

Draft Report

**DIESEL PARTICULATE MATTER MITIGATION PLAN
FOR THE BNSF RAILROAD SAN BERNARDINO RAIL YARD**

Prepared for
BNSF Railway
2650 Lou Menk Drive
Fort Worth, TX 76131-2830

Prepared by
Christian Lindhjem
ENVIRON International Corporation
773 San Marin Drive, Suite 2115
Novato, CA 94998

August 21, 2008

TABLE OF CONTENTS

	Page
I. INTRODUCTION.....	1
II. SUMMARY OF RAIL YARD OPERATIONS.....	1
III. EMISSIONS SUMMARY	1
IV. EMISSION INVENTORY METHODOLOGY	2
1. Locomotives.....	4
2. HHD Diesel Fueled Drayage Trucks	8
3. Cargo Handling Equipment (CHE).....	8
4. Heavy Equipment.....	10
5. Transport Refrigeration Units (TRUs) and Refrigerated Railcars (Reefer)	10
6. Other Miscellaneous Diesel-Fueled Equipment	11
V. PROJECTED GROWTH RATES	11
VI. MITIGATION MEASURES.....	12
1. Current Mitigation Measures	12
2. Proposed Future Mitigation Measures	12
VII. EVALUATION OF ADDITIONAL MITIGATION MEASURES.....	12
VIII. MECHANISMS FOR TRACKING PROGRESS.....	12
X. CONCLUSIONS	12

APPENDIX A: Detailed Emission Forecasts

TABLES

Table 3-1. Estimated total annual DPM emissions associated with the operations at the San Bernardino facility with 2005 activity levels.	2
Table 4-1. DPM emission (metric tonnes per year) projection summary for BNSF San Bernardino.....	3
Table 4-2a. Locomotive – Emission standards (g/hp-hr) for line-haul (duty cycle) engines.....	5
Table 4-2b. Locomotive – EPA projected emissions factors (g/hp-hr) for line-haul engines	5

Table 4-3a.Locomotive – Emission standards for switching (duty cycle) engines6

Table 4-3b.Locomotive – EPA projected emission factors for switching (duty cycle) engines6

Table 4-4. Fleet composition estimate in the South Coast in future years7

Table 4-6. CHE emission reduction with ARB rulemaking9

Table 4-7. ENVIRON estimated ARB PM emission reductions for TRU10

Table 5-1. Historic activity data for diesel-fueled equipment San Bernardino Rail Yard.....11

FIGURES

Figure 4-1. BNSF San Bernardino emission summary (With and without growth).....4

DIESEL PARTICULATE MATTER MITIGATION PLAN FOR THE BNSF RAILROAD SAN BERNARDINO RAIL YARD

I. Introduction

In accordance with the 2005 California Air Resources Board (CARB)/Railroad Statewide Agreement (MOU), ENVIRON on behalf of BNSF has prepared this Mitigation Plan for the San Bernardino Rail Yard. The purpose of this Plan is to outline the potential mitigation measures that can be used reduce Diesel particulate matter (DPM) emissions from the San Bernardino Rail Yard. The Plan also contains sections detailing how the baseline and projected emissions were calculated and mechanisms that will be used to track progress. The baseline emissions were described in great detail in a series of reports that are publicly available (<http://www.arb.ca.gov/railyard/hra/hra.htm>).

As discussed below, the proposed Mitigation Measures, when fully implemented, will reduce the DPM emissions from the San Bernardino Yard by at least 75% from 2005 baseline. These emission reductions will concurrently lower any existing predicted health risk associated with the facility operations. Other federal, state, and local related air pollution control measures and plans, and existing railroad voluntary agreement measures will supplement the current and future emission reduction discussed in this Plan.

II. Summary of Rail Yard Operations

The San Bernardino yard is a rail yard that is split into two distinct sections – an East-West aligned intermodal rail yard (“A” yard) and a roughly North-South aligned automotive yard (“B” yard). The majority of activity occurs in the intermodal “A” yard. The freight activities in the “B” yard are miniscule for the years 2005 and after due to the termination of an exclusive contract with General Motors. Besides the activities on those two yards, a number of trains pass through or by the yard.

The main purpose of the San Bernardino intermodal yard is to make-up trains. To do so, containers or truck chassis are hauled into the yard, temporarily stored and then loaded onto a rail car. The intermodal cargo is carried in either containers or trailers, and both are loaded onto flatbed railcars. Containers may be carried in double stack configuration.

III. Emissions Summary

Table 3-1 below, shows the DPM emissions from the San Bernardino Yard, by equipment category, for the 2005 baseline year and for future years as the mitigation measures proposed in this Plan are implemented over time. As shown in Table 3-1, when the proposed mitigation measures are implemented DPM emissions will be reduced by more than 75 percent. These emission reductions will concurrently lower any existing predicted health risk related to facility operations. A detailed discussion of each mitigation measure is provided in Section VI.

The projected emission reduction calculations shown in Table 3-1 assume a gradual increase in freight handled at the San Bernardino Yard over time. The assumptions and methodologies used

to predict the rate of growth are discussed in Section V. In addition, the analysis takes into account certain other future regulatory measures and voluntary agreements, which will be implemented and effective by 2020 (e.g., CARB's Cargo Handling Equipment and Drayage Truck regulations, federal truck emission rules, 1998 and 2005 CARB MOUs).

In summary the emission totals for all rail yards were compiled using the adjustments to the emission inventory projecting fleet turnover and future year emission rates. The totals, by source category, are provided in Table 3-1 for San Bernardino. The 2005 cargo handling equipment was revised with new activity data, and the truck emissions were revised with the EMFAC version 2.3 emission rates. A different growth rate was applied to the mainline freight and passenger traffic from that for the activity within the yard.

Table 3-1. Estimated total annual DPM emissions associated with the operations at the San Bernardino facility with 2005 activity levels.

Facility Operations	2005	2005 – revised	2010	2015	2020
	PM Emissions Metric Tonnes				
Basic Services	0.35	0.35	0.09	0.06	0.04
Basic Engine Inspection	N/A	N/A	N/A	N/A	N/A
Full Engine Service/Inspection	N/A	N/A	N/A	N/A	N/A
Switching Engines	3.68	3.68	2.96	1.75	1.54
Arriving and Departing Trains	3.32	3.32	2.58	1.95	1.25
Adjacent Freight Movements	2.10	2.10	1.82	1.33	0.77
Adjacent Commuter Rail Operations	0.14	0.14	0.14	0.14	0.14
Cargo Handling Equipment	3.31	2.68 ¹	1.02	0.65	0.27
On-Road Container Truck Operations	3.90	4.90 ²	0.44	0.15	0.18
On-Road Container Truck Operations, Contractors	0.03	0.03 ²	0.00	0.00	0.00
On-Road Fleet Vehicle	0.02	0.02	0.02	0.02	0.02
Other Off-Road TRU	3.00	3.00	1.40	0.76	0.12
Other Off-Road Track Maintenance	0.04	0.04	0.03	0.03	0.02
Stationary Sources	0.08	0.08	0.08	0.08	0.08
Total – without growth	19.98	20.34	10.58	6.92	4.43
Reduction % (without growth)	---	---	48%	66%	78%
Total - with growth	---	---	10.89	7.43	4.94
Reduction % (with growth)	---	---	46%	63%	76%

¹ – Cargo handling activity (hours per year) and load factor adjusted

² – Truck emission factors update to EMFAC v2.3

IV. Emission Inventory Methodology

In forecasting emissions at rail yards, ENVIRON projected the impact of several rulemakings and voluntary initiatives. These rulemakings and initiatives include emission reductions expected to result from Federal, State, and voluntary emission reduction strategies from all sources. These reductions will primarily result from normal and accelerated fleet turnover to engines meeting more stringent new engine emission standards. Normal fleet turnover is the fleet replacement expected due to retirement of older equipment for mechanical or other business reasons. Accelerated turnover of equipment is the centerpiece of many California rulemakings and some voluntary initiatives and is expected to result in emission reductions in years immediately after a change in the new engine emission standards. Retrofit of older equipment is often available as an alternative element to comply with accelerated turnover.

The emission sources affected include the following source categories:

- Locomotives (Line-Haul & Switching)
- HHD Diesel-Fueled Drayage Trucks
- Cargo Handling Equipment
- Heavy Equipment
- Transport Refrigeration Units (TRU) and Refrigerated Railcars
- Other Miscellaneous Diesel-Fueled Equipment

The emissions consider a constant 2005 level of activity and apply activity changes after the fact. Overall ENVIRON expects emissions from rail yards to have significant reductions in the years 2005 through 2020 as a result of Federal, State, and local initiatives affecting new engines and of replacement or retrofit of older equipment with engines and equipment using low emission technology. The projected emission reductions without considering growth range from 56% to 81%, and adding the expected growth of 0% for containers and 3% per year for mainline locomotive traffic results in emission reductions from 54% to 79%. A no growth scenario was run to determine the emission reduction due to fleet turnover or other measures prior to applying any growth estimate. The growth estimates for this yard consist of two primary activity indicators, container lifts on site and mainline traffic passing the yard. The lifts are a measure of the intermodal traffic, which directly correlates to the number of trains stopping, switching engines use, cargo handling equipment, and truck traffic. The mainline traffic is unrelated to the yard but was another emission source within the boundaries of the site studied. The no growth and growth scenarios are shown for San Bernardino rail yards in Table 4-1 and in Figure 4-1 for the San Bernardino rail yard.

Table 4-1. DPM emission (metric tonnes per year) projection summary for BNSF San Bernardino.

Yard (condition)	2005	2005 Revised	2010	2015	2020
<u>No growth</u>	19.98	20.34	10.58	6.92	4.43
<u>With growth</u>	---	---	10.89	7.43	4.94

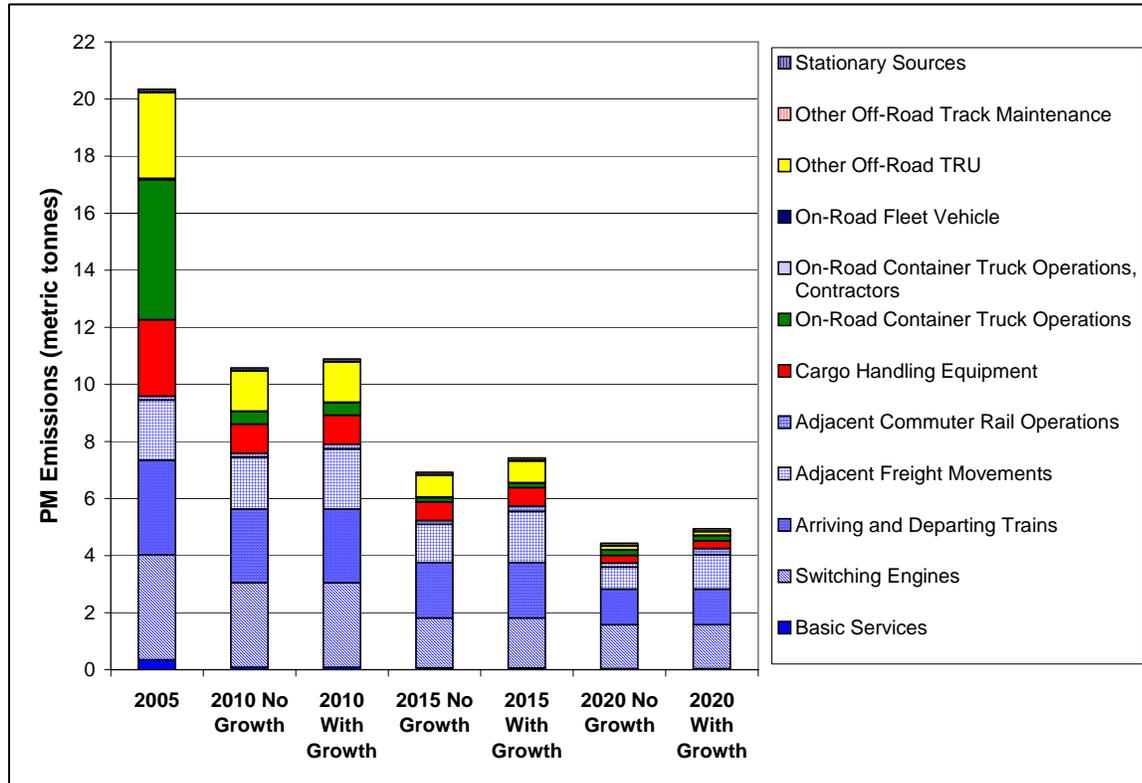


Figure 4-1. BNSF San Bernardino emission summary (With and without growth).

A general discussion of the analytical methodology and assumptions used to calculate the 2005 baseline emissions and to forecast emissions for calendar years 2010 through 2020, for each equipment category is provided below. Detailed emission calculations for the 2005 baseline year can be found in the San Bernardino Toxic Air Contaminants Emissions Inventory with modifications for the revised emission inventory methods described in this report.

1. Locomotives

BNSF has agreed (“Memorandum of Mutual Understandings and Agreements,” July 2, 1998) to meet Tier 2 fleet average emissions for all locomotives operating in the South Coast. This agreement may be met in variety of ways through averaging very low emitters with engines not meeting Tier 2 levels.

In addition, BNSF has agreed in the MOU (ARB/Railroad Statewide Agreement, “Particulate Emission Reduction Program at California Rail Yards,” June 2005) to reduce idling and to use lower sulfur fuels for locomotives based and refueled in California.

The reduced idling agreement calls for engines based in California to be refit with idle shut-off devices, limiting each idle event to no more than 15 minutes. This will affect all switching engines at California yards and likely most line-haul engines operating in the South Coast where many line-haul engines may be dedicated to that area. ENVIRON assumed that all BNSF new engines are fitted with idle shutoff; so at least all Tier 2 engines were expected to use these devices.

BNSF agreed to accelerate the use of low sulfur fuel in California ahead of the Federal standard for 15 ppm sulfur starting in 2012. By agreement, BNSF will use 15 ppm sulfur in 80% of the California refueling gallons with the remaining assumed to be at the 2007 Federal standard of 500 ppm. Based on an assessment of the in-bound engines using Federal fuel and out-bound engines using California fuel along with refueling rates at locations inside and outside of California, ENVIRON calculated the average sulfur level to be no higher than 0.034% in 2007-2011 time frame compared with 0.105% in 2005 due to the agreement.

EPA announced final emission standards (EPA, 2008) that include an analysis of the expected benefit of normal fleet turnover and the additional benefit of the EPA rule. The emission standards include a retrofit of existing equipment as well as new engine emission standards. Existing Tier 0, 1, and 2 engines will be subject to retrofit at the time of rebuild; so the engines will be rebuilt gradually throughout their remaining useful life.

The emissions standards and projected EPA emission factors are shown in Tables 4-2 and 4-3, depending on the duty cycle chosen to certify the engines - either line-haul or switching engine duty cycles. The duty cycle for line-haul engines typically leads to lower emission on a gram per horsepower-hour (hp-hr) basis because the switching engine duty cycle has a considerable idling time (no hp-hr generated). In some cases the uncontrolled emissions are much lower than some of the emission standards, so no emission reduction would be expected from those standards especially for HC and CO emissions. The relative emission factors provided by EPA were used to adjust the locomotive emission rates. For instance, for the Tier 2 remanufactured engines the PM emissions were reduced by 55.6% that reflect the expected emission reduction from 0.08 g/hp-hr for remanufactured locomotives compared to 0.18 g/hp-hr for the baseline Tier 2 locomotives in Table 4-2b.

Table 4-2a. Locomotive – Emission standards (g/hp-hr) for line-haul (duty cycle) engines.

Emission Standard	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	Pre-1973	0.48	1.28	13.0	0.32
Tier 0 – original	1973 – 2001	1.00	5.0	9.5	0.60
Tier 0 – final ¹	2008 / 2010	1.00	5.0	8.0	0.22
Tier 1 – original	2002 – 2004	0.55	2.2	7.4	0.45
Tier 1 – final ¹	2008 / 2010	0.55	5.0	7.4	0.22
Tier 2 – original	2005	0.30	1.5	5.5	0.20
Tier 2 – final ¹	2013	0.30	1.5	5.5	0.10
Tier 3	2012 – 2014	0.30	1.5	5.5	0.10
Tier 4 ²	2015	0.14	1.5	1.3	0.03

¹ These are retrofit standards at the time of rebuild and phased in as retrofit kit availability.

² The Tier 4 NOx standard can be a 1.4 NOx + HC standard.

Table 4-2b. Locomotive – EPA projected emissions factors (g/hp-hr) for line-haul engines.

Engine Type	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	Pre-1973	0.48	1.28	13.0	0.32
Tier 0 – original	1973 – 2001	0.48	1.28	8.60	0.32
Tier 0 – final ¹	2008 / 2010	0.30	1.28	7.20	0.20
Tier 1 – original	2002 – 2004	0.47	1.28	6.70	0.32
Tier 1 – final ¹	2008 / 2010	0.29	1.28	6.70	0.20
Tier 2 – original	2005	0.26	1.28	5.50	0.18
Tier 2 – final ¹	2008 / 2013	0.13	1.28	4.95	0.08
Tier 3	2012 – 2014	0.13	1.28	4.95	0.08
Tier 4 ²	2015	0.04	1.28	1.00	0.015

¹ These are estimated emissions with retrofit with some exceptions for older Tier 0 engines.

² The Tier 4 NOx standard would not apply until 2017, while the other standards would apply starting in 2015. The Tier 4 NOx standard would apply, however, at remanufacture for model year 2015 and 2016 locomotives.

Table 4-3a. Locomotive – Emission standards for switching (duty cycle) engines.

Emission Standard	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	Pre-1973	1.01	1.83	17.4	0.44
Tier 0 – original	1973 – 2001	2.10	8.0	14.00	0.72
Tier 0 – final ¹	2008 / 2010	2.10	8.0	11.80	0.26
Tier 1 – original	2002 – 2004	1.20	2.5	11.00	0.54
Tier 1 – final ¹	2008 / 2010	1.20	2.5	11.00	0.26
Tier 2 – original	2005	0.60	2.4	8.10	0.24
Tier 2 – final ¹	2008 / 2013	0.60	2.4	8.10	0.13
Tier 3	2011 - 2015	0.60	2.4	5.00	0.10
Tier 4 ²	2015	0.14	2.4	1.30	0.03

1 These are retrofit standards at the time of rebuild and phased in as retrofit kit availability allows.

2 The Tier 4 NOx standard can be a 1.3 NOx + HC standard.

Table 4-3b. Locomotive – EPA projected emission factors for switching (duty cycle) engines.

Engine Type	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	Pre-1973	1.01	1.83	17.4	0.44
Tier 0 – original	1973 – 2001	1.01	1.83	14.0	0.44
Tier 0 – final ¹	2008 / 2010	0.57	1.83	10.62	0.23
Tier 1 – original	2002 – 2004	1.01	1.83	9.9	0.43
Tier 1 – final ¹	2008 / 2010	0.57	1.83	9.9	0.23
Tier 2 – original	2005	0.51	1.83	7.3	0.19
Tier 2 – final ¹	2008 / 2013	0.26	1.83	7.3	0.11
Tier 3	2011 - 2015	0.26	1.83	5.4	0.08
Tier 4 ²	2015	0.08	1.83	1.00	0.015

1 These are estimated emissions with retrofit with some exceptions for older Tier 0 engines.

2 The Tier 4 NOx standard would not apply until 2017, while the other standards would apply starting in 2015. The Tier 4 NOx standard would apply, however, at remanufacture for model year 2015 and 2016 locomotives.

a) Line-haul Locomotives

Line-haul locomotives are responsible for long-haul trips that pass rail yards on the mainline tracks and also enter classification and intermodal yard pulling arriving and departing trains (TA/TD). The two types of activities, passing and TA/TD, are treated uniquely in the assessment of the rail yards because the spatial allocation of the activity and the engine duty cycles are unique to each type of train. For San Bernardino, a train type was introduced to address trains that enter the yard but merely change the crew, and so it has a duty cycle different from engines serving either TA/TD or passing trains.

Because the South Coast agreement is an averaging standard, the exact fleet composition may change from day to day. For the purposes of this work, ENVIRON assumed a fleet mix of locomotives such that 75% of the fleet were GE ES44DC engines that meet NOx and other pollutant emission levels below the Tier 2 standard, and 15% were GE Dash 9 engines meeting the Tier 1 standard. The remaining 10% of line-haul locomotives were Tier 0 GE Dash 9. This assumption of the fleet make-up somewhat overstates future year emissions because Dash 9 and the Tier 2 engines have higher rated power than some of the engines used in 2005. Therefore either fewer engines or lower power notch settings would be used to perform the same work.

For 2015 and 2020, ENVIRON estimated the fleet turnover to Tier 3 and Tier 4 engines to be 3% per year with the equivalent fleet replacement of Tier 0, Tier 1, and Tier 2 engines by the Tier 3

and Tier 4 engines. ENVIRON assumed that the Tier 3 and 4 engines percentage emissions reductions would occur equivalently for all modes (idle and notches) from the Tier 2 engines. The Tier 3 PM emission standard is essentially the same as the rebuilt Tier 2, but the engines meeting Tier 4 standards have a lower PM emission standard.

BNSF estimated that the remaining Tier 0 and Tier 1 engines would undergo engine rebuilds every 6 years or 17% of the fleet per year. Likewise because Tier 2 engines would be rebuilt every 8 years, 12.5% of the Tier 2 fleet would be rebuilt per year. The final rebuild kits would be available for all engines starting in 2010 for Tier 0 and Tier 1, and 2013 for Tier 2. Some emission reductions could occur earlier, but ENVIRON chose to ignore the phase-in period for rebuild kits. The emission reduction was calculated to be 37.5% for Tier 0 and 1 rebuilds (0.20 g/hp-hr compared to the baseline PM emission rate of 0.32 g/hp-hr) and 50% for Tier 2 rebuilds from Tier 2 base emissions (0.20 to 0.10 g/hp-hr PM emission rate reduction).

Table 4-4 provides expected fleet composition with introduction of the Tier 3 and Tier 4 engines replacing the South Coast fleet. ENVIRON assumes that the introduction of Tier 3 and 4 engines could replace the fleet of Tier 0 / 1 / 2 engines in equal proportion and so the fleet fraction of remaining Tier 0, 1, and 2 engines were proportionally reduced.

Table 4-4. Fleet composition estimate in the South Coast in future years.

Engine Model	2010	2015	2020
Tier 0	10%	1.3%	0.0%
Tier 0 rebuild	0%	7.5%	7.3%
Tier 1	15%	2.0%	0.0%
Tier 1 rebuild	0%	11.2%	11.0%
Tier 2	75%	49.5%	6.8%
Tier 2 rebuild	0%	16.5%	47.9%
Tier 3	0%	9.0%	9.0%
Tier 4	0%	3.0%	18.0%
Overall	100%	100%	100%

Idle emission reductions are difficult to predict. Passing locomotive idle times were found to be short and result from main line congestion and speed limits forcing engineers to back off power, but no idle emission reductions are expected for this activity category. The TA/TD engines however do spend more time in the yard where engines can idle a significant amount of time. ENVIRON assumed that the idle shut-off devices would reduce TA/TD engines idle time to 1 hour (15 minutes for each event; arrival and train cut out, move to refueling area, arrival at ready track awaiting assignment, and prior to leaving with a new train) per arrival of new Tier 2 engines with factory installed idle limiting timers.

b) Switching Locomotives

Based on conversation with BNSF, the switching engines would otherwise continue to be Tier 0 compliant and remanufactured according to the schedule that EPA has finalized. The emissions for switching engines will be affected by the MOU idle reduction measure in addition to the remanufacturing emissions reductions.

It will take a study to determine the idle reduction due to idle shut off devices installed on these engines. Because some emission reduction will be realized with these devices, ENVIRON assumed 30% reduction of the idle mode.

2. HHD Diesel-Fueled Drayage Trucks

BNSF has little control over private owner/operators who carry containers to and from the site. The vehicle types are the heaviest trucks on the road and often are not the most modern or recent model years. However, there is a rule making mandating complete fleet turnover for container trucks to this site by 2013 with an interim control scenario implemented by 2010.

At the BNSF San Bernardino site, ENVIRON used the default truck age distribution as found in San Bernardino County for the 2005 in-use year evaluation. However, significant emission reductions are expected with port and intermodal trucks due to the 2007 new engine emission standards (that result in very low PM emission rates) and to the California “Regulation to Control Emissions from In-Use On-Road Diesel-Fueled Heavy Duty Drayage Trucks.” Trucks arriving at the San Bernardino yard would be responsible for fleet turnover to 2007 and later model years by December 31, 2013.

Since the CARB HRA report was released in November of 2007, the EMFAC2007 v2.3 has become the standard model to estimate emissions from on-road vehicles. The base was revised using this version of EMFAC instead of a prerelease version of EMFAC used in the CARB HRA.

3. Cargo Handling Equipment (CHE)

BNSF cargo handling equipment (CHE) emissions were projected to 2010, 2015, and 2020 based on 2005 annual emission estimates generated by ARB and control factors by equipment type to account for decreases in emissions due to fleet turnover. The ARB CHE Port Regulation requires that in addition to natural fleet turnover, an accelerated turnover of older engines to newer cleaner engines and/or Verified Diesel Emission Control Systems (VDECS) be implemented in CHE fleets. The control factor estimates used to generate future year emission estimates incorporate emissions reductions due to natural and accelerated regulation driven fleet turnovers. Note that BNSF CHE activity and population were assumed equivalent to 2005 levels in all future years for the initial analysis, and a growth factor was applied after the no growth emission levels to calculate emissions with growth.

Fleet turnover reductions were estimated based on data included in the ARB Proposed Regulation For Mobile Cargo Handling Equipment At Ports And Intermodal Rail Yards, Initial Statement of Reasons (ISOR) (Data source: CHE ISOR, <http://www.arb.ca.gov/regact/cargo2005/isor.pdf>, 10/2005: Table VI-1: Projected Annual Emissions for Cargo Handling Equipment Used in Ports and Intermodal Rail Yard Applications with Implementation of the Proposed Regulation For Mobile Cargo Handling Equipment At Ports And Intermodal Rail Yards). These data include: 1) statewide emissions reductions by equipment type, 2) ARB Port Regulation population and activity growth estimates, and 3) ARB Port Regulation port and rail population fractions by equipment type. Fleet turnover control factors were assumed to be equivalent for Port and Rail equipment and were estimated according

to the methodology outlined in the example below, where yard truck control factors are estimated for the period from 2004 to 2010:

$$FC_{04-10,yt} = E_{2010,yt} / (AF_{,yt} * PF_{,yt} * E_{2004,yt})$$

Where:

$FC_{04-10,yt}$ = Fleet turnover control factor from 2004 to 2010 for yard trucks

E_{2004} = CA statewide 2004 annual yard truck emissions

E_{2010} = CA statewide 2010 annual yard truck emissions

AF = Average activity growth factor by equipment type weighted by Port and Rail population:

$$AF_{,yt} = A_{port,yt} * FP_{port,yt} + A_{rail,yt} * FP_{rail,yt}$$

A = Rail or port activity growth factor

FP = Rail or port Population Fraction

PF = Average population growth factor by equipment type weighted by Port and Rail population: $PF_{,yt} = P_{port,yt} * FP_{port,yt} + P_{rail,yt} * FP_{rail,yt}$

P = Rail or port population growth factor

FP = Rail or port Population Fraction

The control factor above was assumed to be linear, and future year emissions were estimated according to the fleet turnover correction factor, scaled to the number of years between the base year and future year. 2010 to 2020 control factors were calculated in similar fashion to the 2004 to 2010 control factors and all control factors are shown in Table 4-6.

Table 4-6. CHE emission reduction with ARB rulemaking.

Equipment Type	Emission Reduction	
	2004 to 2010	2010 to 2020
Crane	71%	67%
Forklift	75%	72%
Material Handling Equip	68%	73%
Yard Tractor offroad	77%	77%

Since the CARB HRA reports were released in November of 2007, additional information has become available, and the 2005 baseline emission inventory, as shown in Table 3-1, has been adjusted accordingly. Specifically, the default engine load factor for yard hostlers has been adjusted based on new data. The default load factor (65%) for yard hostlers contained in the OFFROAD model is based on data collected for equipment operating at various facilities and not specifically at an intermodal rail yard. Additional data have been collected by both UPRR and BNSF Railway to determine an appropriate engine load factor for yard hostlers operating at intermodal rail yards. The data collected by both railroads show that the default load factor from the OFFROAD model and the load factor from the Ports study are too high for yard hostlers operating at intermodal rail yards. Based on the UPRR and BNSF data, a more appropriate load factor for yard hostlers operating at intermodal rail yards is between 15 and 20%. Therefore, the 2005 baseline emission estimates for yard hostlers that were presented in the CARB HRA report have been recalculated using a load factor of 19%.

For San Bernardino, the hostler hours were adjusted upward from the default value used in the original analysis to 3,180 hours per year based on the total number of all hostler hours recorded during 2005 divided by 52, the number of hostlers included in the emission inventory analysis.

With adjustment in hours and load factor of the hostlers, the CHE emissions at San Bernardino estimated for 2005 were revised to 2.95 from 3.31 tons per year.

4. Heavy Equipment

Locomotives are refueled on site from tanker trucks driving into the yard. These trucks by and large are a relatively minor source category. The tanker trucks were largely controlled through fleet turnover though the emissions were small in 2005.

Other on-road vehicle fleets based at the site are used by BNSF and contractor staff for crew changes, errands, and other general uses. The vehicle types are mostly fuel by gasoline with a few smaller (e.g. pickup trucks) vehicles. The vehicle mileage on site for these vehicles is a very small portion of the vehicle's annual mileage and therefore results in little emissions in 2005. To estimate the emission reduction in future years, the EMFAC model was run to determine the expected emission reduction percentage using the default age distribution and fleet turnover in the county. For light-heavy duty diesel trucks, the minimum emission reduction that occurs from normal fleet turnover is 11% for 2005 to 2010, about 21% to 2015, and 24% to 2020.

5. Transport Refrigeration Units (TRUs) and Refrigerated Railcars (Reefer)

Transport refrigeration units (TRU) use small diesel generators to run refrigeration compressors on containers and refrigerated boxcars. By far more emissions are derived from containers than from boxcars in general. BNSF submitted emission estimates for its sites using the time on site of loaded containers and boxcar, however later it was realized that the engines running the refrigeration compressors only run 60% of the time on average. BNSF and ENVIRON conducted a survey of several dozen TRU units and compare the hours the TRU was working to the engine hours, both read from individual hour meters on each unit. Because ENVIRON overestimated the on-site TRU diesel generator engine emissions, the total emissions were adjusted downward for this analysis prior to assessing future year emissions.

ARB has written a rulemaking to address TRU emissions (2003). From this rulemaking, ARB estimated TRU emission reductions.

2005 BNSF TRU PM emission estimates were projected to 2010, 2015, 2020 based on emission factor reduction estimates that were drawn from the 2003 TRU ATCM ISOR, Figure VII-2 (ARB, ATCM ISOR, Figure VII-2, October 2003, website: <http://www.arb.ca.gov/regact/trude03/trude03.htm>). The emission reduction control factors are shown in Table 4-7.

Table 4-7. ENVIRON estimated ARB PM emission reductions for TRU.

Year	<25 HP	25-50HP	Combined
2000 to 2010	-18%	-70%	-66%
2010 to 2020	-28%	-91%	-79%

For each site, future year activity and population were assumed to be equivalent to 2005 activity and population. ENVIRON estimated the emission reduction for TRU for the years 2010, 2015 (through interpolation), and 2020.

6. Other Miscellaneous Diesel-Fueled Equipment

Other offroad equipment primarily consists of track maintenance equipment with portable engines occasionally used for general industrial purposes. Track maintenance equipment is comprised of any number of various equipment types from small pumps and generators to larger, specially designed equipment for rail line maintenance. However, equipment based at each site is used over the entire rail network, so a low fraction of this equipment activity and emissions occur on site.

To estimate emission reductions from this equipment, an OFFROAD model run using construction and industrial equipment was made to determine the relative emission reduction. The emission reduction equipment with rated power of 50 – 500 hp (the breadth of the equipment found at rail yards) are typically similar even though the standards and phase-in schedules for new emission standards vary by engine power. ENVIRON estimated the average emission reduction for 2010 at 14%, 2015 at 36%, and 2020 at 59%.

V. Projected Growth Rates

Historic activity data from calendar years 1999 through the first half of 2008 were reviewed to determine the expected activity growth rate for the San Bernardino Yard. Table 5-1 summarized the historic activity data for the San Bernardino Yard.

Table 5-1. Historic activity data for diesel-fueled equipment San Bernardino Rail Yard.

Activity	Historic Actual Data										Growth Rate (%)
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008 (half year extrapolated)	
Container (Lifts)				449,906	496,777	554,904	557,170	568,910	499,974	444,009	<0%
Mainline traffic (MMGT)	117	121	119	127	137	130	136	148	148	Not Provided	3.0%

As shown in Table 5-1, based on historic actual data activity at the San Bernardino Yard has grown at a rate of less than zero percent from 2002 through 2008 with projected 2008 activity to be 20% below that for 2005. The forecast for the San Bernardino Yard activity however was set at the same level as 2005 for all future years. The mainline traffic moving past San Bernardino however has been increasing at a rate of about 3% per year based on data from 1999 through 2007.

VI. Mitigation Measures

1. Current Mitigation Measures

The current measures being implemented at the San Bernardino yard include fleet turnover to new engines for all cargo handling equipment, truck idle shutoff at the entrance and exit gates, and rapid turnover of yard hostlers to on-road compliant emission

standards. These mitigation measures will provide early emissions reductions compared to the 2010 emission forecasts presented in this report.

2. Proposed Future Mitigation Measures

BNSF will work with local and state authorities to purchase and use clean switching engines on site. The purchase of these engines could include assistance from State funding to supplement the cost to BNSF. The primary target for the future mitigation is to use the clean switching locomotives at San Bernardino by 2015. The precise technology to be used in these switching locomotives is yet to be determined but at least Tier 3 compliant engines would be used.

VII. Evaluation of Additional Mitigation Measures

The evaluation of the current and proposed mitigation measures will be conducted once the mitigation measures have been specifically defined.

VIII. Mechanisms for Tracking Progress

BNSF will work with state officials to determine a method for tracking the emissions reductions achieved through the implementation of the Mitigation Measures.

IX. Conclusions

The emissions at the San Bernardino yard will be reduced by more than 75% by 2020 without considering any additional mitigation measures.

APPENDIX A.

Detailed Emission Forecasts

Drayage Trucks**Table A-1.** Truck PM emissions rates in 2005.

Model Year	Fleet Fraction	Idle Emissions (g/hour)	Travel Emissions at 16.7 mph (g/mile)
2005	3.98%	1.03	0.3420
2004	2.88%	1.03	0.3889
2003	3.40%	1.03	0.4365
2002	2.76%	1.33	1.2521
2001	4.25%	1.33	1.3797
2000	6.02%	1.33	1.5011
1999	6.03%	1.33	1.6151
1998	5.01%	1.33	1.7211
1997	5.10%	1.93	1.8620
1996	5.89%	1.93	1.9607
1995	6.70%	1.93	2.0508
1994	5.35%	1.93	2.1328
1993	4.24%	2.57	3.0502
1992	3.06%	2.57	3.1397
1991	3.43%	2.57	3.2215
1990	4.46%	3.43	4.7490
1989	4.51%	3.43	4.8374
1988	3.37%	3.43	4.9191
1987	2.98%	4.28	5.0545
1986	2.53%	6.88	5.3166
1985	2.45%	6.88	5.3900
1984	2.09%	6.88	5.4583
1983	0.91%	6.88	5.5217
1982	1.00%	6.88	5.5803
1981	1.25%	6.88	5.6340
1980	0.95%	6.88	5.6829
1979	1.02%	6.88	5.7270
1978	0.75%	6.88	5.7661
1977	0.50%	6.88	5.8004
1976	0.42%	6.88	5.8300
1975	0.46%	6.88	5.8550
1974	0.44%	6.88	5.8758
1973	0.39%	6.88	5.8930
1972	0.40%	6.88	5.9071
1971	0.24%	6.88	5.9188
1970	0.26%	6.88	5.9306
1969	0.24%	6.88	5.9423
1968	0.13%	6.88	5.9540
1967	0.10%	6.88	5.9658
1966	0.05%	6.88	5.9775
1965	0.00%	6.88	5.9892
Fleet Average	100.00%	2.84	2.88
		g/hour	g/mile

Table A-2. Truck PM emissions rates in 2010.

Model Year	SanBern Age Distribution	Port Truck Rule Age Distribution	LEVEL 3 VDECS % reduction	Idle Emissions (g/hour)	Travel Emissions at 16.7 mph (g/mile)
2010	3.98%	3.98%	0.00%	0.11	0.0404
2009	2.88%	10.53%	0.00%	0.11	0.0498
2008	3.40%	11.04%	0.00%	0.11	0.0592
2007	2.76%	10.41%	0.00%	0.11	0.0685
2006	4.25%	4.25%	0.00%	0.99	0.5092
2005	6.02%	6.02%	0.00%	0.99	0.5509
2004	6.03%	6.03%	0.00%	0.99	0.5900
2003	5.01%	5.01%	85%	0.99	0.6264
2002	5.10%	5.10%	85%	1.28	1.7519
2001	5.89%	5.89%	85%	1.28	1.8382
2000	6.70%	6.70%	85%	1.28	1.9171
1999	5.35%	5.35%	85%	1.28	1.9889
1998	4.24%	4.24%	85%	1.28	2.0543
1997	3.06%	3.06%	85%	1.85	2.1928
1996	3.43%	3.43%	85%	1.85	2.2528
1995	4.46%	4.46%	85%	1.85	2.3077
1994	4.51%	4.51%	85%	1.85	2.3583
1993	3.37%	0.00%	0.00%	2.47	3.3041
1992	2.98%	0.00%	0.00%	2.47	3.3610
1991	2.53%	0.00%	0.00%	2.47	3.4138
1990	2.45%	0.00%	0.00%	3.30	4.9425
1989	2.09%	0.00%	0.00%	3.30	5.0012
1988	0.91%	0.00%	0.00%	3.30	5.0557
1987	1.00%	0.00%	0.00%	4.12	5.1726
1986	1.25%	0.00%	0.00%	6.62	5.4288
1985	0.95%	0.00%	0.00%	6.62	5.4759
1984	1.02%	0.00%	0.00%	6.62	5.5184
1983	0.75%	0.00%	0.00%	6.62	5.5562
1982	0.50%	0.00%	0.00%	6.62	5.5893
1981	0.42%	0.00%	0.00%	6.62	5.6178
1980	0.46%	0.00%	0.00%	6.62	5.6419
1979	0.44%	0.00%	0.00%	6.62	5.6620
1978	0.39%	0.00%	0.00%	6.62	5.6786
1977	0.40%	0.00%	0.00%	6.62	5.6922
1976	0.24%	0.00%	0.00%	6.62	5.7035
1975	0.26%	0.00%	0.00%	6.62	5.7148
1974	0.24%	0.00%	0.00%	6.62	5.7262
1973	0.13%	0.00%	0.00%	6.62	5.7375
1972	0.10%	0.00%	0.00%	6.62	5.7488
1971	0.05%	0.00%	0.00%	6.62	5.7601
1970	0.00%	0.00%	0.00%	6.62	5.7714
Fleet Average				0.30	0.25
				g/hour	g/mile

Table A-3. Truck PM emissions rates in 2015.

Model Year	Port Truck Rule Age Distribution	Idle Emissions (g/hour)	Travel Emissions at 16.7 mph (g/mile)
2015	3.98%	0.11	0.0385
2014	2.88%	0.11	0.0456
2013	12.05%	0.11	0.0529
2012	11.42%	0.11	0.0680
2011	12.90%	0.11	0.0768
2010	14.67%	0.11	0.0853
2009	14.68%	0.11	0.0939
2008	13.66%	0.11	0.1013
2007	13.75%	0.11	0.1082
Fleet Average		0.11	0.08
		g/hour	g/mile

Table A-4. Truck PM emissions rates in 2020.

Model Year	Port Truck Rule Age Distribution	Idle Emissions (g/hour)	Travel Emissions at 16.7 mph (g/mile)
2020	3.98%	0.11	0.0385
2019	2.88%	0.11	0.0456
2018	3.40%	0.11	0.0529
2017	2.76%	0.11	0.0600
2016	4.25%	0.11	0.0670
2015	6.02%	0.11	0.0736
2014	6.03%	0.11	0.0798
2013	10.06%	0.11	0.0855
2012	10.14%	0.11	0.1072
2011	10.93%	0.11	0.1134
2010	11.75%	0.11	0.1191
2009	10.40%	0.11	0.1253
2008	9.29%	0.11	0.1301
2007	8.11%	0.11	0.1344
Fleet Average		0.11	0.10
		g/hour	g/mile