

# SPA 2005 Rail Related Emissions

**Line Haul** - Container Train Traffic in/out of Charleston only. DNI roadpower idling, switching or cargo handling in private railyards

Annual Rail TEU Estimate	TEU per Train	No. of Trains
348,746	360	969

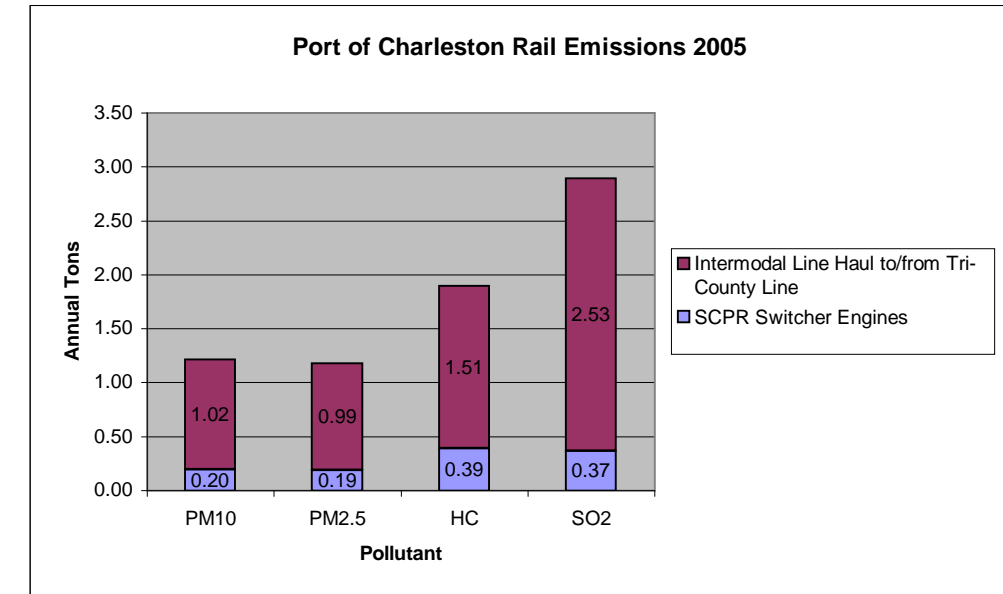
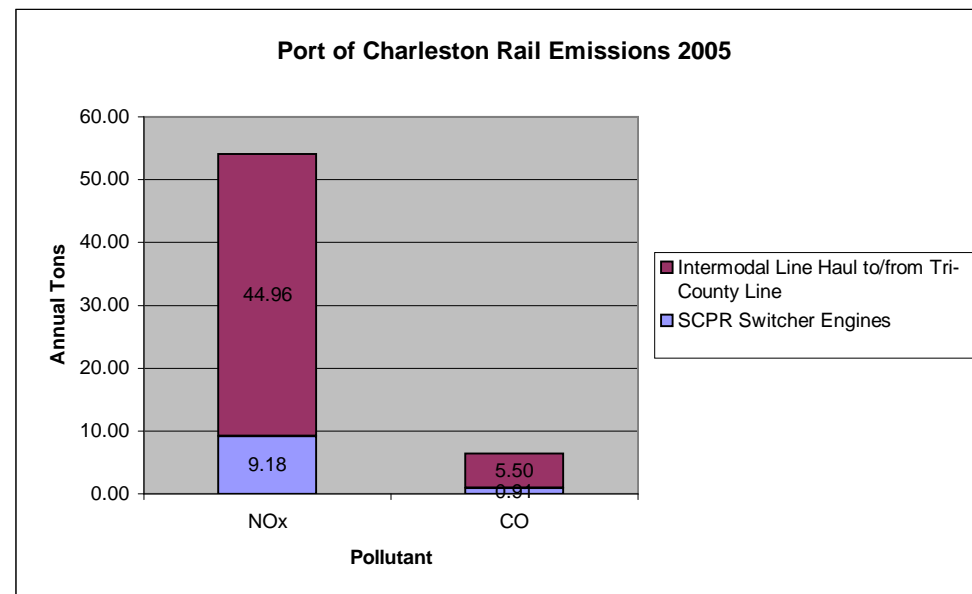
Line Haul Locomotive Hours	Annual # Trains	Assumed Locomotive Hp	Locomotive s per Train	Avg Speed (mph)	Avg Dist To Tri-County Border (mi)	Annual Locomotive Hrs	Avg Hp in Use	Emission Factors (lbs/hr)						Line Haul Emissions (tons)						Annual Est'd Diesel Consumption	
								NOx	PM10	PM2.5	HC	CO	SO2	Est Fuel Use	NOx	PM10	PM2.5	HC	CO		SO2
	969	3,500	4	40	35	3,391	972	26.52	0.60	0.58	0.89	3.24	1.492	326.5	44.96	1.02	0.99	1.51	5.50	2.53	154,824
<b>Total Line Haul</b>															44.96	1.02	0.99	1.51	5.50	2.53	154,824

## Switcher Emissions - PTR and PUC Operated Switchers Only

PTR Switcher serving NCT	PUC Switcher serving Union Pier & Columbus St.	Daily Run Hrs (from SCPR)	Avg Locomotive HP	Annual Locomotive Hours	Avg Hp in Use	Emission Factors (lbs/hr)						Switcher Emissions (tons)						Annual Est'd Diesel Consumption	Reported Annual Consumption		
						NOx	PM10	PM2.5	HC	CO	SO2	Est Fuel Use	NOx	PM10	PM2.5	HC	CO				SO2
		3	1,750	780	186	7.16	0.16	0.15	0.31	0.71	0.29	62.51	2.79	0.06	0.06	0.12	0.28	0.11	6,819	5,400	126%
		12	1,000	3,120	106	4.09	0.09	0.09	0.18	0.41	0.16	35.72	6.39	0.14	0.13	0.27	0.63	0.25	15,586	18,000	87%
<b>Total Switching</b>					3,900								9.18	0.20	0.19	0.39	0.91	0.37	22,405	23,400	96%

Switcher Emissions based on HP and operating hours of PUC and PTR switchers as provided by SCPR  
 Line Haul Emissions are an estimate of double-stack line haul emissions of SPA related container cargo out to tri-county line only and do not include any emission within private intermodal yards

Total Rail	54.14	1.22	1.18	1.90	6.41	2.90
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**Rail Emission Factors, M&N building up from EPA RSD, April 1998**

Basis of Rail Emission Factors are EPA Office of Mobil Sources, April 1998, revised. Locomotive Emission Standards Regulatory Support Document

Year of Analysis 2005

Assumed Sulfur 2283

**Line Haul Locomotive Example HP**

3,500

Notch	% of rated power	HP	% of Time in this mode	Hourly emissions (lbs)											Estimated Fuel Consumption lbs/hr
				M&N	Nox g/bh-hr	PM g/bhp-hr	HC g/bhp-hr	CO g/bh-hr	Sox gr/hp-hr	Nox	PM	HC	CO	SO2	
DB	2.0%	70	12.5%	53.65	2.96	7.22	10.28	0.697	8.3	0.5	1.1	1.6	0.11	24	
Idle	0.4%	15	38.0%	90.68	4.80	13.42	23.97	0.697	3.0	0.2	0.4	0.8	0.02	5	
1	5.1%	179	6.5%	13.68	0.46	1.04	1.36	0.697	5.4	0.2	0.4	0.5	0.28	60	
2	11.4%	399	6.5%	11.98	0.37	0.46	0.90	0.697	10.5	0.3	0.4	0.8	0.61	134	
3	23.4%	820	5.2%	11.49	0.37	0.35	0.91	0.697	20.7	0.7	0.6	1.6	1.26	275	
4	34.3%	1,202	4.4%	11.90	0.27	0.27	1.17	0.697	31.5	0.7	0.7	3.1	1.84	404	
5	48.2%	1,686	3.8%	12.05	0.21	0.25	1.45	0.697	44.7	0.8	0.9	5.4	2.59	566	
6	64.5%	2,257	3.9%	11.86	0.23	0.25	1.64	0.697	59.0	1.1	1.2	8.1	3.46	758	
7	86.8%	3,037	3.0%	11.72	0.20	0.25	1.52	0.697	78.4	1.3	1.7	10.1	4.66	1,020	
8	102.5%	3,587	16.2%	11.32	0.21	0.26	1.26	0.697	89.4	1.7	2.0	9.9	5.50	1,205	

Starcrest data above from table 5.18, pg 241 of POLA inventory

Composite Line-Haul M&N	Grams / BHP-Hr				Load Factor	Lbs-Hr (example HP)					Avg Hp	Composite Fuel Consumption lbs/hr
	Nox	PM	HC	CO		Nox	PM	HC	CO	SO2		
	12.38	0.28	0.41	1.51	0.278	26.52	0.60	0.89	3.24	1.49	972	326.5

**1998 EPA Standards**

Standard Description	Tier	Nox	PM	HC	CO
Any engine built between 1973 and 2001, whenever they are remanufactured	Tier 0	9.50	0.60	1.00	5.00
Built 2002 through 2004	Tier 1	7.4	0.45	0.55	2.2
Built 2005 and later	Tier 2	5.5	0.2	0.3	1.5

1. HC standards are in the form of THC for diesel, bio-diesel, or any combination of fuels with diesel as the primary fuel  
NMHC for natural gas, or any combination for fuels where natural gas is the primary fuel  
and THCE for alcohol, or any combination of fuels where alcohol is the primary fuel.

**2008 EPA Standards**

Standard Description	Tier	Nox	PM	HC	CO	Compliance Schedule
Remanufactured Tier 0 without separate loop intake aire cooling	Tier 0+	8.00	0.22	1.00		2008 as available, 2010 required
Remanufactured Tier 0 with separate loop intake aire cooling	Tier 0+	7.40	0.22	0.55		2008 as available, 2010 required
Remanufactured Tier 1	Tier 1+	7.40	0.22	0.55		2008 as available, 2010 required
Remanufactured Tier 2	Tier 2+	5.50	0.10	0.30		2008 as available, 2013 required
New Tier 3	Tier 3	5.50	0.10	0.30		2012
New Tier 4	Tier 4	1.30	0.03	0.14		2015

**Switcher Locomotive Example HP**

1,000

Notch	% of rated power	HP	% of Time in this mode	Hourly emissions (lbs)											Estimated Fuel Consumption lbs/hr
				M&N	Nox g/bh-hr	PM g/bhp-hr	HC g/bhp-hr	CO g/bh-hr	Sox gr/hp-hr	Nox	PM	HC	CO	SO2	
DB	4.3%	43	0.0%	41.48	0.84	2.68	6.76	0.697	4.0	0.1	0.3	0.6	0.067	15	
Idle	0.9%	9	59.8%	74.47	2.30	7.44	15.47	0.697	1.4	0.0	0.1	0.3	0.013	3	
1	4.9%	49	12.4%	17.92	0.32	1.27	2.50	0.697	1.9	0.0	0.1	0.3	0.075	16	
2	16.2%	162	12.3%	12.47	0.33	0.48	1.28	0.697	4.4	0.1	0.2	0.5	0.248	54	
3	29.4%	294	5.8%	13.40	0.31	0.33	0.75	0.697	8.7	0.2	0.2	0.5	0.451	99	
4	44.0%	440	3.6%	14.45	0.24	0.30	0.54	0.697	14.0	0.2	0.3	0.5	0.675	148	
5	58.5%	585	3.6%	15.30	0.23	0.32	0.50	0.697	19.7	0.3	0.4	0.6	0.897	196	
6	73.5%	735	1.5%	16.05	0.28	0.33	0.62	0.697	26.0	0.5	0.5	1.0	1.128	247	
7	90.9%	909	0.2%	16.16	0.25	0.37	1.25	0.697	32.4	0.5	0.7	2.5	1.395	305	
8	106.0%	1,060	0.8%	15.76	0.28	0.40	2.74	0.697	36.8	0.7	0.9	6.4	1.626	356	

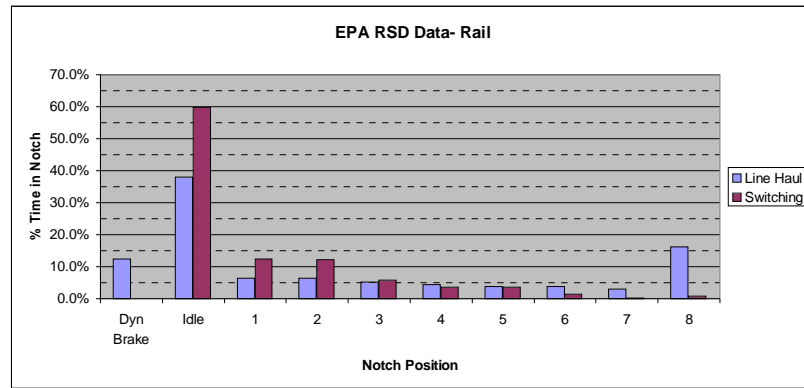
Composite Switcher M&N	Grams / BHP-Hr				Load Factor	Lbs-Hr (example HP)					Avg Hp	Composite Fuel Consumption lbs/hr
	Nox	PM	HC	CO		Nox	PM	HC	CO	SO2		
	17.47	0.38	0.75	1.73	10.63%	4.09	0.09	0.18	0.41	0.16	106	35.7

Standard Description	Tier	Nox	PM	HC	CO
Any engine built between 1973 and 2001, whenever they are remanufactured	Tier 0	14.00	0.72	2.10	8.00
Built 2002 through 2004	Tier 1	11.00	0.54	1.20	2.50
Built 2005 and later	Tier 2	8.10	0.24	0.60	2.40
EPA considering a 2011 standard (see CFR 6/29/04)	Tier 3?				

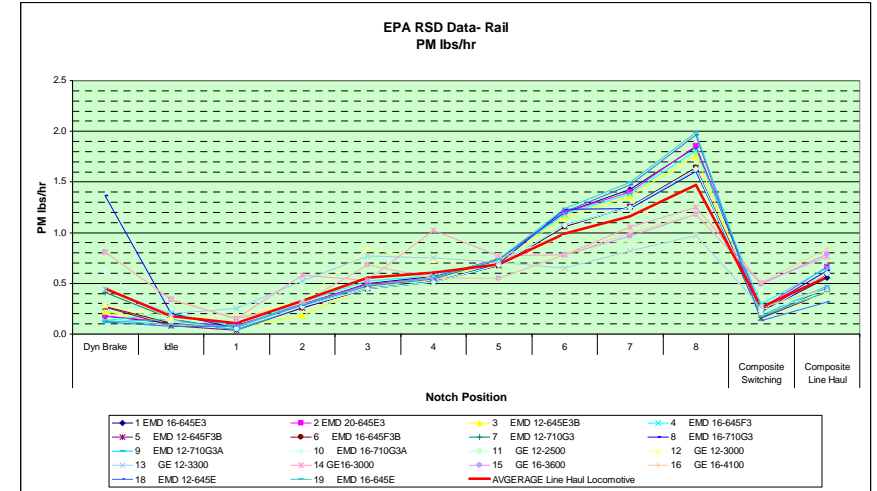
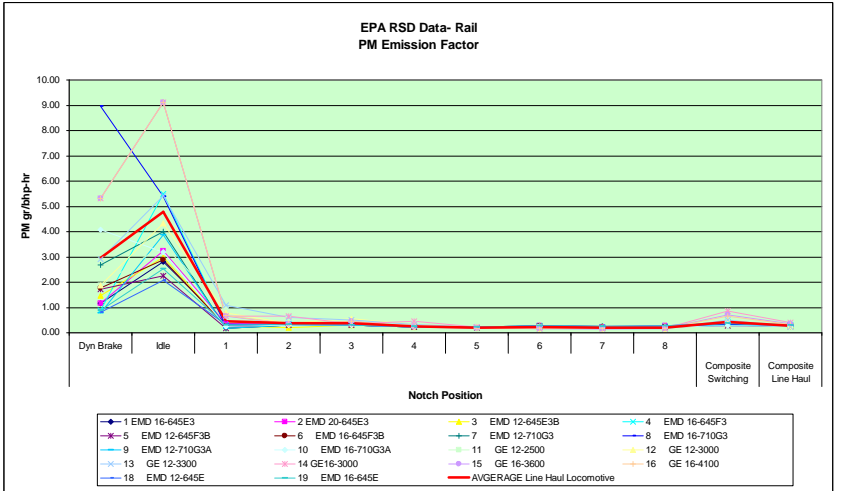
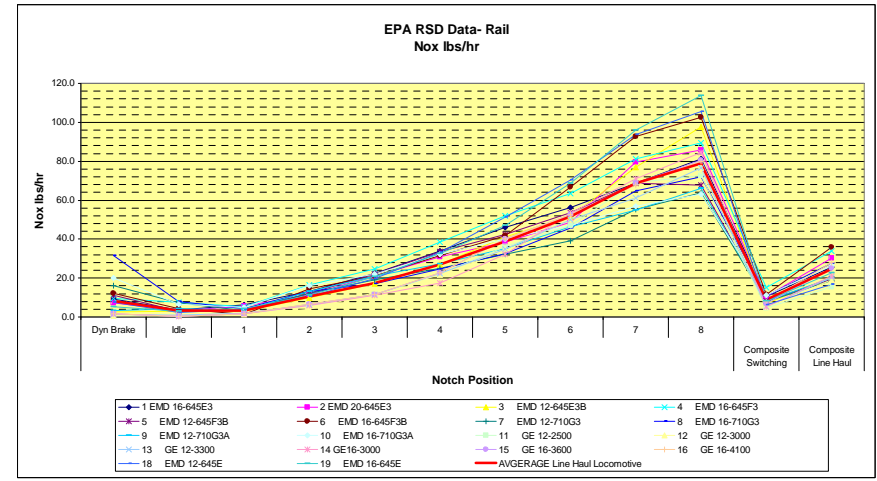
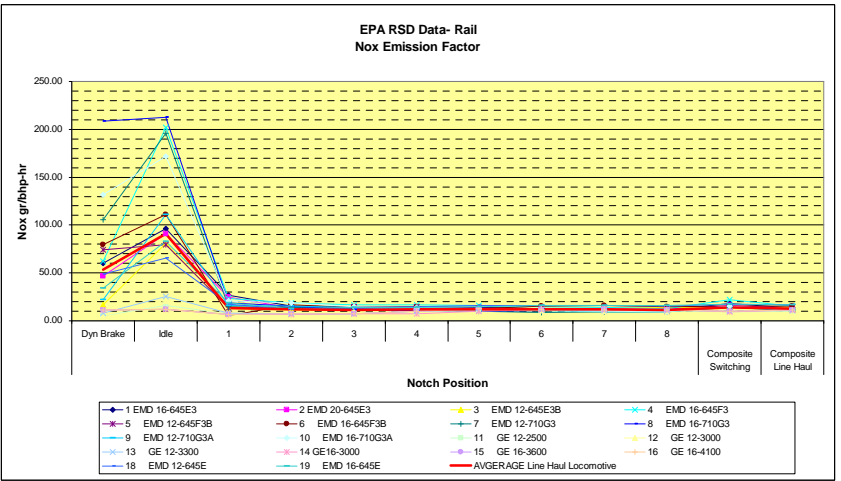
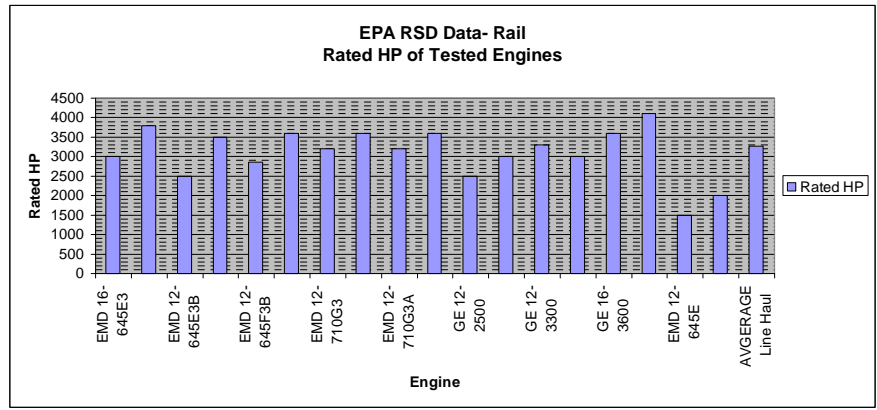
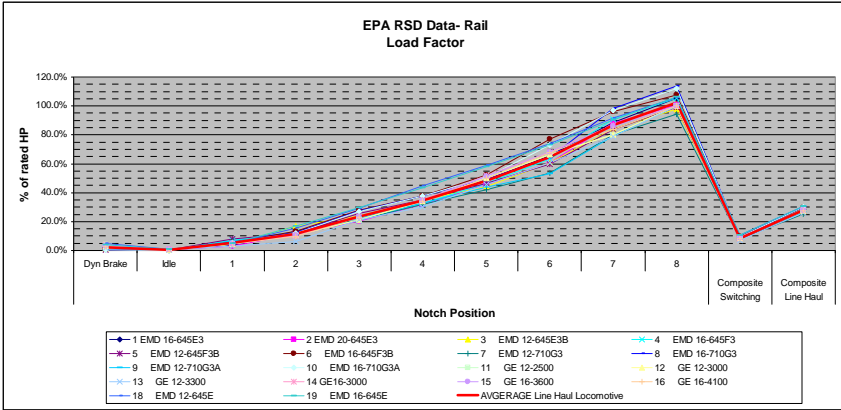
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NMHC for natural gas, or any combination for fuels where natural gas is the primary fuel  
and THCE for alcohol, or any combination of fuels where alcohol is the primary fuel.

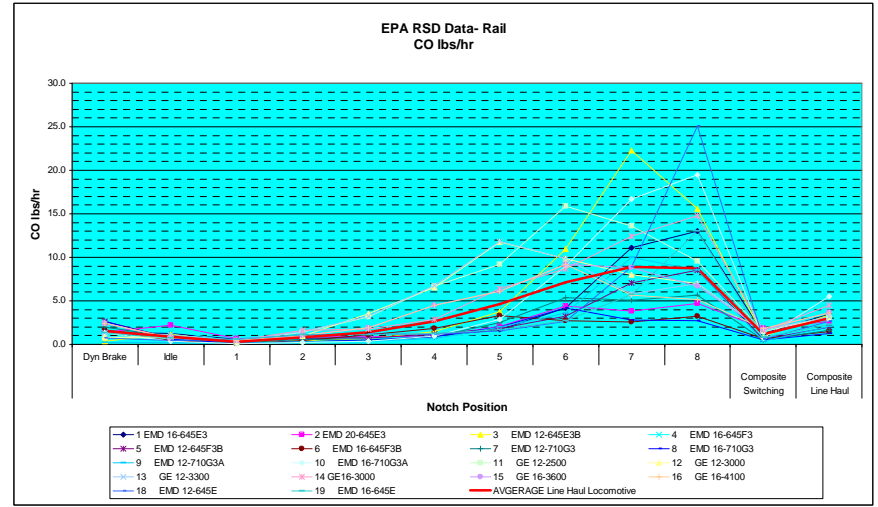
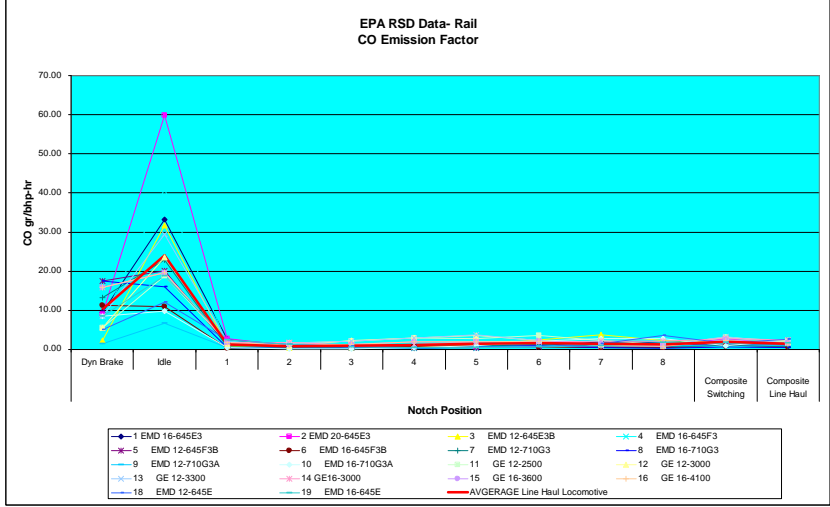
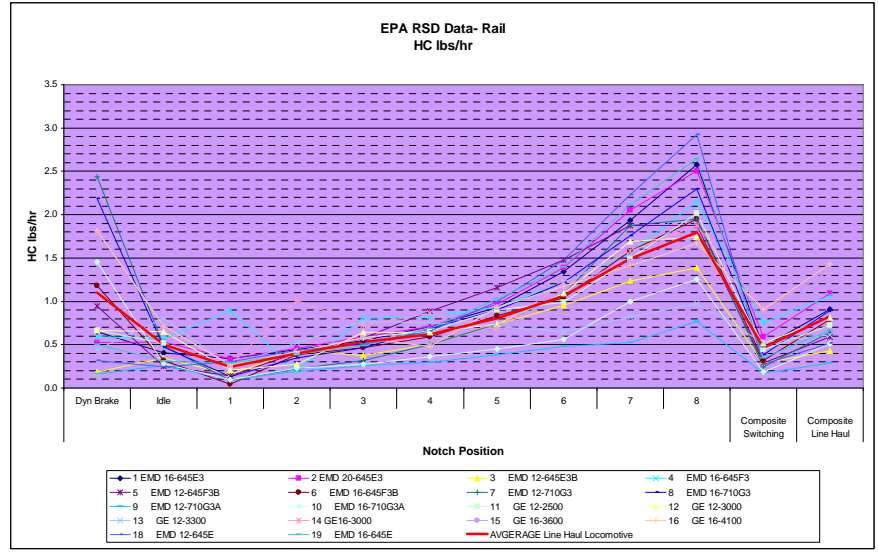
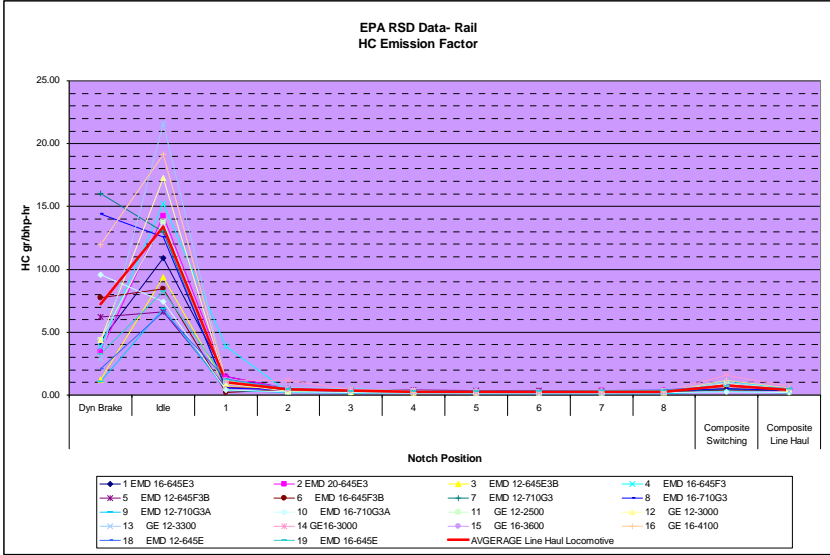
**2008 EPA Standards**

Standard Description	Tier	Nox	PM	HC	CO	Compliance Schedule
Remanufactured Tier 0	Tier 0+	11.80	0.26	2.10		2008 as available, 2010 required
Remanufactured Tier 1	Tier 1+	11.00	0.26	1.20		2008 as available, 2010 required
Remanufactured Tier 2	Tier 2+	8.10	0.13	0.60		2008 as available, 2013 required
New Tier 3	Tier 3	5.00	0.10	0.60		2011
New Tier 4	Tier 4	1.30	0.03	0.14		2015



#	Name	Rated HP
1	EMD 16-645E3	3000
2	EMD 20-645E3	3000
3	EMD 12-645E3B	2500
4	EMD 16-645F3	3500
5	EMD 12-645F3B	2850
6	EMD 16-645F3B	3600
7	EMD 12-710G3	3200
8	EMD 16-710G3	3600
9	EMD 12-710G3A	3200
10	EMD 16-710G3A	3600
11	GE 12-2500	2500
12	GE 12-3000	3000
13	GE 12-3300	3300
14	GE16-3000	3000
15	GE 16-3600	3600
16	GE 16-4100	4100
18	EMD 12-645E	1500 switcher
19	EMD 16-645E	2000 switcher
0	AVGERAGE Line Haul	3271.875





% Time in Notch Switching	0.0%	59.8%	12.4%	12.3%	5.8%	3.6%	3.6%	1.5%	0.2%	0.8%	100.0%
% Time in Notch Line-Haul	12.5%	38.0%	6.5%	6.9%	5.2%	4.4%	3.8%	3.9%	3.0%	16.2%	100.0%

Engine	Rated HP	Notch	Dyn Brake	Idle	1	2	3	4	5	6	7	8	Composite Switching	Composite Line Haul
AVGERAGE Line Haul Locomotive	3272	HP in Notch	66	14	168	373	766	1124	1576	2110	2839	3393	290.7	998.4
		% of Rated	2.0%	0.4%	5.1%	11.4%	23.4%	34.3%	48.2%	64.5%	86.9%	102.9%	8.6%	27.9%
		g/bhp-hr	53.65	90.68	13.68	11.98	11.49	11.90	12.05	11.86	11.72	11.32	14.27	12.38
		PM	2.98	4.80	0.46	0.37	0.37	0.27	0.21	0.23	0.20	0.21	0.43	0.28
		HC	7.22	13.42	1.04	0.46	0.35	0.27	0.25	0.25	0.25	0.26	0.75	0.41
		CO	10.29	23.97	1.36	0.90	0.91	1.17	1.45	1.64	1.52	1.29	1.99	1.51
		Lbs/hr	8.2	3.4	3.2	10.4	17.4	27.1	38.8	51.5	68.7	78.7	8.82	24.77
		PM	0.4	0.2	0.1	0.3	0.6	0.6	0.7	1.0	1.2	1.5	0.26	0.56
		HC	1.1	0.5	0.2	0.4	0.5	0.6	0.8	1.1	1.5	1.8	0.46	0.93
		CO	1.6	0.9	0.3	0.8	1.4	2.7	4.7	7.1	8.9	8.8	1.17	3.03
		Fuel	110	29	78	151	289	415	570	745	975	1183	120.14	341.25
		Fuel lbs/hr	1.67	2.08	0.47	0.41	0.38	0.37	0.36	0.35	0.34	0.35	0.43	0.38

Engine	Rated HP	Notch	Dyn Brake	Idle	1	2	3	4	5	6	7	8	Composite Switching	Composite Line Haul
AVGERAGE Switcher Locomotive	1750	HP in Notch	76	15	85	283	515	770	1023	1287	1591	1855	186.0	537.1
		% of Rated	4.3%	0.9%	4.9%	16.2%	29.4%	44.0%	58.5%	73.5%	90.9%	106.0%	10.6%	30.7%
		g/bhp-hr	41.48	74.47	17.92	12.47	13.40	14.45	15.30	16.05	16.16	15.76	17.47	16.57
		PM	0.84	2.30	0.32	0.33	0.31	0.24	0.23	0.28	0.25	0.28	0.38	0.31
		HC	2.68	7.44	1.27	0.48	0.33	0.30	0.32	0.33	0.37	0.40	0.75	0.50
		CO	6.76	15.47	2.50	1.28	0.75	0.54	0.50	0.62	1.25	2.74	1.73	2.16
		Lbs/hr	6.3	2.8	4.1	10.8	20.2	32.9	49.2	69.7	94.7	109.6	7.16	19.60
		PM	0.1	0.1	0.1	0.3	0.5	0.5	0.7	1.2	1.5	2.0	0.15	0.37
		HC	0.4	0.3	0.3	0.4	0.5	0.7	1.0	1.4	2.2	2.8	0.31	0.99
		CO	1.0	0.6	0.6	1.1	1.1	1.2	1.6	2.7	7.3	19.0	0.71	2.55
		Fuel	92	29	48	116	197	290	387	493	620	742	87.90	228.82
		Fuel lbs/hr	1.20	1.93	0.56	0.41	0.38	0.38	0.38	0.38	0.39	0.40	0.47	0.43