California Environmental Protection Agency

Air Resources Board

Update on the Implementation of the 2005 ARB/Railroad Statewide Agreement

Ultra Low Emissions Diesel Genset Switchers – UPY 2715 & 2749
(UP City of Industry)

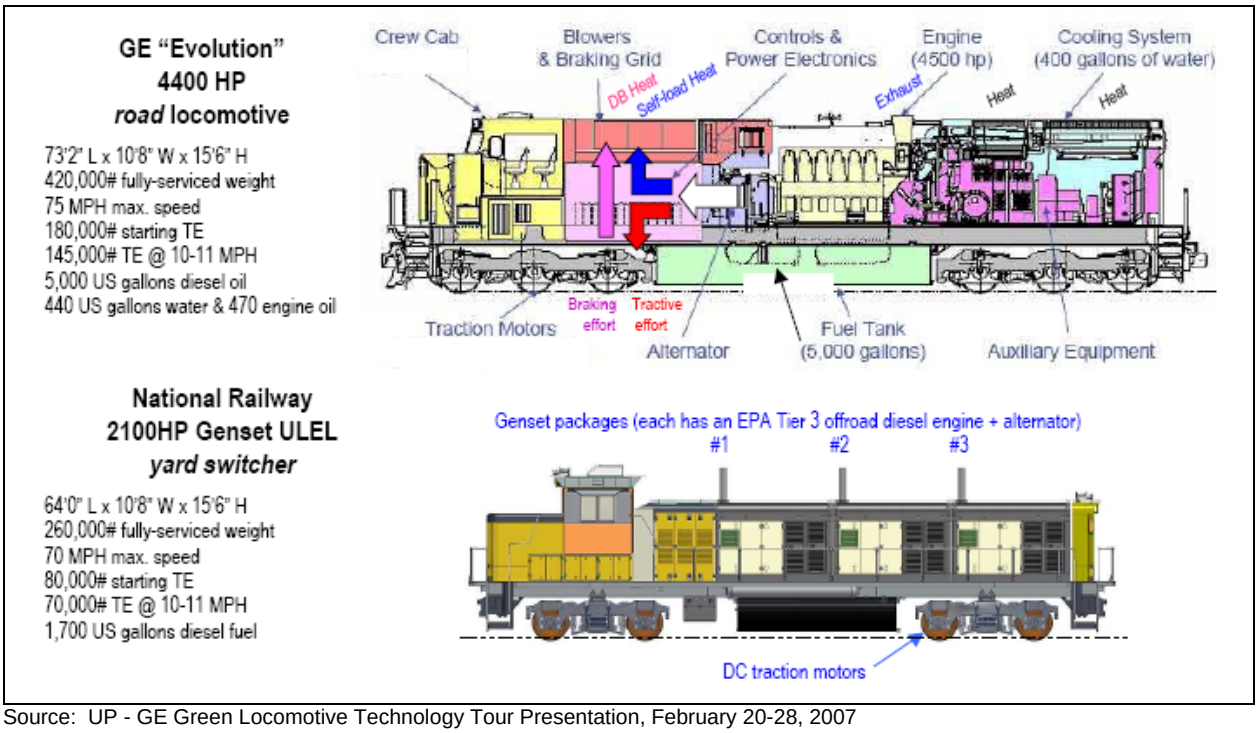
Release Date: April 11, 2008

Front Cover Photo Details

	Front Cover	Compared to typical line haul / road locomotive
Manufacturer:	National Railway Equipment Company (NREC)	General Electric (GE) Company
Model:	3GS-21B (3-engine)	GE “Evolution”
Locomotive Type:	Switcher	Road or Line Haul
Emissions Level: (g/bhp-hr)	Tier 2+: NOx = 2.7, PM = 0.07, HC = 0.1, CO = 1.2 (see note A)	Tier 2: NOx=5.5, PM=0.20, HC=0.30, CO=1.5 (see note B)
Size:	62’6” L x 10’6” W x 16’3” H	73’2” L x 10’8” W x 15’6” H
Weight:	268,000 pounds	420,000 pounds
Max Speed:	~70 MPH	75 MPH
Engine Type (cycle):	Cummins QSK19, In-line 6, 4 cycle, diesel	GEVO V-12, 4 cycle, diesel
Horse Power:	~700 HP or 522Kw per engine or x 3 = ~2,100 HP (1,566 Kw) total	4,400 HP or 3,281 Kw
Total Engine Displacement :	~1,159 cubic inches (in^3) or 19 liters (L) per engine or x 3 = 2.0 ft^3 or 57 L	~ 6.7 cubic feet (ft^3) or ~ 190 Liters (L)
Number of Cylinders:	6 per engine	12
Single Cylinder Displacement:	~193 cubic inches (in^3) or 3.2 Liters (L)	~ 950 cubic inches (in^3) or ~ 15.7 Liters (L)
Rated Engine Speed:	1,500 – 2,000 RPM	1,050 RPM
Tractive Effort (pulling force starting):	~77,000 pounds	180,000 pounds
Tractive Effort (@ 10-11 MPH):	~52,000 pounds	145,000 pounds
Fuel Tank Volume:	1,700 - 2,900 gallons (diesel)	5,000 gallons (diesel)
Engine Cooling Fluid:	44 U.S. Quarts or 41.6 Liters (L) per engine or x 3 = 33 gallons	440 gallons (water)
Engine Oil:	80 U.S. Quarts or 76 Liters (L) per engine or x 3 = 60 gallons	470 gallons

A: U.S. EPA locomotive certification data - http://www.epa.gov/omswww/certdata.htm#locomotive, family - 7NREG0060LOC.
B: U.S. EPA Tier 2 locomotive emission standard – Final rule April 1998.

Compared to typical line haul / road locomotive



Source: UP - GE Green Locomotive Technology Tour Presentation, February 20-28, 2007

State of California
California Environmental Protection Agency
AIR RESOURCES BOARD
Stationary Source Division

Update on the Implementation of the 2005 ARB/Railroad Statewide Agreement

Date of Release: April 11, 2008
Board Meeting Date: April 24, 2008

Location:

California Department of Transportation
111 Grand Avenue
1st Floor, Auditorium
Oakland, California 94612

This report has been reviewed by the staff of the Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

This page left intentionally blank

Acknowledgments

This report was prepared with the assistance and support from the other divisions and offices of the Air Resources Board.

In addition, we would like to acknowledge the assistance and cooperation that we have received from many individuals and organizations.

Principal Author:
Mike Jaczola, Engineering Evaluation Section

Acknowledgements:
Eugene Yang, Engineering Evaluation Section
Stephen Cutts, Engineering Evaluation Section
Ambreen Mahmood, Engineering Evaluation Section
Hector Castaneda, Engineering Evaluation Section
Les Simonson, Enforcement Division
John Oback, Enforcement Division

Reviewed by:
Michael H. Scheible, Deputy Executive Officer
Robert D. Fletcher, Chief, Stationary Source Division
Dean C. Simeroth, Chief, Criteria Pollutants Branch
Harold Holmes, Manager, Engineering Evaluation Section

This page left intentionally blank

Table of Contents

This page left intentionally blank

I. SUMMARY

A. Introduction

On June 24, 2005, the Executive Officer of the Air Resources Board (ARB or Board) entered into a statewide railroad pollution reduction agreement (Agreement) with Union Pacific Railroad (UP) and BNSF Railway (BNSF). This Agreement was developed to implement near term measures to reduce diesel particulate matter (PM) emissions in and around railyards by approximately 20 percent.

On January 27, 2006, the Board heard public testimony, accepted clarifications to the Agreement, received a status report on implementation of the Agreement, and directed staff to return with status reports. On July 20, 2006, January 25, 2007, and July 27, 2007, the Board received semi-annual status reports on the implementation of the Agreement. This document provides the fifth status report on the implementation of the Agreement covering a period of thirty months, with an emphasis on the implementation efforts that have occurred over the past six months.

B. Progress on Implementation of the Agreement

Staff and the railroads began implementing the Agreement in July 2005. A summary of the status of the key implementation requirements is provided in Table 1. As Table 1 illustrates (see page 8), the railroads and staff have met, or are on schedule to meet, each of the requirements specified for the second year of implementation. Details on the progress made to implement the program elements are provided in Chapter II. Details on other efforts are provided in Chapter III. A review and summary of the recent promulgation of the U.S. EPA locomotive regulations is presented in Chapter IV.

1. Implementation Activities

Summarized below are the key implementation milestones that have been accomplished within the past six months.

Install Idle Reduction Devices On Over 99 Percent of Unequipped Intrastate Locomotives by June 30, 2008:

- Since July 26, 2007, 15 new idle reduction devices have been installed on UP and BNSF's California-based locomotives. To date, 398 out of the California's 413 intrastate locomotives are now equipped with idle reduction devices which represents 96 percent of California's intrastate fleet. This is more than twice the rate of installations that have occurred to date in the rest of the country. As of March 31, 2008, staff believes both railroads are on schedule to meet the 99 percent requirement by June 30, 2008.

Dispense CARB Diesel for all Intrastate Locomotives and a Minimum of 80 Percent Low Sulfur Diesel for Locomotives by January 1, 2007:

- Staff's review of diesel fuel data from both railroads indicates that both railroads continue to comply with both:
  - The CARB diesel fuel regulation for intrastate locomotives; and
  - The Agreement's requirements to dispense a minimum of 80 percent low sulfur (15 ppmw) diesel fuel (CARB or U.S. EPA diesel fuel) to interstate locomotives fueled in California.

Today UP and BNSF are fully complying by dispensing virtually 100 percent ultra-low sulfur diesel in California. About 70 percent is CARB diesel and the remaining 30 percent is U.S. EPA ultra-low sulfur diesel fuel. This is well in excess of the requirements for fuel quality and is five years before U.S. EPA requirement that locomotives be fueled with 15 ppmw sulfur fuels.

Visible Emission Reduction

- Under the Agreement, the railroads are required to achieve a 99 percent compliance rate for visible emissions over a calendar year. Over the past six months, more than 21,691 visible emission inspections were performed by railroad personnel resulting in more than 64,000 visible emission inspections performed since June 2005. Overall, both UP and BNSF have maintained a 99 percent compliance rate since June 2005.
- Overall, about 4,600 employees in numerous classifications (e.g., managers, supervisors, dispatchers, etc.) have received visible emission evaluation training.

Health Risk Assessments at Designated Yards

- Under the Agreement, sixteen health risk assessments at designated railyards are required to be completed in two phases; nine in the first phase and seven in the second phase.
- Staff completed the first nine draft health risk assessments in May 2007. Public meetings were held in the affected communities in May and June 2007 to release and explain the draft assessments. Each initial meeting was followed about one month later by a second meeting to allow for questions and public comments and to discuss possible mitigation. After considering the public comments, staff finalized the first nine health risk assessments in November 2007.
- The assessments show that the diesel PM emissions from the railyards result in higher risks in nearby communities. The largest impacts are associated with the four railyards in the City of Commerce. The combined potential cancer risk from these four railyards is about 700 per million for an exposed population of 5,000 people and about 200 per million for an exposed population of about 80,000 people. The assessments for the other railyards have lower potential cancer risks and expose fewer people, but risks are still significant and need to be reduced.

- The assessments also included estimated pollution risks from other sources around the railyards. The most significant source of toxic emissions is diesel truck traffic (not associated with the railyards) within a one to two mile zone surrounding the railyards. Generally, offsite diesel PM emissions from trucks result in similar or higher diesel PM exposures than the railyard-related emissions.
- In addition, staff began a separate, but parallel effort to develop an interim methodology to quantify the noncancer health benefits around the railyards and to identify and evaluate potential mitigation options needed to reduce the risks. ARB is currently working with OEHHA to develop an approved statewide methodology to quantify non-cancer health effects of diesel PM.
- The next seven health risk assessments are scheduled to be completed by mid 2008. The draft assessments for the UP railyards (i.e., City of Industry, Colton, ICTF/Dolores, and Oakland) were released in March 2008. The draft assessments for the three BNSF railyards (i.e., San Diego, Barstow, and San Bernardino) will be released in April 2008.
- Staff held initial public meetings in November 2007 to discuss additional mitigation measures for the ten railyard HRAs (Phase 1) that were finalized in November 2007. Staff will conduct additional public meetings this summer to discuss mitigation plans for each of the ten railyards. Also, staff will hold initial meetings for the seven remaining railyard HRAs (Phase 2) once they have been finalized.

Locomotive Remote Sensing Pilot Program

- Assembly Bill (AB) 1222, authored by Assemblyman Jones, was signed into law in 2005, and requires the ARB, in consultation with an advisory group, to develop a locomotive remote sensing pilot program.
- Staff has been working with an advisory group on a three phase test program to assess the ability of remote sensing to effectively and accurately measure locomotive emissions. The first phase of test program was designed to ensure that the equipment will work in practice. This first phase (Phase 1) was conducted at a locomotive test track in Pueblo Colorado and was completed in March 2007. Phase 1 testing revealed problems with the line haul remote sensing device which resulted in its operation being discontinued. The yard extraction remote sensing system, however, provided more favorable operation and the advisory committee decided to go forward with further utilization of that system before being applied to mainline operation. The advisory group concluded that additional evaluation of the yard extraction remote sensing system was needed to resolve technical issues before implementation of field testing in Phase 2.
- To address the technical issues, a second round of testing was conducted at the Pueblo test track in May 2007. Although there were still technical issues identified, the advisory group felt that the Phase 2 field testing should be pursued. In this phase, the equipment was located at specific sites within a railyard and along a railroad track to measure as many locomotives in the field

as possible to determine the potential of the equipment to identify gross polluters in the locomotive fleet. This testing occurred at the UP Colton railyard and a BNSF Cajon site in October 2007. Also, additional Phase 2 field testing was conducted in Northern California at Weimar in February 2008.

- Phase 3 was conducted jointly by Environmental Systems Products (ESP) and Southwest Research Institute (SwRI). This testing compares the remote sensing results to the approved federal locomotive test procedure to determine the accuracy of the measurements from the remote sensor. This testing occurred in February 2008. A final report is anticipated by mid 2008.

Ongoing Evaluation of Other, Medium Term, and Longer Term Emission Control Measures for Existing Locomotives

- Staff and the railroads agreed to cooperatively evaluate the feasibility of developing diesel particulate filters or diesel oxidation catalysts for use on a typical switch locomotive representative of the current California switcher fleet. UP and BNSF indicated they would commit up to $5 million towards this evaluation. To date, about $4 million of this funding has been expended on prototype and demonstration testing at Southwest Research Institute (SwRI) through January 1, 2008. The current status of efforts is summarized below.

  - The UP diesel particulate filter equipped switch locomotive (UPY 1378) arrived in Oakland, California back in October 2006. It started its field service in Oakland, California, and was later transferred to Roseville, California. The move to Roseville was prompted by the need to expose the locomotive to a higher activity level. In February 2008, after accomplishing more than 12 months of service, SwRI performed federal emissions testing.
  - The BNSF diesel particulate filter equipped switch locomotive is BNSF 3703. This locomotive recently received a second generation diesel particulate filter manufactured by HUG. Testing at the SwRI facility in San Antonio, Texas, continued through 2007. It is anticipated to arrive in Los Angeles, California, in mid 2008.
  - Emission testing for DPF equipped locomotives (UPY 1378 and BNSF 3703) shows PM reductions of 80 percent and HC reductions of 30 percent. Additional testing and development are ongoing to improve the efficiency of the DPFs.
  - If the current in-use demonstration testing is successful, both UP and BNSF have committed to retrofit one additional switch locomotive each and operate these locomotives in California.

- The U.S. EPA and UP began a test program in 2006 to demonstrate and test a diesel oxidation catalyst with an existing line haul locomotive by retrofitting a 3,800 horsepower line haul locomotive (UP 2368), built in 1992 by EMD (Model SD-60M), with a diesel oxidation catalyst. This locomotive was assigned to helper/hauler service in the Los Angeles basin in November 2006. Over the next twelve months, the locomotive compiled approximately 2,800 hours of field

service. No significant impacts to engine performance (e.g., maintaining power, fuel penalty, and backpressure) have been noted at this time, but failures involving the catalyst elements did occur. During scheduled inspection intervals, three separate failures occurred involving the catalyst elements and their supports. Currently the DOC device is undergoing failure analysis by the manufacturer Miratec. UP 2368 continued to operate in service, but without the catalyst elements. Once Miratec completes its failure analysis and repair plan, the DOC will be reinstalled in early 2008 for continued testing.

- ARB recently funded a contract with Southwest Research Institute (SwRI) to research a compact SCR system offered by Engine Fuel and Emissions Engineering, Inc. (EF&EE) with catalysts parts supplied by Haldor Topsoe, a Danish Catalyst Company. The SCR device tested by SwRI was a urea-SCR catalyst technology retrofitted to an EMD 12-710G3 engine at SwRI's test facility. By November 2007, the initial engine tests (e.g., baseline, backpressure, and crankcase blowby) were completed and the SCR device was installed to perform preliminary SCR testing. During performance testing, significant issues occurred ranging from structural design to improper urea dosing. EF&EE is currently working to address these issues.
- ARB and the railroads conducted the first semi-annual technology symposium on April 25, 2006, at the ARB offices in El Monte. The second symposium occurred on July 13, 2006, at the Cal/EPA building in Sacramento. A report summarizing the two symposiums was released in December 2006. The third technology symposium was held on June 6, 2007, and a fourth technology symposium held on November 28, 2007. A report summarizing the two symposiums held in 2007 will be released by mid 2008.

Enforcement of the Agreement

- In the second half of 2007, the ARB Enforcement staff visited the 31 designated and covered railyards and inspected 1,015 locomotives and issued 29 notices of violation for idling infractions and one notice of violation issued for a smoking locomotive. For comparison in the first half of 2007, Enforcement staff inspected 964 locomotives and issued 40 notices of violation for idling. Since inspections began in 2006, Enforcement staff have inspected 3,299 locomotives and issued 103 notices of violation.

2. Other Activities

As discussed in Chapter III, staff and the railroads have been engaged in activities not specifically required in the 2005 Agreement. These are summarized below.

Modernization of Locomotive Fleet

Mostly in response to the 1998 Railroad Agreement to reduce locomotive NOx emissions in the South Coast, both UP and BNSF have made significant progress to

transition to advanced technology line-haul and switch locomotives that have or will operate in California. Together, the two railroads have done the following:

- The combined railroads are currently operating about 9,900 new and rebuilt Tier 0, 1, and 2 locomotives. Of those, about 2,100 locomotives are expected to meet Tier 2 standards by the end of 2008. In total, UP and BNSF have over 65 percent of their 15,000 national locomotive fleet meeting at least Tier 0 standards and 49 percent are equipped with idle reduction devices.
- Since 2005, 12 new electric-hybrid, ultra low emitting, locomotives (Green Goats) have been placed into service in California. Eleven are located in the Los Angeles area and one is located in Northern California (Fresno). These locomotives were recently returned to the manufacturer (Railpower) to remedy a potential fire hazard associated with the large bank of 300 lead-acid batteries. These locomotives are in the process of being upgraded so they can be reintroduced into revenue service.
- In southern California, UP now has 61 ultra low emitting Gen-set switch locomotives operating in the Los Angeles basin. These 61 Gen-sets were funded by UP. These new ultra low-emitting switch locomotives will provide up to a 90 percent reduction in NOx and diesel PM emissions when compared to the higher emitting older switch locomotives that are replaced.
- In northern California, BNSF has 11 Gen-sets in their fleet that are located Richmond (6) and San Joaquin Valley (5). By June of 2008, four UP Gen-set switch locomotives are scheduled to arrive and be assigned to the UP Roseville railyard. These fifteen northern California Gen-set locomotives were co-funded by the railroads and the ARB's Carl Moyer Program**.**
- Today there are 72 gen-sets, 12 Green Goats, and 4 LNG locomotives operating in California service. Another four gen-sets are expected to be in service by June of 2008. A goal in the goods movement strategy is to upgrade the rest of the intrastate switching fleet to ultra-low emitting emission levels by 2010.

Community Complaint Process

- Both railroads have established and implemented procedures to process, handle, and respond to community complaints. The systems operate 24 hours a day and 365 days a year. Mechanisms are in place to track and forward complaints to appropriate company staff to respond.
- In the last six months, both railroads have received a combined average of 29 idling complaint calls per month. By comparison, for the first six months of 2006 both railroads received a combined average of 27 idling complaint calls per month.

C. U.S. EPA Rulemaking

The U.S. EPA released its proposed draft Tier 4 locomotive and marine rulemaking in April 2007 with a public comment period until July 2, 2007. In July 2007 the ARB staff and many other parties provided comments on the U.S. EPA proposed locomotive

rulemaking. ARB's comments were supportive of most elements included in the April 3, 2007 proposal, but suggested significant acceleration of the implementation schedule (see link - http://www.arb.ca.gov/railyard/ryagreement/0707epaloco.pdf). On March 14, 2008, the U.S. EPA formally announced it's final locomotive and marine rule.

U.S. EPA's final locomotive rulemaking sets new Tier 4 new line haul locomotive standards for PM and NOx in 2015. The standards require emission reductions for new locomotives of 85 and 75 percent, respectively, below current Tier 2 standards. In addition, Tier 3 new line haul locomotive standards for PM will be required in 2012 and provides a 50 percent reduction beyond the Tier 2 PM standard. Existing Tier 0-2 line haul locomotives will be required to provide about a 50 percent PM (relative to current levels) reduction upon remanufacturing beginning in 2008 through 2013. Further, existing Tier 0 line haul locomotives will be required to provide about a 16 to 22 percent NOx reduction by when they are rebuilt. Finally, idle emission controls are required for newly manufactured and remanufactured locomotives.

The California State Implementation Plan relies upon the U.S. EPA program to provide both highly effective and expeditious pollution reductions from locomotives. The new federal locomotive emission standards will eventually provide the level of reductions needed, but they will not provide California with the necessary emission reductions in the timeframes needed for initial attainment of federal standards for PM 2.5.

Consequently, a combination of strategies to more expeditiously reduce locomotive emissions, including replacement of switch locomotives, exhaust aftertreatment retrofits on older line haul locomotives, and acceleration of the introduction of new Tier 4 interstate line haul locomotives in California service need to be pursued. Accordingly, the ARB staff will need to continue to work with U.S. EPA, the railroads, and other stakeholders to identify innovative ways to accelerate the reduction of locomotive emissions in California.

Table 1
Implementation Status of Individual Program Elements

PROGRAM REQUIREMENTS	2005	2006	2007	2008					
				Mar	Apr	May	Jun	July	Dec
IDLING REDUCTION									
Program Coordinators	✓								
Locomotive Inventories	✓	✓	✓						
Community Reporting Process	✓								
Railroad Training Programs	✓								
Adjudicatory Appeal Process	✓								
Training Implementation Status	✓	✓	✓						
Percent Idle Reduction Device Install Requirement - 35% 2006, 70% 2007, >99% June 2008		✓	✓						
VISIBLE EMISSION (VE)									
Program Coordinators	✓								
Program Establishment	✓								
Community Reporting Process	✓								
Railroad Training Programs	✓								
VE Inspection Report	✓	✓	✓						
Training Implementation Status	✓	✓	✓						
Annual Program Review	✓	✓	✓						
EARLY REVIEW OF EMISSIONS / MITIGATION									
Emission Inventory	✓								
Community Meetings ***(Due Date 10/31/05)***		✓							
Mitigation Plans	✓								
HEALTH RISK ASSESSMENTS									
Railroad Study Plan	✓								
Health Risk Assessment Guidelines		✓							
Health Risk Assessments (two phases: Phase 1 - Final, Phase 2 - Draft = 2D, Phase 2 - Final = 2F)			1	2D	2D			2F	
TECHNICAL ASSESSMENTS									
Continue Study of Diesel Particulate Filter and Diesel Oxidation Catalysts	✓	✓	✓						
Diesel Particulate Filters and Diesel Oxidation Catalysts Use -Europe & U.S.	✓								
*Remote Sensing Pilot Program (Original Due Date 12/31/06)**	✓	✓	✓					▪	
Public Meetings (Due Date 12/31/05)	✓	✓	✓						
Joint Report on Public Meetings		✓							
COMPLIANCE									
Inspection / Program Review Protocols	✓								
Railyard Inspections - Idle Reduction Devices & Visible Emissions - semiannual		✓	✓						

✓ = Satisfied or ongoing per Agreement requirements. (May have reoccurring future date requirements specified in Agreement), ▪ = Future milestone date.
* = AB 1222 Remote Sensing Pilot Program – Initiated by 12/31/05; Report to Legislature original due date 12/31/06, estimate completion by mid 2008.

II. UPDATE ON THE IMPLEMENTATION OF THE AGREEMENT

Staff and the railroads began implementing the Agreement in July 2005. As presented in Table 1, the railroads and staff have met the requirements that are specified for the first year and a half of implementation of the Agreement. The key program elements are identified below:

- Idle Reduction Program;
- Low Sulfur Diesel Fuel Program;
- Visible Emission Reduction Program;
- Health Risk Assessments at Designated Railyards Program;
- Ongoing Evaluation of Other, Medium-Term, and Longer-Term Emission Control Measures.

This chapter more fully describes the progress made to date with an emphasis on the last six months.

A. Idle Reduction Program

1. Requirements of the Agreement

Under the Agreement, intrastate and interstate locomotives must limit non-essential idling through the use of automated idle reduction devices or by manually shutting down engines to prevent non-essential idling in excess of 60 consecutive minutes. Essential idling is defined as idling necessary to:

- Ensure adequate air brake pressure for locomotive and railcars;
- Ensure other safety related purposes;
- Prevent freezing of engine coolant;
- Ensure compliance with federal guidelines for occupied locomotive cab temperatures; and
- Engage in necessary maintenance activities.

The preferred method of all parties to reduce non-essential idling is the use of automated idle reduction devices. Under the Agreement, where locomotives are equipped with idle reduction devices, non-essential idling is limited to no more than 15 consecutive minutes. For locomotives not equipped with idle reduction devices, locomotives are to be shutdown as soon as it is clear that essential idling is not required and, in no case, is non-essential idling to exceed more than 60 consecutive minutes. In those situations where there is uncertainty over the expected duration of idling, the railroads are obligated to make efforts to notify their train crews if the anticipated wait time could be greater than 60 consecutive minutes so that train crews can shut down their locomotive(s). Railroad training programs are required to inform and educate train crews and other railroad operational employees about the need to faithfully observe the restrictions on idling.

2. Installation of Idle Reduction Devices

The railroads are on schedule to meet the commitments to install idle reduction devices on their intrastate locomotive fleets. Specifically, the railroads were to install idle reduction devices on their unequipped locomotives with the final goal of installing idle reduction devices on at least 99% of these locomotives by June 30, 2008.

In the last six months, the railroads installed 15 idle reduction devices on unequipped locomotives. As shown in Table 2, these additional installations bring the total number of idle reduction devices installed on unequipped locomotives to about 95 percent by January 31, 2008. The installation rate is expected to achieve the greater than 99 percent requirement by June 30, 2008, as required by the Agreement.

Table 2
Annual Requirements for Installation of
Idle Reduction Devices on Unequipped Locomotives - March 2008

Year	Number Of Locomotives (Intrastate Fleet)	Cumulative Number of Idle Reduction Devices Installed	Percent Achieved
2005	428	117[1]	NA
2006	438	113	35%
2007	450	379	80%
2008	413	394*	95%

1. Number of idle reduction devices installed at Agreement signing.
* As of March 2008. Expect 99% by June 30, 2008 as required by MOU.

Based on the information provided by the railroads, there are now 413 intrastate locomotives operating in the State. This represents a decrease in total intrastate locomotives from 450 in 2007 (438 in 2006 and 428 in 2005). As can be seen in Table 3, 96 percent of the 413 intrastate locomotives in California operation are now equipped with idle reduction devices. This is more than twice the rate of installations that have occurred to date in the rest of the country. Staff expects that the Agreement will ensure that progress in California will continue to be accelerated relative to the rest of the nation.

Table 3
Installation of Idle-Reduction Devices on
All California Intrastate Locomotives Relative to National Fleet

California Switcher & Local Fleet			National Switcher & Local Fleet		
Current Inventory	**Installed By June 30, 2007**	**Percent of Fleet***	**Current Inventory**	**Installed By June 30, 2007**	**Percent of Fleet***
413	398	96%	3,421	1,499	44%

3. Idle Reduction Training Programs

The training of locomotive operators and other appropriate railroad employees on the idling provisions and requirements of the Agreement is an ongoing process. Since some employees, such as dispatchers and potentially some train crews, are impacted by the Agreement but may not be stationed in California, a significant number of railroad employees outside of California have also been trained on the idling provisions and requirements of the Agreement and are included in this total. Nearly 9,700 railroad employees have been trained or have been scheduled for training by January 31, 2008, as provided in Table 4.

Table 4
Number of Railroad Employees Trained Regarding the Idle Reduction Program

Employee Classification	Idle Training by June 30, 2007
Managers	219
Supervisors	188
Dispatchers	46
Response Center	21
Train Crews	6,298
Mechanical	716
Other	18
Total Trained	**9,696**

B. Low Sulfur Diesel Fuel Program

Effective January 1, 2007, the Agreement requires both railroads to dispense CARB diesel fuel only to the 418 intrastate locomotives. Under this regulation, staff estimates that about seven percent of the total diesel fuel dispensed to locomotives in California by both railroads is required to be CARB diesel. Staff estimates that both railroads have used CARB diesel for nearly 70 percent of the diesel fuel dispensed to locomotives in California, or nearly ten times the volumes required under the regulation.

Under the 2005 Agreement, the railroads also agreed to dispense a minimum of 80 percent of low sulfur level (15 ppmw) diesel fuels, either CARB or U.S. EPA onroad, to locomotives fueled in California. This low sulfur diesel fuel requirement in the 2005 Agreement also became effective on January 1, 2007. Staff estimates that both railroads' dispensed 99 percent or greater volumes of low sulfur (15 ppmw) diesel fuel to their locomotives fueled in California in during 2007. Note that the diesel fuel types and volumes dispensed to locomotives can fluctuate based on fuel market conditions and business practices.

To ensure compliance, staff reviewed both railroad's diesel fueling records and discussed fuel shipments with California's major pipeline operator. In addition, fuel testing by ARB was able to confirm the types and quality of diesel fuels dispensed in

major railyards. Based on these assessments, staff is confident that the railroads continue to comply with both sets of California's locomotive diesel fuel requirements which became effective January 1, 2007.

C. Visible Emission Reduction Program

The railroads have been conducting visible emission inspections over the past year as specified under their visible emission reduction and repair programs as shown in Table 5. Locomotives operating in California and exceeding a steady state opacity measurement of 20 percent must be sent to maintenance facilities to determine whether repairs are needed to comply with applicable visible emission standards as set forth in the national railroad regulation.

Under the Agreement, the railroads are required to achieve a 99 percent compliance rate for visible emissions over a calendar year. The railroads became subject to the opacity compliance level on January 1, 2006. In the last six months, over 21,691 visible emission inspections were performed by BNSF and UP. Visible emission inspections for both BNSF and UP since June 2005 to now are compiled in Table 5. The overall compliance rate for the three types of visible emission inspections performed is 99 percent. The locomotives that failed were repaired to meet Federal opacity standards.

Table 5
Results of Visible Emission Inspections
Cumulative Total Since June 2005

BNSF & UP	Certified Opacity Meter	Certified U.S. EPA Method 9	Non-certified Visible	Total	Overall Compliance Rate
# Inspected	9,325	37,743	17,819	64,887	99%
# passed*	9,324	37,463	17,732	64,519	

* Opacity not greater than 20 percent

1. Visible Emission Reduction Training Programs

Similar to the idle reduction program, both railroads have submitted information on the development of their visible emission reduction and repair training programs, and their plans to train appropriate railroad staff regarding the programs. Both railroads have been conducting their training programs over the past two years. The railroads have indicated they intend to train the same staff (i.e., managers, supervisors, dispatchers, response center, train crews, mechanical, and other) as trained on the provisions of the idle reduction program. Information on the railroads' visible emission reduction and repair training programs has been posted on the ARB railyard website under "Railroad Submittals" (www.arb.ca.gov/railyard/ryagreement/rrsubmittal.htm).

The number of employees trained by January 31, 2008, for both railroads is shown in Table 6. Employees outside of California are also being trained because they either work with or operate locomotives that operate in the State. Overall, since June 2005, over 4,600 employees in numerous classifications (e.g., managers, supervisors, dispatchers, etc.) have received visible emission evaluation training.

Table 6
Number of UP and BNSF Employees Trained
Cumulative Total Since June 2005

Certified U.S. EPA Method 9	Non-Certified VE Training	General Awareness Training	Total
248	710	3,712	4,670

D. Health Risk Assessments at Designated Yards Program

1. Requirements of the Agreement

In the 2005 Agreement, staff and the railroads committed to prepare health risk assessments (HRAs or assessments) for 16 designated railyards. This was done to quantify pollution risk levels near railyards, identify specific emission sources, and to allow development of measures to reduce health risks. The assessments were to be completed in two phases; nine in the first phase and seven in the second phase. To facilitate this effort, draft health risk assessment guidelines were completed in July 2006.

For the first time for these railyards, it was possible to use health risk assessments to estimate pollution exposures and resulting potential lifetime cancer risks associated with railyard activities. Health risk assessments do not gather information or health data on specific individuals, but provide estimates for the potential health impacts on a population at large. The health risk assessment process uses standardized general assumptions designed to assure that public health is fully protected. In this case, the assumptions used in the health risk assessments were a residential setting with the exposed population living at the same location for 70 years, doing moderate activity outdoors for 24 hours a day, for 350 days of the year. The information derived from the railyard health risk assessments also serves as a basis to identify the greatest opportunities for emission reduction measures.

One of the first tasks in performing a railyard health risk assessment is to quantify air toxic emissions released within a railyard and significant sources of air toxic emissions nearby the railyard. Railyard emission data are developed for the activities occurring in the railyards. This is the responsibility of the railroad that operates the railyard, and subject to ARB review and approval. These included emission estimates for line haul locomotives, switch locomotives, cargo handling equipment such as cranes and fork lifts, trucks, light duty vehicles, generators, off-road fueled equipment, and fuel storage tanks. Also the geographical and temporal distribution of these emissions are documented. To support dispersion modeling, meteorological data are summarized.

Dispersion modeling is then conducted. The results of all of this work are then are presented to ARB staff. The ARB staff uses this data, in conjunction with other sources of information, to characterize the distributions of emissions within the railyards and significant sources of emissions nearby the railyard (e.g., freeways, refineries, trucks operating outside the railyard). Using this information, staff prepares estimates of air pollution exposure and develops the health risk assessments.

2. Revised Schedule for Completion of All Health Risk Assessments

The first nine draft health risk assessments were released in May 2007 and finalized in November 2007. The second group of draft heath risk assessments are scheduled to be completed by mid 2008. Table 7 identifies the schedule for completion of the health risk assessments at the 16 designated railyards.

Table 7
Schedule for Completing Health Risk Assessments

Final Health Risk Assessments November *2007*		**Draft Health Risk Assessments to be Completed by *March/April, 2008***	
Railyard	**Company**	**Railyard**	**Company**
Commerce (Eastern/Sheila)	BNSF	Barstow[2]	BNSF
Hobart	BNSF	San Bernardino[2]	BNSF
Richmond	BNSF	San Diego[2]	BNSF
Stockton	BNSF	Colton[1]	UP
Wilmington (Watson)	BNSF	Dolores (ICTF)[1]	UP
Commerce	UP	Industry[1]	UP
LA (LATC)	UP	Oakland[1]	UP
Mira Loma	UP		
Stockton	UP		

1. Draft HRA's released March 2008
2. Draft HRA's scheduled to be released in April 2008

3. The First Nine Railyard Health Risk Assessments

Assessments for nine designated railyards, and one additional non-designated railyard (BNSF Sheila), were finalized in November 2007. ARB staff prepared the health risk assessment portions of the draft HRAs. UP and BNSF provided the railyard emissions inventories and exposure modeling pursuant to ARB guidelines. The railyard HRAs are similar to the assessments for the UP Roseville Railyard (2004) and the combined Port of Los Angeles and Port of Long Beach (2006).

Staff and the railroads held public meetings to present the results of the first nine draft HRAs in May and June 2007. At the meetings, staff and the railroads discussed what we learned, what is being done to reduce railyard pollution, and answered questions. The release of the draft HRAs was followed by at least a 30 day public comment period. Following the comment period, a second series of community meetings were held in

late June and early July to: 1) allow another opportunity for comment and questions, and 2) to seek community suggestions on how best to further reduce emissions. Based on these results, ARB finalized the first nine HRAs. We are now in the early stages of working with the railroads, local air pollution control districts, and communities to identify additional feasible mitigation measures that can be implemented to reduce diesel PM emissions.

4. Health Risks from Exposure to Toxic Air Pollutants

The staff estimates that the excess cancer risk from breathing toxic air contaminants (TACs) in ambient air in the South Coast Air Basin is on the average, about 1,000 per million in the year 2000. Potential cancer risk in the San Francisco Bay Area and the San Joaquin Valley are about one-third lower. About 70 percent of this risk is attributed to one TAC, diesel particulate matter (diesel PM). The average regional risk for diesel PM in urban areas was between 500 to 800 excess cancers per million in the year 2000.

Emissions from freight transport activities, also called goods movement, are a very significant source of diesel PM in California. These sources include ships, trucks, locomotives, and cargo handling equipment. Some residential areas are in close proximity to ports, railyards, and freeways where many diesel fueled sources operate. In these areas, increases in cancer risk from nearby diesel sources are often significant. In a few cases, the localized risk can double and be as great as the regional background levels. The concentration of diesel PM in the air declines rapidly with distance from any one source, and the impact of even a large facility, measured as a percent of the regional risk level, is much smaller for those living a mile or more from the source area.

5. Results of the First Nine Railyard Health Risk Assessments

The assessments show that the diesel PM emissions from the railyards result in significantly higher pollution exposure and related risks in nearby communities. The largest impacts are associated with the four railyards in Commerce. Diesel PM emissions from these four yards (combined) were about 40 tons per year in 2005. This is about 0.5 percent of the regional diesel PM emissions, and much less than the emissions at the basin's ports. However, the Commerce yards emissions are concentrated and occur next to and generally upwind of the city's populated areas. The elevated exposures result in an estimated 70 percent increase in exposure to TACs (over regional levels) for about 5,000 local residents. Exposure increases from the other yards in the Los Angeles area are significantly less and fewer people are highly impacted[1]. Risk increases range from about 5 to 20 percent increase over regional levels. Consistent with the findings of Roseville Railyard Study (ARB, 2004), the cancer risks decrease significantly within a one mile distance from railyards.

[1] HRA reports and fact sheets are available at http://www.arb.ca.gov/railyard/hra/hra.htm

In the first group of assessments finalized in November 2007, staff also estimated pollution risks from other sources of diesel PM. The major emission source is diesel truck traffic in a one to two mile zone around each railyard. Generally, offsite diesel PM emissions result in similar or higher diesel PM exposure than railyard related emissions. A summary of diesel PM emissions from each railyard and air basin regional levels is presented in Table 8.

Table 8
Summary of Railyard, Port, Off-Site, and Air Basin Diesel PM Emissions (2005)

PORT OR RAILYARDS	**FACILITY** Diesel PM (Tons Per Year)	**OFFSITE*** Diesel PM (Tons Per Year)	**AIR BASIN** Diesel PM (Tons Per Year)
Los Angeles Region			
Port of LA and Long Beach	1,760	N/A	7,800
Four Commerce Yards Combined	40	113	
UP LATC	7	33	
UP Mira Loma	5	31	
BNSF Watson	2	5	
Other Areas			
UP and BNSF Stockton Combined	10	10	4,000
BNSF Richmond	5	20	4,600
UP Roseville	25[1]	N/A	2,400

* Off-site diesel PM emissions were estimated within 1 mile of the railyard boundaries, except for the four Commerce railyards in which diesel PM emissions were estimated within 2 miles of the railyard boundaries. [1] Locomotive diesel PM emissions only.

6. Draft Results from the Second Set of Railyard Health Risk Assessments

The draft emissions inventories for UP (ICTF/Dolores, Colton, City of Industry, Oakland) and BNSF (San Bernardino, Barstow, and San Diego) railyards, along with UP Roseville (released in 2004), and the first ten railyard HRAs finalized in November 2007 are presented in Table 9. The draft HRAs also estimate exposure (population) impacts from other sources of diesel PM, such as truck traffic, within a one-mile zone around each railyard. The seven railyards also have significantly less exposure impact than the four Commerce railyards due to a lower population within their vicinity. However, BNSF San Bernardino has near source areas (less than ¼ mile from the north-eastern portion of the railyard) with diesel PM cancer risks equal to the South Coast Air Basin regional average background cancer risk level of 1,000 in a million.

A detailed draft summary of diesel PM emissions from eighteen railyards is presented in Table 9. This table identifies the primary emission sources within the railyard and grouped by air district or region of the state.

Table 9
Diesel PM Emissions from Eighteen Major California Railyards
(tons per year)

Railyard	Locomotive	Cargo Handling Equipment	On-Road Trucks	Others (Off-Road Equipment, TRUs, Stationary Sources, etc.)	Total[§]
South Coast Air Quality Management District					
BNSF Hobart	5.9	4.2	10.1	3.7	**23.9**
UP ICTF/Dolores[1]	9.8	4.4	7.5	2.0	**23.7**
BNSF San Bernardino[1]	10.6	3.7	4.4	3.4	**22.0**
UP Colton[1]	16.3	N/A	0.2	0.05	**16.5**
UP Commerce	4.9	4.8	2.0	0.4	**12.1**
UP City of Industry[1]	5.9	2.8	2.0	0.3	**10.9**
UP LATC	3.2	2.7	1.0	0.5	**7.3**
UP Mira Loma	4.4	N/A	0.2	0.2	**4.9**
BNSF Commerce Eastern	0.6	0.4	1.1	1.0	**3.1**
BNSF Sheila	2.2	N/A	N/A	0.4	**2.7**
BNSF Watson	1.9	N/A	<0.01	0.04	**1.9**
Bay Area Air Quality Management District					
UP Oakland[1]	3.9	2.0	1.9	3.4	**11.2**
BNSF Richmond	3.3	0.3	0.5	0.6	**4.7**
San Joaquin Valley Unified Air Pollution Control District					
UP Stockton	6.5	N/A	0.2	0.2	**6.9**
BNSF Stockton	3.6	N/A	N/A	0.02	**3.6**
San Diego Air Pollution Control District					
BNSF San Diego[1]	1.6	N/A	0.007	0.04	**1.7**
Mojave Desert Air Quality Management District					
BNSF Barstow[1]	27.1	0.03	0.04	0.75	**27.9**
Placer County Air District/Sac Metro AQMD					
UP Roseville[2]	25.1	N/A	N/A	N/A	**25.1**
STATEWIDE RY TOTAL	136.8	25.3	31.2	17.0	**210.1[§]**
Statewide RY Percent	*65%*	*12%*	*15%*	*8%*	***100%***

1. Draft results from second set of railyard HRAs. Final HRAs for these railyards are expected by mid 2008.
2. UP Roseville Health Risk Assessment (ARB, 2004a) was based on 1999-2000 emission estimate, only locomotive diesel PM emissions were reported in that study. The actual emissions were estimated at a range of 22 to 25 tons per year.

7. Actions to Reduce Diesel PM Emissions In and Around Railyards

The recently developed health risk assessments confirm that diesel PM levels, both regionally and near ports, freeways and railyards, are far too high, and provide additional reasons to move as rapidly as possible to implement the control programs that have already been initiated. In 2000, ARB adopted a Statewide Diesel Risk Reduction Plan. Recognizing the problems posed by the rapid growth in freight movement, the Board adopted a Goods Movement Emission Reduction Plan (GMERP) in 2006. One of the elements of the GMERP is to reduce locomotive emissions by up to 85 percent by 2020.

ARB's efforts to comprehensively reduce locomotive and railyard emissions include voluntary agreements, state and federal regulations, and incentive mitigation programs, including early replacement of California's line haul and yard locomotive fleets (see Fact Sheet Strategies to Reduce Locomotive and Associated Railyard Emissions, http://www.arb.ca.gov/railyard/hra/hra.htm).

Locomotives represent between one-third and to almost 100 percent of the diesel PM emissions at the designated railyards. Large classification railyards like UP Roseville and Colton and BNSF Barstow generate almost their entire diesel PM emissions from locomotives, with line haul and yard switcher locomotives split evenly in their contributions. Large intermodal railyards like BNSF Hobart and UP ICTF/Dolores have about a 1/3 split between locomotive, cargo handling equipment, and heavy-duty diesel truck diesel PM emissions.

Staff estimates that the following fully implemented measures have provided up to 30% reduction in railyard diesel PM emissions between 2005, the inventory year for the HRA, and early 2008.

- 2005 Statewide Railroad Agreement (up to 20%)
- ARB diesel fuel regulation for intrastate locomotives (up to 14%)
- Replacement of switcher locomotives (up to 90%)

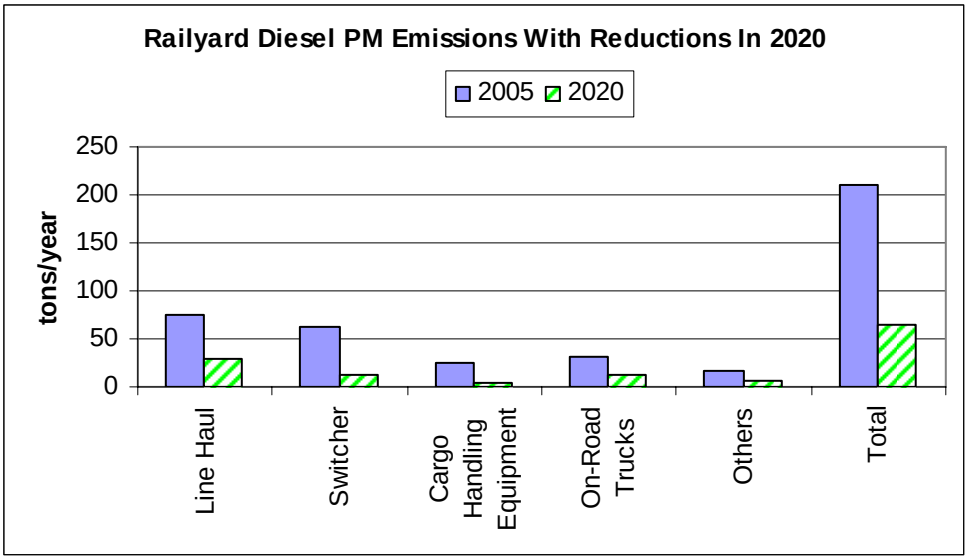
An additional 30% reduction is expected to be generated by measures implemented between 2008 and 2010:

- Locomotive NOx Fleet Average Agreement in South Coast (up to 50%)
- ARB Cargo Handling Equipment Regulation (up to 40%)
- Port and Intermodal Drayage Truck Railyard Regulation (up to 90%)
- Transport Refrigeration Unit Airborne Toxic Control Measure (up to 65%)

These measures will achieve very large reductions by 2010 and will be nearly fully implemented by 2015. The goal with all of these measures combined is to reduce

locomotive and railyard related diesel PM emissions by up to 85% between 2015 and 2020. Figure 1 below illustrates implementation of these measures.

Figure 1



E. Locomotive Remote Sensing Pilot Program

Assembly Bill 1222 became law in January 2006. Under the provisions of AB 1222, the ARB is required to design and implement a remote sensing pilot program in consultation with an advisory group consisting of up to 14 specified members. These members were appointed by the South Coast Air Quality Management District, Sacramento Metropolitan Air Quality Management District, UP, and BNSF. AB 1222 required a report to the legislature by December 31, 2006 on the feasibility and cost effectiveness of the use of remote sensing with locomotives.

The objectives of AB 1222 are to determine whether remote sensing devices can accurately and reliably determine, with a reasonable level of precision:

1. The levels of nitrogen oxides, particulate matter, and carbon monoxide emissions from locomotives;
2. Whether a locomotive is subject to tier 0, 1, or 2 federal certification standards; and
3. Whether the measured results can be calibrated to determine compliance with applicable federal emission certification levels.

To date, there have been 30 advisory group meetings. The members of the advisory group expressed a desire to take the time necessary to implement an effective and comprehensive pilot program. The design of the test program was more challenging than anticipated and the existing remote sensing technology needed to be adapted to measure locomotive emissions.

Staff, in consultation with the Advisory Group, developed a three phase approach towards implementing and achieving the objectives of this bill. Phase 1 involved an initial field test to determine the ability of remote sensing devices to measure the emissions from locomotive exhaust stacks. This part of Phase 1 was conducted at the Transportation Technology Center Inc. (TTCi) in Pueblo, Colorado, in February 2007. Phase 2 includes installation of the remote sensing devices at several locations in Northern and Southern California and monitoring emissions of locomotives that travel through these monitoring locations. The objective of Phase 2 is to assess the ability of the devices to evaluate locomotive emissions in the real world. Phase 3 is designed to compare measurements from remote sensing devices against U.S. EPA locomotive certification emission testing pursuant to 40 CFR Part 92. This phase is designed to determine the accuracy and precision of remote sensing devices as compared with the measurement of locomotive emissions required under the federal locomotive test procedures.

The Phase 1 work in Pueblo, Colorado was completed by March 2007. Phase 1 testing revealed problems with the line haul remote sensing device which resulted in its operation being discontinued. The yard extraction remote sensing system, however, provided more favorable operation and the advisory committee decided to go forward with further utilization of that system before being applied to mainline operation. The advisory group concluded that additional evaluation of the yard extraction remote sensing system was needed to resolve technical issues before implementation of field testing in Phase 2.

As a result, the Advisory Group agreed to create a pre-Phase 2 element (known as Phase 2a). This added Phase 2a testing element pushed back the project completion date from summer to fall 2007. Phase 2a testing occurred in May 2007. However, technical issues were still encountered in Phase 2a testing. The Advisory Group decided that these issues could be resolved during early testing in Phase 2. In this phase, the equipment was located at specific sites within a railyard and along a railroad track to measure as many locomotives in the field as possible to determine the potential of the equipment to identify gross polluters in the locomotive fleet. This testing occurred at the UP Colton railyard and a BNSF Cajon site in October 2007. Also, additional, Phase 2 testing occurred in northern California at Weimar (east of Auburn) in February 2008.

Phase 3 was conducted jointly by Environmental Systems Products (ESP) and Southwest Research Institute (SwRI). This testing compares the remote sensing results to the approved federal locomotive test procedure to determine the accuracy of the measurements from the remote sensor. This testing occurred in February 2008. A final report is anticipated by mid 2008.

F. Ongoing Evaluation of Other, Medium-Term, and Longer-Term Emission Control Measures

1. Requirements of the Agreement

Under the Agreement, the ARB and the railroads agreed to continue to evaluate and implement other feasible mitigation measures. These measures included funding and research of diesel particulate filters and diesel oxidation catalysts studies and demonstrations for switch locomotives and additional measures to evaluate and demonstrate advanced technologies for locomotives and the use of alternative fuels. In addition, the ARB and railroads committed to conduct semi-annual technical evaluation meetings with the public to evaluate future potential emission reduction measures.

2. Diesel Particulate Filters and Oxidation Catalysts

Staff and the railroads have been cooperatively evaluating the feasibility of developing diesel particulate filters or diesel oxidation catalysts for use on a typical locomotive representative of the current California switcher fleet. UP and BNSF indicated they would commit up to $5 million towards this evaluation. About $4 million of this money had already been expended for prototype and demonstration testing of a locomotive diesel particulate filter through January 1, 2008.

The next step in the diesel particulate filter locomotive demonstration is in-use durability testing in California. As part of the demonstration, both BNSF and UP agreed to retrofit California switch locomotives. These older switch locomotives are powered by 1,500 horsepower roots blown engines that have operated for 35 years or more. The UP diesel particulate filter equipped switch locomotive (UPY 1378) arrived in Oakland, California, in December 2006 and was later moved to Roseville, California.

The move to Roseville was prompted by the need to expose the locomotive to a higher activity level. In February 2008, after accomplishing more than 12 months of service, SwRI performed Federal emissions testing to evaluate performance of the DPF. The BNSF diesel particulate filter equipped switch locomotive (BNSF 3703) received a second generation diesel particulate filter manufactured by HUG. Testing of BNSF 3703 continued through 2007 at the SwRI facility in San Antonio, Texas. The locomotive is scheduled to arrive in Los Angeles, California, in the first half of 2008. If the in-use DPF demonstration is successful, both UP and BNSF have committed to retrofit one additional locomotive each for a total of four diesel particulate filter switcher locomotives operating in California.

In a separate test program, UP recently collaborated with the U.S. EPA to test an older freight locomotive retrofitted with a diesel oxidation catalyst to reduce diesel PM emissions. UP 2368, a 3,800 horsepower line haul locomotive and originally built in January 1992, was retrofitted with a diesel oxidation catalyst. This locomotive arrived in California in November 2006 and began in-use testing in the Los Angeles area for

approximately one year starting in early 2007. This locomotive was assigned to helper/hauler service in the Los Angeles basin. Over the next twelve months, the locomotive compiled approximately 2,800 hours of field service. No significant impacts to engine performance (e.g., maintaining power, fuel penalty, and backpressure) have been noted at this time, but failures involving the catalyst elements did occur. During scheduled inspection intervals, three separate failures occurred involving the catalyst elements and their supports. Currently the DOC device is undergoing failure analysis by the manufacturer Miratec. After the most recent failure, the DOC was removed and UP 2368 continued to operate in full service. Once Miratec completes its failure analysis and repair plan the DOC will be reinstalled in early 2008 for continued testing.

3. ARB Locomotive SCR Project

ARB recently funded a contract with Southwest Research Institute (SwRI) to research a compact SCR system offered by Engine Fuel and Emissions Engineering, Inc. (EF&EE) with catalysts parts supplied by Haldor Topsoe, a Danish Catalyst Company. The SCR device tested by was a urea-SCR catalyst technology originally developed for heavy duty truck applications in Europe modified for use in locomotive applications. This SCR device is also being used in the SCAQMD test program to retrofit an SCR device to a Metrolink passenger locomotive. The SwRI tests were conducted on an EMD 12-710G3 engine which is also the same engine family commonly used on pre-2000 freight line haul locomotives (~75%), passenger locomotives (most in California), and marine vessels. The research effort consisted of performance and emission testing of the compact SCR device retrofitted onto an EMD 12-710G3 engine. The test program objectives at SwRI were to perform baseline emission testing without the SCR, study the effects of higher exhaust back pressure on engine performance to simulate exhaust afterteatment devices, characterize crankcase blowby, and perform preliminary screening of the SCR device installed on an EMD 12-710G3 engine. All testing was performed at SwRI's facility. By November 2007, the initial engine tests (e.g., baseline, backpressure, and crankcase blowby) were completed and the SCR device was installed to perform preliminary SCR testing. During the performance testing, significant issues occurred ranging from structural design issues that involved failures with catalyst retainers and covers, the need for better turbo charger outlet and SCR device flow characterization, along with a redesign of the urea/air mixing system to achieve a more homogeneous distribution. As a result, the SCR system was unable to dose the urea properly. Ammonia concentrations in the exhaust were higher than expected. Liquid urea was observed leaking from the catalyst inlet gasket and the catalyst covers. This imbalance in the dosing of the urea resulted in large amounts of ammonia slip and dried urea crystals deposited in the turbo outlet and SCR device. EF&EE is currently working to address these issues.

4. Symposiums to Evaluate Future Potential Measures

Under the Agreement, the ARB and railroads are required to conduct public semi-annual technical evaluation symposiums to identify and evaluate future emission reduction measures for locomotive and railyard emissions. The initial technical

evaluation symposium was held on April 25, 2006 at the ARB offices in El Monte, California. The second symposium was held on July 13, 2006 at the Cal/EPA building in Sacramento, California. The ARB and railroads prepared a written report on progress and findings from the symposiums which was posted in December 2006. This report as posted on the ARB railyard website in December 2006 and is available at: http://www.arb.ca.gov/railyard/ryagreement/102006rpt_rrtech.pdf. A third symposium was held on June 6, 2007, at the Cal/EPA building in Sacramento, California. The fourth and most recent technology symposium was held on November 28, 2007, in El Monte, California. At this meeting the ARB summarized the need for additional emission reductions beyond U.S. EPA's proposed locomotive rulemaking and the railroads provided their perspectives of the successes and limitations of new technologies. In addition updates were provided on locomotive exhaust aftertreatment retrofit technology for freight and passenger. Finally, other technologies in development such as a BNSF fuel cell locomotive, GE's hybrid locomotive, and a question and answer report on "Natural Gas-fueled Locomotives" were released. A report summarizing the two symposiums held in 2007 will be released in early 2008.

G. ARB Enforcement Inspections

Consistent with the Agreement, staff implemented an idling enforcement training program for ARB and local air district enforcement personnel, and coordination with the railroads to provide visible emission training to railroad employees. Enforcement Division staff conducted railyard inspections to evaluate compliance with the requirements specified in the Agreement.

1. Inspection Results and Preliminary Findings For 2007

Two statewide inspections occurred in 2007. As shown in Table 10, a fourth statewide inspection was completed by Enforcement staff during the second half of 2007. Staff visited 31 designated and covered railyards and inspected over 1,000 locomotives. In this fourth round of inspections, staff inspected 1,015 locomotives and issued 29 notices of violation for idling infractions and one notice of violation issued for a smoking locomotive.

Most of the idling NOV's (~2/3) were issued to locomotives equipped with idle reduction devices and were observed idling beyond the 15 minute requirement. The remaining NOV's were issued to locomotives that exceeded the 60 minute requirement and were not equipped with idle reduction devices. The reasons why the locomotives exceeded the 15 or 60 minute requirement ranged from idle reduction device malfunctions to essential idling. Idle reduction device malfunctions are sent to the nearest maintenance facility for repair. Essential idling occurs when the locomotive is maintaining a key operational parameter (e.g., pressure for air brakes, low battery voltage, engine coolant temperature) and is allowed to exceed the 15 or 60 minute requirement specified in the Agreement. In either instance the reason why the locomotive exceeds its idle time is not always immediately evident at the time of inspection and requires the assistance of railroad technical personnel for investigation. Enforcement staff work with railroad

technical personnel to not only identify the root cause for the locomotive exceeding its allowed idle time, but to also ensure the locomotive is operating correctly and repaired if necessary.

The results represent about a 97 percent compliance rate for the second half of 2007. For comparison, in 2006, over 1,300 locomotives were inspected during two separate rounds of railyard inspections. As a result of these inspections, Enforcement staff issued 32 notice of violations for idling infractions and one notice of violation issued for a smoking locomotive. This is about a 98 percent compliance rate for the locomotives sampled for all of 2006. Since inspections began in 2006, about 3,300 locomotives were inspected, 101 notices of violation for idling infractions were issued, and two notices were issued for smoking locomotives. Overall, for 2006 and 2007, this represents about a 97 percent compliance rate for the last two years.

Table 10
Inspection Results Summary 2006 & 2007

Air Basin	# of Railyards Visited	Idling Locomotives Observed	Non-Idling Locomotives Observed[5]	Total Number of Locomotives Inspected	Notice of Violations[4]
2006 Total	31	372	948	1,320	33[3]
March – May 2007 (Round 1)					
Mojave Desert	3	24	158	182	5
Mountain Counties	2	35	112	147	4
Sacramento Valley[1]	0[1]	9	10	19	9
San Diego	1	0	6	6	0
San Joaquin Valley	6	15	120	135	8
SF Bay Area	5	5	25	30	3
South Coast	14	12	433	445	11
2007 subtotal	31	100	864	964	40
September – November 2007 (Round 2)					
Mojave Desert	3	8	144	152	0
Mountain Counties	1	11	133	144	9
San Diego	2	3	7	10	3
San Joaquin Valley	6	5	94	99	2
SF Bay Area	5	3	39	42	3
South Coast[2]	14	18	550	568	13
2007 subtotal	31	48	967	1,015	30[3]
2007 Total	31	148	1,831	1,979	70
2006 / 2007 Total	31	520	2,779	3,299	103

1. Non-Railyard area. UP bridge fire event – traffic congestion occurred at a railroad siding in Elk Grove, California.
2. Includes BNSF and UP off-site (non-railyard) inspections.
3. Includes one visible emissions violation.
4. Final resolution status not reflected in totals.
5. Locomotive engine not running, but present during inspection.

III. OTHER IMPLEMENTATION EFFORTS

A. Modernization of the Locomotive Fleet

ARB and others have taken a number of actions to address the impacts of locomotive emissions throughout the State. This includes the 1998 Memorandum of Understanding with the railroads to reduce locomotive oxides of nitrogen (NOx) emissions in the South Coast, requirements for the use of cleaner fuel in intrastate locomotives, Carl Moyer Program funding by some local air districts, and the current Agreement. As a result, the railroads have undertaken a number of steps that will provide significant reductions in the emission impacts of railyards on local communities.

The combined railroads are currently operating about 9,900 new and rebuilt Tier 0, 1, and 2 locomotives. Of those, over 2,100 locomotives are expected to meet Tier 2 standards by the end of 2008. In total, UP and BNSF have over 65 percent of their 15,000 national locomotive fleet meeting at least Tier 0 standards and 49 percent are equipped with idle reduction devices.

Green Goats are electric hybrid switch locomotives that operate primarily through energy provided by over 300 lead acid batteries weighing 25 tons. Both railroads, combined, have placed 12 Green Goats into service in California over the past couple of years. However, these locomotives were recently returned to the manufacturer (Railpower) to remedy a potential fire hazard associated with the large bank of 300 lead-acid batteries. These locomotives are in the process of being upgraded so they can be reintroduced into revenue service.

Other railroad modernization efforts to reduce emissions include the introduction of gen-sets switch locomotives. In southern California UP now has 61 ultra low emitting Gen-set switch locomotives operating in the Los Angeles basin. These 61 Gen-sets were funded by UP. These new ultra low-emitting switch locomotives will provide up to a 90 percent reduction in NOx and diesel PM emissions when compared to the higher emitting older switch locomotives that are replaced. In northern California, BNSF has 11 Gen-sets in their fleet that are located Richmond (6) and San Joaquin Valley (5). By June of 2008, four UP Gen-set switch locomotives are scheduled to arrive and be assigned to the UP Roseville railyard. These fifteen northern California Gen-set locomotives were co-funded by the railroads and the ARB's Carl Moyer Program.

Today there are 72 gen-sets, 12 Green Goats, and 4 LNG locomotives operating in California service. Another four gen-sets are expected to be in service by mid 2008. These 92 locomotives brings California closer to one of the goals outlined in the Goods Movement Emission Reduction Plan (GMERP) to upgrade the rest of the intrastate switching fleet to ultra-low emitting emission levels by 2010.

B. Community Complaint Process

This section discusses the railroads' implementation efforts to establish and implement a community complaint process for idling and smoking locomotives.

1. Pre-existing Railroad Complaint Process

Prior to the implementation of the Agreement, each railroad had established procedures to process, handle, and respond to community complaints. Under these procedures, each railroad utilizes a national phone call center to receive and record complaints regarding its operations instead of individual local phone centers. The national phone systems allow the railroads to utilize a centrally trained staff and existing mechanisms that allows the public to register complaints about idling or smoking locomotives from all locations in the state at any time. The systems operate 24 hours a day and 365 days a year, and utilize computerized mechanisms to track and forward complaints to the appropriate company staff to respond.

The call center phone numbers for each railroad are:

- **Union Pacific Railroad**

  1-888-UPRRCOP or 1-888-877-7267

- **BNSF Railway**

  1-800-832-5452

While each railroads call center system is different, they are similarly structured in that calls received are logged and appropriate railroad employees are directed to respond.

2. Establishment of Railroad Complaint Process Under the Agreement

By August 31, 2005, both railroads submitted their plans to develop a process for informing members of the community on the results of their investigations of complaints. Under their programs, the railroads utilize their existing call centers and phone numbers for community members to report locomotive complaints by augmenting their national systems to be able to respond to and provide complaint resolution information to complainants. Each complaint is logged in a central database upon receipt, and generates a complaint report, which is forwarded to the appropriate railroad operations, environmental, or safety management personnel. Management reviews the complaints and based on the type of complaint and need for action, assigns the appropriate local railroad staff to investigate the complaint and correct the problem. Daily emails are now being automatically generated to environmental staff that must follow-up on the incidents and, in some cases, provide a response back to the individual who reported

the complaint. The transition to the new system-wide protocols has been developed and implemented. It will take time to evaluate and make any necessary program adjustments.

Staff continues to work with the railroads to evaluate the existing processes, and develop recommendations on how the system can be more responsive and accountable. This includes the establishment of protocols for better system tracking and recording of the complaint investigation process at the local level, and protocols for notifying individuals who file a complaint on the findings of the railroads' investigations, including any corrective actions taken.

3. Status of Railroad Complaint Process Under the Agreement

Table 11 summarizes complaint activity for the six month period from June 2007 through December 2007 and compares the activity to two previous periods. During the most recent six month period, UP and BNSF received a combined average of about 29 calls per month to their 800 numbers reporting idling locomotives. The first two months of 2008 averaged 31 calls per month. During the current period, there were some special events which may have affected the number of calls. In December 2007 there was severe flooding in Oregon and Washington that had ripple effects on California rail operations for both UP and BNSF. In January 2008 there was a mudslide in Oregon that spread 60 acres; the track is still not open as of this report.

By comparison, in the preceding six month reporting periods there were approximately 27, 21, and 36 calls per month, respectively. To put these call rates in context, the railroads have thousands of locomotives operating in California each month.

Table 11
1-800 Call Summary 2005 thru 2007

	Jan – Feb 2008	Jun 2007 thru Dec 2007	Dec 2006 thru May 2007	Jun 2006 thru Nov 2006	Dec 2005 thru May 2006
Average Monthly Calls to 800 Numbers	31	29	27	21	36

Since the July 2007 staff report, both railroads have continued to track and improve on how the community 800 number calls are processed. As before, citizens, the ARB, local air quality districts, and other local government agencies have been using the call center phone numbers to register complaints they have regarding specific locomotive events. Each railroad has been utilizing this information source to address identified problems. Both railroads have developed a follow-up process providing feedback to the caller, as appropriate, detailing problems that were identified and what actions could be taken.

Both railroads continue to further improve the process for gathering the necessary information for timely close-outs.

4. Development of an ARB Railyard Website

On August 1, 2005, staff established a "Railyard Emission Reduction" website at: http://www.arb.ca.gov/railyard/railyard.htm. This website is intended to provide information to the public about the ARB's ongoing efforts to reduce the emission impacts of railyard operations, including staff's activities to implement the Agreement and other related railroad information. The release of the first group of nine health risk assessments, which were finalized in November, and the recent release of the second group of seven draft health risk assessments can be found at http://www.arb.ca.gov/railyard/hra/hra.htm. In addition, the U.S. EPA released its proposed locomotive and marine rulemaking in April 2007 with a public comment period until July 2, 2007. In July 2007 the staff provided comments on the U.S. EPA proposed locomotive rulemaking. These comments can also be found at http://www.arb.ca.gov/railyard/railyard.htm under "What's New" and "Locomotives" links.

C. Other Outreach Efforts

Besides the community meetings required under the Agreement, the railroads have initiated a number of other outreach activities and events with the public. Table 11 lists all examples of the outreach activities conducted in the last six months.

Table 12
Railroad Community Meetings / Outreach
October 2007 thru March 2008

Year 2007	
10/10	Locomotive Remote Sensing Project Site Visits Colton, Cajon
11/5	HRA BNSF Watson/Wilmington Community Meeting
11/5	RR 101 to Oakland Maritime Air Quality Improvement Plan stakeholders group
11/5	HRA BNSF Hobart BNSF, Commerce-Eastern, BNSF Sheila Community Meeting
11/7	HRA UP LATC Community Meeting
11/7	HRA UP Mira Loma Community Meeting
11/8	HRA UP Commerce Community Meeting
11/28	RR/CARB Technology Symposium
12/4	HRA UP Stockton Community Meeting
12/5	HRA BNSF Stockton Community Meeting
12/6	HRA BNSF Richmond Community Meeting
Year 2008	
1/11	HRA BNSF Richmond Community Meeting with EJ group
2/25-2/27	Faster Freight Cleaner Air Conference at LA Convention Center
2/5	Locomotive Remote Sensing Project Site Visits at Roseville
3/11	HRA UP meeting Industry
3/12	HRA UP meeting Colton
3/18	HRA UP meeting ICTF
3/ 19	HRA UP meeting Oakland
5/6	HRA BNSF meeting – San Diego (Tentative)
5/7	HRA BNSF meeting – Barstow (Tentative)
5/8	HRA BNSF meeting – San Berardino (Tentative)

IV. PROMULGATION OF U.S. EPA'S LOCOMOTIVE EMISSION REGULATIONS

The U.S. EPA released its proposed draft Tier 4 locomotive and marine rulemaking in April 2007 with a public comment period until July 2, 2007. In July 2007, the staff provided comments on the U.S. EPA proposed locomotive rulemaking and were supportive of most elements included in the April 3, 2007 proposal (see link - http://www.arb.ca.gov/railyard/ryagreement/0707epaloco.pdf). On March 14, 2008, the U.S. EPA formally announced it's final locomotive and marine rule (see link - http://www.epa.gov/omswww/locomotv.htm#2008final).

U.S. EPA's final locomotive rulemaking would set Tier 4 new line haul locomotive standards for PM and NOx in 2015 and achieve emission reductions of 85 and 75 percent respectively, below current Tier 2 standards. In addition, Tier 3 new line haul locomotive standards for PM will be required in 2012 that would provide a 50 percent reduction beyond the Tier 2 PM standard. Existing Tier 0-2 line haul locomotives will be required to provide about a 50 percent PM reduction upon remanufacturing beginning in 2008 through 2013. Further, existing Tier 0 line haul locomotives with a separate loop intake air cooling will be required to provide about a 22 percent NOx reduction by 2010 and Tier 0 locomotives without a separate loop intake air cooling would be required to provide about a 16 percent NOx reduction by 2010. Finally, idle emission controls are required for newly manufactured and remanufactured locomotives. See Tables 13 and 14 for a summary NOx and PM standards for line-haul and switcher locomotives.

The new standards for locomotives are a significant advancement over the current standards, and the ARB commends the U.S. EPA for strengthening several aspects of the proposal it made last year. For example, the ARB supports the new Tier 4 locomotive standards which take effect in 2015 for both PM and NOx, instead of 2015 for PM and 2017 for NOx as contained in the proposal. In addition, the ARB recognizes and supports the U.S. EPA's action to require significant PM reductions from existing engines as they undergo periodic rebuilds. However, the ARB is disappointed with the long lead times before full control will be achieved. The lack of NOx control for engines built before 2015 and the long lead time required to achieve sufficient fleet turnover with new or remanufactured locomotives is a concern for California. Tier 0-3 locomotives may represent up to 90 percent of the national locomotive fleets through 2020 or longer. This could have been addressed by the U.S. EPA rulemaking should have providing regulatory contingencies to further reduce NOx and PM emissions upon future U.S. EPA certification of NOx or PM aftertreatment devices that can be retrofitted to Tier 0-3 locomotives. Under this approach, U.S. EPA would have had the authority to require a certified NOx and PM aftertreatment device for Tier 0-3 locomotives upon remanufacturing (every 7-10 years).

Table 13
U.S. EPA Final Locomotive NOx Emission Standards

Type	Tier	Date of Original Manufacture	Existing NOx Standard (g/bhp-hr)	New NOx Standard New or Remanufactured (g/bhp-hr)	Percent Control When Engine is New or Remanu-factured
Line-haul locomotives	Uncontrolled	Pre-1973	13.5	8.0 or 7.4	41% or 45%
	Tier 0	1973 - 2001	9.5	8.0 or 7.4	16% or 22%
	Tier 1	2002 - 2004	7.4	7.4	0%
	Tier 2	2005-2012	5.5	5.5	0%
	Tier 3	2012	N/A	5.5	0%
	Tier 4*	2015-2017	N/A	1.3	76% (vs. Tier 2)
Switcher locomotives	Uncontrolled	Pre-1973	19.8	11.8	40%
	Tier 0	1973 - 2001	14.0	11.8	16%
	Tier 1	2002 - 2004	11.0	11.0	0%
	Tier 2	2005-2011	8.1	8.1	0%
	Tier 3	2011	N/A	5.0	48% (vs. Tier 2)
	Tier 4*	2015	N/A	1.3	84% (vs. Tier 2)

* See Table 14

Table 14
U.S. EPA Final Locomotive PM Emission Standards

Type	Tier	Date of Original Manufacture	Existing PM Standards (g/bhp-hr)	New PM Standards New or Remanufactured (g/bhp-hr)	Percent Control When Engine is New or Remanu-factured
Line-haul locomotives	Uncontrolled	Pre-1973	0.34	0.22	35%
	Tier 0	1973 - 2001	0.60	0.22	63%
	Tier 1	2002 - 2004	0.45	0.22	49%
	Tier 2	2005-2011	0.20	0.10	50%
	Tier 3	2012	N/A	0.10	50% (vs. Tier 2)
	Tier 4*	2014	N/A	0.03	85% (vs. Tier 2)
Switcher locomotives	Tier 0	1973 - 2001	0.72	0.26	64%
	Tier 1	2002 - 2004	0.54	0.26	48%
	Tier 2	2005-2010	0.24	0.13	54%
	Tier 3	2011	N/A	0.10	58% (vs. Tier 2)
	Tier 4*	2015	N/A	0.03	87% (vs. Tier 2)

* Interim provision, in-use compliance add-on allowed. Option 1 allows a NOx add-on of up to 1.3 g/bhp-hr (i.e., 2.6 g/bhp-hr for in-use testing) for model years 2015 thru 2017. Option 2 allows a NOx add-on of 0.6 g/bhp-hr (i.e., 1.9 g/bhp-hr for in-use testing) for model years 2015 thru 2022. Option 1 or 2 must be declared when certifying engine family.
Note: In most cases, gen-set switchers have been certified at levels below 0.15 g/bhphr, without aftertreatment.

California needs both effective and expeditious pollution reductions from locomotives. The new federal locomotive emission standards will help, but they will not provide California with the necessary emission reductions in the timeframes in which they are needed. The final rulemaking will not provide the 85 percent NOx or PM emission reductions needed to meet the GMERP goals by 2020 or the NOx reductions needed to meet the South Coast PM 2.5 SIP by 2014. The final rulemaking leaves California with a 60 to 80 percent NOx and 25 to 50 percent PM shortfall through 2025 or later.

The new federal locomotive emission standards will help, but they will not provide California with the necessary emission reductions in the timeframes in which they are needed. California needs a combination of strategies to reduce locomotive emissions in California including full replacement of switch locomotives, exhaust aftertreatment retrofits on older captive line haul locomotives, and acceleration of the introduction of new Tier 4 interstate line haul locomotives directed towards California. Consequently, the ARB will continue to work with U.S. EPA, the railroads, and other stakeholders to identify innovative ways to accelerate the reduction of locomotive emissions in California.

This page left intentionally blank