RICHMOND RAILYARD
TAC EMISSIONS INVENTORY

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1.0 INTRODUCTION

This document describes the data and methods used in estimating toxic air contaminant (TAC) emissions resulting from facility operations and other activities in and around the Richmond facility. The data describe activities grouped by like emission source and by spatial activity. The emission sources include:

- Locomotives
- Cargo Handling equipment
- On-road vehicles
- Off-road equipment
- Stationary sources

Emissions factors for diesel PM and organic gases (which are then speciated into other relevant toxic air contaminants) for each source are included, and emissions estimates provided.

2.0 OVERVIEW OF THE RICHMOND YARD

BNSF has been reconsidering the use of the Richmond yard, and according to BNSF, the use of this site during 2005 was less than in previous years. In previous years, the site had handled cargo from the Port of Oakland, but since the opening of the Oakland near dock facility in 2002, less traffic has moved through Richmond. The Richmond yard in 2005 continued intermodal operations, although limited, with trains arriving and originating from the yard.

The site runs generally northeast and southwest with no through traffic immediately adjacent to the yard. There is a yard to the north of the site, but BNSF has no control over it and no traffic moves between the Richmond site and those operations to the north. Nearly all engines at the Richmond yard arrive from and leave toward the northeast A small line runs south of the Richmond yard for only about one mile. Since only a small number of cars move into the Richmond yard from the southern direction we do not consider a through track in this assessment.

3.0 LOCOMOTIVE FACILITY OPERATIONS

The operations at the Richmond facility include engine-on locomotive activity within the service facility (Sections 3.1 - 3.3), switching engines (Section 3.4), and train arrival and departures within the yard (Section 3.5). There are no adjacent operating tracks with freight (Section 3.6) or commuter (Section 3.7) traffic. Under each heading is a description of the operations.

Because different locomotive and engine models have different emissions characteristics, it is important to characterize the types and models of the locomotives that are arrive and are serviced in the Richmond facility. ENVIRON estimated the locomotive fleet fractions for different locomotive types and models using data provided by BNSF. The operation descriptions below each include a uniquely applicable fleet characterization.

3.1 Basic Locomotive Service

According to BNSF records, 9,630 locomotives were serviced at Richmond in 2005. The only types of service carried out at the Richmond facility are sand, fuel, and lubricant service (SFS), and M66 and M92 inspections. Load testing is not performed.

<u>Number Served:</u> 9,630 over one year

<u>Operations</u>
(1) Movement into yard at about 5 mph in Notch 1 (single locomotive) or Notch 2 (with 4 locomotives) - 100% on Notch 1 is assumed in the study.
(2) Idle time while refueling is estimated to be 1 hour.
(3) In-Consist (4 locomotives on average) is estimated to be 30 minutes at Idle.
(4) [Lead engine load testing - Not performed at Richmond.]
(5) Movement out of yard at about 5 mph in Notch 2 (4-locomotive consist).

Idle shutdown sometimes occurs after 30 minutes and two 30-minute idle periods are typical during service BNSF indicated that this operation occurs throughout a 24-hour period. The activities (duration and modes of operations) for the Basic Services are summarized in Table 3-1.

Table 3-1. Activities for the Basic Services in the Richmond facility.

Activities	Est. Speed (mph)	Est. Distance (mile)	Est. Time (hour)	Operation Mode
A1: Movement into Yard	5	0.17	0.03	Notch 1
A2: Idling while Refueling	0	0	1.0	Idle
A3: In-consist	0	0	0.5	Idle
A4: Lead Engine Load Test	0	0	0	-
A5: Movement out of Yard	5	0.17	0.03	Notch 2

Since Basic Services are performed on all locomotives passing through the facility, ENVIRON assumed the fleet characteristics for this activity group are equivalent to average fleet characteristics of the locomotive arrivals to the yard. Data provided by BNSF detailed the fleet of locomotives passing the Richmond facility between May 1, 2005 and April 30, 2006. ENVIRON classified the annual locomotive counts by unique engine model description for all BNSF owned and operated engines. Seven percent of BNSF engine model types could not be identified because some engines originally owned by other railroads (such as CSX or Norfolk Southern) were leased by BNSF. This fraction of unidentified engines was reallocated proportionally across the rest of the fleet. The final fleet characterization is shown in Table 3-2. Engine surrogates were assigned for use with emission factor data.

Table 3-2. Fleet characterization for locomotive mainline activity past the Richmond facility, as well as for Basic Services in the Richmond facility.

Locomotive Model	Certification Tier	HP	Fleet Fraction	Engine Surrogate
C44-9W	0	4400	35.4%	Dash-9
C44-9W	1	4400	17.2%	Dash-9
SD40-2	Precontrolled	3000	7.2%	GP-4x
C44-9W	Precontrolled	4400	7.1%	Dash-9
GP30	Precontrolled	2500	6.3%	GP-3x
ES44DC	2	4400	6.2%	ES44/Dash-9
C40-8W	0	4135	4.6%	Dash-8
GP39-2	Precontrolled	2300	3.7%	GP-3x
GP35	Precontrolled	2500	3.3%	GP-3x
B40-8W	Precontrolled	4000	1.2%	Dash-8 Tier 0
B40-8	Precontrolled	4000	1.2%	Dash-8 Tier 0
GP60M	0	3800	1.1%	GP-60
B40-8W	0	4000	0.9%	Dash-8
SD40-2	0	3000	0.8%	GP-4x Precontrolled
GP60	0	3800	0.5%	GP-60
GP38-2	Precontrolled	2000	0.5%	GP-3x
SD39	Precontrolled	2300	0.3%	GP-3x
GP39E	Precontrolled	2300	0.3%	GP-3x
GP60B	0	3800	0.2%	GP-60
SD60M	Precontrolled	3800	0.2%	GP-60
SD60	Precontrolled	3800	0.2%	GP-60
GP60	Precontrolled	3800	0.2%	GP-60
SD50	Precontrolled	3482	0.1%	GP-50
B23-7	Precontrolled	2250	0.1%	Dash-7
GP9	Precontrolled	1750	0.1%	Switchers
GP25	Precontrolled	2500	0.1%	GP-3x
SD45-2	Precontrolled	3272	0.1%	GP-4x
SW1500	Precontrolled	1500	0.1%	Switchers
GP40M	Precontrolled	3000	0.1%	GP-4x
SD45-2T	Precontrolled	3400	0.07%	GP-4x
GP38	Precontrolled	2000	0.06%	GP-3x
SD40	Precontrolled	3000	0.05%	GP-4x
SD75M	0	4300	0.05%	SO-7x
GP15-1	Precontrolled	1500	0.05%	Switchers
SD40-2T	Precontrolled	3000	0.05%	GP-4x
SD45	Precontrolled	3450	0.05%	GP-4x
SD40-2B	Precontrolled	3000	0.04%	GP-4x
AC4400CW	1	4400	0.03%	Dash-9
GP39M	Precontrolled	2300	0.03%	GP-3x
SD70MAC	Precontrolled	4000	0.03%	SO-7x
GP40E	Precontrolled	3000	0.02%	GP-4x
SD45-2B	Precontrolled	3600	0.02%	GP-4x
SD60M	0	3800	0.02%	GP-60

Locomotive Model	Certification Tier	HP	Fleet Fraction	Engine Surrogate
GP40X	Precontrolled	3600	0.01%	GP-4x
GP50	Precontrolled	3600	0.01%	GP-50
SD60	0	3800	0.01%	GP-60
SD70MAC	0	4000	0.010%	SD-7x
SD40-1	Precontrolled	3000	0.005%	GP-4x

3.2 Basic Engine Inspection

No such activity occurs within the Richmond facility.

3.3 Full Engine Service/Inspection

No such activity occurs within the Richmond facility.

3.4 Switching Engine Activity

Switching engine fleet characteristics in the Richmond area were determined by a roster of engines made available by BNSF in early 2006. The data are shown in Table 3-3. Most engines are of similar power and type. This fleet was used to describe the switching engine activity assuming equivalent use of all six engines in the fleet.

Table 3-3. Locomotive switching engine fleet characterization for service to the Richmond facility.

Locomotive Model	Certification Tier	HP	Number of Engines	Engine Surrogate
GP-25	Precontrolled	2500	1	GP-3x
GP-35	Precontrolled	2500	1	GP-3x
GP-9	Precontrolled	1750	1	Switcher
SW1500	Precontrolled	1500	3	Switcher

The time in mode for switching engine activity in Table 3-4 was determined from event recorder downloads of a sample of three engines operating in this yard. For one of the engines, two days of event recorder data were available. The three engines chosen range from 1,500 - 2,500 hp, and are representative of the switching engines dedicated to the area. The time in mode from the event recorder downloads could not distinguish engine idling and engine off periods, so the idle mode was fixed at the EPA switching engine cycle estimate of 59.8% and the remaining notch settings renormalized so that the full cycle sums to 100% of the time. This adjustment has the effect of increasing the emissions estimate by placing more of the activity into the higher notch settings.

Table 3-4. Switching engine (~1,500 hp) relative time in mode

Throttle Notch	Time in Mode
DB	0.12%
Idle	59.80%
1	13.45%
2	13.93%
3	6.44%
4	3.12%
5	1.29%
6	0.63%
7	0.24%
8	1.00%

The total switching engine activity consists of two engines operating at all times each day of the year (i.e. 48 hours of switching engine use per day or 17,520 hours per year).

3.5 Train Arrival and Departures in and from the Yard

The primary locomotive activity was determined to be arriving and departing line-haul engines throughout the yard. The typical activity of line-haul engines in the Richmond yard is to arrive with a train, be cut from the train, move to the refueling area, move the ready area where the engines will be assigned a train and then leave. Because the refueling/maintenance is done at a specific location, that activity was singled out of the overall yard activity of engines

The number of engines moving through the yard was determined from two data sources; automatic readers located north of the yard and train arrival and departure databases. The automatic readers are deemed more accurate than the train arrival and departure data, however automatic readers can make errors if the train is immobile or moving slowly near readers. Data provided by BNSF showed a total of 10,752 locomotives moving in or out of the Richmond facility between May 1, 2005 and April 30, 2006. By contrast, the train arrival and departure information had included 10,845 arrivals and 10,747 departures of which nearly 821 arrivals and departures occurred within one minute of each other, making clear a level of uncertainty in those estimates. Despite the uncertainty in the number of engines arriving at the site, for this analysis, 10,752 locomotives were estimated to enter the yard

BNSF provided duty cycle information to characterize the notch settings used by these locomotives. ENVIRON calculated average time in mode for freight movement activity along the mainline from the event recorder data for four representative locomotives, as well as complete start-up data for three representative locomotives. The average time in mode data are summarized in Table 3-5

Table 3-5 Locomotive time in mode arriving at the Richmond facility.

Throttle Notch	Est. Time (hours)
DB	0.445
Idle	2.333
1	0.196
2	0.091
3	0.020

The fleet characterization for locomotives along the mainline was provided in Table 3-2, and derived from all engines passing the site on the adjacent mainlines.

3.6. Freight Movements on Adjacent Mainline

BNSF reads radio tags for most of the traffic along its mainline, cataloging every locomotive that comes in and out through the northeast entrance to the yard. However, the main line is removed and not adjacent to the Richmond yard, so no emissions were estimated. There is no non-BNSF (foreign) activity on those mainlines or within the Richmond yard.

3.7 Commuter Rail Operations on Adjacent Mainline

No such activity occurs within the Richmond facility.

4.0 LOCOMOTIVE EMISSION FACTORS FOR DIESEL PARTICULATE MATTER

Emission factors used in this study were based primarily on the emission factors used in the California Air Resources Board (ARB)'s Risk Assessment Study for the Union Pacific Roseville facility, and the Southwest Research Institute (SwRI, 2000) study sponsored by ARB, entitled "Diesel Fuel Effects on Locomotive Exhaust Emissions." Since the publication date of the Roseville report, ARB provided ENVIRON with additional emission factors for criteria pollutants, and made some adjustments to the original Roseville data (ARB, 2006a). ENVIRON also received permission from the engine owners to obtain additional emission factor data from the Exhaust Plume Study performed by SwRI (2005). The PM emission factors relevant to all locomotives in the Richmond facility are summarized in Tables 6a and 6b for several different locomotive model groups and certification tiers. Specific locomotives and engines in each locomotive model group can be inferred from the fleet characterization tables provided above

Based on conversation with the principal researcher on all the locomotive studies (SwRI, 2006), ENVIRON learned that a default fuel sulfur content of 0 3% was used on all test results and certification data produced with locomotives to date (the emission rates in SwRI, 2000 were those with 0.3% sulfur fuel) The emission rates using this fuel are reflected in Table 4-1a.

Table 4-1a. PM emission factors for locomotives used in the study, assuming default fuel sulfur content (0.3%).

Locomotive Model Group	Cert Tier[a]	Emission Factors (g/hr) by Throttle Notch									
		Idle	DB[b]	1	2	3	4	5	6	7	8
Switchers [1]	Precnt	31.0	56.0	23.0	76.0	138.0	159.0	201.0	308.0	345.0	448.0
GP-3x [1]	Precnt	38.0	72.0	31.0	110.0	186.0	212.0	267.0	417.0	463.0	608.0
GP-4x [1]	Precnt	47.9	80.0	35.7	134.3	226.4	258.5	336.0	551.9	638.6	821.3
GP-50 [1]	Precnt	26.0	64.1	51.3	142.5	301.5	311.2	394.0	663.8	725.3	927.8
GP-60 [1]	Precnt	48.6	98.5	48.7	131.7	284.5	299.4	375.3	645.7	743.6	941.6
SD-7x [1]	Precnt	24.0	4.8	41.0	65.7	156.8	243.1	321.1	374.8	475.2	589.2
Dash-7 [1]	Precnt	65.0	180.5	108.2	121.2	359.5	327.7	331.5	299.4	336.7	420.0
Dash-9 [2]	Precnt	32.1	53.9	54.2	108.1	219.9	289.1	370.6	437.7	486.1	705.7
EMD 12-710G3 [3]	Precnt	27.5	54.5	34.0	112.5	208.0	234.5	291.0	423.0	545.0	727.5
GP-60 [4]	0	21.1	25.4	37.6	75.5	239.4	352.2	517.8	724.8	1125.9	1319.8
SD-7x [1]	0	14.8	15.1	36.8	61.1	230.4	379.8	450.8	866.2	1019.1	1105.7
Dash-8 [1]	0	37.0	147.5	86.0	133.1	291.4	293.2	327.7	373.5	469.4	615.2
Dash-9 [5]	0	33.8	50.7	56.1	117.4	229.2	263.8	615.9	573.9	608.0	566.6
Dash-9 [4]	1	16.9	88.4	62.1	140.2	304.0	383.5	423.9	520.2	544.6	778.1
ES44/Dash-9 [4]	2	7.7	42.0	69.3	145.8	304.3	365.0	405.2	418.4	513.5	607.5

[1] Final locomotive emission factors (an update to the Roseville study emission factors Table B-1) received via email from Dan Donohue of ARB, May 9, 2006.
[2] "Diesel Fuel Effects on Locomotive Exhaust Emissions," Southwest Research Institute, October 2000.
[3] EPA, 1997.
[4] Confidential data from SwRI, 2006.
[5] Average of ARB and SwRI, 2006.
[a] Precnt : Precontrolled
[b] DB: Dynamic Braking

Table 4-1b provides emission factors adjusted for fuel sulfur content of 0.105%. This adjustment was performed according to documented ARB procedures from the OFFROAD Modeling

Change Technical Memo (Wong, 2005). All locomotive emissions presented in this document utilized the emission factors from Table 4-2b.

Table 4-1b. Emission Factors for locomotives used in the study, adjusted for reduced fuel sulfur content (0.105%).

Locomotive Model Group	Cert Tier[a]	Emission Factors (g/hr) by Throttle Notch									
		Idle	DB[b]	1	2	3	4	5	6	7	8
Switchers [1]	Precnt	31.0	56.0	23.0	76.0	131.8	146.1	181.5	283.2	324.4	420.7
GP-3x [1]	Precnt	38.0	72.0	31.0	110.0	177.7	194.8	241.2	383.4	435.3	570.9
GP-4x [1]	Precnt	47.9	80.0	35.7	134.3	216.2	237.5	303.5	507.4	600.4	771.2
GP-50 [1]	Precnt	26.0	64.1	51.3	142.5	288.0	285.9	355.8	610.4	681.9	871.2
GP-60 [1]	Precnt	48.6	98.5	48.7	131.7	271.7	275.1	338.9	593.7	699.1	884.2
SD-7x [1]	Precnt	24.0	4.8	41.0	65.7	149.8	223.4	290.0	344.6	446.8	553.3
Dash-7 [1]	Precnt	65.0	180.5	108.2	121.2	322.6	302.9	307.7	268.4	275.2	341.2
Dash-9 [2]	Precnt	32.1	53.9	54.2	108.1	197.3	267.3	343.9	392.4	397.3	573.3
EMO 12-710G3 [3]	Precnt	27.5	54.5	34.0	112.5	186.6	216.8	270.1	379.3	445.4	591.0
GP-60 [4]	0	21.1	25.4	37.6	75.5	228.7	323.6	467.7	666.4	1058.5	1239.3
SD-7x [1]	0	14.8	15.1	36.8	61.1	220.1	349 0	407 1	796 5	958.1	1038.3
Dash-8 [1]	0	37.0	147.5	86.0	133.1	261.5	271 0	304 1	334 9	383.6	499.7
Dash-9 [5]	0	33.8	50.7	56.1	117.4	205.7	243 9	571 5	514 6	496.9	460.3
Dash-9 [4]	1	16.9	88.4	62.1	140.2	272.8	354 5	393 4	466 4	445.1	632.1
ES44/Dash-9 [4]	2	7.7	42.0	69.3	145.8	273.0	337 4	376 0	375 1	419.6	493.5

[1] Final locomotive emission factors (an update to the Roseville study emission factors Table B-1) received via email from Dan Donohue of ARB, May 9, 2006.
[2] "Diesel Fuel Effects on Locomotive Exhaust Emissions," Southwest Research Institute, October 2000.
[3] EPA, 1997.
[4] Confidential data from SwRI, 2006.
[5] Average of ARB and SwRI, 2006.
[a] Precnt : Precontrolled
[b] DB: Dynamic Braking

The sulfur content value of 0.105% used for the adjustment was obtained by averaging data provided by BNSF for diesel fuel dispensed and corresponding sulfur level at all California sites and those near California. For sites outside of California, ENVIRON assumed that half of the fuel dispensed would be used in California, because trains moving in either direction may be fueled there. In reality, it is likely that less than half of the out-of-state fuel dispense will be used in California, because many of those sites are a significant distance from the state border.

Table 4-3 Fuel sulfur and total annual fueling at various locomotive fueling locations.

Location	State	Total Gallons	% Sulfur
Holbrook	AZ	21,935	0.192
Phoenix	AZ	3,542,292	0.034
Flagstaff	AZ	2,019	0.192
Kingman	AZ	334,309	0.034
Vacaville	CA	33,074	0.034
Redding	CA	1,004	0.192
Summit	CA	1,750	0.192
San Diego	CA	530	0.192
Bakersfield	CA	240,976	0.034
Barstow	CA	1,946,092	0.015
Oakland	CA	1,762,993	0.034
Need es	CA	770,667	0.192
Bakersfield	CA	131,075	0.034

Location	State	Total Gallons	% Sulfur
Bakersfield	CA	11,070	0.034
Corona	CA	103,982	0.034
Fresno	CA	2,669,884	0.034
Kaiser	CA	460,390	0.034
Kings Park	CA	61,900	0.034
Pittsburg	CA	12,695	0.034
Riverbank	CA	2,070,244	0.034
San Bernardino	CA	9,940,295	0.034
San Diego	CA	111,369	0.192
Stockton	CA	1,018,965	0.034
Stuart Mesa	CA	41,509	0.192
Terminal Island	CA	14,816,643	0.192
Victorville	CA	66,042	0.034
Watson	CA	1,152,454	0.192
Bakersfield	CA	11,236	0.192
Winslow	AZ	3,496,072	0.170
Belen	NM	202,462,278	0.192
Barstow	CA	52,439,321	0.015
Commerce	CA	31,573,289	0.015
Richmond	CA	22,255,177	0.034
Klamath Falls	OR	3,070,865	0.381

The fuel sulfur correction methodology described by ARB (2005a) was used to adjust PM emission rates from an average fuel sulfur level of 0.3% to 0.105% using the fuel sulfur - PM relationship equation, A + B * (fuel sulfur, ppm). The emission reductions calculated for GE and EMD engines shown in Table 4-4 were applied to the base emission rates to calculate the emission rates at the in-use fuel sulfur levels.

Table 4-4. Fuel sulfur emission reductions by notch and engine type.

Notch	B	A	Fuel Sulfur 0.3% EF (g/hp-hr)	Fuel Sulfur 0.105% EF (g/hp-hr)	Reduction
GE 4-stroke Engine					
8	0.00001308	0.0967	0.13594	0.110434	18.76%
7	0.00001102	0.0845	0.11756	0.096071	18.28%
6	0.00000654	0.1037	0.12332	0.110567	10.34%
5	0.00000548	0.132	0.14844	0.137754	7.20%
4	0.00000663	0.1513	0.17119	0.1582615	7.55%
3	0.00000979	0.1565	0.18587	0.1667795	10.27%
EMD 2-stroke engine					
8	0.0000123	0.3563	0.3932	0.369215	6.10%
7	0.0000096	0.284	0.3128	0.29408	5.98%
6	0.0000134	0.2843	0.3245	0.29837	8.05%
5	0.000015	0.2572	0.3022	0.27295	9.68%
4	0.0000125	0.2629	0.3004	0.276025	8.11%
3	0.0000065	0.2635	0.283	0.270325	4.48%

5.0 LOCOMOTIVE DIESEL PM EMISSION ESTIMATES

5.1. Basic Service

The annual PM emissions for Basic Service by individual activities are presented in Table 5-1. Most of the maintenance PM emissions were estimated to originate from the idling activities (A2+A3, 90%) in this facility.

Table 5-1. Estimated annual PM emissions associated with the Basic Services in the Richmond facility.

Locomotive Model Group	Cert Tier	# of Loco	PM Emissions by Operation Activity (grams)					Annual Total (grams)
			A1	A2	A3	A4	A5	
Switchers	Precnt	25	17	779	390	-	57	**1,244**
GP-3x	Precnt	1408	1,309	53,495	26,747	-	4,646	**86,197**
GP-4x	Precnt	817	875	39,167	19,584	-	3,292	**62,197**
GP-50	Precnt	15	23	390	195	-	64	**672**
GP-60	Precnt	61	90	2,984	1,492	-	243	**4,808**
SD-7x	Precnt	3	4	70	35	-	6	**114**
Dash-7	Precnt	14	44	879	440	-	49	**1,412**
Dash-9	Precnt	686	1,116	22,028	11,014	-	2,225	**36,383**
GP-60	0	175	197	3,693	1,846	-	396	**6,133**
SD-7x	0	6	6	86	43	-	11	**146**
Dash-8	0	758	1,955	27,993	13,996	-	3,025	**46,970**
Dash-9	0	3408	5,734	115,304	57,652	-	11,998	**190,688**
Dash-9	1	1655	3,083	27,966	13,983	-	6,960	**51,992**
ES44/Dash-9	2	600	1,248	4,623	2,312	-	2,626	**10,809**
Total		**9,630**	**15,702**	**299,456**	**149,728**	-	**35,598**	**500,484**

5.2. Basic Engine Inspection

No such activity occurs within the Richmond facility.

5.3. Full Engine Service/Inspection

No such activity occurs within the Richmond facility.

5.4. Switching Engine Activity

Estimated annual PM emissions for switching activities at the Richmond facility are presented in Table 5-2. Forty-eight hours per day of switching activity over 365 days per year were assumed to be divided equally between all six locomotives in the switching fleet.

Table 5-2. Estimated annual PM emissions associated with movements of cars to car repair yard and in the adjacent classification yard of the Richmond facility.

Locomotive Model Group	Cert Tier	# of Loco	PM Emissions (grams)
Switchers	Precnt	4	**635,402**
GP-3x	Precnt	2	**420,738**
Total		**6**	**1,056,140**

5.5. Train Arrival and Departure

The PM emission estimates for BNSF freight movements during the one-year period are presented in Table 5-3.

Table 5-3. Estimated annual PM emissions associated with BNSF freight movements along the mainline adjacent to the Richmond facility.

Locomotive Model Group	Cert Tier	# of Loco	PM Emissions by Throttle Notch (grams)					Annual Total PM Emissions (grams)
			Idle	DB	1	2	3	
Switchers	Precnt	28	2,030	700	126	193	74	3,124
GP-3x	Precnt	1572	139,364	50,376	9,539	15,657	5,605	220,540
GP-4x	Precnt	912	102,038	32,501	6,375	11,094	3,959	155,966
GP-50	Precnt	17	1,015	477	168	216	97	1,973
GP-60	Precnt	69	7,774	3,004	654	818	374	12,623
SD-7x	Precnt	3	182	7	26	19	10	243
Dash-7	Precnt	15	2,290	1,214	320	166	98	4,089
Dash-9	Precnt	766	57,387	18,373	8,130	7,498	3,033	94,422
GP-60	0	195	9,620	2,209	1,438	1,336	897	15,500
SD-7x	0	6	223	44	47	36	29	378
Dash-8	0	846	72,926	55,539	14,246	10,196	4,438	157,347
Dash-9	0	3805	300,388	85,818	41,778	40,436	15,705	484,126
Dash-9	1	1848	72,857	72,704	22,461	23,457	10,115	201,594
ES44/Dash-9	2	670	12,045	12,533	9,095	8,851	3,674	46,197
Total		**10,752**	**780,140**	**335,499**	**114,404**	**119,973**	**48 106**	**1,398,122**

5.6. Commuter Rail Operations on Adjacent Mainline

No such activity occurs within the Richmond facility.

6.0 NON-LOCOMOTIVE FACILITY OPERATIONS, EMISSION FACTORS AND EMISSION ESTIMATES

The operations at the Richmond facility also include non-locomotive activity within the yard, as described in Sections 6.1 through 6.5. Under each heading is a description of the operations

6.1 Cargo Handling Equipment Operations

Cargo handling equipment (CHE) is used to handle intermodal freight at the Richmond site and includes yard hostlers, cranes, and container handling equipment.

Activity

Input data was received for BNSF for California sites CHE characteristics BNSF could only provide the CHE 2005 fuel consumption at the Richmond site at 44,421 gallons diesel for all equipment. While default hours of operation were available and the fuel consumption could have provided an estimate of the actual load factor, ARB (2006c) used the equipment population list and the default input data to estimate emissions using their modeling approach and activity estimates for such equipment. Table 6-1 shows Richmond site CHE characteristics and activity.

Table 6-1. Richmond CHE characteristics and activity.

ARB Equipment Type	Model Year	Fuel Type	Rated Horsepower	Activity (hrs/yr)
Cranes	1994	D	225	2569
Cranes	1996	D	225	1555
Container Handling Equipment	1999	D	225	236
Yard Trucks	1997	D	200	1289[a]
Yard Trucks	1997	D	150	1289[a]
Yard Trucks	2004	D	150	1289[a]
Yard Trucks	2004	D	150	1289[a]
Yard Trucks	2004	D	150	1289[a]

[a] ARB, 2005b default

Emissions

Emissions from CHE were estimated by ARB for the Richmond facility with the CHE emissions shown in Table 6-2

Table 6-2. CHE Emissions Estimates (grams per year).

Fuel Type	ARB Equipment Type	PM (grams)
D	Cranes	102,477
D	Cranes	25,455
D	Container Handling Equipment	4,869
D	Yard Trucks	24,072
D	Yard Trucks	41,438
D	Yard Trucks	17,522
D	Yard Trucks	17,522
D	Yard Trucks	17,522
Total		**250,878**

6.2 On-road Container Truck Operations

The Richmond site is characterized by container service where tractor-trailers receive or deliver containers to the container yard. BNSF determined the truck counts at the facility entrance and exit gates. However, these truck counts are conducted in such a manner that only tractor-trailer combination trucks are counted. Therefore, summing the total truck entrances and exits will overestimate the total truck trips by the number of trips where trucks both enter and leave as a tractor-trailer combination. To address this problem, BNSF identified the trucks using tags that were counted as both an entrance and exit as tractor-only or tractor-trailer combinations within a period of time. But because many tractors may make several trips to the facility within a single day, a time limit for matching entrances and exits was used to limit the entrance and exit matches. The derived truck trip totals, shown in Table 6-3, using 30 minutes, 1 hour, 1.5 hours, and 2 hours as the period for determining truck matches. Note how the estimated truck trips decrease as the matching period increases. Because the time a truck spends on site at Richmond is nearly an hour on average, return trips cannot reasonably have been within one hour. Thus, one hour was used as the period of matching, but it is acknowledged that some trucks may spend more than an hour on site, and therefore would be counted at both the entrance and exit.

Table 6-3. Richmond truck counts by matching time period for 4 months.

Truck Trip Description	30 Min	1 Hr	1.5 Hr	2 Hr
Total Trucks Logging In & Out Gates (Trailer-Truck In, Trailer-Truck Out) (Matches)	2,635	3,811	4,017	4,073
Trucks Logging In Without Logging Out (Trailer-Truck In, Bobtail Out)	9,084	7,908	7,702	7,646
Trucks Logging Out Without Logging In (Bobtail In, Trailer-Truck Out)	8,107	6,931	6,725	6,669
Total Truck Trips	19,826	18,650	18,444	18,388
Scaled to 12 months		**55,950**		

A sample chase truck study was conducted to determine entrance queuing time, average speed and distance on site, time on site (engine on or off noted), and exit queuing time. The results for five trucks chased were used to estimate the average operation characteristics for all trucks at the Richmond site. This information is summarized in Table 6-4.

Table 6-4. Average truck operation characteristics at the Richmond site.

Mode	Time (min)	Speed (mph)	Distance (miles)
Entrance	1.26	--	--
Travel on site	10.70	14.58	2.6
Idle on Site	29.45	--	--
Exit Queue	1 7	--	--

ENVIRON estimated the emissions for these container trucks using the Bay Area population age distribution to determine the average HHDDV truck emission rates for 2005 using the draft EMFAC2005 model (2006c). The emission rates were calculated for each age of engine by interpolating between 10 and 15 mph at an average speed of 14.58 mph emission factor.

Table 6-5. PM Emission rates by truck age for Richmond.

Age	Bay Area Truck Age Distribution	Idle PM EF (g/hr)	10 mph PM EF (g/mile)	14.58 mph PM EF (g/mile)	15 mph PM EF (g/mile)
1	5.47%	1.07	0.53	0.42	0.41
2	5.23%	1.07	0.59	0.47	0.46
3	4.81%	1. 07	0.65	0.51	0.50
4	4.49%	1.38	2.12	1.38	1.31
5	4.20%	1.38	2.30	1.50	1.42
6	3.95%	1.38	2.48	1.61	1.53
7	4.33%	1.38	2.64	1.71	1.63
8	4.48%	1.38	2.79	1.81	1.72
9	6.01%	1.99	2.96	1.92	1.83
10	5.27%	1.99	3.10	2.01	1.91
11	6.53%	1.99	3.23	2.10	1.99
12	5.63%	1.99	3.34	2.17	2.07
13	4.23%	2.65	4.82	3.13	2.97
14	3.29%	2.65	4.94	3.21	3.05
15	4.00%	2.65	5.06	3.29	3.13
16	4.92%	3.54	5.63	4.46	4.35
17	4.26%	3.54	5.72	4.53	4.42
18	3.35%	3.54	5.81	4.60	4.49
19	2.65%	4.42	5.94	4.70	4.59
20	2.39%	7.10	6.17	4.89	4.77
21	2.36%	7.10	6.25	4.95	4.83
22	1.80%	7.10	6.32	5.01	4.89
23	0.86%	7.10	6.39	5.06	4.94
24	0.75%	7.10	6.45	5.11	4.99
25	0.79%	7.10	6.51	5.15	5.03
26	0.61%	7.10	6.56	5.19	5.07
27	0.71%	7.10	6.60	5.23	5.10
28	0.47%	7.10	6.65	5.26	5.14
29	0.32%	7.10	6.68	5.29	5.16
30	0.19%	7.10	6.71	5.32	5.19
31	0.28%	7.10	6.74	5.34	5.21
32	0.29%	7.10	6.76	5.35	5.23
33	0.25%	7.10	6.78	5.37	5.24
34	0.18%	7.10	6.79	5.38	5.25
35	0.14%	7.10	6.81	5.39	5.26
36	0.12%	7.10	6.82	5.40	5.27
37	0.11%	7.10	6.83	5.41	5.28
38	0.08%	7.10	6.84	5.42	5.29
39	0.04%	7.10	6.86	5.43	5.30
40	0.05%	7.10	6.87	5.44	5.31
>40	0.10%	7.10	6.88	5.45	5.32
Average		2.71		2.61	

Combining the emission factor data with the age distribution data, emission values were calculated on a per truck basis and are shown in Table 6-6. The emissions labeled as On-site refer to trucks that are moving within the site boundary as a mobile source. Idle on site represents the idling done by trucks that are on site but away from the exit gate Idle - entrance and Idle - exit represent the emissions at the entrance/exit gate queues. Table 6-6 also provides an approximation of the per site trip emissions by mode from all trucks at the Richmond facility based on the estimated 55,950 truck trips in 2005.

Table 6-6. PM emissions per truck trip and for 2005 at Richmond.

Mode	Per Truck Trip (g)	Annual (55,950 Truck Trips) (g)
Travel on Site	6.79	380,091
Idle on Site	1.33	74,362
Idle - Entrance	0.06	3,171
Idle - Exit	0.08	4,292
Annual Estimate		461,916

6.3. On-road Fleet Vehicle Operations

There are 22 fleet vehicles based at the Richmond facility according to records from BNSF. Eighteen of these vehicles are associated with the Mechanical department at the Richmond site, and four with the Intermodal or other administrative department. Parameters including gross vehicle weight rating (GVWR), fuel type and annual mileage are known for each vehicle. The draft EMFAC2005 model (ARB, 2006c) provides an average trip distance for each vehicle type in 2005. With this estimate of miles per trip, total annual mileage for each vehicle can be converted to an estimated number of trips. A conservative assumption that all trips either start or end on site can be combined with an approximate distance of about 3000 feet from the Mechanical facility parking lot to the gate or about 850 feet from the Intermodal/Administrative facility parking lot to the gate in order to estimate the amount of on-site driving for each vehicle

Using this procedure, the distance driven on site each year by the 22 fleet vehicles is estimated. Each vehicle's GVWR can be used to assign the appropriate vehicle type and emission factor to calculate the emissions associated with driving on site throughout the year. Table 6-7 provides a summary of relevant parameters for emissions modeling

Table 6-7. On-road Fleet Vehicle activity at the Richmond facility.

EMFAC Vehicle Type	Fuel	# of Vehicles	Average Annual Mileage	Est. Annual Mileage on Site
LDT2	Gasoline	4	77,768	2,422
LHDT1	Gasoline	10	233,838	115,236
MHDT	Diesel	6	44,433	12,703
HHDT	Diesel	2	21,577	431

Annual PM and TOG emission factors from a draft version of EMFAC2005 and on-site emissions estimates for the fleet vehicles are presented in Table 6-8. Note that gasoline and diesel vehicle estimates were kept separate, so that gasoline TOG exhaust and evaporative emissions could be speciated into TACs differently. ARB Speciate Profile #2105 will be used for the gasoline TOG exhaust emissions, and Profile #422 will be used for the gasoline TOG evaporative emissions.

Table 6-8. On-road Fleet Vehicle emissions at the Richmond facility.

<table>
<tr><th>EMFAC Vehicle Type</th><th>Fuel</th><th>PM EF (g/mi)</th><th>PM Emissions (grams)</th><th>TOG Exhaust EF (g/mi)</th><th>TOG Exhaust Emissions (grams)</th><th>TOG Evap EF (g/mi)</th><th>TOG Evap Emissions (grams)</th></tr>
<tr><td>LDT2</td><td>Gasoline</td><td>0.04</td><td rowspan="2">1,523</td><td>0.44</td><td rowspan="2">187,114</td><td>0.25</td><td rowspan="2">110,426</td></tr>
<tr><td>LHDT1</td><td>Gasoline</td><td>0.04</td><td>0.61</td><td>0.39</td></tr>
<tr><td>MHDT</td><td>Diesel</td><td>0.354</td><td rowspan="2">4,296</td><td>0.395</td><td rowspan="2">4,063</td><td>0</td><td rowspan="2">0</td></tr>
<tr><td>HHDT</td><td>Diesel</td><td>0.366</td><td>0.821</td><td>0</td></tr>
</table>

6.4. Other Off-Road Equipment

6.4.1. Transport Refrigeration Unit Operations

Transportation Refrigeration units (TRUs) are used to regulate temperatures during the transport of products with temperature requirements. In BNSF operations, temperatures are regulated by TRUs in shipping containers and in railcars when the material being shipped require such temperature regulation.

TRU emissions were estimated in accordance with the methodology presented by an early version of the OFFROAD model provided by ARB (2006c). TRU yearly activity was estimated using the time onsite by TRU configuration (either railcar or shipping container) and mode of transport was provided by BNSF. This activity data was used along with ARB default age, horsepower, and load factor input estimates in the OFFROAD model to estimate TRU emissions. All TRUs are assumed to use diesel fuel

6.4.1.1. Boxcars

Richmond site boxcar TRU activity is shown in Table 6-9. As TRUs are not expected to be operating when a boxcar is not loaded, the TRU activity presented here represents loaded TRU shipping containers only. Richmond boxcar TRU emissions are presented in Table 6-10.

Table 6-9. Richmond site Boxcar TRU yearly activity.

Yearly Visits	Total Time Onsite (hours)	Average Time Onsite / Visit (hours)
327	5,886	18

Table 6-10. Richmond site Boxcar TRU emissions (grams per year).

Mode	TOG	PM
Train Arrival - Train Departure	409,909	83,400

6.4.1.2. Containers

Richmond site container TRU activity is shown in Table 6-11. As TRUs are not expected to be operating when a shipping container is not loaded, the TRU activity presented here represents loaded TRU shipping containers only. Richmond container TRU emissions by mode are presented in Table 6-12.

Table 6-11. Richmond site shipping container TRU yearly activity.

Yearly Visits	Total Time Onsite (hours)	Average Time Onsite / Visit (hours)
2,187	21,870	10

Table 6-12. Richmond site shipping container TRU emissions (grams per year).

Mode	TOG	PM
All Modes	1,523,057	309,879

6.4.2. Track Maintenance Equipment Operations

Track maintenance equipment includes equipment used to service tracks anywhere in California though it may be housed at any given facility. This equipment category includes large and small engines and equipment.

Activity

BNSF California track maintenance equipment can be used on any or all tracks within California to maintain the network. Therefore, the approach used to determine the activity and emissions for a given facility was to estimate emissions from all track maintenance equipment and apportion those emissions by site using the relative track mileage (including all tracks, main line and other tracks) at the site to the California total track mileage.

The Richmond site has 16.5 miles of track within its boundaries compared with the California regional total of 3,779 miles. This represents 0.4% of the total California track mileage that is maintained.

Appendix I shows a list of all BNSF track maintenance equipment located in California with horsepower and operational parameters. Based on BNSF staff knowledge of equipment characteristics, it was assumed that all track maintenance equipment was diesel powered except two forklifts (equipment IDs TM1 and TM2) which were assumed to be powered by 4-stroke gasoline engines. Forklifts TM1 and TM2 could not be assumed to be diesel powered because diesel forklifts of 16 to 25 horsepower diesel forklifts were not included in the ARB OFFROAD model.

If rated horsepower was not available, horsepower was assumed to be ARB default (ARB, 2006c) for the most populous horsepower range for the assigned ARB equipment category and type. Load factors were assumed to be ARB OFFROAD model default (ARB, 2006b).

Emissions

Exhaust emissions from track maintenance equipment were estimated using the draft version of the OFFROAD model (ARB, 2006c). Emissions from track maintenance equipment at the Richmond facility along with California totals are shown in Table 6-13.

Table 6-13. Track maintenance equipment emissions estimates (grams per year).

Site	Gasoline			Diesel	
	Evaporative TOG	Exhaust TOG	PM	TOG	PM
Richmond	94	533	15	53,724	19,668
California Totals	21,469	121,981	3,525	12,305,162	4,504,844

Activity

Surveys were returned by equipment operators with relevant equipment characteristics and operational information. Table 6-14 shows Richmond site portable engine characteristics and activity. When not available, model year was assumed to be equivalent to 2005 minus ARB 2006c useful life.

Table 6-14. Portable and other offroad engine equipment characteristics and operation.

ARB Equipment Type	Model Year	Fuel Type	Rated Horsepower
Forklifts	2000	D	149 [a]
Forklifts	1998[a]	LPG	70[a]
Forklifts	1993[a]	D	149[a]
Specialty Vehicles	2002[c]	G	20[b]
Specialty Vehicles	2002[c]	G	20[b]
Specialty Vehicles	2002[c]	G	20[b]
Specialty Vehicles	2002[c]	G	20[b]
Specialty Vehicles	2001	G	20
Specialty Vehicles	2001	G	20
Specialty Vehicles	2002	G	20
Specialty Vehicles	2002	G	20
Specialty Vehicles	2002	G	20
Specialty Vehicles	2003	G	20
Specialty Vehicles	2001	G	10
Specialty Vehicles	2002[c]	G	20[b]
Specialty Vehicles	2002[c]	G	20[b]
Specialty Vehicles	2002[c]	G	20[b]
Specialty Vehicles	2002[c]	G	20[b]

[a] Based on ARB, 2006c
[b] Based on characteristics of simi ar equipment at Richmond site

Emissions

Emissions from portable engine offroad equipment at the Richmond facility are shown in Table 6-15 using default activity and other input data from the draft OFFROAD model (ARB, 2006c). The diesel TOG from this equipment will be speciated using ARB Speciate Profile #818.

Table 6-15. Portable engine equipment emissions estimates (grams per year).

Fuel Type	ARB Equipment Type	Evaporative TOG (grams)	Exhaust TOG (grams)	PM (grams)
D	Forklifts	0	114,720	43,204
LPG	Forklifts	0	143,367	2,268
D	Forklifts	0	160,626	60,405
G	Specialty Vehicles	3,934	4,627	130
G	Specialty Vehicles	3,934	4,627	130
G	Specialty Vehicles	3,934	4,627	130
G	Specialty Vehicles	3,626	4,627	130

Fuel Type	ARB Equipment Type	Evaporative TOG (grams)	Exhaust TOG (grams)	PM (grams)
G	Specialty Vehicles	3,934	4,930	140
G	Specialty Vehicles	3,626	4,930	140
G	Specialty Vehicles	3,626	4,930	140
G	Specialty Vehicles	3,626	4,930	140
G	Specialty Vehicles	3,626	4,930	140
G	Specialty Vehicles	3,626	4,627	130
G	Specialty Vehicles	3,626	2,061	70
G	Specialty Vehicles	3,626	4,627	130
G	Specialty Vehicles	3,626	4,627	130
G	Specialty Vehicles	3,934	4,627	130
G	Specialty Vehicles	3,934	4,627	130
LPG Fuel		**0**	**143,367**	**2,268**
2-Stroke Gasoline Fuel		**56,238**	**2,061**	**70**
4-Stroke Gasoline Fuel			**66,295**	**1,870**
Diesel Fuel		**---**	**275,346**	**103,609**

6.5. Stationary Sources

Air quality permits for the Richmond facility show several types of stationary sources for potential evaluation.

Source types:
(1) Gasoline storage and dispensing unit [1 on site]
(2) Diesel-fueled internal combustion engines (ICEs) [3 on site]

The gasoline storage and dispensing unit is comprised of a 1000 gallon tank and hose with nozzle Phase I and II vapor recovery systems are in place. Throughput is set at 4,800 gallons per year, based on the BAAQMD permit application (# 23575). The total TOG emissions were calculated based on throughput and TOG emission factors for losses due to filling/working, breathing, dispensing, and spillage from the Gasoline Service Station Industry-Wide Risk Assessment Guidelines (CAPCOA, 1997) prepared by the Toxics Committee of the California Air Pollution Control Officers Association (CAPCOA). Emission factors for filling/working, breathing, dispensing, and spillage are presented in Table 6-16.

Table 6-16. Emission factors and total TOG emissions for the gasoline dispensing and storage facility at the Richmond facility.

Specifications	Annual Gasoline Throughput (gal)	Filling/ Working Emission Factor (lb/1000 gal)	Breathing Emission Factor (lb/1000 gal)	Dispensing Emission Factor (lb/1000 gal)	Spillage Emission Factor (lb/1000 gal)	Total TOG Emissions (grams)
Gasoline Dispensing and Storage facility with Aboveground Storage Tank (Phase and Vapor Recovery)	4,800	0.42	0.053	0.63	0.42	3,316

The relevant parameters for the three diesel ICEs, as well as their estimated annual PM emissions are presented in Table 6-17. To estimate emissions from the three diesel ICEs at the Richmond site, ENVIRON utilized the BAAQMD Permit for these sources (Application # 7577).
The diesel TOG from these ICEs will be speciated using ARB Speciate Profile #818.

Table 6-17. Parameters and PM emissions estimates for the diesel-fueled ICEs at the Richmond facility.

Specifications	Brake horsepower (hp)	Est. Operation Time (hr/yr)	PM Emission Factor (g/bhp-hr)	PM Emissions (grams)
Generac SD 300 w/ filter	446	26	0.05	581
Generac SD 250 w/ filter	400	26	0.05	520
Generac SD 600	900	26	0.15	3510
Total				**4,611**

7.0 TOTAL TAC EMISSIONS FROM THE RICHMOND FACILITY

The estimated total annual diesel PM (DPM) emissions associated with the operations in the Richmond facility are summarized in Table 7-1.

Table 7-1. Estimated total annual DPM emissions associated with the operations in the Richmond facility.

Facility Operations	DPM Emissions		Percentage
	Grams	Metric Tons	
Basic Services (A)	500,484	0.50	12%
Basic Engine Inspection (B)	0	0	0%
Full Engine Service/Inspection (C)	0	0	0%
Switching (D)	1,056,140	1.06	25%
Train Arrival and Departure (E)	1,398,122	1.40	33%
Adjacent Freight Movements (F)	0	0	0%
Adjacent Commuter Rail Operations (G)	0	0	0%
Cargo Handling Equipment Operations (H)	250,878	0.25	6%
On-Road Container Truck Operations (I)	461,916	0.46	11%
On-Road Fleet Vehicle (J)	4,296	0.00	0%
Transport Refrigeration Units (K)	393,279	0.39	9%
Other Off-Road (K) Track Maintenance	19,668	0.02	0%
Other Off-Road (K)	103,609	0.10	2%
Stationary Sources (L)	4,611	0.00	0%
Total	**4,193,003**	**4.1**	

The estimated total annual emissions of total organic gases (TOG) (for speciation into the other TACs) associated with gasoline, LPG, or CNG operations in the Richmond facility are summarized in Table 7-2. Diesel TOG is not included in the tabulation.

Table 7-2. Estimated total annual TOG associated with gasoline, LPG, or LNG emissions operations in the Richmond facility.

Facility Operations	TOG Emissions		Percentage
	Grams	Metric Tons	
Basic Services	0	0	0%
Basic Engine Inspection	0	0	0%
Full Engine Service/Inspection	0	0	0%
Switching	0	0	0%
Train Arrival and Departure	0	0	0%
Adjacent Freight Movements	0	0	0%
Adjacent Commuter Rail Operations	0	0	0%
Cargo Handling Equipment Operations	0	0	0%
On-Road Container Truck Operations	0	0	0%
On-Road Fleet Vehicle Exhaust	187,114	0.19	33%
On-Road Fleet Vehicle Evaporative	110,426	0.11	19%
Other Off-Road TRU	0	0.00	0%
Other Off-Road Track Maintenance Exhaust	533	0.00	0%
Other Off-Road Track Maintenance Evaporative	94	0.00	0%
Other Off-Road Portable Engines Exhaust	211,723	0.21	37%
Other Off-Road Portable Engines Evaporative	56,238	0.06	10%
Stationary Sources Evaporative	3,316	0.00	1%
Total	**56,444**	**0.57**	

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APPENDIX A

TRACK MAINTENANCE EQUIPMENT

Equipment ID	Equipment Type	ARB Category	ARB Equipment type	Engine Model Year	Engine Horsepower	Dual Engine (Y/N)	Operating Hours Per week	Average Operating Hours Per Year
TM1	FORKLIFT	Industrial	Forklifts	1998	17	N	30	1440
TM2	FORKLIFT	Industrial	Forklifts	1985	17	N	30	1440
TM3	ANCHOR APPLICATOR	Industrial	Other General Industrial	1988	50	N	25	1200
TM4	ANCH REMVR	Industrial	Other General Industrial	1994	90	N	15	720
TM5	ANCHOR BOXER	Industrial	Other General Industrial	1987	76	N	25	1200
TM6	ANCHOR BOXER	Industrial	Other General Industrial	1987	76	N	25	1200
TM7	ANCHOR REMOVER	Industrial	Other General Industrial	1995	50	N	20	960
TM8	ANCHOR APP/REM	Industrial	Other General Industrial	2004	50	N	25	1200
TM9	ANCHOR APP/REM	Industrial	Other General Industrial	2004	50	N	25	1200
TM10	ANCHOR APP/REM	Industrial	Other General Industrial	2004	50	N	25	1200
TM11	AIR COMPRESSOR	Commercial	Air Compressors	1989	35	N	12	576
TM12	AIR COMPRESSOR	Commercial	Air Compressors	1989[a]	35	N	15	720
TM13	AIR COMPRESSOR	Commercial	Air Compressors	1989[a]	35	N	10	480
TM14	AIR COMPRESSOR	Commercial	Air Compressors	1989[a]	35	N	10	480
TM15	AOZ/CR B-OCF	Industrial	Other General Industrial	2002	90	N	15	720
TM16	DBL BRM	Industrial	Other General Industrial	1983	100	N	0	0
TM17	DBL BRM	Industrial	Other General Industrial	1985	100	N	0	0
TM18	DBL BRM TRLR	Industrial	Other General Industrial	2000	100	N	25	1200
TM19	BALLAST REGULATOR	Industrial	Other General Industrial	1981	64	N	17.29	829.92
TM20	BALLAST REGULATOR	Industrial	Other General Industrial	1991	64	N	0	0
TM21	BALLAST REGULATOR	Industrial	Other General Industrial	1986	64	N	0	0
TM22	BALLAST REGULATOR	Industrial	Other General Industrial	1979	64	N	45	2160
TM23	BALLAST REGULATOR	Industrial	Other General Industrial	1984	175	N	45	2160
TM24	BALLAST REGULATOR	Industrial	Other General Industrial	1983	175	N	0	0
TM25	BALLAST REGULATOR	Industrial	Other General Industrial	1985	175	N	0	0
TM26	BALLAST REGULATOR	Industrial	Other General Industrial	1996	175	N	10.2	489.6
TM27	BALLAST REGULATOR	Industrial	Other General Industrial	1996	175	N	31.33	1503.84
TM28	BALLAST REGULATOR	Industrial	Other General Industrial	1996	175	N	0	0
TM29	BALLAST REGULATOR	Industrial	Other General Industrial	2003	175	N	15	720
TM30	LOCOMOTIVE CRANE	Construction	Cranes	1979	250	N	0	0
TM31	TRUCK CRANE	Construction	Cranes	1986	175	Y	0	0
TM32	RUBBER TIRED CRANE	Construction	Cranes	1982	175	N	0	0
TM33	RUBBER TIRED CRANE	Construction	Cranes	1999	175	N	0	0
TM34	RUBBER TIRED CRANE	Construction	Cranes	2001	175	N	0	0

Equipment ID	Equipment Type	ARB Category	ARB Equipment type	Engine Model Year	Engine Horsepower	Dual Engine (Y/N)	Operating Hours Per week	Average Operating Hours Per Year
TM35	WHL LDR	Construction	Rubber Tired Loaders	1974	300	N	3.06	146.88
TM36	CRN/LDR HR	Construction	Cranes	1974	100	N	0	0
TM37	CRN/LDR HR	Construction	Cranes	1984	100	N	0	0
TM38	CRN/LDR HR	Construction	Cranes	1984	100	N	3.36	161.28
TM39	CRN/LDR HR	Construction	Cranes	1984	100	N	28.8	1382.4
TM40	WHL LDR*GP	Construction	Rubber Tired Loaders	1995	120	N	0	0
TM41	SKID-LDR FBHTAH	Construction	Skid Steer Loaders	2003	74	N	0	0
TM42	CRN/LDR HR	Construction	Cranes	2004	100	N	26.56	1274.88
TM43	BK-HO/LDR	Construction	Tractors/Loaders/Backhoes	1992	75.5	N	2	96
TM44	BK-HO/LDR	Construction	Tractors/Loaders/Backhoes	1992	75.5	N	0	0
TM45	BK-HO/LDR EH	Construction	Tractors/Loaders/Backhoes	1995	69	N	12.37	593.76
TM46	BK-HO/LDR EH	Construction	Tractors/Loaders/Backhoes	1995	69	N	46.38	2226.24
TM47	BK-HO/LDR EF	Construction	Tractors/Loaders/Backhoes	1998	78	N	0	0
TM48	BK-HO/LDR EF	Construction	Tractors/Loaders/Backhoes	1999	78	N	0	0
TM49	BK-HO/LDR EF	Construction	Tractors/Loaders/Backhoes	1999	78	N	12.88	618.24
TM50	BK-HO/LDR EF	Construction	Tractors/Loaders/Backhoes	1999	78	N	7.31	350.88
TM51	BK-HO/LDR EF	Construction	Tractors/Loaders/Backhoes	1999	78	N	8.91	427.68
TM52	BK-HO/LDR EF	Construction	Tractors/Loaders/Backhoes	2000	78	N	0	0
TM53	BK-HO/LDR EF	Construction	Tractors/Loaders/Backhoes	2003	88	N	0	0
TM54	BK-HO/LDR EF	Construction	Tractors/Loaders/Backhoes	2004	88	N	1.65	79.2
TM55	BK-HO/LDR EF	Construction	Tractors/Loaders/Backhoes	2004	88	N	9.93	476.64
TM56	BK-HO/LDR EF	Construction	Tractors/Loaders/Backhoes	2004	88	N	6.13	294.24
TM57	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	119	N	15	720
TM58	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	85	N	15	720
TM59	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	74	N	15	720
TM60	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	74	N	15	720
TM61	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	74	N	15	720
TM62	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	74	N	15	720
TM63	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	74	N	15	720
TM64	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	74	N	15	720
TM65	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	74	N	15	720
TM66	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	85	N	15	720
TM67	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	99	N	15	720
TM68	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	74	N	15	720
TM69	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	74	N	15	720
TM70	BK-HO/LFR EF	Construction	Tractors/Loaders/Backhoes	1989[a]	85	N	15	720

Equipment ID	Equipment Type	ARB Category	ARB Equipment type	Engine Model Year	Engine Horsepower	Dual Engine (Y/N)	Operating Hours Per week	Average Operating Hours Per Year
TM71	Directional Boring Machine	Construction	Bore/Drill Rigs	2002[a]	82[b]	N	15	720
TM72	Manlift	Industrial	Aeria Lifts	1989[a]	34[b]	N	15	720
TM73	Trencher	Construction	Trenchers	1998[a]	39	N	15	720
TM74	Trencher	Construction	Trenchers	1998[a]	39	N	15	720
TM75	Trencher	Construction	Trenchers	1998[a]	39	N	15	720
TM76	Trencher Rider	Construction	Trenchers	1998[a]	79	N	15	720
TM77	RAIL LIFTER	Industrial	Other General Industrial	1997	19	N	20	960
TM78	TIE SPIKER	Industrial	Other General Industrial	1986	19	N	0	0
TM79	TIE SPIKER	Industrial	Other General Industrial	1986	19	N	0	0
TM80	TIE SPIKER	Industrial	Other General Industrial	1991	19	N	3.1	148.8
TM81	TIE SPIKER	Industrial	Other General Industrial	2002	90	N	10	480
TM82	TIE SPIKER	Industrial	Other General Industrial	2002	90	N	10	480
TM83	TIE SPIKER	Industrial	Other General Industrial	2002	90	N	10	480
TM84	SPIKE PULLER	Industrial	Other General Industrial	1984	35	N	10	480
TM85	SPIKE PULLER	Industrial	Other General Industrial	1995	35	N	10	480
TM86	SPIKE PULLER	Industrial	Other General Industrial	1995	35	N	10	480
TM87	SPIKE PULLER	Industrial	Other General Industrial	1986	35	N	0	0
TM88	DITCHER/SPREADER	Industrial	Other General Industrial	1980	97[b]	N	15	720
TM89	TIE TAMPER	Industrial	Other General Industrial	1985	175	N	20	960
TM90	TIE TAMPER	Industrial	Other General Industrial	1985	175	N	3.74	179.52
TM91	TIE TAMPER	Industrial	Other General Industrial	1989	250	N	22.4	1075.2
TM92	TIE TAMPER	Industrial	Other General Industrial	1995	250	N	40	1920
TM93	TIE TAMPER	Industrial	Other General Industrial	1996	250	N	40	1920
TM94	TIE TAMPER	Industrial	Other General Industrial	1996	250	N	90	4320
TM95	TIE TAMPER	Industrial	Other General Industrial	1996	250	N	40	1920
TM96	TIE TAMPER	Industrial	Other General Industrial	1997	250	N	0.92	44.16
TM97	TIE TAMPER	Industrial	Other General Industrial	2000	250	N	35	1680
TM98	TIE TAMPER	Industrial	Other General Industrial	2000	300	N	40	1920
TM99	TIE TAMPER	Industrial	Other General Industrial	2001	250	N	31	1488
TM100	TIE TAMPER	Industrial	Other General Industrial	2002	300	N	35	1680
TM101	TIE TAMPER	Industrial	Other General Industrial	2003	250	N	0	0
TM102	TIE TAMPER	Industrial	Other General Industrial	1995	175	N	0	0
TM103	TIE TAMPER	Industrial	Other General Industrial	1987	175	N	0	0
TM104	TIE TAMPER	Industrial	Other General Industrial	1985	150	N	15	720
TM105	TIE CRANE	Construction	Cranes	1982	64	N	15	720

Equipment ID	Equipment Type	ARB Category	ARB Equipment type	Engine Model Year	Engine Horsepower	Dual Engine (Y/N)	Operating Hours Per week	Average Operating Hours Per Year
TM106	TIE CRANE	Construction	Cranes	1982	64	N	0	0
TM107	TIE CRANE	Construction	Cranes	1985	64	N	0	0
TM108	TIE CRANE	Construction	Cranes	1986	64	N	0	0
TM109	TIE PLUGGER	Industrial	Other General Industrial	2000	90	N	20	960
TM110	TIE PLUGGER	Industrial	Other General Industrial	2002	90	N	20	960
TM111	TIE PLUGGER	Industrial	Other General Industrial	2003	90	N	20	960
TM112	TIE INSERT/EXTRACT	Industrial	Other General Industrial	1985	175	N	0	0
TM113	TIE INSERT/EXTRACT	Industrial	Other General Industrial	1985	175	N	0	0
TM114	TIE INSERT/EXTRACT	Industrial	Other General Industrial	1987	175	N	41 58	1995 84
TM115	DOZER	Construction	Crawler Tractors	1985	145	N	0	0
TM116	WELDER	Commercial	Welders	1984	64	N	25	1200
TM117	WELDER	Commercial	Welders	1984	64	N	25	1200
TM118	WELDER	Commercial	Welders	1986	64	N	25	1200
TM119	WELDER	Commercial	Welders	1987	64	N	25	1200
TM120	WELDER	Commercial	Welders	1988	40	N	25	1200
TM121	WELDER	Commercial	Welders	1988	64	N	25	1200
TM122	WELDER	Commercial	Welders	1988	64	N	25	1200
TM123	WELDER	Commercial	Welders	1998	64	N	25	1200
TM124	WELDER	Commercial	Welders	1999	64	N	25	1200
TM125	WELDER	Commercial	Welders	1999	64	N	25	1200
TM126	WELDER	Commercial	Welders	1999	64	N	25	1200
TM127	WELDER	Commercial	Welders	2000	64	N	25	1200
TM128	WELDER	Commercial	Welders	2000	64	N	25	1200
TM129	WELDER	Commercial	Welders	2000	40	N	25	1200
TM130	WELDER	Commercial	Welders	2000	40	N	25	1200
TM131	WELDER	Commercial	Welders	2001	64	N	25	1200
TM132	WELDER	Commercial	Welders	2003	40	N	25	1200
TM133	WELDER	Commercial	Welders	2003	64	N	25	1200
TM134	WELDER	Commercial	Welders	2003	40	N	25	1200
TM135	WELDER	Commercial	Welders	2004	64	N	25	1200
TM136	WELDER	Commercial	Welders	2004	64	N	25	1200
TM137	WELDER	Commercial	Welders	2004	64	N	25	1200
TM138	WELDER	Commercial	Welders	2004	40	N	25	1200
TM139	WELDER	Commercial	Welders	2005	40	N	25	1200
TM140	WELDER	Commercial	Welders	2005	40	N	25	1200
TM141	WELDER	Commercial	Welders	2005	40	N	25	1200

Equipment ID	Equipment Type	ARB Category	ARB Equipment type	Engine Model Year	Engine Horsepower	Dual Engine (Y/N)	Operating Hours Per week	Average Operating Hours Per Year
TM142	WELDER	Commercial	Welders	2005	40	N	25	1200
TM143	RAIL HEATER	Industrial	Other General Industrial	1982	90	N	25	1200
TM144	RAIL HEATER	Industrial	Other General Industrial	1995	90	N	25	1200
TM145	SPIKE RECLAIMER	Industrial	Other General Industrial	1992	90	N	25	1200
TM146	TIE PLATE RETRIEVER	Industrial	Other General Industrial	2003	25	N	25	1200
TM147	TRACK STABILIZER	Industrial	Other General Industrial	1989	300	N	9.26	444.48
TM148	TRACK STABILIZER	Industrial	Other General Industrial	2000	300	N	45	2160
TM149	TRACK STABILIZER	Industrial	Other General Industrial	2001	300	N	45	2160

[a] Model year estimated as 2005 minus ARB 2006c default useful life

[b] Horsepower estimated as ARB 2006c default for the most populous horsepower range for the associated equipment type