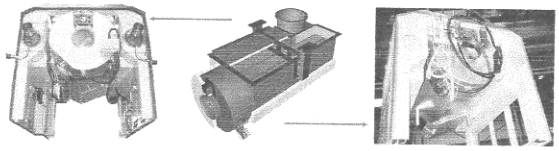
SBB_Vossloh: Am843 (1'500 kW)
mobiclean S26



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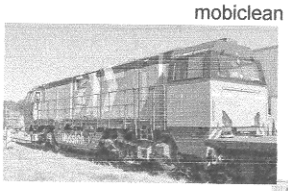
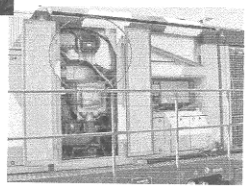
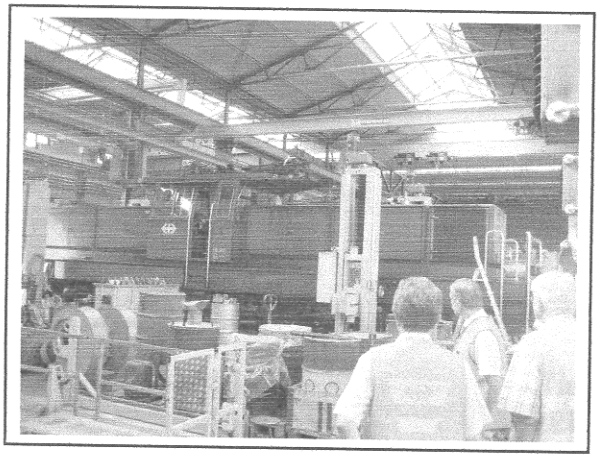
Vossloh Kiel: G2000 (2'700 kW)
mobiclean S56







VERT Requirements

Filtration Efficiency	New State	After 2000 Hours
Particle Count 20-300 nm	> 95%	> 95%
EC Mass Concentration	> 90%	> 90%

VERT Filter List, Tested and approved Particle-Trap Systems for retrofitting Diesel Engines
May 11, 2005, Appendix 1, p13

General Electric – Proposed "Retrofittable DPF for Main Line Locomotives"

- Develop DPF for 4500-HP locomotives
- Use fibrous ceramic media
- Use diesel fuel injector - aid regeneration
- 90% filtration, only 1% fuel penalty
- Retrofittable to UP and BNSF locomotives

GE Proposed DPF Retrofit for Main Line Locomotives

- Current DPF Systems
  - Extruded ceramic monoliths wall-type filter
  - Regeneration by a separate diesel fuel injector
- GE Proposed DPF System
  - Fibrous ceramic media type filter using the principal of depth filtration
  - Regeneration by system integration and control techniques
- Reduce the **size**, weight, cost and back pressure of the filter

General Electric – Proposed "Retrofittable Diesel Particulate Filter (DPF) for Main Line Locomotives"

6-8-05 Proposed CARB ICAT project $534K total, $250K CARB request

6-28-05 ARB/Railroad MOU announced

7-5-05 Project withdrawn - cost increased > $600K

7-8-05 Supplemental funding declined

Agreement to Evaluate Others, Medium-Term and Longer-Term Alternatives

2005 MOU

- Participating Railroads will propose a spending plan (≥$3.5 million)
- Approval of the Plan will be the discretion of the Executive Officer
- No timeline specified

AQMD Recommendation

- Participating Railroads will provide the fund (≥$3.5 million) to ARB for Advanced Locomotive Technology Demonstration focused on
  - DPF
  - SCR
- Administrated through ARB's Innovative Clean Air Technologies (ICAT) Program
- Timeline consistent with and supportive to EPA's Rulemaking process (Tier III)