Progress Rail Tier 4 Linehaul Locomotive
Urea/SCR System
Progress Rail Urea/SCR System
Concept Consist

Module Arrangement Exhaust

Converter Gp

Control Gp - System

Tank Gp - Urea
PR30 Locomotive

- PR30 Locomotive
  - 4 or 6-axle locomotive for road service
  - Built off of GP-38/40 and SD40-2 locomotive (formerly the workhorses of the US railroad industry)
- 3005/2650 hp using single CAT 3516C-HD engine
- US EPA Tier 2 engine out emission certified
PR30 – Leading the Industry

- PR30 is FIRST 3000+ hp locomotive with SCR aftertreatment system packaged in a locomotive
  - Caterpillar Clean Emissions Module (CCEM)
  - Specialized mounting structure for CCEM assembly
  - Diesel Exhaust Fluid (DEF) tank & support equipment
- Five (5) locomotives in service in California/Arizona with working SCR
Urea supply system
Urea supply system

- 250 gallon system sized for one refill per three fuel refills
- Compatible with tank mounted heaters
- Temp and level sensors, vent and pickup mounted on single plate.
- Heated urea supply lines
- Dosing cabinet houses pump, and control system module
Urea Tank going in
Dosing Cabinet Install
Installing the CEM
Status of PR30 units with SCR

• Total SCR hour accumulation on Locomotive >16,000
  - PHL-40  – 1146 hours – PHL
  - 3005    – 3485 hours – PHL
  - 3004    – 3247 hours – Colton to El Centro (ARB Funded)
  - 3003    – 3213 hours – AZ-CA
  - 3002    – 5120 hours – AZ-CA

✓ SCR inspections completed at 500, 1000, and 2700 hours of operation.

✓ Emissions testing at 0, 1500, and 3000 hours
Based on the SwRI test data, staff recognizes the PR30C, hp, locomotive has line-haul NOx and PM emission levels at or below 0.90 and 0.03 g/bhp-hr, respectively.

- Optimized for PM and Fuel consumption
- ~5% fuel consumption benefit over Tier 2 EPA Certified
What’s Next

- Additional Testing on PRLX3004 with SCR
  - Hardware to be funded by EPA with ARB as partner
  - 2X Increase in emissions useful life
  - System is on EPA’s Emerging Technology Funding list
  - Unit to be EPA and California ARB Verified
Questions?
Backup
February 22, 2011

Mr. William P. Allen, Manager
Global Emissions Certification
and Compliance
Large Power Systems Division (MOS 11)
Caterpillar Inc.
P.O. Box 600
Mossville, Illinois 61552-600

Dear Mr. Allen:

This letter is in reply to your request dated February 3, 2011, for an Air Resources Board (ARB) verification of the oxides of nitrogen (NOx) and particulate matter (PM) emission levels for Caterpillar’s PR30C. The PR30C is an EMD SD40 – CAT 3516 - 3005 horsepower - Tier 2 Engine Repower – with Selective Catalytic Reduction (SCR) and Diesel Oxidation Catalyst (DOC) retrofits to achieve Tier 4 NOx and PM emission levels.

As you know, in 1998, the BNSF Railway Company (BNSF) and Union Pacific Railroad (UP) Company, along with ARB entered into a Memorandum of Mutual Understandings and Agreements (1998 MOU) to reduce locomotive emissions in the South Coast Air Basin. Under the 1998 MOU, beginning no later than 2010, each Participating Railroad must calculate the fleet average for NOx emissions from its locomotive fleet operating in the South Coast Air Basin. The fleet average is calculated using the emission level, as determined pursuant to 40 Code of Federal Regulations (CFR) 92 and 1033 for the line-haul duty cycle, for each locomotive in operation in the South Coast Nonattainment Area. Pursuant to the 1998 MOU, and as verified by ARB, UP and BNSF can receive ultra-low-emitting locomotive credit for advanced technology line-haul locomotives with NOx emissions levels at or below 3.0 grams per brake horsepower hour (g/bhphr) through 2014.

Southwest Research Institute (SwRI) performed line-haul duty cycle locomotive emission tests pursuant to 40 CFR Part 92 and 1033, for Caterpillar’s PR30C, 3005 hp, locomotive equipped with SCR and DOC retrofits. Based on the SwRI test data, staff recognizes the PR30C, 3005 hp, locomotive has line-haul NOx and PM emission levels

1 MEMORANDUM OF MUTUAL UNDERSTANDINGS AND AGREEMENTS, South Coast Locomotive Fleet Average Emissions Program, July 2, 1998

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our website: http://www.arb.ca.gov

California Environmental Protection Agency

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at or below 0.90 and 0.03 g/bhp-hr, respectively. The 0.90 g/bhp-hr NOx emission level for can be used in calculating the average NOx emissions for a locomotive fleet operating in the South Coast Air Basin. These verified emissions levels also comply with U. S. Environmental Protection Agency (U.S. EPA) Tier 4 limits.

Alternative technology switcher locomotives funded by the Carl Moyer Program, such as genset locomotives, typically include an existing locomotive frame significantly refurbished with a new engine or engines, electronics, controls, and other equipment. For Carl Moyer Program funding, an alternative technology switcher must achieve a NOx emission rate of 3.5 g/bhp-hr and a PM emission rate of 0.14 g/bhp-hr, based on U.S. EPA locomotive emission testing requirements specified in Title 40 CFR Part 92.

SwRI also performed switch-duty-cycle locomotive emission tests pursuant to 40 CFR Part 92 and 1033 for Caterpillar’s PR30C, 3005 hp, locomotive equipped with SCR and DOC retrofits. Based on the SwRI test data, staff recognizes the PR30C, 3005 hp, locomotive has switcher NOx and PM emission levels at or below 2.09 and 0.04 g/bhp-hr, respectively, both of which meet the switch-duty-cycle NOx and PM emission levels specified for ARB incentive funding programs.

It should be noted that this verification expands the one issued on December 13, 2010, for the 3005 hp rating.

If you have any questions please contact Mr. Harold Holmes, Manager, Engineering Evaluation Section at (916) 322-8029, or hholmes@arb.ca.gov.

Sincerely,

Michael S. Waugh, Chief
Criteria Pollutants Branch

cc: See next page
cc: Mr. Glenn Passavant, Director
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February 22, 2011

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Global Emissions Certification and Compliance
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Dear Mr. Allen:

This letter is in reply to your request dated February 3, 2011, for an Air Resources Board (ARB) verification of the oxides of nitrogen (NOx) and particulate matter (PM) emission levels for Caterpillar's PR30C. The PR30C is an EMD SD40 – CAT 3516 - 2650 horsepower - Tier 2 Engine Repower – with Selective Catalytic Reduction (SCR) and Diesel Oxidation Catalyst (DOC) retrofits to achieve Tier 4 NOx and PM emission levels.

As you know, in 1998, the BNSF Railway Company (BNSF) and Union Pacific Railroad (UP) Company, along with ARB entered into a Memorandum of Mutual Understandings and Agreements¹ (1998 MOU) to reduce locomotive emissions in the South Coast Air Basin. Under the 1998 MOU, beginning no later than 2010, each Participating Railroad must calculate the fleet average for NOx emissions from its locomotive fleet operating in the South Coast Air Basin. The fleet average is calculated using the emission level, as determined pursuant to 40 Code of Federal Regulations (CFR) 92 and 1033 for the line-haul duty cycle, for each locomotive in operation in the South Coast Nonattainment Area. Pursuant to the 1998 MOU, and as verified by ARB, UP and BNSF can receive ultra-low-emitting locomotive credit for advanced technology line-haul locomotives with NOx emissions levels at or below 3.0 grams per brake horsepower hour (g/bhphr) through 2014.

Southwest Research Institute (SwRI) performed line-haul duty cycle locomotive emission tests pursuant to 40 CFR Part 92 and 1033, for Caterpillar's PR30C, 2650 hp, locomotive equipped with SCR and DOC retrofits. Based on the SwRI test data, staff recognizes the PR30C, 2650 hp, locomotive has line-haul NOx and PM emission levels

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at or below 0.99 and 0.03 g/bhp-hr, respectively. The 0.99 g/bhp-hr NOx emission level for can be used in calculating the average NOx emissions for a locomotive fleet operating in the South Coast Air Basin. These verified emissions levels also comply with U.S. Environmental Protection Agency (U.S. EPA) Tier 4 limits.

Alternative technology switcher locomotives funded by the Carl Moyer Program, such as genset locomotives, typically include an existing locomotive frame significantly refurbished with a new engine or engines, electronics, controls, and other equipment. For Carl Moyer Program funding, an alternative technology switcher must achieve a NOx emission rate of 3.5 g/bhp-hr and a PM emission rate of 0.14 g/bhp-hr, based on U.S. EPA locomotive emission testing requirements specified in Title 40 CFR Part 92.

SwRI also performed switch-duty-cycle locomotive emission tests pursuant to 40 CFR Part 92 and 1033 for Caterpillar’s PR30C, 2650 hp, locomotive equipped with SCR and DOC retrofits. Based on the SwRI test data, staff recognizes the PR30C, 2650 hp, locomotive has switcher NOx and PM emission levels at or below 2.34 and 0.04 g/bhp-hr, respectively, both of which meet the switch-duty-cycle NOx and PM emission levels specified for ARB incentive funding programs.

It should be noted that this verification supersedes the one issued on December 13, 2010, for the 2650 hp rating.

If you have any questions please contact Mr. Harold Holmes, Manager, Engineering Evaluation Section at (916) 322-8029, or hholmes@arb.ca.gov.

Sincerely,

Michael S. Waugh, Chief
Criteria Pollutants Branch

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Page 3

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