



## COMMERCE-EASTERN RAILYARD TAC EMISSIONS INVENTORY

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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 Commerce-Eastern 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.

### **Overview of the Commerce – Eastern Yard**

The Commerce – Eastern yard lies diagonally opposite across the BNSF mainline from the Commerce – Mechanical yard. The two yards have little in common and little interaction despite their proximity to one another. The Eastern yard is an intermodal and classification yard handling very few trains.

### **Locomotive Facility Operations**

The engine-on locomotive operations at the Commerce - Eastern facility do not include service or inspection activities (headings A – C), but do include switching (D) and activities in the classification yard (E) and on the operating tracks (F and G). Under each heading is a description of the operations.

Since different locomotive and engine models have different emissions characteristics, it is important to characterize the types and models of the locomotives that are being serviced in the Commerce - Eastern 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.

#### A. Basic Locomotive Service

No service or locomotive refueling activity occurs at Commerce – Eastern.

#### B. Basic Engine Inspection

No such activity occurs within the Commerce - Eastern facility.

#### C. Full Engine Service/Inspection

No such activity occurs within the Commerce - Eastern facility.

#### D. Switching Engine Activity in the Yard

Switching engine fleet characteristics in the Commerce - Eastern area were determined by a roster of engines made available by BNSF in early 2006 and reflects the roster for Commerce – Mechanical and Hobart yards as each facility shares switching engines. The data are shown in Table 1. 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 1.** Locomotive switching engine fleet characterization for service to the Commerce - Eastern facility.

| <b>Locomotive Model</b> | <b>Certification Tier</b> | <b>HP</b> | <b>Number of Engines</b> | <b>Engine Surrogate</b> |
|-------------------------|---------------------------|-----------|--------------------------|-------------------------|
| GP-25                   | Precontrolled             | 2500      | 1                        | GP-3x                   |
| GP-30                   | Precontrolled             | 2500      | 3                        | GP-3x                   |
| GP-35                   | Precontrolled             | 2500      | 4                        | GP-3x                   |
| GP39-2                  | Precontrolled             | 2300      | 6                        | GP-3x                   |
| GP39E                   | Precontrolled             | 2300      | 1                        | GP-3x                   |
| SD39                    | Precontrolled             | 2300      | 1                        | GP-3x                   |
| MK1200G                 | Precontrolled             | 1200      | 2                        | Switcher                |

The time in mode for switching engine activity in Table 2 was determined from event recorder downloads of a sample of three engines operating in this yard and Commerce - Mechanical. The three engines chosen range from 2,300 – 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 2.** Switching engine (~2,500 hp) relative time in mode.

| Throttle Notch | Time in Mode |
|----------------|--------------|
| DB             | 0.03%        |
| Idle           | 59.80%       |
| 1              | 12.66%       |
| 2              | 14.92%       |
| 3              | 7.14%        |
| 4              | 3.86%        |
| 5              | 0.85%        |
| 6              | 0.31%        |
| 7              | 0.18%        |
| 8              | 0.25%        |

The total switching engine activity consists of two shifts 5 days a week and one shift the other 2 days. Engines operating about 4.5 hours per shift. This results in an estimate of 2808 hours per year

#### E. Train Arrival and Departures in the Yard

Trains arrive and depart from the Commerce-Eastern classification yard and have a distinct operating profile from other engines moving through or by the yard. BNSF provided engine counts for arriving and departing trains based on a designation from the yard. However, all trains/engines noted as arriving and departing do not necessarily have business in the yard and may be using the yard tracks as an alternative route to the adjacent mainline. Trains/engines that arrive and depart within an hour were subtracted from the total number of the arrivals and departures.

The number of engines listed as arriving and departing from the site was the larger of those labeled train arrival and train departure. A total number of engines that arrive and depart from the yard were estimated at 1515, with 100 short term stays most likely corresponding to trains only passing through the yard. Therefore, 1415 engines were used for this activity category. The fleet characteristics by model and emission tier level for arriving and departing trains is shown in Table 3.

**Table 3.** Fleet characteristics for arriving and departing engines

| Tier     | Model     | Number | Fleet Fraction |
|----------|-----------|--------|----------------|
| Precntrl | Switchers | 0      | 0%             |
| Precntrl | GP-3x     | 7      | 1%             |
| Precntrl | GP-4x     | 59     | 4%             |
| Precntrl | GP-50     | 3      | 0%             |
| Precntrl | GP-60     | 7      | 1%             |

| Tier     | Model       | Number | Fleet Fraction |
|----------|-------------|--------|----------------|
| Precntrl | SD-7x       | 0      | 0%             |
| Precntrl | Dash-7      | 0      | 0%             |
| Precntrl | Dash-9      | 118    | 8%             |
| 0        | GP-60       | 10     | 1%             |
| 0        | SD-7x       | 2      | 0%             |
| 0        | Dash-8      | 87     | 6%             |
| 0        | Dash-9      | 679    | 48%            |
| 1        | Dash-9      | 338    | 24%            |
| 2        | ES44/Dash-9 | 104    | 7%             |
| Total    |             | 1415   |                |

BNSF provided throttle position for a sample engine that arrived and departed out of the Hobart Yard and was considered to be representative of the Commerce-Eastern trains' activity. That data is shown in Table 4. The idle mode in the sample could not distinguish between idle with the engine on and idle with the engine off. A separate data set provided information on when the engine was turned on, but not when turned off. This sample engine indicated that the engine was cranked on twice upon arrival. Therefore, the engine must have been shut off during some periods while in the yard. A more in-depth study for Richmond showed that engines arriving and departing averaged 2.33 hours of idle, so the idle time for the arriving engines at Commerce-Eastern was adjusted so that the total arrival and departure idle time would be 2.33 hours.

**Table 4.** Activity by mode for arriving and departing trains

| Throttle Position | Arriving (Hours) | Departing (Hours) |
|-------------------|------------------|-------------------|
| DB                | 0.081            | 0.037             |
| Idle              | 0.631            | 1.702             |
| T1                | 0.223            | 0.160             |
| T2                | 0.134            | 0.033             |
| T3                | 0.066            | 0.011             |
| T4                | 0.008            | 0.005             |
| T5                | 0.000            | 0.000             |
| T6                | 0.000            | 0.000             |
| T7                | 0.000            | 0.000             |
| T8                | 0.000            | 0.000             |

#### F. Freight Movements on Adjacent Mainline

The adjacent main line along the (primarily) north-northwest edge of the facility and runs approximately 0.7 miles, and corresponds to milepost 147.3 to 148. The Commerce-Eastern Avenue site is listed as milepost 147.3, and the track distance from Eastern Avenue to the southwest edge of the Commerce-Mechanical Facility is 0.7 miles.

Two subcategories of freight movements occur on the mainline: BNSF and non-BNSF (foreign). All operations for both subcategories are assumed to occur throughout a 24-hour period. BNSF reads radio tags for most of the traffic along its mainline, cataloging every locomotive except most of the Metrolink engines operating commuter trains during weekdays at milepost 152, a few miles east of the facility.

### BNSF Freight Movements

Data provided by BNSF showed a total of 57,124 locomotives at the Commerce-Eastern facility between May 1, 2005 and April 30, 2006. The fleet characteristics for these engines are shown in Table 5. From this list of all locomotives at the site, 1415 were estimated to have arrived and departed from Commerce-Eastern according to data from BNSF. Thus, the 1415 arriving and departing trains were subtracted out from the total for each arrival and departure because that train/engine activity was included under Heading E and would be counted at milepost 152 when heading westbound (arriving) and eastbound (departing). Since only the total number of locomotives was available, ENVIRON assumed one-half (27,045) were traveling Eastbound, and one-half (27,045) were traveling Westbound. ENVIRON determined the time in mode distributions for Eastbound and Westbound mainline activity using computer simulation data provided by BNSF for a hypothetical locomotive traveling at approximately 30 mph past the Commerce-Eastern facility (milepost 147.3-148). These data are summarized in Table 6.

Note that the total time to pass the Commerce - Eastern facility traveling eastbound amounts to 85 seconds, while the total time in the Westbound direction is only 82 seconds on average.

**Table 5.** Fleet characterization for locomotive mainline activity past the Commerce-Eastern facility.

| <b>Locomotive Model</b> | <b>Certification Tier</b> | <b>HP</b> | <b>Fleet Fraction</b> | <b>Engine Surrogate</b> |
|-------------------------|---------------------------|-----------|-----------------------|-------------------------|
| C44-9W                  | 0                         | 4400      | 39.6%                 | Dash-9                  |
| C44-9W                  | 1                         | 4400      | 18.1%                 | Dash-9                  |
| C44-9W                  | Precontrolled             | 4400      | 7.7%                  | Dash-9                  |
| SD40-2                  | Precontrolled             | 2997      | 6.7%                  | GP-4x                   |
| ES44DC                  | 2                         | 4400      | 6.0%                  | ES44/Dash-9             |
| C40-8W                  | 0                         | 4135      | 5.5%                  | Dash-8                  |
| GP35                    | Precontrolled             | 2500      | 2.2%                  | GP-3x                   |
| GP60M                   | 0                         | 3800      | 1.9%                  | GP-60                   |
| B40-8W                  | Precontrolled             | 4000      | 1.7%                  | Dash-8 Tier 0           |
| SD40-2                  | 0                         | 3000      | 1.2%                  | GP-4x Precontrolled     |
| GP39-2                  | Precontrolled             | 2300      | 1.1%                  | GP-3x                   |
| GP30                    | Precontrolled             | 2500      | 1.1%                  | GP-3x                   |
| B40-8                   | Precontrolled             | 4000      | 0.9%                  | Dash-8 Tier 0           |
| GP60                    | 0                         | 3800      | 0.9%                  | GP-60                   |
| GP60B                   | 0                         | 3800      | 0.8%                  | GP-60                   |
| B40-8W                  | 0                         | 4000      | 0.8%                  | Dash-8                  |
| GP60                    | Precontrolled             | 3800      | 0.8%                  | GP-60                   |
| SD60M                   | Precontrolled             | 3800      | 0.5%                  | GP-60                   |
| SD60                    | Precontrolled             | 3800      | 0.3%                  | GP-60                   |

| Locomotive Model | Certification Tier | HP   | Fleet Fraction | Engine Surrogate    |
|------------------|--------------------|------|----------------|---------------------|
| SD45-2           | Precontrolled      | 3345 | 0.3%           | GP-4x               |
| SD50             | Precontrolled      | 3385 | 0.3%           | GP-50               |
| GP38-2           | Precontrolled      | 2000 | 0.3%           | GP-3x               |
| SD39             | Precontrolled      | 2300 | 0.2%           | GP-3x               |
| GP25             | Precontrolled      | 2500 | 0.2%           | GP-3x               |
| GP38             | Precontrolled      | 2000 | 0.1%           | GP-3x               |
| GP39M            | Precontrolled      | 2300 | 0.1%           | GP-3x               |
| GP40M            | Precontrolled      | 3000 | 0.1%           | GP-4x               |
| SD40             | Precontrolled      | 2930 | 0.1%           | GP-4x               |
| SD45             | Precontrolled      | 3480 | 0.1%           | GP-4x               |
| B23-7            | Precontrolled      | 2250 | 0.1%           | Dash-7              |
| SD40-2T          | Precontrolled      | 3000 | 0.1%           | GP-4x               |
| SD75M            | 0                  | 4300 | 0.04%          | SD-7x               |
| SW1500           | Precontrolled      | 1500 | 0.04%          | Switcher            |
| SD60M            | 0                  | 3800 | 0.03%          | GP-60               |
| AC4400CW         | 1                  | 4400 | 0.03%          | Dash-9              |
| SD40-2B          | Precontrolled      | 3000 | 0.03%          | GP-4x               |
| SD40-2S          | 0                  | 3000 | 0.02%          | GP-4x Precontrolled |
| SD70MAC          | Precontrolled      | 4000 | 0.02%          | SD-7x               |
| SD70MAC          | 0                  | 4000 | 0.02%          | SD-7x               |
| GP39E            | Precontrolled      | 2300 | 0.02%          | GP-3x               |
| GP50             | Precontrolled      | 3300 | 0.02%          | GP-50               |
| GP9              | Precontrolled      | 1750 | 0.02%          | Switcher            |
| SD45-2T          | Precontrolled      | 3400 | 0.02%          | GP-4x               |
| SW1000N          | Precontrolled      | 1000 | 0.02%          | Switcher            |
| SD45-2B          | Precontrolled      | 3400 | 0.01%          | GP-4x               |
| ES44AC           | 2                  | 4400 | 0.01%          | ES44/Dash-9         |
| SD40-3           | Precontrolled      | 3000 | 0.01%          | GP-4x               |
| SD9              | Precontrolled      | 1750 | 0.01%          | Switcher            |
| SD45-2BF         | Precontrolled      | 3600 | 0.01%          | GP-4x               |
| GG-20B           | Precontrolled      | 2000 | 0.003%         | GP-3x               |
| GP40E            | Precontrolled      | 3000 | 0.003%         | GP-4x               |
| GP40X            | Precontrolled      | 3600 | 0.003%         | GP-4x               |
| SD38-2           | Precontrolled      | 2300 | 0.003%         | GP-3x               |
| SD60             | 0                  | 3800 | 0.003%         | GP-60               |

**Table 6.** Locomotive time in mode passing the Commerce - Eastern facility.

| Throttle Notch | Westbound Est. Time (hours) | Eastbound Est. Time (hours) |
|----------------|-----------------------------|-----------------------------|
| DB             | 0.0229                      | 0.0235                      |

### Foreign (non-BNSF) Freight Movements

Data provided by BNSF showed only 222 foreign (non-BNSF and non-Commuter) locomotives passing the Commerce - Eastern facility between May 1, 2005 and April 30, 2006. As with the BNSF freight, ENVIRON assumed one-half (111) were traveling Eastbound, and one-half (111) were traveling Westbound. Without engine model descriptions for these locomotives, ENVIRON made the assumption that the fleet mix and time in mode for these engines would be the same as what Tables 5 and 6 show for the BNSF engines.

### G. Commuter Rail Operations on Adjacent Mainline

BNSF data show that AMTRAK operates 10,391 trains per year in both directions throughout the week along this line. BNSF also confirmed that Metrolink operates 7,280 trains per year along this line, with activity occurring only during weekdays. Although it does not occur throughout a 24-hour period, this operation is assumed to occur throughout a 24-hour period for modeling simplicity in this study.

Exact fleet characteristics are not known for the AMTRAK and Metrolink locomotives. However, both ARB and BNSF have indicated the predominance of F59PHI (EMD 710E3, 3000 hp) engines in the AMTRAK and Metrolink fleets, which for purposes of emissions estimates in this study are modeled using the average emission levels from the EPA (1997) study for the two 12 cylinder EMD 710G3 engines based on similarities in engine design, size, and power rating.

### **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 Commerce - Eastern facility are summarized in Tables 7a and 7b 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 7a.

**Table 7a.** PM emission factors for locomotives used in the study, assuming default fuel sulfur content (0.3%).

| Locomotive Model Group | Cert Tier <sup>a</sup> | Emission Factors (g/hr) by Throttle Notch |                 |       |       |       |       |       |       |        |        |
|------------------------|------------------------|---|-----------------|-------|-------|-------|-------|-------|-------|--------|--------|
|                        |                        | Idle                                      | DB <sup>b</sup> | 1     | 2     | 3     | 4     | 5     | 6     | 7      | 8      |
| Switchers (1)          | Precntl                | 31.0                                      | 56.0            | 23.0  | 76.0  | 138.0 | 159.0 | 201.0 | 308.0 | 345.0  | 448.0  |
| GP-3x (1)              | Precntl                | 38.0                                      | 72.0            | 31.0  | 110.0 | 186.0 | 212.0 | 267.0 | 417.0 | 463.0  | 608.0  |
| GP-4x (1)              | Precntl                | 47.9                                      | 80.0            | 35.7  | 134.3 | 226.4 | 258.5 | 336.0 | 551.9 | 638.6  | 821.3  |
| GP-50 (1)              | Precntl                | 26.0                                      | 64.1            | 51.3  | 142.5 | 301.5 | 311.2 | 394.0 | 663.8 | 725.3  | 927.8  |
| GP-60 (1)              | Precntl                | 48.6                                      | 98.5            | 48.7  | 131.7 | 284.5 | 299.4 | 375.3 | 645.7 | 743.6  | 941.6  |
| SD-7x (1)              | Precntl                | 24.0                                      | 4.8             | 41.0  | 65.7  | 156.8 | 243.1 | 321.1 | 374.8 | 475.2  | 589.2  |
| Dash-7 (1)             | Precntl                | 65.0                                      | 180.5           | 108.2 | 121.2 | 359.5 | 327.7 | 331.5 | 299.4 | 336.7  | 420.0  |
| Dash-9 (2)             | Precntl                | 32.1                                      | 53.9            | 54.2  | 108.1 | 219.9 | 289.1 | 370.6 | 437.7 | 486.1  | 705.7  |
| EMD 12-710G3 (3)       | Precntl                | 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.

<sup>a</sup> Precntl: Precontrolled

<sup>b</sup> DB: Dynamic Braking

Table 7b 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 7b.

**Table 7b.** Emission Factors for locomotives used in the study, adjusted for reduced fuel sulfur content (0.105%).

| Locomotive Model Group | Cert Tier <sup>a</sup> | Emission Factors (g/hr) by Throttle Notch |                 |       |       |       |       |       |       |        |        |
|------------------------|------------------------|---|-----------------|-------|-------|-------|-------|-------|-------|--------|--------|
|                        |                        | Idle                                      | DB <sup>b</sup> | 1     | 2     | 3     | 4     | 5     | 6     | 7      | 8      |
| Switchers (1)          | Precntl                | 31.0                                      | 56.0            | 23.0  | 76.0  | 131.8 | 146.1 | 181.5 | 283.2 | 324.4  | 420.7  |
| GP-3x (1)              | Precntl                | 38.0                                      | 72.0            | 31.0  | 110.0 | 177.7 | 194.8 | 241.2 | 383.4 | 435.3  | 570.9  |
| GP-4x (1)              | Precntl                | 47.9                                      | 80.0            | 35.7  | 134.3 | 216.2 | 237.5 | 303.5 | 507.4 | 600.4  | 771.2  |
| GP-50 (1)              | Precntl                | 26.0                                      | 64.1            | 51.3  | 142.5 | 288.0 | 285.9 | 355.8 | 610.4 | 681.9  | 871.2  |
| GP-60 (1)              | Precntl                | 48.6                                      | 98.5            | 48.7  | 131.7 | 271.7 | 275.1 | 338.9 | 593.7 | 699.1  | 884.2  |
| SD-7x (1)              | Precntl                | 24.0                                      | 4.8             | 41.0  | 65.7  | 149.8 | 223.4 | 290.0 | 344.6 | 446.8  | 553.3  |
| Dash-7 (1)             | Precntl                | 65.0                                      | 180.5           | 108.2 | 121.2 | 322.6 | 302.9 | 307.7 | 268.4 | 275.2  | 341.2  |
| Dash-9 (2)             | Precntl                | 32.1                                      | 53.9            | 54.2  | 108.1 | 197.3 | 267.3 | 343.9 | 392.4 | 397.3  | 573.3  |
| EMD 12-710G3 (3)       | Precntl                | 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.

<sup>a</sup> Precntl: Precontrolled

<sup>b</sup> 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. The data and overall estimates are shown in Table 8.

**Table 8.** 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    |
| Needles         | CA    | 770,667       | 0.192    |
| Bakersfield     | CA    | 131,075       | 0.034    |
| 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    |

| Location      | State | Total Gallons | % Sulfur |
|---------------|-------|---------------|----------|
| 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,  $A + B * (\text{fuel sulfur, ppm})$ . The emission reductions calculated for GE and EMD engines shown in Table 9 were applied to the base emission rates to calculate the emission rates at the in-use fuel sulfur levels.

**Table 9.** Fuel sulfur emission reductions by notch and engine type

| Notch               | B          | A      | Fuel Sulfur 0.3% | Fuel Sulfur 0.105% | Reduction |
|---------------------|------------|--------|------------------|--------------------|-----------|
|                     |            |        | EF (g/hp-hr)     | EF (g/hp-hr)       |           |
| 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%     |

## Locomotive Diesel PM Emission Estimates

### A. Basic Service

No such activity occurs within the Commerce - Eastern facility.

### B. Basic Engine Inspection

No such activity occurs within the Commerce - Eastern facility.

### C. Full Engine Service/Inspection

No such activity occurs within the Commerce - Eastern facility.

### D. Switching Engines in the Yard

Estimated annual PM emissions for switching activities at the Commerce-Eastern facility are presented in Table 10. ENVIRON calculated these emissions using the engine-specific emission factors by notch in Table 7b, the fleet characteristics in Table 1, and the relative time in mode data from Table 2. The switching activity over 365 days per year was distributed equally across all 18 engines in the switching fleet. This category represents the switching engines activity that can occur any where in the yard. The switching engine activity is known only by the engine hours and selected downloads of the time in mode (notch) for the activity in the general area.

**Table 10.** Estimated annual PM emissions associated with movements of cars within the classification yard of the Commerce-Eastern facility.

| <b>Locomotive Model Group</b> | <b>Cert Tier</b> | <b># of Loco</b> | <b>PM Emissions (grams)</b> |
|-------------------------------|------------------|------------------|-----------------------------|
| Switchers                     | Precntl          | 2                | <b>16,199</b>               |
| GP-3x                         | Precntl          | 16               | <b>171,586</b>              |
| <b>Total</b>                  |                  | <b>18</b>        | <b>187,785</b>              |

### E. Train Arrivals and Departures in the Yard

Engines on trains that arrive and depart from the yard have a different activity profile than the switching engines or those that pass the yard. Emissions were derived based on the activity for an arriving and departing train and the emissions for all engines arriving and departing are shown in Tables 11 and 12.

**Table 11.** Arriving train's engine emissions for Commerce-Eastern

| <b>Model Group</b> | <b>Cert Tier</b> | <b>Emissions by Mode (g/year)</b> |              |               |              |              |              | <b>Total</b>  |
|--------------------|------------------|-----------------------------------|--------------|---------------|--------------|--------------|--------------|---------------|
|                    |                  | <b>Idle</b>                       | <b>DB</b>    | <b>1</b>      | <b>2</b>     | <b>3</b>     | <b>4</b>     |               |
| Switchers          | Precntl          | 0                                 | 0            | 0             | 0            | 0            | 0            | <b>0</b>      |
| GP-3x              | Precntl          | 453                               | 18           | 35            | 25           | 13           | 6            | <b>551</b>    |
| GP-4x              | Precntl          | 4,815                             | 173          | 337           | 262          | 135          | 66           | <b>5,788</b>  |
| GP-50              | Precntl          | 133                               | 7            | 25            | 14           | 9            | 4            | <b>192</b>    |
| GP-60              | Precntl          | 579                               | 25           | 55            | 30           | 20           | 9            | <b>719</b>    |
| SD-7x              | Precntl          | 0                                 | 0            | 0             | 0            | 0            | 0            | <b>0</b>      |
| Dash-7             | Precntl          | 0                                 | 0            | 0             | 0            | 0            | 0            | <b>0</b>      |
| Dash-9             | Precntl          | 6,450                             | 233          | 1,024         | 422          | 246          | 149          | <b>8,523</b>  |
| GP-60              | 0                | 359                               | 9            | 60            | 25           | 24           | 15           | <b>493</b>    |
| SD-7x              | 0                | 50                                | 1            | 12            | 4            | 5            | 3            | <b>75</b>     |
| Dash-8             | 0                | 5,472                             | 471          | 1,198         | 383          | 240          | 111          | <b>7,875</b>  |
| Dash-9             | 0                | 39,108                            | 1,262        | 6,094         | 2,634        | 1,474        | 782          | <b>51,353</b> |
| Dash-9             | 1                | 9,723                             | 1,096        | 3,358         | 1,566        | 973          | 566          | <b>17,283</b> |
| ES44/Dash-9        | 2                | 1,363                             | 160          | 1,153         | 501          | 300          | 166          | <b>3,643</b>  |
| <b>Total</b>       |                  | <b>68,506</b>                     | <b>3,455</b> | <b>13,349</b> | <b>5,867</b> | <b>3,439</b> | <b>1,878</b> | <b>96,495</b> |

**Table 12.** Departing train's engine emissions for Commerce-Eastern

| Model Group | Cert Tier | Emissions by Mode (g/year) |       |        |        |        |       | Total   |
|-------------|-----------|----------------------------|-------|--------|--------|--------|-------|---------|
|             |           | Idle                       | DB    | 1      | 2      | 3      | 4     |         |
| Switchers   | Precntl   | 0                          | 0     | 0      | 0      | 0      | 0     | 0       |
| GP-3x       | Precntl   | 168                        | 41    | 48     | 104    | 82     | 11    | 453     |
| GP-4x       | Precntl   | 1,784                      | 380   | 470    | 1,065  | 836    | 117   | 4,653   |
| GP-50       | Precntl   | 49                         | 15    | 34     | 57     | 57     | 7     | 220     |
| GP-60       | Precntl   | 215                        | 56    | 76     | 124    | 125    | 16    | 611     |
| SD-7x       | Precntl   | 0                          | 0     | 0      | 0      | 0      | 0     | 0       |
| Dash-7      | Precntl   | 0                          | 0     | 0      | 0      | 0      | 0     | 0       |
| Dash-9      | Precntl   | 2,390                      | 512   | 1,429  | 1,715  | 1,526  | 263   | 7,835   |
| GP-60       | 0         | 133                        | 20    | 84     | 102    | 150    | 27    | 516     |
| SD-7x       | 0         | 19                         | 2     | 16     | 16     | 29     | 6     | 89      |
| Dash-8      | 0         | 2,028                      | 1,034 | 1,672  | 1,557  | 1,491  | 196   | 7,978   |
| Dash-9      | 0         | 14,492                     | 2,772 | 8,506  | 10,713 | 9,155  | 1,380 | 47,018  |
| Dash-9      | 1         | 3,603                      | 2,407 | 4,688  | 6,371  | 6,044  | 999   | 24,112  |
| ES44/Dash-9 | 2         | 505                        | 352   | 1,610  | 2,039  | 1,862  | 292   | 6,659   |
| Total       |           | 25,386                     | 7,591 | 18,634 | 23,863 | 21,356 | 3,315 | 100,145 |

#### F. Freight Movements on Adjacent Mainline

The PM emission estimates for BNSF freight movements during the one-year period are presented in Table 13 and those for other railroad engines in Table 14. These engines operate primarily in dynamic braking mode as both east and westbound trains are not accelerating through this section.

**Table 13.** Estimated annual PM emissions associated with BNSF freight movements along the mainline adjacent to the Commerce - Eastern facility.

| Locomotive Model Group | Cert Tier | # of Loco     | Annual Total PM Emissions (grams) |               | Total         |
|------------------------|-----------|---------------|-----------------------------------|---------------|---------------|
|                        |           |               | Westbound                         | Eastbound     |               |
| Switchers              | Precntl   | 47            | 30                                | 31            | 61            |
| GP-3x                  | Precntl   | 3025          | 2,493                             | 2,561         | 5,054         |
| GP-4x                  | Precntl   | 4790          | 4,388                             | 4,508         | 8,896         |
| GP-50                  | Precntl   | 163           | 120                               | 123           | 242           |
| GP-60                  | Precntl   | 866           | 976                               | 1,002         | 1,978         |
| SD-7x                  | Precntl   | 13            | 1                                 | 1             | 1             |
| Dash-7                 | Precntl   | 46            | 95                                | 98            | 193           |
| Dash-9                 | Precntl   | 4166          | 2,570                             | 2,640         | 5,209         |
| GP-60                  | 0         | 2042          | 594                               | 610           | 1,204         |
| SD-7x                  | 0         | 32            | 6                                 | 6             | 11            |
| Dash-8                 | 0         | 4898          | 8,270                             | 8,496         | 16,766        |
| Dash-9                 | 0         | 21155         | 12,269                            | 12,604        | 24,873        |
| Dash-9                 | 1         | 9661          | 9,775                             | 10,042        | 19,817        |
| ES44/Dash-9            | 2         | 3187          | 1,532                             | 1,574         | 3,106         |
| <b>Total</b>           |           | <b>54,091</b> | <b>43,118</b>                     | <b>44,294</b> | <b>87,413</b> |

**Table 14.** Estimated annual PM emissions associated with non-BNSF freight movements along the mainline adjacent to the Commerce - Eastern facility.

| Locomotive Model Group | Cert Tier | # of Loco | Annual Total PM Emissions (grams) |           | Total |
|------------------------|-----------|-----------|-----------------------------------|-----------|-------|
|                        |           |           | Westbound                         | Eastbound |       |
| Switchers              | Precntl   | 0         | 0                                 | 0         | 0     |
| GP-3x                  | Precntl   | 12        | 10                                | 10        | 20    |
| GP-4x                  | Precntl   | 20        | 18                                | 19        | 37    |
| GP-50                  | Precntl   | 1         | 1                                 | 1         | 1     |
| GP-60                  | Precntl   | 4         | 5                                 | 5         | 9     |
| SD-7x                  | Precntl   | 0         | 0                                 | 0         | 0     |
| Dash-7                 | Precntl   | 0         | 0                                 | 0         | 0     |
| Dash-9                 | Precntl   | 17        | 10                                | 11        | 21    |
| GP-60                  | 0         | 8         | 2                                 | 2         | 5     |
| SD-7x                  | 0         | 0         | 0                                 | 0         | 0     |
| Dash-8                 | 0         | 20        | 34                                | 35        | 68    |
| Dash-9                 | 0         | 88        | 51                                | 52        | 103   |
| Dash-9                 | 1         | 41        | 41                                | 43        | 84    |
| ES44/Dash-9            | 2         | 13        | 6                                 | 6         | 13    |
| <b>Total</b>           |           | 224       | 179                               | 184       | 362   |

#### G. Commuter Rail Operations on Adjacent Mainline

The annual PM emission estimates for commuter movements on the adjacent mainline are presented in Table 15. Time in notch for these locomotives was assumed to be the same as was modeled for the freight locomotives. AMTRAK and Metrolink estimates are kept separate, since Metrolink only operates on weekdays.

**Table 15.** Estimated annual PM missions associated with commuter movements along the mainline adjacent to the Commerce - Eastern facility.

| Agency       | Locomotive Model Group | Cert Tier | # of Loco | PM Emissions by Direction (grams) |           | Total  |
|--------------|------------------------|-----------|-----------|-----------------------------------|-----------|--------|
|              |                        |           |           | Westbound                         | Eastbound |        |
| AMTRAK       | EMD 12 710G3           | Precntl   | 10,469    | 6,482                             | 6,659     | 13,141 |
| Metrolink    | EMD 12 710G3           | Precntl   | 7,280     | 4,541                             | 4,665     | 9,207  |
| <b>Total</b> |                        |           |           | 11,023                            | 11,324    | 22,347 |

#### **Non-Locomotive Facility Operations, Emission Factors and Emission Estimates**

The operations at the Commerce - Eastern facility also include non-locomotive activity within the yard (H through L). Under each heading is a description of the operations.

#### H. Cargo Handling Equipment Operations

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

## Activity

Equipment population data was received for BNSF for California sites CHE characteristics. CHE July 2004 to June 2005 diesel fuel consumption at the Commerce Eastern site was also obtained from BNSF (122,640 gallons diesel) and was the only activity data available for use for all equipment types to estimate 2005 CHE diesel fuel consumption, but hours per year was available for cranes and container handling equipment.

**Table 16.** Commerce-Eastern CHE characteristics and activity.

| ID   | Equipment Type               | Number | Model Year | Fuel Type | Engine Rated HP | Annual Use (hrs) <sup>1</sup> |
|------|------------------------------|--------|------------|-----------|-----------------|-------------------------------|
| CE-1 | Cranes                       | 1      | 2003       | D         | 225             | 4763                          |
| CE-2 | Cranes                       | 1      | 2003       | D         | 225             | 4575                          |
| CE-3 | Cranes                       | 1      | 2003       | D         | 225             | 4290                          |
| CE-4 | Container Handling Equipment | 1      | 1997       | D         | 205             | 943                           |
| CE-5 | Container Handling Equipment | 1      | 1990       | D         | 205             | 9                             |
| CE-6 | Yard Trucks                  | 3      | 2003       | D         | 155             | 1289                          |
| CE-7 | Yard Trucks                  | 5      | 2004       | D         | 155             | 1289                          |
| CE-8 | Yard Trucks                  | 1      | 2005       | D         | 155             | 1289                          |

<sup>1</sup> Yard Trucks Annual Use Estimates are ARB, 2005b defaults

## Emissions

Emissions from CHE were estimated by ARB using their methodology and activity (hours and load factor) assumptions. Commerce Eastern facility CHE emissions are shown in Table 17.

**Table 17.** CHE Emissions Estimates (grams per year).

| ID            | Equipment Type               | Fuel Type | Number | PM (gpy)       |
|---------------|------------------------------|-----------|--------|----------------|
| CE-1          | Cranes                       | D         | 1      | 50,531         |
| CE-2          | Cranes                       | D         | 1      | 48,537         |
| CE-3          | Cranes                       | D         | 1      | 45,513         |
| CE-4          | Container Handling Equipment | D         | 1      | 18,774         |
| CE-5          | Container Handling Equipment | D         | 1      | 495            |
| CE-6          | Yard Trucks                  | D         | 3      | 70,401         |
| CE-7          | Yard Trucks                  | D         | 5      | 90,531         |
| CE-8          | Yard Trucks                  | D         | 1      | 14,850         |
| <b>Totals</b> |                              |           |        | <b>339,632</b> |

### I. On-road Container Truck Operations

The Commerce - Eastern site is characterized by container service where tractor-trailers receive or deliver containers to the container yard and by trailer on rail service where the entire trailer is delivered or shipped on a rail car.

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. Shown in Table 18 are the derived truck trip totals 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 Commerce - Eastern 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 18.** Commerce - Eastern truck counts by matching time period for 4 months.

| <b>Truck Trip Description</b>  | <b>30 Min</b> | <b>1 Hr</b>    | <b>1.5 Hr</b> | <b>2 Hr</b> |
|--|---------------|----------------|---------------|-------------|
| Total Trucks Logging In & Out Gates<br>(Trailer-Truck In, Trailer-Truck Out) (Matches) | 6,706         | 7,342          | 7,474         | 7,524       |
| Trucks Logging In Without Logging Out<br>(Trailer-Truck In, Bobtail Out)               | 31,381        | 30,745         | 30,613        | 30,563      |
| Trucks Logging Out Without Logging In<br>(Bobtail In, Trailer-Truck Out)               | 30,382        | 29,746         | 29,614        | 29,564      |
| Total Truck Trips  | 68,469        | 67,833         | 67,701        | 67,651      |
| <b>Scaled to 12 months</b>   |               | <b>203,499</b> |               |             |

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 eight trucks chased were used to estimate the average operation characteristics for all trucks at the Commerce - Eastern site. This information is summarized in Table 19.

**Table 19.** Average truck operation characteristics at the Commerce-Eastern site.

| <b>Mode</b>    | <b>Time (min)</b> | <b>Speed (mph)</b> | <b>Distance (miles)</b> |
|----------------|-------------------|--------------------|-------------------------|
| Entrance       | 15.3              | --                 | --                      |
| Travel on site | 4.2               | 11.5               | 0.8                     |
| Idle on Site   | 20.5              | --                 | --                      |
| Exit Queue     | 2.9               | --                 | --                      |

The emissions for these trucks used the Ports (POLA 2005) truck age distribution using HHDDV truck emission rates for 2005 calculated using a draft version of EMFAC2005 supplied by ARB (2006c). Because this site largely serves containers from Ports and the South Coast area, the average age distribution at the Ports' gates was used. The emission rates were calculated for

each aged engine by interpolating between 10 and 15 mph for an average speed of 11.5 mph emission factor as shown in Table 20.

**Table 20.** Emission rates calculations for Commerce-Eastern

| <b>Truck Age Distribution</b> | <b>Idle PM EF (g/hr)</b> | <b>10 mph PM EF (g/mile)</b> | <b>11.48 mph PM EF (g/mile)</b> | <b>15 mph PM EF (g/mile)</b> |
|-------------------------------|--------------------------|------------------------------|---------------------------------|------------------------------|
| 0.27%                         | 1.03                     | 0.54                         | 0.50                            | 0.42                         |
| 0.36%                         | 1.03                     | 0.60                         | 0.56                            | 0.47                         |
| 0.73%                         | 1.03                     | 0.67                         | 0.62                            | 0.52                         |
| 0.94%                         | 1.33                     | 2.22                         | 1.97                            | 1.37                         |
| 1.06%                         | 1.33                     | 2.43                         | 2.15                            | 1.50                         |
| 2.62%                         | 1.33                     | 2.62                         | 2.32                            | 1.62                         |
| 5.33%                         | 1.33                     | 2.80                         | 2.49                            | 1.73                         |
| 7.18%                         | 1.33                     | 2.97                         | 2.64                            | 1.84                         |
| 9.45%                         | 1.93                     | 3.18                         | 2.82                            | 1.97                         |
| 9.27%                         | 1.93                     | 3.34                         | 2.96                            | 2.06                         |
| 6.49%                         | 1.93                     | 3.49                         | 3.09                            | 2.15                         |
| 6.91%                         | 1.93                     | 3.62                         | 3.21                            | 2.24                         |
| 7.23%                         | 2.57                     | 5.19                         | 4.61                            | 3.21                         |
| 8.52%                         | 2.57                     | 5.34                         | 4.73                            | 3.30                         |
| 5.91%                         | 2.57                     | 5.47                         | 4.85                            | 3.38                         |
| 4.37%                         | 3.43                     | 6.03                         | 5.62                            | 4.66                         |
| 3.59%                         | 3.43                     | 6.13                         | 5.72                            | 4.74                         |
| 6.19%                         | 3.43                     | 6.23                         | 5.81                            | 4.82                         |
| 5.47%                         | 4.28                     | 6.39                         | 5.96                            | 4.94                         |
| 1.84%                         | 6.88                     | 6.67                         | 6.23                            | 5.16                         |
| 1.26%                         | 6.88                     | 6.76                         | 6.31                            | 5.23                         |
| 1.02%                         | 6.88                     | 6.84                         | 6.38                            | 5.29                         |
| 1.02%                         | 6.88                     | 6.92                         | 6.45                            | 5.35                         |
| 0.84%                         | 6.88                     | 6.99                         | 6.52                            | 5.40                         |
| 0.49%                         | 6.88                     | 7.05                         | 6.58                            | 5.45                         |
| 0.36%                         | 6.88                     | 7.11                         | 6.63                            | 5.50                         |
| 0.18%                         | 6.88                     | 7.16                         | 6.68                            | 5.54                         |
| 0.25%                         | 6.88                     | 7.21                         | 6.73                            | 5.57                         |
| 0.27%                         | 6.88                     | 7.25                         | 6.76                            | 5.60                         |
| 0.17%                         | 6.88                     | 7.29                         | 6.80                            | 5.63                         |
| 0.13%                         | 6.88                     | 7.32                         | 6.82                            | 5.65                         |
| 0.11%                         | 6.88                     | 7.34                         | 6.85                            | 5.67                         |
| 0.10%                         | 6.88                     | 7.36                         | 6.87                            | 5.69                         |
| 0.00%                         | 6.88                     | 7.38                         | 6.89                            | 5.70                         |
| 0.00%                         | 6.88                     | 7.39                         | 6.90                            | 5.71                         |
| 0.00%                         | 6.88                     | 7.41                         | 6.91                            | 5.72                         |
| 0.03%                         | 6.88                     | 7.42                         | 6.92                            | 5.73                         |
| 0.00%                         | 6.88                     | 7.43                         | 6.93                            | 5.75                         |
| 0.00%                         | 6.88                     | 7.45                         | 6.95                            | 5.76                         |
| 0.00%                         | 6.88                     | 7.46                         | 6.96                            | 5.77                         |
| 0.06%                         | 6.88                     | 7.48                         | 6.97                            | 5.78                         |

Combining the emission factor data with the age distribution data, emission values were calculated on a per truck basis and are shown in Table 21. 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 21 also provides an approximation of the per site trip emissions by mode from all trucks at the Commerce - Eastern facility based on the estimated 203,499 truck trips in 2005.

**Table 21.** PM emissions per truck trip and for 2005 at Commerce - Eastern.

| Mode            | Per Truck Trip (g) | Annual Emissions for 203,499 Truck Trips (g) |
|-----------------|--------------------|--|
| Travel on Site  | 3.31               | 674,370                                      |
| Idle on Site    | 0.92               | 187,514                                      |
| Idle – Entrance | 0.69               | 139,464                                      |
| Idle – Exit     | 0.13               | 26,292                                       |
| Annual Estimate | ---                | 1,027,640                                    |

#### J. On-road Fleet Vehicle Operations

There were 5 fleet vehicles based at the Commerce-Eastern facility according to records from BNSF and their on-site contractor. The draft version of the EMFAC model provided by ARB (2006c) was used to determine the average number of trips per year. The parking lots are at either end of the yard and close to the facility entrances, so 0.1 mile on site for each trip either beginning or ending on site.

**Table 22.** On-road fleet vehicle activity at the Commerce - Eastern facility.

| EMFAC Vehicle Type | Fuel     | # of Vehicles | Default Annual Trips | Est. Annual Mileage on Site |
|--------------------|----------|---------------|----------------------|-----------------------------|
| LDT2               | Gasoline | 3             | 2,276                | 228                         |
| LHDT1              | Diesel   | 2             | 4,591                | 459                         |

Annual PM and TOG emission factors from the draft version of the EMFAC model for on-site emissions estimates for the fleet vehicles are presented in Table 23. 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 23.** On-road fleet vehicle emissions at the Commerce - Eastern facility.

| EMFAC Vehicle Type | Fuel     | PM Emissions (grams) | TOG Exhaust Emissions (grams) | TOG Evap Emissions (grams) |
|--------------------|----------|----------------------|-------------------------------|----------------------------|
| LDT2               | Gasoline | 8                    | 309                           | 303                        |
| LHDT1              | Diesel   | 39                   | N/A                           | 0                          |

## K. Other Off-Road Equipment

### K1. Transport Refrigeration Unit Operations

Transportation Refrigeration units (TRUs) are typically 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 ship requires 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.

#### K1a. Boxcars

No such activity occurs within the Commerce Eastern facility.

#### K1b. Containers

Commerce Eastern site container TRU activity and emissions are shown in Table 24. 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.

**Table 24.** Commerce Eastern site shipping container TRU yearly activity and emissions.

| Yearly Visits | Average Time Onsite / Visit (hours) | PM (gpy) |
|---------------|-------------------------------------|----------|
| 4,124         | 15                                  | 876,504  |

## K2. 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 Commerce Eastern site has 5.25 miles of track within its boundaries compared with the California regional total of 3,779 miles. This represents 0.1% 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 supplied by ARB (2006c). Emissions from track maintenance equipment at the Commerce Eastern facility along with California totals are shown in Table 25.

**Table 25.** Track maintenance equipment emissions estimates (grams per year).

| Site              | Gasoline        |             | Diesel |           |
|-------------------|-----------------|-------------|--------|-----------|
|                   | Evaporative TOG | Exhaust TOG | PM     | PM        |
| Commerce Eastern  | 30              | 169         | 5      | 6,258     |
| California Totals | 21,469          | 121,981     | 3,525  | 4,504,844 |

K3. Other Off-road Equipment (including Portable Engine) Operations

No such activity occurs within the Commerce Eastern facility.

L. Stationary Sources

There are no stationary sources at Commerce – Eastern either permitted or otherwise.

**Total TAC emissions from the Commerce - Eastern facility**

The estimated total annual diesel PM (DPM) emissions associated with the operations in the Commerce - Eastern facility are summarized in Table 26.

**Table 26.** Estimated total annual DPM emissions associated with the operations in the Commerce - Eastern facility.

| Facility Operations                       | PM Emissions     |             | Percentage |
|---|------------------|-------------|------------|
|   | Grams            | Metric Tons |            |
| Basic Services (A)                        | 0                | 0.00        | 0%         |
| Basic Engine Inspection (B)               | 0                | 0.00        | 0%         |
| Full Engine Service/Inspection (C)        | 0                | 0.00        | 0%         |
| Switching (D)                             | 187,785          | 0.19        | 7%         |
| Arriving and Departing Trains (E)         | 196,640          | 0.20        | 7%         |
| Adjacent Freight Movements (F)            | 87,775           | 0.09        | 3%         |
| Adjacent Commuter Rail Operations (G)     | 22,347           | 0.02        | 1%         |
| Cargo Handling Equipment Operations (H)   | 339,632          | 0.34        | 12%        |
| On-Road Container Truck Operations (I)    | 1,027,640        | 1.03        | 37%        |
| On-Road Fleet Vehicle (J)                 | 39               | 0.00        | 0%         |
| Other Off-Road (K) TRU                    | 876,504          | 0.88        | 32%        |
| Other Off-Road (K) Track Maintenance      | 6,258            | 0.01        | 0%         |
| Other Off-Road (K) Other Portable Engines | 0                | 0.00        | 0%         |
| Stationary Sources (L)                    | 0                | 0.00        | 0%         |
| <b>Total</b>                              | <b>2,744,620</b> | <b>2.74</b> |            |

The estimated total annual emissions of total organic gases (TOG) (for speciation into the other TACs) associated with gasoline, LPG, and CNG operations in the Commerce-Eastern facility are summarized in Table 27. The only emissions were from gasoline fleet vehicles and two track maintenance forklifts. Diesel TOG is not included in the tabulation.

**Table 27.** Estimated total annual TOG emissions from gasoline/LPG/NG fueled engines associated with the operations in the Commerce - Eastern facility.

| Facility Operations                              | TOG Emissions |             | Percentage |
|--|---------------|-------------|------------|
|  | Grams         | Metric Tons |            |
| Basic Services (A)                               | 0             | 0           | 0%         |
| Basic Engine Inspection (B)                      | 0             | 0           | 0%         |
| Full Engine Service/Inspection (C)               | 0             | 0           | 0%         |
| Switching (D)                                    | 0             | 0           | 0%         |
| Arriving and Departing Trains (E)                | 0             | 0           | 0%         |
| Adjacent Freight Movements (F)                   | 0             | 0           | 0%         |
| Adjacent Commuter Rail Operations (G)            | 0             | 0           | 0%         |
| Cargo Handling Equipment Operations (H)          | 0             | 0           | 0%         |
| On-Road Container Truck Operations (I)           | 0             | 0           | 0%         |
| On-Road Fleet Vehicle (J) Exhaust                | 309           | 0           | 38%        |
| On-Road Fleet Vehicle (J) Evaporative            | 303           | 0           | 37%        |
| Other Off-Road (K) TRU                           | 0             | 0           | 0%         |
| Other Off-Road (K) Track Maintenance Exhaust     | 169           | 0           | 21%        |
| Other Off-Road (K) Track Maintenance Evaporative | 30            | 0           | 4%         |
| Other Off-Road (K) Other Portable Engines        | 0             | 0           | 0%         |
| Stationary Sources (L)                           | 0             | 0           | 0%         |
| <b>Total</b>                                     | <b>811</b>    | <b>0</b>    |            |

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**APPENDIX I**

**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 <sup>a</sup> | 35                | N                 | 15                       | 720                              |
| TM13         | AIR COMPRESSOR    | Commercial   | Air Compressors          | 1989 <sup>a</sup> | 35                | N                 | 10                       | 480                              |
| TM14         | AIR COMPRESSOR    | Commercial   | Air Compressors          | 1989 <sup>a</sup> | 35                | N                 | 10                       | 480                              |
| TM15         | ADZ/CRIB-DCF      | 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                                |

| 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 |
|--------------|--------------------|--------------|---------------------------|-------------------|-------------------|-------------------|--------------------------|----------------------------------|
| 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                                |
| 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 <sup>a</sup> | 119               | N                 | 15                       | 720                              |
| TM58         | BK-HO/LFR EF       | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 85                | N                 | 15                       | 720                              |
| TM59         | BK-HO/LFR EF       | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 74                | N                 | 15                       | 720                              |
| TM60         | BK-HO/LFR EF       | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 74                | 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 |
|--------------|----------------------------|--------------|---------------------------|-------------------|-------------------|-------------------|--------------------------|----------------------------------|
| TM61         | BK-HO/LFR EF               | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 74                | N                 | 15                       | 720                              |
| TM62         | BK-HO/LFR EF               | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 74                | N                 | 15                       | 720                              |
| TM63         | BK-HO/LFR EF               | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 74                | N                 | 15                       | 720                              |
| TM64         | BK-HO/LFR EF               | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 74                | N                 | 15                       | 720                              |
| TM65         | BK-HO/LFR EF               | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 74                | N                 | 15                       | 720                              |
| TM66         | BK-HO/LFR EF               | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 85                | N                 | 15                       | 720                              |
| TM67         | BK-HO/LFR EF               | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 99                | N                 | 15                       | 720                              |
| TM68         | BK-HO/LFR EF               | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 74                | N                 | 15                       | 720                              |
| TM69         | BK-HO/LFR EF               | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 74                | N                 | 15                       | 720                              |
| TM70         | BK-HO/LFR EF               | Construction | Tractors/Loaders/Backhoes | 1989 <sup>a</sup> | 85                | N                 | 15                       | 720                              |
| TM71         | Directional Boring Machine | Construction | Bore/Drill Rigs           | 2002 <sup>a</sup> | 82 <sup>b</sup>   | N                 | 15                       | 720                              |
| TM72         | Manlift                    | Industrial   | Aerial Lifts              | 1989 <sup>a</sup> | 34 <sup>b</sup>   | N                 | 15                       | 720                              |
| TM73         | Trencher                   | Construction | Trenchers                 | 1998 <sup>a</sup> | 39                | N                 | 15                       | 720                              |
| TM74         | Trencher                   | Construction | Trenchers                 | 1998 <sup>a</sup> | 39                | N                 | 15                       | 720                              |
| TM75         | Trencher                   | Construction | Trenchers                 | 1998 <sup>a</sup> | 39                | N                 | 15                       | 720                              |
| TM76         | Trencher Rider             | Construction | Trenchers                 | 1998 <sup>a</sup> | 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 <sup>b</sup>   | 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                           |

| 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 |
|--------------|--------------------|--------------|--------------------------|-------------------|-------------------|-------------------|--------------------------|----------------------------------|
| 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                              |
| 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                             |

| 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 |
|--------------|---------------------|--------------|--------------------------|-------------------|-------------------|-------------------|--------------------------|----------------------------------|
| 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                             |
| 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                             |

<sup>a</sup> Model year estimated as 2005 minus ARB default Error! Bookmark not defined. useful life.

<sup>b</sup> Horsepower estimated as ARB default Error! Bookmark not defined. for the most populous horsepower range for the associated equipment type.