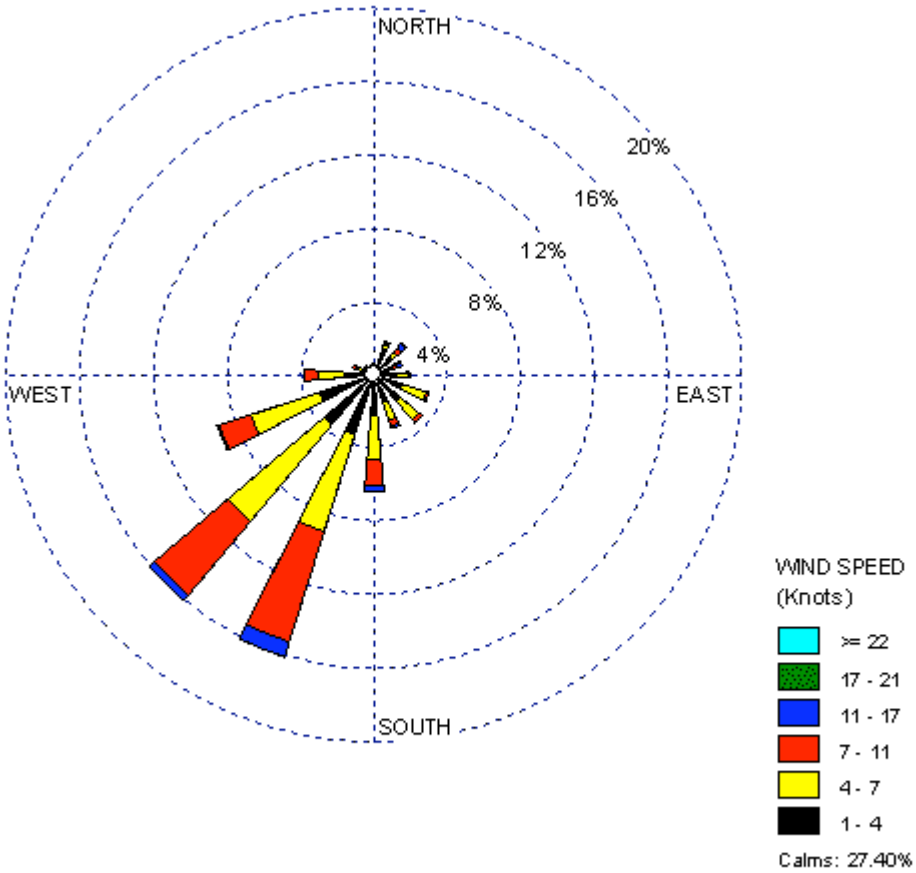
AIR QUALITY DATA

SEASONAL WIND ROSES AND FREQUENCY DISTRIBUTIONS



Annual windrose for John Wayne Airport
Data taken from 2002-2006 for all months.

Displays wind speed, direction (blowing from)

Station ID: 72297 Run ID:
Year: 2002 2003 2004 2005 2006
Date Range: Jan 1 - Dec 31 ANNUAL
Time Range: 00:00 - 23:00

Frequency Distribution
(Count)

Speed Knots

Wind Direction	1 - 4	4 - 7	7 - 11	11 - 17	17 - 21	>= 22	Total
348.75 - 11.25	240	59	6	1	0	0	306
11.25 - 33.75	668	118	37	22	3	1	849
33.75 - 56.25	577	154	106	141	32	15	1025
56.25 - 78.75	344	151	105	99	11	5	715
78.75 - 101.25	550	253	46	11	0	1	861
101.25 - 123.75	717	587	64	0	0	0	1368
123.75 - 146.25	817	578	80	13	0	0	1488
146.25 - 168.75	673	457	146	53	5	3	1337
168.75 - 191.25	981	1007	604	131	3	2	2728
191.25 - 213.75	1472	2364	2669	365	2	0	6872
213.75 - 236.25	1530	2917	2234	186	0	0	6867
236.25 - 258.75	1336	1680	774	40	0	0	3830
258.75 - 281.25	714	608	293	34	0	0	1649
281.25 - 303.75	330	158	45	4	0	0	537
303.75 - 326.25	235	71	13	1	0	0	320
326.25 - 348.75	189	48	4	0	0	0	241
Sub-Total:	11373	11210	7226	1101	56	27	30993
Calms:					11695		
Missing/Incomplete:						1136	
Total:					43824		

Frequency of Calm Winds: 27.40%
Average Wind Speed: 4.39 Knots

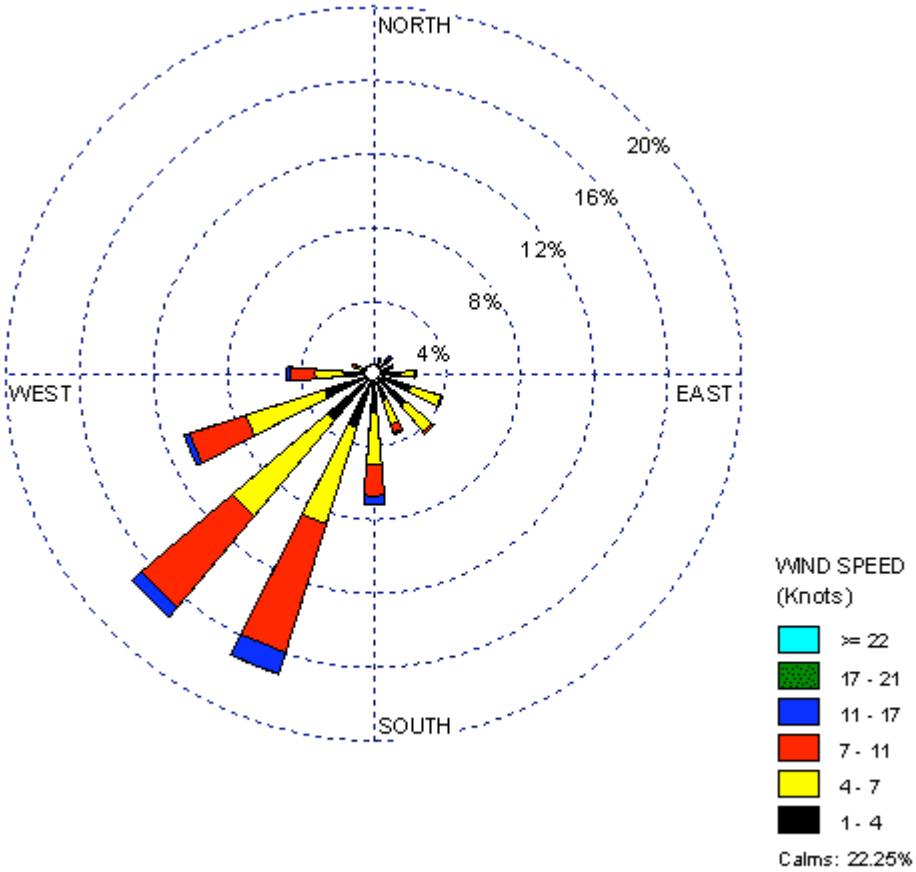
Station ID: 72297 Run ID:
Year: 2002 2003 2004 2005 2006
Date Range: Jan 1 - Dec 31 ANNUAL
Time Range: 00:00 - 23:00

Frequency Distribution
(Normalized)

Speed Knots

Wind Direction	1 - 4	4 - 7	7 - 11	11 - 17	17 - 21	>= 22	Total
348.75 - 11.25	0.005622	0.001382	0.000141	0.000023	0.000000	0.000000	0.007168
11.25 - 33.75	0.015648	0.002764	0.000867	0.000515	0.000070	0.000023	0.019888
33.75 - 56.25	0.013517	0.003608	0.002483	0.003303	0.000750	0.000351	0.024011
56.25 - 78.75	0.008058	0.003537	0.002460	0.002319	0.000258	0.000117	0.016749
78.75 - 101.25	0.012884	0.005927	0.001078	0.000258	0.000000	0.000023	0.020170
101.25 - 123.75	0.016796	0.013751	0.001499	0.000000	0.000000	0.000000	0.032046
123.75 - 146.25	0.019139	0.013540	0.001874	0.000305	0.000000	0.000000	0.034858
146.25 - 168.75	0.015766	0.010706	0.003420	0.001242	0.000117	0.000070	0.031320
168.75 - 191.25	0.022981	0.023590	0.014149	0.003069	0.000070	0.000047	0.063906
191.25 - 213.75	0.034483	0.055379	0.062523	0.008550	0.000047	0.000000	0.160982
213.75 - 236.25	0.035841	0.068333	0.052333	0.004357	0.000000	0.000000	0.160865
236.25 - 258.75	0.031297	0.039355	0.018132	0.000937	0.000000	0.000000	0.089721
258.75 - 281.25	0.016726	0.014243	0.006864	0.000796	0.000000	0.000000	0.038629
281.25 - 303.75	0.007731	0.003701	0.001054	0.000094	0.000000	0.000000	0.012580
303.75 - 326.25	0.005505	0.001663	0.000305	0.000023	0.000000	0.000000	0.007496
326.25 - 348.75	0.004427	0.001124	0.000094	0.000000	0.000000	0.000000	0.005646
Sub-Total:	0.266421	0.262603	0.169275	0.025792	0.001312	0.000632	0.707215
Calms:				0.266863			
Missing/Incomplete:					0.025922		
Total:				1.000000			

Frequency of Calm Winds: 27.40%
Average Wind Speed: 4.39



Spring windrose for John Wayne Airport
Data taken from 2002-2006 for Mar., Apr., and May months

Displays wind speed, direction (blowing from)

Station ID: 72297 Run ID:
Year: 2002 2003 2004 2005 2006
Date Range: Mar 1 - May 31 SPRING
Time Range: 00:00 - 23:00

Frequency Distribution
(Count)

Speed Knots

Wind Direction	1 - 4	4 - 7	7 - 11	11 - 17	17 - 21	>= 22	Total
348.75 - 11.25	35	11	3	0	0	0	49
11.25 - 33.75	85	15	1	1	1	1	104
33.75 - 56.25	97	18	8	18	6	3	150
56.25 - 78.75	67	29	13	13	1	2	125
78.75 - 101.25	169	79	6	1	0	0	255
101.25 - 123.75	236	188	12	0	0	0	436
123.75 - 146.25	252	202	20	1	0	0	475
146.25 - 168.75	171	152	48	11	1	0	383
168.75 - 191.25	237	300	189	49	2	0	777
191.25 - 213.75	340	596	795	132	1	0	1864
213.75 - 236.25	366	736	705	77	0	0	1884
236.25 - 258.75	312	486	349	34	0	0	1181
258.75 - 281.25	175	176	148	19	0	0	518
281.25 - 303.75	81	42	19	2	0	0	144
303.75 - 326.25	41	15	8	1	0	0	65
326.25 - 348.75	42	8	2	0	0	0	52
Sub-Total:	2706	3053	2326	359	12	6	8462
Calms:					2421		
Missing/Incomplete:						1136	
Total:					12019		

Frequency of Calm Winds: 22.25%
Average Wind Speed: 4.94 Knots

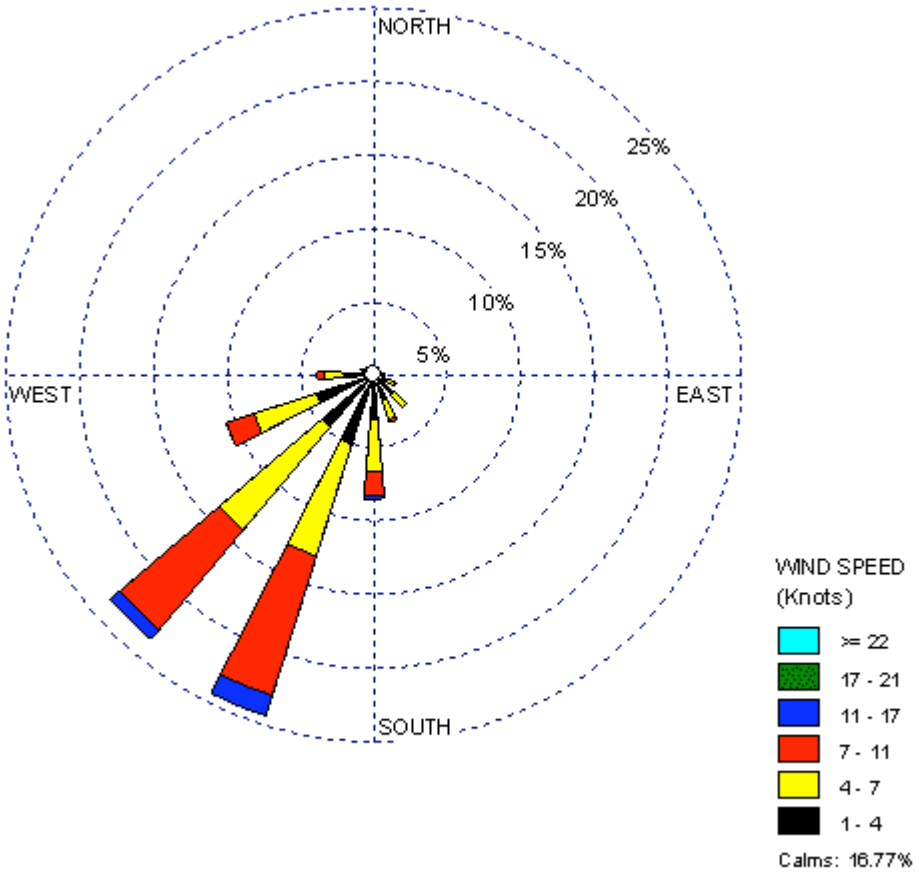
Station ID: 72297 Run ID:
Year: 2002 2003 2004 2005 2006
Date Range: Mar 1 - May 31 SPRING
Time Range: 00:00 - 23:00

Frequency Distribution
(Normalized)

Speed Knots

Wind Direction	1 - 4	4 - 7	7 - 11	11 - 17	17 - 21	>= 22	Total
348.75 - 11.25	0.003216	0.001011	0.000276	0.000000	0.000000	0.000000	0.004502
11.25 - 33.75	0.007810	0.001378	0.000092	0.000092	0.000092	0.000092	0.009556
33.75 - 56.25	0.008913	0.001654	0.000735	0.001654	0.000551	0.000276	0.013783
56.25 - 78.75	0.006156	0.002665	0.001195	0.001195	0.000092	0.000184	0.011486
78.75 - 101.25	0.015529	0.007259	0.000551	0.000092	0.000000	0.000000	0.023431
101.25 - 123.75	0.021685	0.017275	0.001103	0.000000	0.000000	0.000000	0.040062
123.75 - 146.25	0.023155	0.018561	0.001838	0.000092	0.000000	0.000000	0.043646
146.25 - 168.75	0.015713	0.013967	0.004411	0.001011	0.000092	0.000000	0.035193
168.75 - 191.25	0.021777	0.027566	0.017367	0.004502	0.000184	0.000000	0.071396
191.25 - 213.75	0.031241	0.054764	0.073050	0.012129	0.000092	0.000000	0.171276
213.75 - 236.25	0.033630	0.067628	0.064780	0.007075	0.000000	0.000000	0.173114
236.25 - 258.75	0.028669	0.044657	0.032068	0.003124	0.000000	0.000000	0.108518
258.75 - 281.25	0.016080	0.016172	0.013599	0.001746	0.000000	0.000000	0.047597
281.25 - 303.75	0.007443	0.003859	0.001746	0.000184	0.000000	0.000000	0.013232
303.75 - 326.25	0.003767	0.001378	0.000735	0.000092	0.000000	0.000000	0.005973
326.25 - 348.75	0.003859	0.000735	0.000184	0.000000	0.000000	0.000000	0.004778
Sub-Total:	0.248645	0.280529	0.213728	0.032987	0.001103	0.000551	0.704052
Calms:				0.201431			
Missing/Incomplete:					0.094517		
Total:				1.000000			

Frequency of Calm Winds: 22.25%
Average Wind Speed: 4.94 Knots



Summer windrose for John Wayne Airport
Data taken from 2002-2006 for Jun., Jul., and Aug. months

Displays wind speed, direction (blowing from)

Station ID: 72297 Run ID:
Year: 2002 2003 2004 2005 2006
Date Range: Jun 1 - Aug 31 SUMMER
Time Range: 00:00 - 23:00

Frequency Distribution
(Count)

Speed Knots

Wind Direction	1 - 4	4 - 7	7 - 11	11 - 17	17 - 21	>= 22	Total
348.75 - 11.25	29	11	0	0	0	0	40
11.25 - 33.75	32	8	1	0	0	0	41
33.75 - 56.25	29	3	0	0	0	0	32
56.25 - 78.75	34	4	1	0	0	0	39
78.75 - 101.25	72	16	0	0	0	0	88
101.25 - 123.75	112	65	2	0	0	0	179
123.75 - 146.25	204	120	3	0	0	0	327
146.25 - 168.75	202	151	22	2	0	0	377
168.75 - 191.25	336	375	187	18	0	0	916
191.25 - 213.75	541	860	1070	157	0	0	2628
213.75 - 236.25	506	987	962	84	0	0	2539
236.25 - 258.75	449	482	212	2	0	0	1145
258.75 - 281.25	229	144	49	0	0	0	422
281.25 - 303.75	84	23	1	0	0	0	108
303.75 - 326.25	54	12	1	0	0	0	67
326.25 - 348.75	46	6	1	0	0	0	53
Sub-Total:	2959	3267	2512	263	0	0	9001
Calms:					1813		
Missing/Incomplete:						1136	
Total:					11950		

Frequency of Calm Winds: 16.77%
Average Wind Speed: 5.16 Knots

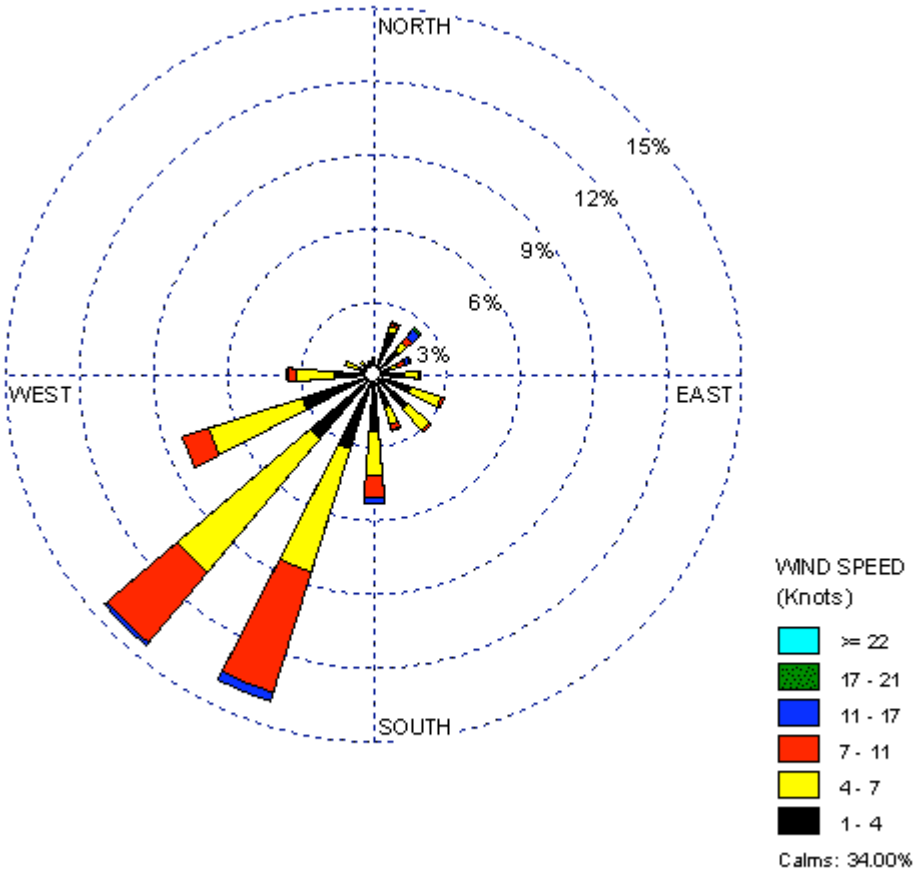
Station ID: 72297 Run ID:
Year: 2002 2003 2004 2005 2006
Date Range: Jun 1 - Aug 31 SUMMER
Time Range: 00:00 - 23:00

Frequency Distribution
(Normalized)

Speed Knots

Wind Direction	1 - 4	4 - 7	7 - 11	11 - 17	17 - 21	>= 22	Total
348.75 - 11.25	0.002682	0.001017	0.000000	0.000000	0.000000	0.000000	0.003699
11.25 - 33.75	0.002959	0.000740	0.000092	0.000000	0.000000	0.000000	0.003791
33.75 - 56.25	0.002682	0.000277	0.000000	0.000000	0.000000	0.000000	0.002959
56.25 - 78.75	0.003144	0.000370	0.000092	0.000000	0.000000	0.000000	0.003606
78.75 - 101.25	0.006658	0.001480	0.000000	0.000000	0.000000	0.000000	0.008138
101.25 - 123.75	0.010357	0.006011	0.000185	0.000000	0.000000	0.000000	0.016553
123.75 - 146.25	0.018864	0.011097	0.000277	0.000000	0.000000	0.000000	0.030239
146.25 - 168.75	0.018679	0.013963	0.002034	0.000185	0.000000	0.000000	0.034862
168.75 - 191.25	0.031071	0.034677	0.017292	0.001665	0.000000	0.000000	0.084705
191.25 - 213.75	0.050028	0.079527	0.098946	0.014518	0.000000	0.000000	0.243018
213.75 - 236.25	0.046791	0.091271	0.088959	0.007768	0.000000	0.000000	0.234788
236.25 - 258.75	0.041520	0.044572	0.019604	0.000185	0.000000	0.000000	0.105881
258.75 - 281.25	0.021176	0.013316	0.004531	0.000000	0.000000	0.000000	0.039023
281.25 - 303.75	0.007768	0.002127	0.000092	0.000000	0.000000	0.000000	0.009987
303.75 - 326.25	0.004994	0.001110	0.000092	0.000000	0.000000	0.000000	0.006196
326.25 - 348.75	0.004254	0.000555	0.000092	0.000000	0.000000	0.000000	0.004901
Sub-Total:	0.273627	0.302108	0.232291	0.024320	0.000000	0.000000	0.753222
Calms:				0.151715			
Missing/Incomplete:					0.095063		
Total:				1.000000			

Frequency of Calm Winds: 16.77%
Average Wind Speed: 5.16 Knots



Fall windrose for John Wayne Airport
Data taken from 2002-2006 Sep., Oct., and Nov. months.

Displays wind speed, direction (blowing from)

Station ID: 72297 Run ID:
Year: 2002 2003 2004 2005 2006
Date Range: Sep 1 - Nov 30 FALL
Time Range: 00:00 - 23:00

Frequency Distribution
(Count)

Speed Knots

Wind Direction	1 - 4	4 - 7	7 - 11	11 - 17	17 - 21	>= 22	Total
348.75 - 11.25	65	12	2	0	0	0	79
11.25 - 33.75	204	23	15	7	1	0	250
33.75 - 56.25	149	40	34	43	9	3	278
56.25 - 78.75	77	38	34	20	6	1	176
78.75 - 101.25	137	58	9	2	0	1	207
101.25 - 123.75	173	139	14	0	0	0	326
123.75 - 146.25	198	125	11	1	0	0	335
146.25 - 168.75	154	80	23	4	1	1	263
168.75 - 191.25	255	189	100	25	0	1	570
191.25 - 213.75	343	565	550	40	0	0	1498
213.75 - 236.25	372	757	401	16	0	0	1546
236.25 - 258.75	333	428	121	0	0	0	882
258.75 - 281.25	181	158	42	1	0	0	382
281.25 - 303.75	82	49	7	0	0	0	138
303.75 - 326.25	63	20	1	0	0	0	84
326.25 - 348.75	48	18	1	0	0	0	67
Sub-Total:	2834	2699	1365	159	17	7	7081
Calms:					3647		
Missing/Incomplete:						1136	
Total:					11864		

Frequency of Calm Winds: 34.00%
Average Wind Speed: 3.78 Knots

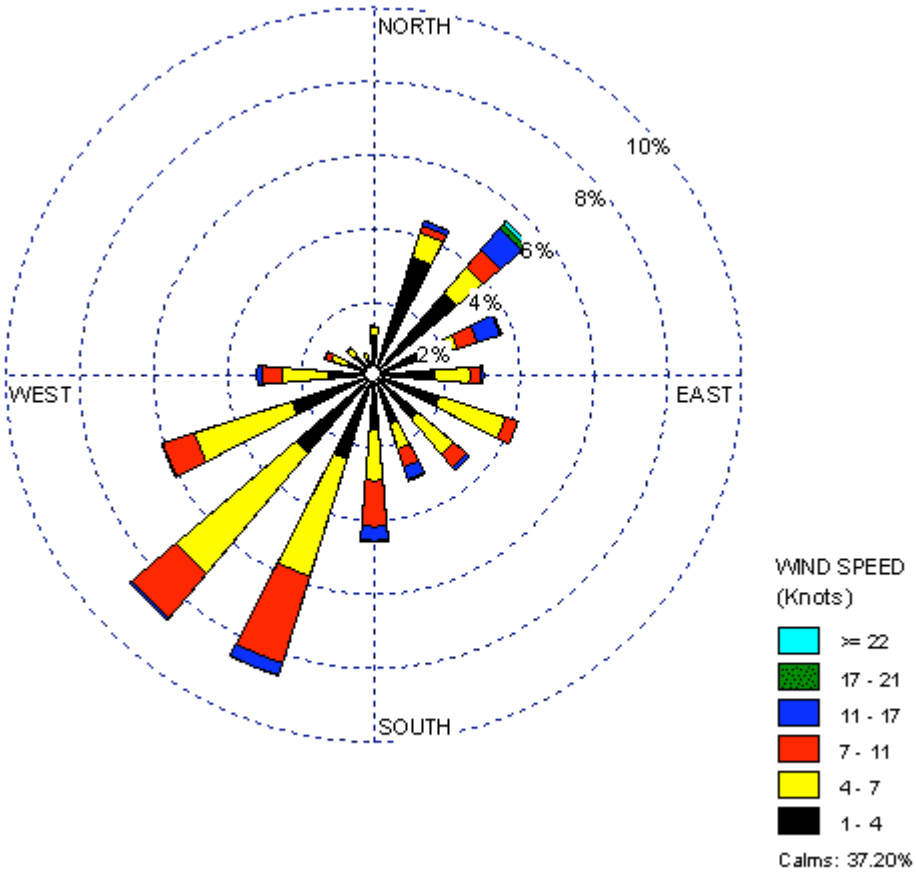
Station ID: 72297 Run ID:
Year: 2002 2003 2004 2005 2006
Date Range: Sep 1 - Nov 30 FALL
Time Range: 00:00 - 23:00

Frequency Distribution
(Normalized)

Speed Knots

Wind Direction	1 - 4	4 - 7	7 - 11	11 - 17	17 - 21	>= 22	Total
348.75 - 11.25	0.006059	0.001119	0.000186	0.000000	0.000000	0.000000	0.007364
11.25 - 33.75	0.019016	0.002144	0.001398	0.000652	0.000093	0.000000	0.023304
33.75 - 56.25	0.013889	0.003729	0.003169	0.004008	0.000839	0.000280	0.025913
56.25 - 78.75	0.007177	0.003542	0.003169	0.001864	0.000559	0.000093	0.016406
78.75 - 101.25	0.012770	0.005406	0.000839	0.000186	0.000000	0.000093	0.019295
101.25 - 123.75	0.016126	0.012957	0.001305	0.000000	0.000000	0.000000	0.030388
123.75 - 146.25	0.018456	0.011652	0.001025	0.000093	0.000000	0.000000	0.031227
146.25 - 168.75	0.014355	0.007457	0.002144	0.000373	0.000093	0.000093	0.024515
168.75 - 191.25	0.023770	0.017617	0.009321	0.002330	0.000000	0.000093	0.053132
191.25 - 213.75	0.031972	0.052666	0.051268	0.003729	0.000000	0.000000	0.139635
213.75 - 236.25	0.034676	0.070563	0.037379	0.001491	0.000000	0.000000	0.144109
236.25 - 258.75	0.031040	0.039896	0.011279	0.000000	0.000000	0.000000	0.082215
258.75 - 281.25	0.016872	0.014728	0.003915	0.000093	0.000000	0.000000	0.035608
281.25 - 303.75	0.007644	0.004567	0.000652	0.000000	0.000000	0.000000	0.012864
303.75 - 326.25	0.005872	0.001864	0.000093	0.000000	0.000000	0.000000	0.007830
326.25 - 348.75	0.004474	0.001678	0.000093	0.000000	0.000000	0.000000	0.006245
Sub-Total:	0.264169	0.251585	0.127237	0.014821	0.001585	0.000652	0.596848
Calms:				0.307401			
Missing/Incomplete:					0.095752		
Total:				1.000000			

Frequency of Calm Winds: 34.00%
Average Wind Speed: 3.78 Knots



Winter windrose for John Wayne Airport
Data taken from 2002-2006 Dec., Jan., and Feb. months.

Displays wind speed, direction (blowing from)

Station ID: 72297 Run ID:
Year: 2002 2003 2004 2005 2006
Date Range: Dec 1 - Feb 28 WINTER
Time Range: 00:00 - 23:00

Frequency Distribution
(Count)

Speed Knots

Wind Direction	1 - 4	4 - 7	7 - 11	11 - 17	17 - 21	>= 22	Total
348.75 - 11.25	111	25	1	1	0	0	138
11.25 - 33.75	347	72	20	14	1	0	454
33.75 - 56.25	302	93	64	80	17	9	565
56.25 - 78.75	166	80	57	66	4	2	375
78.75 - 101.25	170	98	31	8	0	0	307
101.25 - 123.75	194	193	36	0	0	0	423
123.75 - 146.25	163	131	46	11	0	0	351
146.25 - 168.75	146	73	53	36	3	2	313
168.75 - 191.25	153	143	128	39	1	1	465
191.25 - 213.75	248	342	252	36	1	0	879
213.75 - 236.25	285	437	161	9	0	0	892
236.25 - 258.75	242	284	92	4	0	0	622
258.75 - 281.25	128	130	54	14	0	0	326
281.25 - 303.75	83	44	18	2	0	0	147
303.75 - 326.25	77	24	3	0	0	0	104
326.25 - 348.75	53	16	0	0	0	0	69
Sub-Total:	2868	2185	1016	320	27	14	6430
Calms:					3809		
Missing/Incomplete:						1136	
Total:					11375		

Frequency of Calm Winds: 37.20%
Average Wind Speed: 3.63 Knots

Station ID: 72297 Run ID:
Year: 2002 2003 2004 2005 2006
Date Range: Dec 1 - Feb 28 WINTER
Time Range: 00:00 - 23:00

Frequency Distribution
(Normalized)

Speed Knots

Wind Direction	1 - 4	4 - 7	7 - 11	11 - 17	17 - 21	>= 22	Total
348.75 - 11.25	0.010841	0.002442	0.000098	0.000098	0.000000	0.000000	0.013478
11.25 - 33.75	0.033890	0.007032	0.001953	0.001367	0.000098	0.000000	0.044340
33.75 - 56.25	0.029495	0.009083	0.006251	0.007813	0.001660	0.000879	0.055181
56.25 - 78.75	0.016213	0.007813	0.005567	0.006446	0.000391	0.000195	0.036625
78.75 - 101.25	0.016603	0.009571	0.003028	0.000781	0.000000	0.000000	0.029983
101.25 - 123.75	0.018947	0.018849	0.003516	0.000000	0.000000	0.000000	0.041313
123.75 - 146.25	0.015920	0.012794	0.004493	0.001074	0.000000	0.000000	0.034281
146.25 - 168.75	0.014259	0.007130	0.005176	0.003516	0.000293	0.000195	0.030569
168.75 - 191.25	0.014943	0.013966	0.012501	0.003809	0.000098	0.000098	0.045415
191.25 - 213.75	0.024221	0.033402	0.024612	0.003516	0.000098	0.000000	0.085848
213.75 - 236.25	0.027835	0.042680	0.015724	0.000879	0.000000	0.000000	0.087118
236.25 - 258.75	0.023635	0.027737	0.008985	0.000391	0.000000	0.000000	0.060748
258.75 - 281.25	0.012501	0.012697	0.005274	0.001367	0.000000	0.000000	0.031839
281.25 - 303.75	0.008106	0.004297	0.001758	0.000195	0.000000	0.000000	0.014357
303.75 - 326.25	0.007520	0.002344	0.000293	0.000000	0.000000	0.000000	0.010157
326.25 - 348.75	0.005176	0.001563	0.000000	0.000000	0.000000	0.000000	0.006739
Sub-Total:	0.280105	0.213400	0.099228	0.031253	0.002637	0.001367	0.565275
Calms:				0.334857			
Missing/Incomplete:					0.099868		
Total:				1.000000			

Frequency of Calm Winds: 37.20%
Average Wind Speed: 3.63 Knots

CONSTRUCTION EMISSIONS

ONSITE EMISSIONS

Table X.X-11

Daily Maximum Construction Emissions of Criteria Pollutants (lbs/day) Onsite

Activity	PM_{10}	$PM_{2.5}$	CO	ROC	NO_x	SO_x
Onsite Combustion Emissions						
Diesel Construction Equipment	4.69	4.32	35.55	10.44	62.09	0.06
Dump trucks, pickup trucks, service trucks and worker vehicles	0.02	0.02	0.13	0.03	0.41	0.000
Construction Combustion--onsite Subtotal (lbs)	***4.7***	***4.3***	***35.7***	***10.5***	***62.5***	***0.1***
Onsite Fugitive Dust Emissions						
Vehicle Travel on paved and unpaved site	2.35	0.50				
Earth clearing/Bulldozing	1.66	0.34				
Earth Loading/Storage	0.31	0.06				
Demolition	23.12	4.81				
Fugitive dust--linears Emissions subtotal (lbs)	***27.4***	***5.7***				
Offsite On-Highway Emissions						
Worker Passenger Vehicle, Service trucks, and delivery trucks– Combustion Emissions	0.81	0.65	30.88	3.75	17.00	0.04
Worker Passenger Vehicle, Service trucks, and delivery trucks – Paved Road Dust	91.03	15.38				
Subtotal of Offsite Emissions (lbs)	***91.84***	***16.04***	***30.88***	***3.75***	***17.00***	***0.04***
Total Max. Daily Emissions onsite(lbs)	**124.0**	**26.1**	**66.6**	**14.2**	**79.5**	**0.1**

Notes:
PM_{10} = particulate matter less than 10 micrometers in diameter
$PM_{2.5}$ = particulate matter less than 2.5 micrometers in diameter
ROC = reactive organic compounds
CO = carbon monoxide
NO_x = nitrogen oxide(s)
SO_x = sulfur oxide(s)

LINEARS EMISSIONS

Table X.X-12

Daily Maximum Construction Emissions of Criteria Pollutants linears (lbs/day)

Activity	PM_{10}	$PM_{2.5}$	CO	ROC	NO_x	SO_x
Linears Combustion Emissions						
Diesel Construction Equipment	2.66	2.45	17.57	4.77	29.14	0.03
Field, delivery trucks	0.00	0.00	0.02	0.00	0.00	0.00
Construction Combustion--linears Subtotal (lbs)	***2.7***	***2.4***	***17.6***	***4.8***	***29.1***	***0.03***
Linears Fugitive Dust Emissions						
Vehicle Travel on Paved Roads	0.32	0.07				
Earth Loading	0.00	0.00				
Fugitive dust Emissions--linears subtotal (lbs)	***0.3***	***0.1***				
Total Max. Daily Emissions linears(lbs)	**3.0**	**2.5**	**17.6**	**4.8**	**29.1**	**0.03**

Notes:
PM_{10} = particulate matter less than 10 micrometers in diameter
$PM_{2.5}$ = particulate matter less than 2.5 micrometers in diameter
ROC = reactive organic compounds
CO = carbon monoxide
NO_x = nitrogen oxide(s)
SO_x = sulfur oxide(s)

Table X.X-13
Maximum Annual Construction Emissions of Criteria Pollutants onsite(ton/year)

Activity	PM_{10}	$PM_{2.5}$	CO	ROC	NO_x	SO_x
Onsite Combustion Emissions						
Diesel Construction Equipment	0.39	0.35	3.10	0.89	6.29	0.01
Dump trucks, pickup trucks, service trucks and worker vehicles	0.002	0.002	0.03	0.01	0.05	0.0001
Onsite construction Combustion Subtotal (tons)	***0.4***	***0.4***	***3.1***	***0.9***	***6.3***	***0.01***
Onsite Fugitive Dust Emissions						
Worker Passenger Vehicle, Service trucks, and delivery trucks	0.30	0.06				
Earth clearing/Bulldozing	0.15	0.03				
Earth Loading/Storage	0.02	0.004				
Demolition	0.25	0.05				
Onsite fugitive dust Emissions subtotal (tons)	***0.7***	***0.1***				
Offsite On-Highway Emissions						
Worker Passenger Vehicle, Service trucks, and delivery trucks– Combustion Emissions	0.04	0.03	2.99	0.32	0.68	0.00
Worker Passenger Vehicle, Service trucks, and delivery trucks – Paved Road Dust	10.62	1.79				
Subtotal of Offsite Emissions (tons)	***10.66***	***1.83***	***2.99***	***0.32***	***0.68***	***0.00***
Total Max. Annual onsite/offsite Emissions (tons)	**11.8**	**2.3**	**6.1**	**1.2**	**7.0**	**0.01**

Notes:
PM_{10} = particulate matter less than 10 micrometers in diameter
$PM_{2.5}$ = particulate matter less than 2.5 micrometers in diameter
ROC = reactive organic compounds
CO = carbon monoxide
NO_x = nitrogen oxide(s)
SO_x = sulfur oxide(s)

Table X.X-14
Maximum Annual Construction Emissions of Criteria Pollutants linears (ton/year)

Activity	PM_{10}	$PM_{2.5}$	CO	ROC	NO_x	SO_x
Linears Combustion Emissions						
Diesel Construction Equipment	0.15	0.13	0.97	0.26	1.60	0.002
Delivery trucks and field trucks	0.00	0.00	0.00	0.00	0.00	0.000
Linears construction Combustion Subtotal (tons)	***0.1***	***0.1***	***1.0***	***0.3***	***1.6***	***0.002***
Linears Fugitive Dust Emissions						
Field trucks, delivery trucks	0.02	0.01				
Earth Loading	0.00	0.00				
Linears fugitive dust Emissions subtotal (tons)	***0.0***	***0.0***				
Total Max. Annual linear Emissions (tons)	**0.2**	**0.1**	**1.0**	**0.3**	**1.6**	**0.002**

Notes:
PM_{10} = particulate matter less than 10 micrometers in diameter
$PM_{2.5}$ = particulate matter less than 2.5 micrometers in diameter
ROC = reactive organic compounds
CO = carbon monoxide
NO_x = nitrogen oxide(s)
SO_x = sulfur oxide(s)

eqp schedule

Table X.X-9
Estimated Pieces of Construction Equipment and Schedules for onsite construction of power station

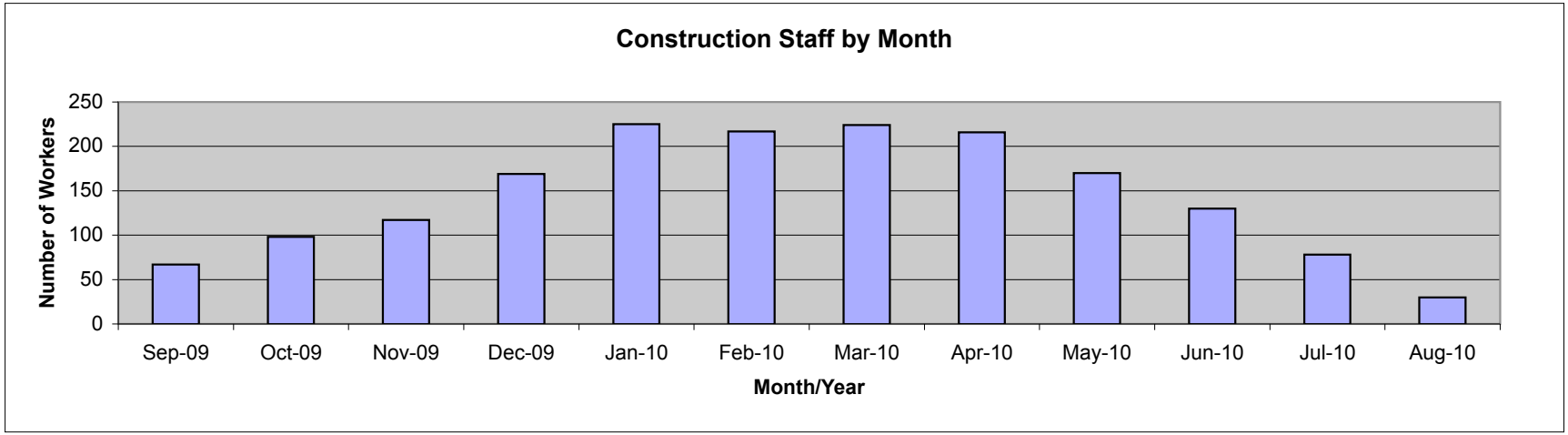
	CONSTRUCTION EQUIPMENT	AVERAGE HOURS PER DA	AVERAGE UNITS ON SITE PER MONTH												TOTAL MONTH 1-12
			1	2	3	4	5	6	7	8	9	10	11	12	
1	Grader	8	1	1	1										3
2	Dozer	8	1	1											2
3	Scraper	8	1												1
4	Vibrator	8	1	1											2
5	Loader	8	2												2
6	Forklift	8			1	2	3	3	3	3	3	3	2		23
7	Backhoe	8	2	3	3	2	2	1	1	1	1	1			17
8	Crane	8		1	1	2	3	4	4	3	2	1			21
10	Field truck (3/4T)	6	1	1	1	1	1	2	2	2	2	1	1	1	16
11	Dump truck	8	2	2	2	1	1								8
12	Water truck	12	1	1	1	1	1	1	1	1	1	1			10
15	Boom truck	8				1	1	1	1	1	1	1			7
16	Concrete pump truck	8	1	2	3	3	2	1	1						13
17	Port air compressor	8	1	1	1	1	1	1	1	1	1	1			10
18	Light plant	3	1	1	1	1	1	1	1	1	1	1			10
	Equipment per Month		15	15	15	15	16	15	15	13	12	10	3	1	145

Table X.X-10
Estimated Pieces of Construction Equipment and Schedules for the construction of linears

	CONSTRUCTION EQUIPMENT	AVERAGE HOURS PER DA	AVERAGE UNITS ON SITE PER MONTH												TOTAL MONTH 1-12
			1	2	3	4	5	6	7	8	9	10	11	12	
1	Loader	8		2	2	2	3	2	2	2					15
2	Backhoe	8		2	2	2	3	2	2	2					15
3	Field truck (3/4T)	6		1	1	1	1	1	1	1					7
	Equipment per Month		0	5	5	5	7	5	5	5	0	0	0	0	37

Note:
Onsite construction equipment was provided by client. Some onsite equip was estimated for modelin
Linears construction equipment estimated.

workers by month



Number of Workers by Month												TOTAL ALL MONTHS
1	2	3	4	5	6	7	8	9	10	11	12	
Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	
67	98	117	169	225	217	224	216	170	130	78	30	1741

Worker/Delivery Commuting Emissions months 1-12
Annual Maximum

COMBUSTION EMISSION FACTOR FOR ONROAD VEHICLES

Onroad Vehicle Combustion	Fuel Type	Daily Vehicle Count	Vehicle Type	EF (lbs/mile)[1]					
				PM_{10}	$PM_{2.5}$	CO	VOC	NOx	SO_2
Heavy Truck (concrete, water, dump trucks)	Diesel	4	HHD	0.0020	0.0018	0.0128	0.0033	0.0418	0.00004
Personal Commuting Vehicles	Gasoline	97	Passenger	0.0001	0.0001	0.0097	0.0010	0.0010	0.00001
Light delivery truck (e.g. Fed-Ex)	Gasoline	15	Delivery	0.0008	0.0007	0.0202	0.0028	0.0224	0.00003
Heavy delivery truck (e.g. flat beds carrying construction eqp)	Diesel	3	HHD	0.0020	0.0018	0.0128	0.0033	0.0418	0.00004
			Total	0.0049	0.0043	0.0555	0.0104	0.1071	0.0001

Note: From client:

15	Light delivery truck traffic daily estimate
3	Heavy Haul Truck average delivery per day estimate (all deliveries averaged over months 3-7)
10	Heavy Haul Truck peak delivery per day estimate (all deliveries averaged over month 6)
300	Total heavy equipment deliveries estimated

Assumes that the heavy trucks scheduled will make deliveries during 12 days of the 22 day construction month

Average deliveries	12	days per month
	5	months (months 3-7)
	3	average truck deliveries per day

Peak deliveries	12	days per month
	1	month (month 6)
	10	peak deliveries per day

EMISSION CALCULATION FOR ONROAD VEHICLES

	Total Days / Year	Daily VMT / Vehicle	Annual VMT	Daily Emissions (lbs/day)					
				PM_{10}	$PM_{2.5}$	CO	VOC	NOx	SO_2
Heavy Truck (concrete, fuel, water, dump trucks)	176	23.2	18,199	0.206	0.181	1.326	0.341	4.327	0.004
Personal Commuting Vehicles	264	23.2	592,404	0.193	0.121	21.734	2.227	2.256	0.024
Light delivery truck (e.g. Fed-Ex)	264	23.2	91,872	0.280	0.241	7.016	0.971	7.783	0.009
Heavy delivery truck (e.g. flat beds carrying construction eqp)	110	23.2	6,912	0.125	0.110	0.806	0.207	2.629	0.003
			Total	0.805	0.653	30.882	3.745	16.996	0.040

Onroad Vehicle Combustion	Annual Emission Rate (tons/year)					
	PM_{10}	$PM_{2.5}$	CO	VOC	NOx	SO_2
Heavy Truck (concrete, water, dump trucks)	0.018	0.016	0.117	0.030	0.381	0.000
Personal Commuting Vehicles	0.025	0.016	2.869	0.294	0.298	0.003
Light delivery truck (e.g. Fed-Ex)	0.037	0.032	0.926	0.128	1.027	0.001
Heavy delivery truck (e.g. flat beds carrying construction eqp)	0.007	0.006	0.044	0.011	0.145	0.000
Total	**0.044**	**0.032**	**2.986**	**0.324**	**0.679**	**0.004**

Note 1: SCAQMD Prepared - Highest (Most Conservative) Emfac 2007 (version 2.3)
Emission Factors for On-Road Personal Commuting Vehicles and Trucks
Scenario Year: 2009
-the 2009 scenario year was chosen for emission factors because construction is expected to start in the 3rd quarter of 2009 and carry on through 2010. 2009 emission factors also more conservative than 2010 emission factors.
All model years in the range 1965 to 2009

FUGITIVE EMISSION FACTOR FOR ONROAD VEHICLES

Personal Commuting Vehicles EF=	0.0064	PM10 lb/VMT (from CEQA Handbook, Table A9-9-B-1 for major streets/highways)
Truck Travel on paved roads EF =	0.1491	PM10 lb/VMT (from CEQA Handbook Table A9-9-C-1 for major streets/highways)

Onroad Vehicle Fugitive	Daily PM10 Emissions (lb/day)	Annual PM10 Emissions (tons/yr)	Daily PM2.5 Emissions (lb/day)	Annual PM2.5 Emissions (tons/yr)
Heavy Truck (concrete, fuel, water, dump trucks)	15.4	1.36	2.61	0.23
Personal Commuting Vehicles	14.4	1.90	2.43	0.32
Light delivery truck (e.g. Fed-Ex)	51.9	6.85	8.77	1.16
Heavy delivery truck (e.g. flat beds carrying construction eqp)	9.4	0.52	1.58	0.09
Total	**91.03**	**10.62**	**15.38**	**1.79**

Assumptions:

"Heavy Truck" assumes the average number of concrete, water,and dump trucks onsite for the daily vehicle count. These trucks are used over an average 8 month period per the equip. schedule tab

8 months, average heavy truck schedule

Assumed average distance travelled off site for all employees commuting will be 11.6 miles (from CEQA Handbook, Table A9-5-D for Orange county work trips, year 2010

times 2 for return trip = 23.2 miles

22 days per month of construction, average

Average daily workers 145

Number of workers per commuter vehicle = 1.5

Assumed number of workers per commuter vechicle based on carpooling in an urban environment
Light and heavy truck daily deliveries, and the months of the deliveries were provided by the client.

Annual Combustion Emissions

months 1-12

Diesel Fired Offroad Equipment

Equipment	Quantity/year	Hours/Day	Horsepower	Days/month	Emission factors (lb/hr) PM10	CO	ROC	NOx	SOx	Annual Emissions (ton/yr) PM10	PM2.5	CO	VOC	NOx	SOx
Grader	3	8	120	22	0.0898	0.5519	0.1663	0.9819	0.0009	0.02	0.02	0.15	0.04	0.26	0.00
Dozer	2	8	175	22	0.1077	0.8774	0.2498	1.8708	0.0015	0.02	0.02	0.15	0.04	0.33	0.00
Scraper	1	8	175	22	0.1101	0.9371	0.2510	1.9270	0.0017	0.01	0.01	0.08	0.02	0.17	0.00
Vibrator	2	8	50	22	0.0283	0.3034	0.1136	0.2833	0.0004	0.00	0.00	0.05	0.02	0.05	0.00
Loader	2	8	100	22	0.0554	0.3661	0.0993	0.6071	0.0006	0.01	0.01	0.06	0.02	0.11	0.00
Forklift	23	8	100	22	0.0373	0.2272	0.0662	0.3757	0.0004	0.08	0.07	0.46	0.13	0.76	0.00
Backhoe	17	8	100	22	0.0554	0.3661	0.0993	0.6071	0.0006	0.08	0.08	0.55	0.15	0.91	0.00
Crane	21	8	300	22	0.0726	0.7157	0.1913	1.8770	0.0018	0.13	0.12	1.32	0.35	3.47	0.00
Port air compressor	10	8	50	22	0.0275	0.2867	0.1220	0.2416	0.0003	0.02	0.02	0.25	0.11	0.21	0.00
Light plant	10	3	50	22	0.0037	0.0617	0.0118	0.0739	0.0002	0.00	0.00	0.02	0.00	0.02	0.00
	91								**Total**	**0.4**	**0.4**	**3.1**	**0.9**	**6.3**	**6.04E-03**

Notes:
Emission factors from SCAQMD composite off-road emission factors from CARB's Off-Road Model for year 2009.
Equipment list, quantity, some horsepower, and hours of operation from client.
PM2.5 emission factors from updated CEIDARS List with PM2.5 fractions. PM2.5 numbers obtained by multiplying the PM10 values by fraction in CEIDARS list for onroad or offroad diesel vehicles.
Vibrator uses "other construction equipment" emission factor

Combustion Exhaust from Travel onsite

Vehicle Type	Quantity/year[1]	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT per Unit	Annual VMT for all Units	Emission factor (lb/mile) PM10	PM2.5	CO	VOC	NOx	SOx	Emission factor vehicle type	Annual Emissions (ton/yr) PM10	PM2.5	CO	VOC	NOx	SOx
Field truck (3/4T)	16	2.0	0.24	0.48	169	8.60E-05	5.38E-05	9.69E-03	9.92E-04	1.01E-03	1.07E-05	passenger	0.000	0.000	0.001	0.000	0.000	0.00
Dump truck	8	4.0	0.24	0.96	169	2.00E-03	1.75E-03	1.28E-02	3.29E-03	4.18E-02	4.01E-05	HHD truck	0.000	0.000	0.001	0.000	0.004	0.00
Water truck	10	24.0	0.36	8.64	1901	2.00E-03	1.75E-03	1.28E-02	3.29E-03	4.18E-02	4.01E-05	HHD truck	0.002	0.002	0.012	0.003	0.040	0.00
Boom truck	7	4.0	0.18	0.72	111	8.05E-04	6.92E-04	2.02E-02	2.79E-03	2.24E-02	2.68E-05	MD truck	0.000	0.000	0.001	0.000	0.001	0.00
Concrete pump truck	13	1.0	0.18	0.18	51	2.00E-03	1.75E-03	1.28E-02	3.29E-03	4.18E-02	4.01E-05	HHD truck	0.000	0.000	0.000	0.000	0.001	0.00
Heavy Delivery Truck	33	2.0	0.06	0.12	86	2.00E-03	1.75E-03	1.28E-02	3.29E-03	4.18E-02	4.01E-05	HHD truck	0.000	0.000	0.001	0.000	0.002	0.00
Light Delivery Truck	180	1.0	0.06	0.06	238	8.05E-04	6.92E-04	2.02E-02	2.79E-03	2.24E-02	2.68E-05	Delivery	0.000	0.000	0.002	0.000	0.003	0.00
Worker Vehicles in Laydown Area	1161	1.0	0.12	0.12	3064	8.60E-05	5.38E-05	9.69E-03	9.92E-04	1.01E-03	1.07E-05	passenger	0.000	0.000	0.015	0.002	0.002	0.00
												Total Unpaved Road	**2.48E-03**	**2.14E-03**	**0.033**	**0.006**	**0.052**	**6.62E-05**

Notes:

SCAQMD Prepared - Highest (Most Conservative) Emfac 2007 (version 2.3)

Emission Factors for On-Road Passenger Vehicles, Medium/Heavy Duty Vechicles (e.g. Delivery Trucks) & Heavy Heavy Duty Diesel Trucks

Water trucks operate 2 times per hour.

From site plan:
Approximate site area: 0.12 mi x 0.12 mi
Approximate construction Laydown area: 0.12 mi x 0.06 mi
Approximate plant area: 0.12 mi x 0.06 mi

Scenario Year: 2009

All model years in the range 1965 to 2009

1. Truck quantity based on monthly maximums, delivery truck and worker vehicle quantity based on total vehicles per day per month

22 Maximum number of days per month of construction

13 hours max hours per day of construction

Emissions for each construction area

Emission location	Activity	number of sources	Emissions per source (lb/hr) NOx Annual	PM10 Annual	SO2 Annual	PM2.5 Annual	Emissions per source (g/s) NOx Annual	PM10 Annual	SO2 Annual	PM2.5 Annual
Turbine construction area	Construction	12	0.1205	0.0074	1.16E-04	0.0068	1.52E-02	9.30E-04	1.46E-05	8.55E-04
Laydown	truck & worker travel	10	1.20E-04	6.37E-06	4.69E-07	4.79E-06	1.52E-05	8.03E-07	5.92E-08	6.04E-07

Annual Fugitive Dust Emissions

Maximum annual construction equipment activity occurs in months 1 - 12.

Bulldozing/Earth clearing

$E = 0.45 * G^{1.5} / H^{1.4} * 2.2046$ PM10 Emissions from bulldozing (lb/hr) from SCAQMD Table A9-9-F

7.5 G = Silt content (%) (from Table A9-9-F-1 for overburden)

15 H = Moisture content of surface material (%) (from Table A9-9-F-2 for moist dirt)

0.46 lb/hr of PM10

Equipment	Quantity/ year	Hours/ Day	Hours/ year/ Unit	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Grader	3	8	704	85%	0.073	0.015
Dozer	2	8	704	85%	0.049	0.010
Scraper	1	8	704	85%	0.024	0.005
				Total	**0.146**	**0.030**

4 Total months of soil movement onsite

22 construction days per month

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

From client: Soil movement will occur within the first 4 months.

Dirt Piling or Material Handling

$E = 0.00112 * (G/5)^{1.3} / (H/2)^{1.4}$ PM10 Emissions from Dirt Piling or Material Handling (lb/hr) from SCAQMD Table A9-9-G

5 G = Mean Wind speed (mph), From NCDC John Wayne Airport NWS surface station, ~12 miles S of site

15 H = Moisture content of surface material (%) (from Table A9-9-G-1 for moist dirt)

0.00007 lb/ton of PM10

Equipment	Quantity/ year	Hours/ Day	Annual Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Loader	2	8	26,628	85%	1.33E-04	2.77E-05
Backhoe	17	8	26,628	85%	1.33E-04	2.77E-05
Dump Trucks	8	8	26,628	85%	1.33E-04	2.77E-05
				Total	**4.00E-04**	**8.31E-05**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

239 yd3/day 303 ton/day

21,016 yd3 26,628 tons 2534 density of soil (lb/yd3)

(USDA NRCS Physical Soil Properties from Orange County for Metz Loamy Sand soil)

Amount of soil moved (from client) 21,016 cubic yds

Cover Storage Pile

SCAQMD Table A9-9-E

$E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J$

PM10 Emission factor from wind erosion of storage piles per day per acre

7.5 G = Silt content (%) (from Table A9-9-E-1 for overburden)

33 H = Mean number of days per year with at least 0.01 inches of precipitation (from Western Regional Climate Center for Anaheim Station)

5 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height

0.5 J = Fraction of TSP that is PM10 = 0.5

2.001 lb/acre/day

wind speed percentage based on 2002-2006 (5 yrs) of wind speed data (actual hours > 12 mph) as recorded at John Wayne airport station

Source	Quantity	Size of Pile (acre)	Days / year	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Cover Storage Pile	1	1	120	85%	1.80E-02	3.75E-03

annual fugitive dust

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
pile size assumed
Days per year accounts for weekend days also, not just work days

Demolition
SCAQMD Table A9-9-H
E=0.00042*J
Total Building and asphalt volume to be demolishe 1,210,912 cubic ft
Demolition to occur in month 1 22 days
55,041 J=Volume (cubic feet) handled per day

Source	PM10 Emissions (lbs/day)	PM2.5 Emissions (lbs/day)	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Demolition	23.12	4.81	0.25	0.05

annual fugitive dust

Travel on unpaved road

$F = 2.1 * G/12 * H/30 * (J/3)^{0.7} * (I/4)^{0.5} * (365-K)/365$ SCAQMD Table A9-9-D

Emission factor for vehicle travel on unpaved roads (lb/VMT)

15 G = Surface silt loading (%) (average value between stone quarrying plant road and farm road, SCAQMD Table A9-9-D-1)

5 H = Mean vehicle speed (mph)

value listed in table I = Mean number of wheels on vehicle

value listed in table J = Mean vehicle weight (ton)

33 K = Mean number of days per year with at least 0.01 inches of precipitation (from Western Regional Climate Center for Anaheim Station)

Vehicle Type	Quantity/ year[1]	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT per Unit	Annual VMT for all Units	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM10 EF (lbs/VMT)	PM2.5 Emissions (tons/yr)
Vibrator	2	2	0.12	0.24	10.56	3	4	0.40	0.000
Forklift	23	4	0.12	0.48	242.88	7	4	0.72	0.003
Crane	21	1	0.06	0.06	27.72	40	12	4.23	0.002
Field Truck	16	2	0.24	0.48	168.96	2	4	0.30	0.001
Water Truck	10	24	0.36	8.64	1900.80	13	10	1.76	0.053
Boom Truck	7	4	0.18	0.72	110.88	13	4	1.11	0.002
Port air compressor	10	0	0	0.00	0.00	0.5	2	0.08	0.000
Light Plant	10	0	0	0.00	0.00	0.5	2	0.08	0.000
Heavy Haul Delivery Truck	33	2	0.06	0.12	85.80	13	10	1.76	0.002
									0.063

Assumed maximum travel speed is 5 mph

Equipment weight from SCAQMD Table A9-9-D-3

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

PM2.5 emission factors from updated CEIDARS List with PM2.5 fractions.

PM2.5 numbers obtained by multiplying the PM10 values by fraction in CEIDARS list for appropriate fugitive dust sources.

Water trucks operate 2 times per hour.

Distances measured from plot plan from Miraloma Avenue to center of construction area and parking area.

1. Truck quantity based on monthly maximums

22 Maximum number of days per month of construction

From site plan:

Approximate site area: 0.12 mi x 0.12 mi

Approximate construction Laydown area: 0.12 mi x 0.06 mi

Approximate plant area: 0.12 mi x 0.06 mi

Travel on paved road

$F = 0.77 * ((G * 0.35)^{0.3})$ SCAQMD Table A9-9-C

Emission factor for vehicle travel on unpaved roads (lb/VMT)

8.85 G = Surface silt loading (oz/yd^3) (construction site without cleaning--conservative. SCAQMD Table A9-9-C-1)

Vehicle Type	Quantity/ year[1]	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT per Unit	Annual VMT for all Units	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (tons/yr)
Concrete Truck	13	1	0.06	0.06	17.16	1.08	85%	0.001
Light Delivery Truck	180	1	0.06	0.06	237.60	1.08	85%	0.019
Worker Personal Vehicles	1161	1	0.12	0.12	3064.16	1.08	85%	0.248
							Total	**0.269**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

PM2.5 emission factors from updated CEIDARS List with PM2.5 fractions.

PM2.5 numbers obtained by multiplying the PM10 values by fraction in CEIDARS list for appropriate fugitive dust sources.

Distances measured from plot plan from Miraloma Avenue to center of construction area and parking lot.

1. Truck quantity based on monthly maximums, worker vehicle and delivery trucks quantity based on total vehicles per day per month

22 Maximum number of days per month of construction

13 Maximum number of hours per construction day

annual fugitive dust

From site plan:
Approximate site area: 0.12 mi x 0.12 mi
Approximate construction Laydown area: 0.12 mi x 0.06 mi
Approximate plant area: 0.12 mi x 0.06 mi

			Total MODEL EMISSION RATE (lb/hr)	
			PM10	PM2.5
Emission location	**Activity**		**Annual**	**Annual**
Plant construction area	grading, excavation		0.0375	0.0078
Plant construction area	demolition		0.0290	0.0060
Plant construction area	travel on unpaved roads		0.0677	0.0144
		Total for plant area	**0.1342**	**0.0282**

			Total MODEL EMISSION RATE (lb/hr)	
			PM10	PM2.5
Emission location	**Activity**		**Annual**	**Annual**
Laydown	demolition		0.0290	0.0060
Laydown	travel on paved roads		0.0614	0.0130
		Total for laydown area	**0.0905**	**0.0191**

					MODEL EMISSION RATE per source (g/s-m2)	
					PM10	PM2.5
Location	**X (m)**	**Y (m)**	**AREA (m2)**	**percent of total area**	**Annual**	**Annual**
Const 1	91.00	46.00	4186.00	0.30	1.23E-06	2.58E-07
Const 2	75.00	128.00	9600.00	0.70	1.23E-06	2.58E-07
Total Plant Construction Area			**13786**			
Lay 1	75.00	55.00	4125.00	0.28	7.82E-07	1.65E-07
Lay 2	91.00	115.00	10465.00	0.72	7.82E-07	1.65E-07
Total Laydown Area			**14590**			

Grading and Demolition - Combustion Emissions

Maximum onsite construction activity occurs in month 1.

Diesel Fired Offroad Equipment

Equipment	Quantity	Hours/Day	Horsepower	Emission factors (lb/hr) PM10	CO	ROC	NOx	SOx	Hourly Emissions (lb/hr) PM10	PM2.5	CO	VOC	NOx	SOx	Daily Emissions (lb/day) PM10	PM2.5	CO	VOC	NOx	SOx
Grader	1	8	120	0.0898	0.5519	0.1663	0.9819	0.0009	0.09	0.08	0.55	0.17	0.98	0.00	0.72	0.66	4.41	1.33	7.86	0.01
Dozer	1	8	175	0.1077	0.8774	0.2498	1.8708	0.0015	0.11	0.10	0.88	0.25	1.87	0.00	0.86	0.79	7.02	2.00	14.97	0.01
Scraper	1	8	175	0.1101	0.9371	0.2510	1.9270	0.0017	0.11	0.10	0.94	0.25	1.93	0.00	0.88	0.81	7.50	2.01	15.42	0.01
Vibrator	1	8	50	0.0283	0.3034	0.1136	0.2833	0.0004	0.03	0.03	0.30	0.11	0.28	0.00	0.23	0.21	2.43	0.91	2.27	0.00
Loader	2	8	100	0.0554	0.3661	0.0993	0.6071	0.0006	0.11	0.10	0.73	0.20	1.21	0.00	0.89	0.82	5.86	1.59	9.71	0.01
Backhoe	2	8	100	0.0554	0.3661	0.0993	0.6071	0.0006	0.11	0.10	0.73	0.20	1.21	0.00	0.89	0.82	5.86	1.59	9.71	0.01
Port air compressor	1	8	50	0.0275	0.2867	0.1220	0.2416	0.0003	0.03	0.03	0.29	0.12	0.24	0.00	0.22	0.20	2.29	0.98	1.93	0.00
Light plant	1	3	50	0.0037	0.0617	0.0118	0.0739	0.0002	0.00	0.00	0.06	0.01	0.07	0.00	0.01	0.01	0.19	0.04	0.22	0.00
	10							**Total**	**0.59**	**0.54**	**4.48**	**1.31**	**7.81**	**0.01**	**4.69**	**4.32**	**35.55**	**10.44**	**62.09**	**0.06**

Notes:
Emission factors from SCAQMD composite off-road emission factors from CARB's Off-Road Model for year 2009.
Equipment list, and quantity from client.
PM2.5 emission factors from updated CEIDARS List with PM2.5 fractions. PM2.5 numbers obtained by multiplying the PM10 values by fraction in CEIDARS list for onroad or offroad diesel vehicles.
Construction day is assumed to be 13 hours long with a 1 hour lunch (7a.m. to 8 p.m.)

Combustion Exhaust from Travel onsite

Vehicle Type	No. Of Unit	Round Trips /Day/ Unit[3]	Round Trip Distance (mile)	Daily VMT (all units)	Emission factor (lb/mile) PM10	PM2.5	CO	VOC	NOx	SOx	Emission factor vehicle type	Hourly Emissions (lb/hr) PM10	PM2.5	CO	VOC	NOx	SOx	Daily Emissions (lb/day) PM10	PM2.5	CO	VOC	NOx	SOx
Field truck (3/4T)	1	2.0	0.24	0.48	8.60E-05	5.38E-05	9.69E-03	9.92E-04	1.01E-03	1.07E-05	passenger	3.1756E-06	1.9879E-06	0.000357623	3.66445E-05	3.71145E-05	3.93776E-07	4.128E-05	2.58431E-05	0.0046491	0.0004764	0.0004825	5.119E-06
Dump truck	2	4.0	0.24	0.96	2.00E-03	1.75E-03	1.28E-02	3.29E-03	4.18E-02	4.01E-05	HHD truck	0.00014738	0.0001294	0.000946882	0.000243191	0.003090159	2.96333E-06	0.0019159	0.001682183	0.0123095	0.0031615	0.0401721	3.852E-05
Water truck	1	24.0	0.36	8.64	2.00E-03	1.75E-03	1.28E-02	3.29E-03	4.18E-02	4.01E-05	HHD truck	0.00132639	0.00116459	0.008521941	0.002188715	0.027811434	2.667E-05	0.017243	0.015139647	0.1107852	0.0284533	0.3615486	0.0003467
Concrete pump truck	1	1.0	0.18	0.18	2.00E-03	1.75E-03	1.28E-02	3.29E-03	4.18E-02	4.01E-05	HHD truck	2.7633E-05	2.4262E-05	0.00017754	4.55982E-05	0.000579405	5.55624E-07	0.0003592	0.000315409	0.002308	0.0005928	0.0075323	7.223E-06
Worker Vehicles in Laydown Area	45	1.0	0.12	0.12	8.60E-05	5.38E-05	9.69E-03	9.92E-04	1.01E-03	1.07E-05	passenger	7.939E-07	4.9698E-07	8.94057E-05	9.16112E-06	9.27862E-06	9.8444E-08	1.032E-05	6.46079E-06	0.0011623	0.0001191	0.0001206	1.28E-06
											Total Unpaved Road	**0.00150536**	**0.00132073**	**0.010093392**	**0.002523309**	**0.031527391**	**3.06811E-05**	**0.0195697**	**0.017169543**	**0.1312141**	**0.032803**	**0.4098561**	**0.0003989**

Notes:
SCAQMD Prepared - Highest (Most Conservative) Emfac 2007 (version 2.3)
Emission Factors for On-Road Passenger Vehicles & Delivery Trucks & Heavy Heavy Duty Diesel Trucks
Scenario Year: 2009
All model years in the range 1965 to 2009
Number of workers in month 1/1.5 people per car
Water trucks operate 2 times per hour.

22 Maximum number of days per month of construction
13 Maximum number of construction work hours per day

From site plan:
Approximate site area: 0.12 mi x 0.12 mi
Approximate construction Laydown area: 0.12 mi x 0.06 mi
Approximate plant area: 0.12 mi x 0.06 mi

Total emissions for each construction area

Emission location	Activity	number of sources	Hourly emissions per source (lb/hr) NOx 1-hr	CO 1 & 8 hr	PM10 24hr	SO2 1 & 3 hr	SO2 24hr	PM2.5 24hr	Hourly emissions per source (g/s) NOx 1-hr	CO 1 & 8 hr	PM10 24hr	SO2 1 & 3 hr	SO2 24hr	PM2.5 24hr
Turbine construction area[1]	demolition, grading	12	0.458	0.262	0.021180	0.000	0.000	0.019	5.78E-02	3.31E-02	2.67E-03	5.39E-05	3.27E-05	2.46E-03
Laydown[2]	demolition, trck, wrkr travel	10	2.34E-01	1.35E-01	1.08E-02	2.18E-04	1.32E-04	9.97E-03	2.95E-02	1.70E-02	1.37E-03	2.75E-05	1.67E-05	1.26E-03

12 sources in plant construction area
10 sources in laydown area

Notes
1 Assumes 70% of Diesel Fired Offroad Equipment emissions for the demolition and grading emissions in the construction area
2 Assumes 30% of Diesel Fired Offroad Equipment emissions for the demolition emissions in the laydown area

Month 1 fugitive dust

Grading and Demolition - Fugitive Dust Emissions

Maximum fugitive dust from construction activity occurs in month 1.

Bulldozing/Earth clearing

$E = 0.45 * G^{1.5} / H^{1.4} * 2.2046$

PM10 Emissions from bulldozing (lb/hr) from SCAQMD Table A9-9-F

7.5 G = Silt content (%) (from Table A9-9-F-1 for overburden)

15 H = Moisture content of surface material (%) (from Table A9-9-F-2 for moist dirt)

0.46 lb/hr of PM10

Equipment	Quantity	Hours/Day	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Grader	1	8	85%	0.07	0.55	0.01	0.11
Dozer	1	8	85%	0.07	0.55	0.01	0.11
Scraper	1	8	85%	0.07	0.55	0.01	0.11
			Total	**0.21**	**1.66**	**0.04**	**0.34**

22 construction days per month

4 Total months of onsite soil movement

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

From client: Soil movement will occur within the first 4 months.

Dirt Piling or Material Handling

$E = 0.00112 * (G/5)^{1.3} / (H/2)^{1.4}$

PM10 Emissions from Dirt Piling or Material Handling (lb/hr) from SCAQMD Table A9-9-G

5 G = Mean Wind speed (mph), From NCDC John Wayne Airport NWS surface station, ~12 miles S of site

15 H = Moisture content of surface material (%) (from Table A9-9-G-1 for moist dirt)

0.00007 lb/ton of PM10

Equipment	Quantity	Hours/Day	Material Handled (ton/day)	Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Loader	2	8	303	26,627	85%	0.0004	0.0030	0.0001	0.0006
Backhoe	2	8	303	26,627	85%	0.0004	0.0030	0.0001	0.0006
Dump Trucks	2	8	303	26,627	85%	0.0004	0.0030	0.0001	0.0006
					Total	**0.0008**	**0.0061**	**0.0002**	**0.0013**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

239 yd3/day 303 ton/day

21,016 yd3 26,627 tons

2534 density of soil (lb/yd3)
(USDA NRCS Physical Soil Properties from Orange County for Metz Loamy Sand soil)

Amount of soil moved (from client) 21,016 cubic yds

Month 1 fugitive dust

Cover Storage Pile
SCAQMD Table A9-9-E
E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J
PM10 Emission factor from wind erosion of storage piles per day per acre

7.5	G = Silt content (%) (from Table A9-9-E-1 for overburden)
33	H = Mean number of days per year with at least 0.01 inches of precipitation (from Western Regional Climate Center for Anaheim Station)
5	I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height
0.5	J = Fraction of TSP that is PM10 = 0.5
2.001	lb/acre/day

wind speed percentage based on 2002-2006 (5 yrs) of wind speed data (actual hours > 12 mph) as recorded at John Wayne airport station

Source	Quantity	Size of Pile (acre)	Hours/Day	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Cover Storage Pile	1	1	24	85%	0.013	0.300	0.003	0.062

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants
pile size assumed

Demolition
SCAQMD Table A9-9-H
E=0.00042*J

Total Building and asphalt volume to be demolished	1210912	cubic ft
Demolition to occur in month 1	22	days
	55,041	J=Building volume (cubic feet) handled per day

Source	PM10 Emissions (lbs/day)	PM2.5 Emissions (lbs/day)	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Demolition	23.12	4.81	0.25	0.05

Month 1 fugitive dust

Travel on unpaved road

$F = 2.1 * G/12 * H/30 * (J/3)^{0.7} * (I/4)^{0.5} * (365-K)/365$ SCAQMD Table A9-9-D

Emission factor for vehicle travel on unpaved roads (lb/VMT)

15 G = Surface silt loading (%) (average value between stone quarrying plant road and farm road, SCAQMD Table A9-9-D-1)

5 H = Mean vehicle speed (mph)

value listed in table I = Mean number of wheels on vehicle

value listed in table J = Mean vehicle weight (ton)

33 K = Mean number of days per year with at least 0.01 inches of precipitation (from Western Regional Climate Center for Anaheim Station)

Vehicle Type	No. Of Unit	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT (all units)	Mean Vehicle Weight (tons)	Number of Wheels on Vehicle	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (lb/hr)
Vibrator	1	2	0.12	0.24	3	4	0.40	85%	0.001
Field Truck	1	2	0.24	0.48	2	4	0.30	85%	0.002
Water Truck	1	24	0.36	8.64	13	10	1.76	85%	0.175
Port air compressor	1	0	0	0	0.5	2	0.08	85%	0.000
Light Plant	1	0	0	0	0.5	2	0.08	85%	0.000
								Total	**0.18**

Assumed maximum travel speed is 5 mph

Equipment weight from SCAQMD Table A9-9-D-3

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

PM2.5 emission factors from updated CEIDARS List with PM2.5 fractions.

PM2.5 numbers obtained by multiplying the PM10 values by fraction in CEIDARS list for appropriate fugitive dust sources.

Water trucks operate 2 times per hour.

Distances measured from plot plan from highway along access road to center of construction area and parking lot.

13 Maximum number of construction work hours per day

Travel on paved road

$F = 0.77 * ((G * 0.35)^{0.3})$ SCAQMD Table A9-9-C

Emission factor for vehicle travel on unpaved roads (lb/VMT)

8.85 G = Surface silt loading (oz/yd^3) (construction site without cleaning--conservative. SCAQMD Table A9-9-C-1)

Vehicle Type	No. of Unit	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT (all units)	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (lbs/hr)	PM10 Emissions (lbs/day)	PM2.5 Emissions (lbs/hr)
Concrete Truck	8	1	0.06	0.06	1.08	85%	0.001	0.010	0.000
Light Delivery Truck	0	1	0.06	0.06	1.08	85%	0.001	0.010	0.000
Worker Personal Vehicles	54	1	0.12	0.12	1.08	85%	0.001	0.019	0.000
						Total	**0.003**	**0.039**	**0.001**

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

PM2.5 emission factors from updated CEIDARS List with PM2.5 fractions.

PM2.5 numbers obtained by multiplying the PM10 values by fraction in CEIDARS list for appropriate fugitive dust sources.

Distances measured from plot plan from Miraloma Avenue to center of construction area and parking lot.

1. Truck quantity based on monthly maximums, worker vehicle quantity based on total vehicles per day per month

22 Maximum number of days per month of construction

13 Maximum number of hours per construction day

Month 1 fugitive dust

Emission location	Activity		Total MODEL EMISSION RATE (lb/hr) PM10 Month 1	PM2.5 Month 1
Plant construction area	grading, excavation		0.1509	0.0314
Plant construction area	demolition		0.8891	0.1849
Plant construction area	travel on unpaved roads		0.1778	0.0377
		Total for plant area	1.2179	0.2540

Emission location	Activity		Total MODEL EMISSION RATE (lb/hr) PM10 Month 1	PM2.5 Month 1
Laydown	demolition		0.8891	0.1849
Laydown	travel on paved roads		0.0030	0.0006
		Total for laydown area	0.8921	0.1856

Location	X (m)	Y (m)	AREA (m2)	percent of total area	MODEL EMISSION RATE (g/s-m2) PM10 24hr	PM2.5 24hr
Const 1	91.00	46.00	4186.00	0.30	1.11E-05	2.32E-06
Const 2	75.00	128.00	9600.00	0.70	1.11E-05	2.32E-06
Total Plant Construction Area			**13786.00**			
Lay 1	75.00	55.00	4125.00	0.28	7.71E-06	1.60E-06
Lay 2	91.00	115.00	10465.00	0.72	7.71E-06	1.60E-06
Total Laydown Area			**14590.00**			

"Annual" (months 2-8) Combustion Emissions from constructing linears/pipelines

Diesel Fired Offroad Equipment

Equipment	Quantity/year	Hours/Day	Horsepower	Days/month	Emission factors (lb/hr) PM10	CO	ROC	NOx	SOx	Annual Emissions (ton/yr) PM10	PM2.5	CO	VOC	NOx	SOx
Loader	15	8	100	22	0.0554	0.3661	0.0993	0.6071	0.0006	0.07	0.07	0.48	0.13	0.80	0.00
Backhoe	15	8	100	22	0.0554	0.3661	0.0993	0.6071	0.0006	0.07	0.07	0.48	0.13	0.80	0.00
	30								**Total**	**0.1**	**0.1**	**1.0**	**0.3**	**1.6**	**0.0**

Notes:
Emission factors from SCAQMD composite off-road emission factors from CARB's Off-Road Model for year 2009.
Equipment and quantity of equipment year based on estimate for the linears being constructed
PM2.5 emission factors from updated CEIDARS List with PM2.5 fractions. PM2.5 numbers obtained by multiplying the PM10 values by fraction in CEIDARS list for onroad or offroad diesel vehicles.

Combustion Exhaust from Travel on pipeline site areas

Vehicle Type	Quantity/year	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT per Unit	Annual VMT for all Units	Emission factor (lb/mile) PM10	PM2.5	CO	VOC	NOx	SOx	Emission factor vehicle type	Annual Emissions (ton/yr) PM10	PM2.5	CO	VOC	NOx	SOx
Field Truck (3/4 ton)	7	2.0	1	2.00	308	8.60E-05	5.38E-05	9.69E-03	9.92E-04	1.01E-03	1.07E-05	passenger	0.000	0.000	0.001	0.000	0.000	1.64237E-06
												Total	**1.32E-05**	**8.29E-06**	**0.001**	**1.53E-04**	**1.55E-04**	**1.64E-06**

SCAQMD Prepared - Highest (Most Conservative) Emfac 2007 (version 2.3)

Emission Factors for On-Road Passenger Vehicles & Delivery Trucks

Equipment and quantity of equipment per year based on estimate for the linears being constructed
Round trips based on average length from site at start of linear area to end of linear area

22 Maximum number of days per month of construction
13 hours max hours per day of construction

Emission location	Activity	number of sources	Emissions per source (lb/hr) NOx Annual	PM10 Annual	SO2 Annual	PM2.5 Annual	Emissions per source (g/s) NOx Annual	PM10 Annual	SO2 Annual	PM2.5 Annual
Linears	underground excavation, grading	31	0.0118	0.0011	1.18E-05	0.0010	1.49E-03	1.36E-04	1.49E-06	1.25E-04

31 Sources in pipeline/linear areas

Annual (months 2-8) Fugitive Dust Emissions from construction of linears

Maximum annual linear construction equipment activity occurs in months 2 - 8.

Dirt Piling or Material Handling

$E = 0.00112 * (G/5)^{1.3} / (H/2)^{1.4}$

PM10 Emissions from Dirt Piling or Material Handling (lb/hr) from SCAQMD Table A9-9-G

5 G = Mean Wind speed (mph), From NCDC John Wayne Airport NWS surface station, ~12 miles S of site

15 H = Moisture content of surface material (%) (from Table A9-9-G-1 for moist dirt)

0.00007 lb/ton of PM10

Equipment	Quantity/ year	Hours/ Day	Annual Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Loader	15	8	33	85%	1.66E-07	3.45E-08
Backhoe	15	8	33	85%	1.66E-07	3.45E-08
				Total	**3.32E-07**	**6.90E-08**

7 Total months of soil movement for construction of linears

22 construction days per month

Notes:

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

0 yd3/day 0 ton/day

26 yd3 33 tons 2534 density of soil (lb/yd3)

(USDA NRCS Physical Soil Properties from Orange County for Metz Loamy Sand soil)

Amount of soil moved 26 cubic yds

Length of disturbed area	10.00	m	10.936	yd
Assumed width of disturbed area	1	m	1.094	yd
Assumed depth of distrubed area	2	m	2.187	yd

Travel on paved road

$F = 0.77 * ((G * 0.35)^{0.3})$ SCAQMD Table A9-9-C

Emission factor for vehicle travel on unpaved roads (lb/VMT)

8.85 G = Surface silt loading (oz/yd^3) (construction site without cleaning--conservative. SCAQMD Table A9-9-C-1)

Vehicle Type	Quantity/ year	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT per Unit	Annual VMT for all Units	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (tons/yr)	PM2.5 Emissions (tons/yr)
Field truck	7	2	1	2	308	1.08	85%	0.025	0.005
							Total	**0.025**	**0.005**

Notes:

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

PM2.5 emission factors from updated CEIDARS List with PM2.5 fractions.

PM2.5 numbers obtained by multiplying the PM10 values by fraction in CEIDARS list for appropriate fugitive dust sources.

Equipment and quantity of equipment year based on estimate for the linears being constructed

Round trips based on average length from site at start of linear area to end of linear area

22 Maximum number of days per month of construction

13 Maximum number of hours per construction day

Emission location	Activity		Total MODEL EMISSION RATE (lb/hr) PM10 Annual	PM2.5 Annual
Linear areas	construction		7.57E-08	1.57E-08
Linear areas	travel on paved roads		0.0057	0.0012
		Total for linears area	**0.0057**	**0.0012**

					MODEL EMISSION RATE per source (g/s-m2) PM10 Annual	PM2.5 Annual
26 area source	100	10	1000	0.034	2.47E-08	5.24E-09
			26000	0.895	2.47E-08	5.24E-09
rdust11	10	26	260	0.009	2.47E-08	5.24E-09
rdust16	10	84	840	0.029	2.47E-08	5.24E-09
rdust17	28	10	280	0.010	2.47E-08	5.24E-09
rddust23	80	10	800	0.028	2.47E-08	5.24E-09
rddust31	10	88	880	0.030	2.47E-08	5.24E-09
Total linear area			**29060**			

Worst month Combustion Emissions from constructing linears/pipelines

Maximum linears construction activity occurs in month 5.

Diesel Fired Offroad Equipment

Equipment	Quantity	Hours/Day	Horsepower	Emission factors (lb/hr) PM10	CO	ROC	NOx	SOx	Hourly Emissions (lb/hr) PM10	PM2.5	CO	VOC	NOx	SOx	Daily Emissions (lb/day) PM10	PM2.5	CO	VOC	NOx	SOx
Loader	3	8	100	0.0554	0.3661	0.0993	0.6071	0.0006	0.17	0.15	1.10	0.30	1.82	0.00	1.33	1.22	8.79	2.38	14.57	0.01
Backhoe	3	8	100	0.0554	0.3661	0.0993	0.6071	0.0006	0.17	0.15	1.10	0.30	1.82	0.00	1.33	1.22	8.79	2.38	14.57	0.01
	6							**Total**	**0.33**	**0.31**	**2.20**	**0.60**	**3.64**	**0.00**	**2.66**	**2.45**	**17.57**	**4.77**	**29.14**	**0.03**

Notes:
Emission factors from SCAQMD composite off-road emission factors from CARB's Off-Road Model for year 2009.
PM2.5 emission factors from updated CEIDARS List with PM2.5 fractions. PM2.5 numbers obtained by multiplying the PM10 values by fraction in CEIDARS list for onroad or offroad diesel vehicles.
Construction day is assumed to be 13 hours long with a 1 hour lunch (7a.m. to 8 p.m.)

Combustion Exhaust from Travel on pipeline site areas

Vehicle Type	No. Of Unit	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT (all units)	Emission factor (lb/mile) PM10	PM2.5	CO	VOC	NOx	SOx	Emission factor vehicle type	Hourly Emissions (lb/hr) PM10	PM2.5	CO	VOC	NOx	SOx	Daily Emissions (lb/day) PM10	PM2.5	CO	VOC	NOx	SOx
Field truck (3/4T)	1	2.0	1.00	2.00	8.60E-05	5.38E-05	9.69E-03	9.92E-04	1.01E-03	1.07E-05	passenger	1.3232E-05	8.2831E-06	0.0014901	0.000152685	0.000154644	1.6407E-06	0.000172	0.00010768	0.0193712	0.0019849	0.0020104	2.133E-05
											Total	**1.3232E-05**	**8.2831E-06**	**0.0014901**	**0.000152685**	**0.000154644**	**1.6407E-06**	**0.000172**	**0.00010768**	**0.0193712**	**0.0019849**	**0.0020104**	**2.133E-05**

Notes:

SCAQMD Prepared - Highest (Most Conservative) Emfac 2007 (version 2.3)

Emission Factors for On-Road Passenger Vehicles & Delivery Trucks

Scenario Year: 2009

All model years in the range 1965 to 2009

Equipment and quantity of equipment per year based on estimate for the linears being constructed
Round trips based on average length from site at start of linear area to end of linear area

22 Maximum number of days per month of construction
13 Maximum number of construction work hours per day

Total emissions for area

Emission location	Activity	number of sources	Hourly emissions per source (lb/hr) NOx 1-hr	CO 1 & 8 hr	PM10 24hr	SO2 1 & 3 hr	SO2 24hr	PM2.5 24hr
linears	excavation, grading	31	0.118	0.071	0.006604	0.000	0.000	0.006

Hourly emissions per source (g/s) NOx 1-hr	CO 1 & 8 hr	PM10 24hr	SO2 1 & 3 hr	SO2 24hr	PM2.5 24hr
1.48E-02	8.94E-03	8.33E-04	1.48E-05	9.12E-06	7.66E-04

31 Sources in pipeline/linear excavation areas

Fugitive Dust Emissions from the construction of linears during month 5

Maximum fugitive dust from construction activity occurs in month 5.

Dirt Piling or Material Handling

$E = 0.00112 * (G/5)^{1.3} / (H/2)^{1.4}$

PM10 Emissions from Dirt Piling or Material Handling (lb/hr) from SCAQMD Table A9-9-G

5 G = Mean Wind speed (mph), From NCDC John Wayne Airport NWS surface station, ~12 miles S of site

15 H = Moisture content of surface material (%) (from Table A9-9-G-1 for moist dirt)

0.00007 lb/ton of PM10

Equipment	Quantity	Hours/Day	Material Handled (ton/day)	Material Handled (ton)	Watering Control Efficiency	PM10 Emissions (lb/hr)	PM10 Emissions (lb/day)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (lb/day)
Loader	3	8	0	33	85%	0.0000	0.0000	0.0000	0.0000
Backhoe	3	8	0	33	85%	0.0000	0.0000	0.0000	0.0000
					Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**

7 Total months of soil movement for construction of linears

22 construction days per month

Notes:

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

0 yd3/day 0 ton/day

26 yd3 33 tons 2534 density of soil (lb/yd3)

(USDA NRCS Physical Soil Properties from Orange County for Metz Loamy Sand soil)

Amount of soil moved 26 cubic yds

Length of disturbed area	10.00	m	10.936 yd
Assumed width of disturbed area	1	m	1.094
Assumed depth of distrubed area	2	m	2.187

Travel on paved road

$F = 0.77 * ((G * 0.35)^{0.3})$ SCAQMD Table A9-9-C

Emission factor for vehicle travel on unpaved roads (lb/VMT)

8.85 G = Surface silt loading (oz/yd^3) (construction site without cleaning--conservative. SCAQMD Table A9-9-C-1)

Vehicle Type	No. of Unit	Round Trips /Day/ Unit	Round Trip Distance (mile)	Daily VMT (all units)	PM10 EF (lbs/VMT)	Watering Control Efficiency	PM10 Emissions (lbs/hr)	PM10 Emissions (lbs/day)	PM2.5 Emissions (lbs/hr)	PM2.5 Emissions (lbs/day)
Field truck	1	2	1	2	1.08	85%	0.025	0.324	0.005	0.069
						Total	**0.025**	**0.324**	**0.005**	**0.069**

Notes:

Water efficiency from CEQA Table 11-4 watering 3 times daily or using chemical suppressants

PM2.5 emission factors from updated CEIDARS List with PM2.5 fractions.

PM2.5 numbers obtained by multiplying the PM10 values by fraction in CEIDARS list for appropriate fugitive dust sources.

Equipment and quantity of equipment per year based on estimate for the linears being constructed

Round trips based on average length from site at start of linear area to end of linear area

22 Maximum number of days per month of construction

13 Maximum number of hours per construction day

Emission location	Activity		Total MODEL EMISSION RATE (lb/hr) PM10 24 hr	PM2.5 24 hr
Linear areas	construction		0.0000	0.0000
Linear areas	travel on paved road		0.0249	0.0053
		Total for linears area	**0.0249**	**0.0053**

					MODEL EMISSION RATE per source (g/s-m2) PM10 24hr	PM2.5 24hr
26 area source	100	10	1000	0.034	1.08E-07	2.29E-08
			26000	0.895	1.08E-07	2.29E-08
rdust11	10	26	260	0.009	1.08E-07	2.29E-08
rdust16	10	84	840	0.029	1.08E-07	2.29E-08
rdust17	28	10	280	0.010	1.08E-07	2.29E-08
rddust23	80	10	800	0.028	1.08E-07	2.29E-08
rddust31	10	88	880	0.030	1.08E-07	2.29E-08
Total linear area			**29060**			

OPERATING EMISSIONS

Vendor Data

Performance By:

Project Info: **City of Anaheim**

Engine: **LM6000PC Sprint with Water Injection for NOx control**
Deck Info:
Generator:

Date: **10-Oct-07**

Fuel:

Version: **Rev D**

	PERMIT SUBSET												
Case #	**1**	**2**	**3**				**4**	**5**	**6**	**7**	**8**	**9**	**ISO**
Ambient Conditions	100	75	50	100	75	50	100	75	50	100	75	50	100
Dry Bulb, °F	109.0	109.0	109.0	89.0	89.0	89.0	59.0	59.0	59.0	38.0	38.0	38.0	59.0
Wet Bulb, °F	71.5	71.5	71.5	68.8	68.8	68.8	51.4	51.4	51.4	34.7	34.7	34.7	51.5
RH, %	15.0	15.0	15.0	36.0	36.0	36.0	60.0	60.0	60.0	72.3	72.3	72.3	60.0
Altitude, ft	220.0	220.0	220.0	220.0	220.0	220.0	220.0	220.0	220.0	220.0	220.0	220.0	0.0
Ambient Pressure, psia	14.580	14.580	14.580	14.580	14.580	14.580	14.580	14.580	14.580	14.580	14.580	14.580	14.696
Engine Inlet													
Comp Inlet Temp, °F	50.2	97.2	109.0	45.0	89.0	89.0	45.0	59.0	59.0	38.0	38.0	38.0	59.0
RH, %	95.0	21.3	15.0	95.0	36.0	36.0	95.0	60.0	60.0	72.3	72.3	72.3	60.0
Conditioning	CHILL	CHILL	NONE	CHILL	NONE	NONE	CHILL	NONE	NONE	NONE	NONE	NONE	NONE
Tons or kBtu/hr	1325	226	0	1398	0	0	338	0	0	0	0	0	0
Pressure Losses													
Inlet Loss, inH20	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Volute Loss, inH20	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Exhaust Loss, inH20	9.40	6.79	4.74	9.59	6.93	4.83	9.59	6.93	4.84	9.83	7.10	4.95	9.27
Partload %	100	75	50	100	75	50	100	75	50	100	75	50	100
kW, Gen Terms	***50116**	**37736**	**25069**	**50951**	**38220**	**25486**	**50951**	**38220**	**25486**	**50851**	**38276**	**25524**	**49169**
Est. Btu/kW-hr, LHV	**8527**	**9052**	**10266**	**8511**	**8997**	**10162**	**8511**	**8961**	**10042**	**8502**	**8917**	**10054**	**8569**
Fuel Flow													
MMBtu/hr, LHV	427.3	341.6	257.4	433.6	343.9	259.0	433.6	342.5	255.9	432.3	341.3	256.6	421.3
lb/hr	20752	16588	12498	21058	16699	12576	21058	16631	12429	20994	16575	12461	20461
NOx Control	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**
Water Injection													
lb/hr	19394	14839	9418	20295	13985	8151	20295	12997	10626	22879	14890	10355	19197
Temperature, °F	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SPRINT	**LPC**	**LPC**	**LPC**	**LPC**	**LPC**	**LPC**	**LPC**	**LPC**	**OFF**	**HPC**	**HPC**	**OFF**	**LPC**
lb/hr	8761	8485	8096	8246	8731	8731	8246	9528	0	3772	3772	0	9604
Control Parameters													
HP Speed, RPM	10451	10440	10124	10432	10389	9976	10432	10102	9826	10454	10024	9663	10480
LP Speed, RPM	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
PS3 - CDP, psia	456.3	384.2	314.1	461.9	388.3	321.5	461.9	398.0	332.4	463.2	405.6	341.2	450.9
T3CRF - CDT, °F	972	999	943	970	981	897	970	908	908	988	905	865	978
T48IN, °R	2038	2003	1899	2038	1989	1855	2038	1914	1811	2038	1887	1758	2038
T48IN, °F	1578	1543	1440	1578	1529	1395	1578	1454	1352	1578	1427	1298	1578
Exhaust Parameters													
Temperature, °F	841.6	858.9	832.6	838.6	846.3	795.0	838.6	785.5	754.2	836.7	759.9	710.4	846.3
lb/sec	296.3	252.2	212.4	300.1	255.6	219.9	300.1	267.7	231.2	301.6	275.7	241.1	292.8
lb/hr	1066554	907936	764619	1080197	920281	791661	1080197	963857	832416	1085651	992555	867866	1054016
Energy, Btu/s- Ref 0 °R	100077	86197	70566	101010	86555	70791	101010	85645	71130	100982	85721	71048	99273
Energy, Btu/s- Ref T2 °F	61977	50812	40309	62858	51191	40576	62858	50844	41402	63310	51553	41429	60971
Cp, Btu/lb-R	0.2776	0.2775	0.2743	0.2772	0.2772	0.2728	0.2772	0.2731	0.2683	0.2760	0.2703	0.2656	0.2778
Emissions (NOT FOR USE IN ENVIRONMENTAL PERMITS)													
NOx ppmvd Ref 15% O2	25	25	25	25	25	25	25	25	25	25	25	25	25
NOx as NO2, lb/hr	43	34	26	44	35	26	44	34	26	43	34	26	42
CO ppmvd Ref 15% O2	15	8	7	18	8	7	18	15	21	30	29	33	14
CO, lb/hr	15.60	6.93	4.53	19.40	6.35	4.45	19.40	12.20	13.25	31.27	24.35	20.91	14.81
CO2, lb/hr	55928.00	44738.18	33747.90	56750.23	45042.00	33968.16	56750.23	44873.37	33598.69	56570.61	44728.35	33690.59	55143.81
HC ppmvd Ref 15% O2	2	2	2	2	2	2	2	2	2	3	3	4	2
HC, lb/hr	1.25	1.00	0.75	1.26	1.00	0.75	1.26	1.00	0.80	1.98	1.54	1.34	1.23
SOX as SO2, lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	PERMIT SUBSET												
Case #	**1**	**2**	**3**				**4**	**5**	**6**	**7**	**8**	**9**	**ISO**
Exh Wght % Wet (NOT FOR USE IN ENVIRONMENTAL PERMITS)													
AR	1.2195	1.2216	1.2294	1.2211	1.2200	1.2291	1.2211	1.2281	1.2444	1.2269	1.2377	1.2498	1.2195
N2	71.5118	71.6360	72.0932	71.6036	71.5421	72.0710	71.6036	72.0172	72.9699	71.9485	72.5764	73.2861	71.5143
O2	14.4945	14.9851	15.8589	14.5081	15.0036	16.0275	14.5081	15.4893	16.6650	14.6735	15.8721	16.9809	14.5126
CO2	5.2438	4.9275	4.4137	5.2537	4.8944	4.2907	5.2537	4.6556	4.0363	5.2108	4.5064	3.8820	5.2318
H20	7.5260	7.2263	6.4018	7.4089	7.3365	6.3789	7.4089	6.6059	5.0806	6.9345	5.8025	4.5965	7.5175
SO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO	0.0015	0.0008	0.0006	0.0018	0.0007	0.0006	0.0018	0.0013	0.0016	0.0029	0.0025	0.0024	0.0014
HC	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0001
NOX	0.0028	0.0026	0.0023	0.0028	0.0026	0.0023	0.0028	0.0025	0.0021	0.0027	0.0024	0.0020	0.0028
Exh Mole % Dry (NOT FOR USE IN ENVIRONMENTAL PERMITS)													
AR	0.9674	0.9653	0.9617	0.9674	0.9651	0.9609	0.9674	0.9633	0.9589	0.9670	0.9621	0.9578	0.9673
N2	80.8967	80.7149	80.4145	80.8986	80.7000	80.3477	80.8986	80.5504	80.1818	80.8610	80.4496	80.0899	80.8898
O2	14.3552	14.7821	15.4869	14.3506	14.8170	15.6434	14.3506	15.1676	16.0321	14.4379	15.4033	16.2469	14.3713
CO2	3.7760	3.5341	3.1338	3.7784	3.5143	3.0449	3.7784	3.3147	2.8232	3.7278	3.1797	2.7005	3.7669
H20	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO	0.0017	0.0009	0.0007	0.0020	0.0008	0.0006	0.0020	0.0014	0.0017	0.0032	0.0027	0.0026	0.0016
HC	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0004	0.0003	0.0003	0.0002
NOX	0.0028	0.0026	0.0023	0.0028	0.0026	0.0022	0.0028	0.0024	0.0021	0.0027	0.0023	0.0020	0.0028
Exh Mole % Wet (NOT FOR USE IN ENVIRONMENTAL PERMITS)													
AR	0.8543	0.8568	0.8656	0.8560	0.8550	0.8652	0.8560	0.8640	0.8823	0.8625	0.8746	0.8884	0.8544
N2	71.4388	71.6438	72.3776	71.5811	71.4989	72.3472	71.5811	72.2493	73.7769	72.1205	73.1347	74.2871	71.4432
O2	12.6769	13.1208	13.9391	12.6977	13.1276	14.0857	12.6977	13.6045	14.7515	12.8773	14.0028	15.0697	12.6930
CO2	3.3345	3.1369	2.8206	3.3432	3.1136	2.7418	3.3432	2.9731	2.5977	3.3248	2.8906	2.5048	3.3270
H20	11.6913	11.2385	9.9943	11.5175	11.4016	9.9574	11.5175	10.3056	7.9879	10.8092	9.0924	7.2454	11.6784
SO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO	0.0015	0.0008	0.0006	0.0018	0.0007	0.0006	0.0018	0.0013	0.0016	0.0029	0.0025	0.0024	0.0014
HC	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003	0.0002
NOX	0.0024	0.0023	0.0021	0.0025	0.0023	0.0020	0.0025	0.0022	0.0019	0.0024	0.0021	0.0018	0.0024
Aero Energy Fuel Number	**900-773 (City of Anaheim Peaker)**												
	Volume %	**Weight %**											
Hydrogen	0.0000	0.0000											
Methane	96.7000	92.4298											
Ethane	1.2500	2.2395											
Ethylene	0.0000	0.0000											
Propane	0.2560	0.6726											
Propylene	0.0000	0.0000											
Butane	0.0920	0.3186											
Butylene	0.0000	0.0000											
Butadiene	0.0000	0.0000											
Pentane	0.0210	0.0903											
Cyclopentane	0.0000	0.0000											
Hexane	0.0200	0.1027											
Heptane	0.0000	0.0000											
Carbon Monoxide	0.0000	0.0000											
Carbon Dioxide	1.4330	3.7577											
Nitrogen	0.2330	0.3889											
Water Vapor	0.0000	0.0000											
Oxygen	0.0000	0.0000											
Hydrogen Sulfide	0.0000	0.0000											
Ammonia	0.0000	0.0000											
Btu/lb, LHV	20593												
Btu/scf, LHV	913												
Btu/scf, HHV	1012												
Btu/lb, HHV	22835												
Fuel Temp, °F	77.0												
NOx Scalar	0.976												
Specific Gravity	0.58												
Engine Exhaust													
Exhaust Avg. Mol. Wt., Wet Basis	28.0	28.0	28.1	28.0	28.0	28.1	28.0	28.1	28.3	28.1	28.2	28.4	28.0
Inlet Flow Wet, pps	286.4	256.5	250.8	290.0	260.8	261.1	290.0	279.2	268.8	292.1	289.4	285.0	282.8
Inlet Flow Dry, pps	284.3	254.4	248.8	288.3	258.0	258.3	288.3	277.4	267.0	291.1	288.4	284.0	281.0
Shaft HP	68377	51582	34449	69512	52238	35012	69512	52238	35012	69377	52314	35063	67090
Generator Information													
Capacity kW	48952	48952	48952	55536	55536	55536	64115	64115	64115	69366	69366	69366	64115
Efficiency	0.983	0.981	0.976	0.983	0.981	0.976	0.983	0.981	0.976	0.983	0.981	0.976	0.983
Inlet Temp, °F	109.0	109.0	109.0	89.0	89.0	89.0	59.0	59.0	59.0	38.0	38.0	38.0	59.0
Gear Box Loss	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TRQ48, Torque Limit Cold End	122121	95993	70510	124066	97090	71919	124066	98427	74396	124522	100293	75821	119904

	PERMIT SUBSET												
Case #	**1**	**2**	**3**				**4**	**5**	**6**	**7**	**8**	**9**	**ISO**
Correct Control Parameters													
PS3JQA, psia	462.025	389.020	318.041	467.695	393.172	325.534	467.695	402.993	336.570	469.011	410.689	345.481	456.512
XN25R3, rpm	6311	6259	6173	6301	6266	6175	6301	6235	6050	6269	6178	6035	6320
8th Stage Bleed													
Flow, pps	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pressure, psia	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Temperature, °R	0	0	0	0	0	0	0	0	0	0	0	0	0
CDP Bleed													
Flow, pps	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pressure, psia	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Est. Gas Pressure at Baseplate, psig	**597.3**	**496.4**	**397.4**	**604.9**	**500.7**	**404.1**	**604.9**	**507.5**	**411.3**	**605.2**	**512.7**	**418.7**	**589.9**
CardPack	**8fk**	**8fk**	**8fk**	**8fk**	**8fk**	**8fk**	**8fk**	**8fk**	**8fk**	**8fk**	**8fk**	**8fk**	**8fk**
Exhaust CardPack	**7f5**	**7f5**	**7f5**	**7f5**	**7f5**	**7f5**	**7f5**	**7f5**	**7f5**	**7f5**	**7f5**	**7f5**	**7f5**
NSI	**304**	**305**	**0**	**304**	**0**	**0**	**304**	**0**	**439**	**304**	**0**	**439**	**304**
NSI	**0**	**0**	**0**	**1716**	**0**	**0**	**1716**	**0**	**0**	**1716**	**0**	**0**	**0**
NSI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
SOx, Lb/hr	0.33	0.27	0.20	0.34	0.27	0.20	0.34	0.27	0.20	0.34	0.27	0.20	**0.33**
PM10, lb/hr	2.99	2.39	1.80	3.04	2.41	1.81	3.04	2.40	1.79	3.03	2.39	1.80	**2.95**
SCR / CO System performance													
Stack Emissions (after SCR/oxcat)													
NOx ppmvd Ref 15% O2	2.32	2.32	2.32	2.32	2.32	2.32	2.32	2.32	2.32	2.32	2.32	2.32	**2.32**
CO ppmvd Ref 15% O2	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	**6.00**
VOC ppmvd Ref 15% O2	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	**2.00**
NH3 ppmvd Ref 15% O2	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	**5.00**
NOx as NO2, lb/hr	3.99	3.19	2.40	4.05	3.21	2.42	4.05	3.20	2.38	4.03	3.18	2.39	**3.93**
CO, lb/hr	6.28	5.01	3.78	6.36	5.08	3.81	6.36	5.01	3.75	6.34	5.00	3.76	**6.17**
VOC, lb/hr	1.19	0.95	0.71	1.20	0.95	0.71	1.20	0.95	0.70	1.20	0.96	0.71	**1.17**
NH3, lb/hr	3.59	2.86	2.12	3.64	2.88	2.14	3.64	2.83	2.07	3.59	2.79	2.05	**3.54**
SOX, lb/hr	0.33	0.27	0.20	0.34	0.27	0.20	0.34	0.27	0.20	0.34	0.27	0.20	**0.33**
PM10, lb/hr	2.99	2.39	1.80	3.04	2.41	1.81	3.04	2.40	1.79	3.03	2.39	1.80	**2.95**
Stack exhaust temperature, F	841.60	858.90	832.60	838.60	846.30	795.00	838.60	785.50	754.20	836.70	759.90	710.40	**846.30**
Stack exhaust mass flow, pps	296.30	252.20	212.40	300.10	255.60	219.90	300.10	267.70	231.20	301.60	275.70	241.10	**292.80**
SO2 ppmvd Ref 15% O2	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14

STARTUP

Derived from typical startup performances curves provided by GE

	NOx		emission rate				
startup minute	0-1		0			0	
	1-2		0			0	
	2-3		16	lb/hr /	60 minutes =	0.267	lb
	3-4		16			0.267	
	4-5		16			0.267	
	5-6		16			0.267	
	6-6.5	16 - 50	33			0.275	
	6.5-7	50 - 18	34			0.283	
	7-8	18 - 26	22			0.367	
	8-9	26 - 34	30			0.500	
	9-10	34 - 42	38			0.633	
					TOTAL STARTUP	3.125	LB/EVENT
warmup	Derived from discussion with Steve Brock PB Engineering						
	10-11	42-38.5	40.25			0.671	
	11-12	38.5-34.5	36.5			0.608	
	12-13	34.5-30.5	32.5			0.542	
	13-14	30.5-26.75	28.625			0.477	
	14-15	26.75-23	24.875			0.415	
	15-16	23-19.25	21.125			0.352	
	16-17	19.25-15.25	17.25			0.288	
	17-18	15.25-11.5	13.375			0.223	
	18-19	11.5-7.75	9.625			0.160	
	19-20	7.75-3.86	5.805			0.097	
					TOTAL WARMUP	3.832	LB/EVENT

STARTUP

	CO		emission rate					
startup minute	0-1		0				0	
	1-2		0				0	
	2-3		21	lb/hr /		60 minutes =	0.350	lb
	3-4		21				0.350	
	4-5		21				0.350	
	5-6		21				0.350	
	6-6.75	21-5	13				0.163	
	6.75-7	5-10	7.5				0.031	
	7-8	10-15	12.5				0.208	
	8-8.5	15-19	17				0.142	
	8.5-8.75	19-13	16				0.067	
	8.75-9	13-14	13.5				0.056	
	9-10	14-18	16				0.267	
					TOTAL STARTUP		2.333	LB/EVENT
warmup	Derived from discussion with Steve Brock PB Engineering							
	10-11	17.5-16.6	17.05				0.284	
	11-12	16.6-15.6	16.1				0.268	
	12-13	15.6-14.6	15.1				0.252	
	13-14	14.6-13.5	14.05				0.234	
	14-15	13.5-12.5	13				0.217	
	15-16	12.5-11.5	12				0.200	
	16-17	11.5-10.5	11				0.183	
	17-18	10.5-9.5	10				0.167	
	18-19	9.5-8.5	9				0.150	
	19-20	8.5-7.5	8				0.133	
					TOTAL WARMUP		2.088	LB/EVENT

STARTUP

	PM10		emission				
startup			rate				
minute	0-1		0			0	
	1-2		0			0	
	2-3		0.75	lb/hr /	60 minutes =	0.013	lb
	3-4		0.75			0.013	
	4-5		0.75			0.013	
	5-6		0.75			0.013	
	6-7	0.75-1.25	1			0.017	
	7-8	1.25-1.75	1.5			0.025	
	8-9	1.75-2.25	2			0.033	
	9-10	2.25-3	2.625			0.044	
startup					TOTAL STARTUP	0.169	LB/EVENT
warmup	Derived from discussion with Steve Brock PB Engineering						
	10-11		3			0.050	
	11-12		3			0.050	
	12-13		3			0.050	
	13-14		3			0.050	
	14-15		3			0.050	
	15-16		3			0.050	
	16-17		3			0.050	
	17-18		3			0.050	
	18-19		3			0.050	
	19-20		3			0.050	
					TOTAL WARMUP	0.500	LB/EVENT

STARTUP

	VOC		emission				
startup			rate				
minute	0-1		0			0	
	1-2		0			0	
	2-3		0.5	lb/hr /	60 minutes =	0.008	lb
	3-4		0.5			0.008	
	4-5		0.5			0.008	
	5-6		0.5			0.008	
	6-6.25	0.5-0.1	0.3			0.001	
	6.25-7	0.1-0.2	0.15			0.002	
	7-8	0.2-0.25	0.225			0.004	
	8-9	0.25	0.25			0.004	
	9-10	0.25-0.3	0.275			0.005	
					TOTAL STARTUP	0.049	LB/EVENT
warmup	Derived from discussion with Steve Brock PB Engineering						
	10-11		0.3			0.005	
	11-12		0.3			0.005	
	12-13		0.3			0.005	
	13-14		0.3			0.005	
	14-15		0.3			0.005	
	15-16		0.3			0.005	
	16-17		0.3			0.005	
	17-18		0.3			0.005	
	18-19		0.3			0.005	
	19-20		0.3			0.005	
					TOTAL WARMUP	0.050	LB/EVENT

SHUTDOWN

Derived from typical shutdown performances curves provided by GE

		PM10		emission rate					
shutdown	minute	0-1	3.1-2.3	2.7				0.045	
		1-2	2.3-1.4	1.85				0.031	
		2-3	1.4-0.7	1.05	lb/hr /		60 minutes =	0.018	lb
		3-4		0.7				0.012	
		4-5		0.7				0.012	
		5-6		0.7				0.012	
		6-7		0.7				0.012	
		7-8		0.7				0.012	
						TOTAL SHUTDOWN		0.152	LB/EVENT

		NOx		emission rate					
shutdown	minute	0-1	42-31	36.5				0.608	
		1-2	31-20	25.5				0.425	
		2-2.3	20-18	19	lb/hr /		60 minutes =	0.095	lb
		2.3-2.4	18-50	34				0.057	
		2.4-3	50-16	33				0.330	
		3-4		16				0.267	
		4-5		16				0.267	
		5-6		16				0.267	
		6-7		16				0.267	
		7-8		16				0.267	
						TOTAL SHUTDOWN		2.848	LB/EVENT

SHUTDOWN

		CO		emission rate					
shutdown	minute	0-0.9	17.5-13	15.25				0.229	
		0.9-1.1	13-19.5	16.25				0.054	
		1.1-2	19.5-11.5	15.5				0.233	
		2-2.4	11.5-5	8.25	lb/hr /		60 minutes =	0.055	lb
		2.4-3	5-21	13				0.130	
		3-4		21				0.350	
		4-5		21				0.350	
		5-6		21				0.350	
		6-7		21				0.350	
		7-8		21				0.350	
						TOTAL SHUTDOWN		2.450	LB/EVENT

		VOC		emission rate					
shutdown	minute	0-1	0.25-0.2	0.225				0.004	
		1-2	0.2-0.15	0.175				0.003	
		2-2.6	0.15-0.1	0.125	lb/hr /		60 minutes =	0.001	lb
		2.6-3	0.1-0.5	0.3				0.002	
		3-4		0.5				0.008	
		4-5		0.5				0.008	
		5-6		0.5				0.008	
		6-7		0.5				0.008	
		7-8		0.5				0.008	
						TOTAL SHUTDOWN		0.052	LB/EVENT

Turbine Operating Scenarios

Case	1	2	3	4	5	6	7	8	9
Ambient Temperature (°F)	109	109	109	59	59	59	38	38	38
Stack Diameter (ft)	11.67	11.67	11.67	11.67	11.67	11.67	11.67	11.67	11.67
Exhaust Flow (lb/hr)	1,066,554	907,936	764,619	1,080,197	963,857	832,416	1,085,651	992,555	867,866
CTG Load Level (%)	**100**	**75**	**50**	**100**	**75**	**50**	**100**	**75**	**50**
Evap. Cooler	ON	ON	NONE	ON	NONE	NONE	NONE	NONE	NONE
Data from Vendor	Area =	106.96	ft^2						

Expected Operation of Each Gas Turbine - Normal Operation

(Reference: City of Anaheim Date 9/24/07 Rev B LM6000 PC Sprint with Water Injection for NOx Control)

Heat Consumed (MMBTU/hr) - LHV	427.3	341.6	257.4	433.6	342.5	255.9	432.3	341.3	256.6
Heat Consumed (MMBTU/hr) - HHV	473.6	378.6	285.3	480.6	379.6	283.6	479.2	378.3	284.4
Turbine Outlet Temperature (°F)	841.6	858.9	832.6	838.6	785.5	754.2	836.7	759.9	710.4
Turbine Outlet Temperature (°K)	722.9	732.5	717.9	721.3	691.8	674.4	720.2	677.5	650.0
Exhaust Flow (acfm)	584126	503865	415867	590234	505123	425274	592346	509469	427386
Stack Exit Velocity, ft/m	5461.0	4710.7	3888.0	5518.1	4722.4	3975.9	5537.9	4763.1	3995.7
Stack Exit Velocity, m/s	27.74	23.93	19.75	28.03	23.99	20.20	28.13	24.20	20.30
Nitrogen, % Vol	80.90	80.71	80.41	80.90	80.55	80.18	80.86	80.45	80.09
Oxygen, % Vol	14.36	14.78	15.49	14.35	15.17	16.03	14.44	15.40	16.25
Carbon Dioxide, % Vol	3.78	3.53	3.13	3.78	3.31	2.82	3.73	3.18	2.70
Argon, % Vol	0.97	0.97	0.96	0.97	0.96	0.96	0.97	0.96	0.96
Water Vapor, % Vol	11.69	11.24	9.99	11.52	10.31	7.99	10.81	9.09	7.25
Molecular Weight	31.40	31.29	31.03	31.37	31.11	30.64	31.23	30.88	30.50

Average Emission Rates from Each Gas Turbine (lbs/hr) - Normal Operations

NO_X at 2.5 ppmvd BACT level	3.99	3.19	2.40	4.05	3.20	2.38	4.03	3.18	2.39
CO at 6.0 ppmvd BACT level	6.28	5.01	3.78	6.36	5.01	3.75	6.34	5.00	3.76
VOC at 2.0 ppmvd BACT level	1.19	0.95	0.71	1.20	0.95	0.70	1.20	0.96	0.71
SO_2 short-term rate	1.34	1.07	0.81	1.36	1.07	0.80	1.35	1.07	0.80
SO_2 long-term rate	0.33	0.27	0.20	0.34	0.27	0.20	0.34	0.27	0.20
PM_{10}	2.99	2.39	1.80	3.04	2.40	1.79	3.03	2.39	1.80
NH_3 at 5 ppmvd BACT level	3.59	2.86	2.12	3.64	2.83	2.07	3.59	2.79	2.05
Sulfur content in fuel basis for above:	1	grains total S/10(	short-term						
	0.25	grains total S/10(	long-term	max hourly value					

Data from Vendor

Startup / Shutdown Emissions Per Turbine

Startup

duration in minutes	10	10	40	1 hour With Startup, warmup and Normal Operation	Emissions if starting & warming up for an entire hour	20
	Startup Emissions	SCR Warmup Emissions	Normal Emissions			total startup + warmup
	lb/event	**lb/event**	lb/hour	lb/hour	lb/hour	**lb/event**
NO_X	3.13	3.83	4.05	9.66	20.87	6.96
CO	2.33	2.09	6.36	8.66	13.27	4.42
VOC	0.20	0.05	1.20	1.05	0.75	0.25
SO_2	0.13	0.23	1.36	1.26	1.08	0.36
PM_{10}	0.17	0.50	3.04	2.69	2.01	0.67

Assumptions:

Startup Emissions for CO, NO_2, PM_{10}, and VOC integrated from data provided by GE.
SO_2 emissions assume complete conversion of all sulfur to SO_2.
Normal emissions are highest of twelve operating cases listed above (case 4).
Startup SO_2 emissions based on peak short-term sulfur content and 50% load 59 F MMBtu/hr
Warmup SO_2 emissions based on peak short-term sulfur content and max emissions from any case
NOx, CO and VOC values highest from GE startup curves

Shutdown

duration in minutes	8	52	Emissions for 1 hour with a shut down and normal operations	Emissions if shutting down for an entire hour
	Shutdown Emissions	Normal Emissions		
	lb/event	lb/hour	lb/hr	lb/hour
NO_X	2.85	4.05	6.36	21.36
CO	2.45	6.36	7.96	18.38
VOC	0.05	1.20	1.09	0.39
SO_2	0.11	1.36	1.28	0.80
PM_{10}	0.15	3.04	2.78	1.14

Assumptions:

Shutdown Emissions for CO, NO_2, PM_{10}, and VOC integrated from data provided by GE.
SO_2 emissions assume complete conversion of all sulfur to SO_2.
Normal emissions are highest of all operating cases listed above (case 4).
Shutdown SO_2 emissions based on peak short-term sulfur content and 50% load 59 F MMBtu/hr

Turbine Operating Scenarios

Worst-Case 1-Hour Emissions per Turbine

Worst-Case (non-commissioning) 1-Hour Emissions consists of the maximum of an hour with 1 startup & normal operations; an hour with 1 shutdown and normal operations; or normal operatic
Comparison of normal, startup and shutdown emissions presented below.

Emissions per turbine	Max Worst-case	Startup /Warmup	Shutdown	Normal Operations	Worst-case Total	Startup /Warmup	Shutdown	Normal Operations	Worst-case Total
	lb/hr				Total lbs				g/s
NO_2	9.66	9.66	6.36	4.05					1.22
CO	8.66	8.66	7.96	6.36					1.09
VOC	1.20	1.05	1.09	1.20					0.15
SO_2	1.36	1.26	1.28	1.36					0.17
PM_{10}	3.04	2.69	2.78	3.04					0.38

Worst-Case 3 Hour Emission Rate per Turbine

Only SO_2 is considered for an average 3-hour Ambient Air Quality Standard.
Worst-case 3-Hour emission Scenario is equal to 3 hours at normal rate with peak short-term sulfur content

Emissions per turbine	Worst-case Total	Startup /Warmup	Shutdown	Normal Operations	Total	Startup /Warmup	Shutdown	Normal Operations	Worst-case Total
	lb/hr				Total lbs				g/s
Total Hours of Operation	3.0	0.333	0.133	2.53		0.333	0.133	2.53	
SO_2 with startup & shutdown	1.30	1.08	0.80	1.36	3.90	0.36	0.11	3.44	0.16
SO_2 normal operations	1.36			1.36					0.17

Worst-Case 8-Hour Emission Rates per Turbine

Only CO is considered for an average 8-hour Ambient Air Quality Standard.
Worst-case (non-commissioning) 8-Hour Scenario includes 1 Startup/Warmup, 1 Shutdown and remaining time at normal rate.

Emissions per turbine	Worst-case Total	Startup /Warmup	Shutdown	Normal Operations	Worst-case Total	Startup /Warmup	Shutdown	Normal Operations	Worst-case Total
	lb/hr				Total lbs				g/s
Total Hours of Operation	8.0	0.33	0.13	7.53		0.33	0.13	7.53	
CO	6.85	13.3	18.38	6.36	54.79	4.42	2.45	47.92	0.86

Worst-Case 24 Hour Emission Rate per Turbine

Only SO_2 and PM_{10} are considered for an average 24-hour Ambient Air Quality Standard.
Worst-case 24-Hour Scenario includes 1 Startup/Warmup, 1 Shutdown, and remaining time at normal rate.
Worst-case 24-hour scenario for SO_2 & PM_{10} use normal operational emissions.

Emissions per turbine	Worst-case Total	Startup /Warmup	Shutdown	Normal Operations	Total	Startup /Warmup	Shutdown	Normal Operations	Worst-case Total
	lb/hr				Total lbs				g/s
Total Hours of Operation	24	0.33	0.13	23.53		0.33	0.13	23.53	
NO_X	4.38	20.87	21.36	4.05	105.08	6.96	2.85	95.28	0.55
CO	6.52	13.27	18.38	6.36	156.56	4.42	2.45	149.69	0.82
VOC	1.19	0.75	0.39	1.20	28.54	0.25	0.05	28.24	0.15
SO_2 with startup & shutdown	1.35	1.08	0.80	1.36	32.40	0.36	0.11	31.93	0.17
PM_{10} with startup & shutdown	3.01	2.01	1.14	3.04	72.27	0.67	0.15	71.45	0.38
SO_2 normal operations	1.36			1.36					0.17
PM_{10} normal operations	3.04			3.04					0.38

Average Annual Emissions

Average Operation lb/hr Emission Rates presented below for normal operations are based on normal operation scenario (max emissions) for 4,006 total operating hours all 4 units, plus a total of 514 startup events and 514 shutdown events for 4 all units.

Emissions per turbine	Worst-case Total	Startup /Warmup	Shutdown	Normal Operations	Total	Startup /Warmup	Shutdown	Normal Operations	Worst-case Total
	lb/hr				Total lbs				g/s
Total Hours of Operation	1061	42.83	17.13	1001.5					
Number per Scenario		128.5	128.5						
Duration of Event (min)		20	8.0	60					
NO_X	0.61	20.87	21.36	4.05	5314.77	894.0	366.0	4054.8	0.08
CO	0.83	13.27	18.38	6.36	7253.26	568.2	314.9	6370.2	0.10
VOC	0.14	0.75	0.39	1.20	1240.55	32.1	6.6	1201.8	0.02
SO_2	0.16	1.08	0.80	1.36	1418.88	46.2	13.7	1358.9	0.02
PM_{10}	0.36	2.01	1.14	3.04	3146.25	85.9	19.5	3040.8	0.05

Note: Worst-case lb/hr is the total emissions (lbs) over 8,760 hours/year

Est. annual normal operating hours per turbine		1001.5				
Number of Turbines:	1	4		4 turbines + blackstart	4 turbines + cooling tower + blackstart	
ANNUAL TOTALS	1 unit	4 units				
NO_X	2.66	10.63	tpy	10.69	10.69	tpy
CO	3.63	14.51	tpy	14.54	14.54	tpy
VOC	0.62	2.48	tpy	2.49	2.49	tpy
SO_2	0.71	2.84	tpy	2.84	2.84	tpy
PM_{10}	1.57	6.29	tpy	6.29	6.37	tpy

GEN SET PACKAGE PERFORMANCE DATA [DM9071]

SEPTEMBER 20, 2007

For Help Desk Phone Numbers Click here

Performance Number: DM9071

Change Level: 00

Sales Model: C27 DITA	**Combustion:** DI	**Aspr:** TA
Engine Power: 750 W/F EKW 778 W/O F EKW 1,141 HP	**Speed:** 1,800 RPM	**After Cooler:** ATAAC
Manifold Type: DRY	**Governor Type:** ELEC	**After Cooler Temp(F):** 120
Turbo Quantity: 2	**Engine App:** GP	**Turbo Arrangement:**
Hertz: 60	**Engine Rating:** PGS	**Strategy:**
Rating Type: STANDBY	**Certification:** EPA TIER-2 2006 - -	

General Performance Data 1

GEN W/F EKW	PERCENT LOAD	ENGINE POWER BHP	ENGINE BMEP PSI	FUEL RATE LB/BHP-HR	FUEL RATE GPH	INTAKE MFLD TEMP DEG F	INTAKE MFLD P IN-HG	INTAKE AIR FLOW CFM	EXH MFLD TEMP DEG F	EXH STACK TEMP DEG F	EXH GAS FLOW CFM
750.0	100	1141	304	0.328	53.5	121.1	53.1	2,034.1	1,213.5	949.8	5,646.8
675.0	90	1036	276	0.333	49.2	117.5	48.5	1,928.2	1,186.7	937.0	5,297.2
600.0	80	931	248	0.338	45.0	114.4	43.8	1,829.3	1,159.2	921.6	4,954.7
562.5	75	879	234	0.341	42.8	112.8	41.4	1,776.3	1,144.8	912.6	4,785.1
525.0	70	826	220	0.343	40.5	110.8	38.4	1,709.2	1,128.6	902.8	4,566.2
450.0	60	722	192	0.345	35.6	106.0	31.9	1,550.3	1,085.5	878.5	4,061.2
375.0	50	618	165	0.347	30.6	101.1	25.3	1,394.9	1,030.1	846.0	3,556.2
300.0	40	517	138	0.350	25.9	97.7	19.2	1,243.1	960.3	800.8	3,072.4
225.0	30	414	110	0.356	21.1	95.7	13.7	1,101.8	868.5	733.5	2,578.0
187.5	25	362	96	0.361	18.7	94.8	11.1	1,031.2	814.5	692.4	2,330.8
150.0	20	308	82	0.368	16.2	93.9	8.6	964.1	755.1	645.8	2,080.0
75.0	10	201	54	0.403	11.5	92.5	4.9	868.7	616.8	532.2	1,663.3

General Performance Data 2

GEN W/F EKW	PERCENT LOAD	ENGINE POWER BHP	COMPRESS OUT PRESS KPA	COMPRESS OUT TEMP DEG F
750.0	100	1141	189	342.3
675.0	90	1036	172	322.9
600.0	80	931	155	304.7
562.5	75	879	147	295.7
525.0	70	826	137	283.6
450.0	60	722	114	255.0
375.0	50	618	91	226.4
300.0	40	517	70	198.7
225.0	30	414	50	170.4
187.5	25	362	41	156.2
150.0	20	308	33	141.8
75.0	10	201	20	120.2

Heat Rejection Data

GEN W/F EKW	PERCENT LOAD	REJ TO JW BTU/MN	REJ TO ATMOS BTU/MN	REJ TO EXHAUST BTU/MN	EXH RCOV TO 350F BTU/MN	FROM OIL CLR BTU/MN	FROM AFT CLR BTU/MN	WORK ENERGY BTU/MN	LHV ENERGY BTU/MN	HHV ENERGY BTU/MN
750.0	100	18,540.0	8,360.0	40,662.0	22,975.0	6,199.0	7,621.0	48,396.0	116,015.0	123,578.0
675.0	90	17,459.0	7,677.0	37,762.0	21,212.0	5,687.0	6,711.0	43,904.0	106,517.0	113,512.0
600.0	80	16,151.0	7,166.0	34,861.0	19,506.0	5,175.0	5,858.0	39,468.0	97,191.0	103,560.0
562.5	75	15,241.0	7,166.0	33,439.0	18,596.0	4,948.0	5,460.0	37,250.0	92,527.0	98,556.0
525.0	70	14,559.0	6,881.0	31,677.0	17,573.0	4,663.0	5,005.0	35,032.0	87,466.0	93,153.0
450.0	60	13,421.0	5,971.0	27,809.0	15,184.0	4,095.0	3,924.0	30,596.0	76,717.0	81,722.0
375.0	50	11,715.0	5,687.0	23,828.0	12,739.0	3,526.0	2,957.0	26,217.0	66,026.0	70,348.0
300.0	40	10,464.0	4,948.0	19,904.0	10,237.0	2,957.0	2,104.0	21,952.0	55,732.0	59,372.0
225.0	30	9,611.0	3,867.0	15,867.0	7,621.0	2,389.0	1,365.0	17,573.0	45,382.0	48,339.0
187.5	25	9,213.0	3,298.0	13,876.0	6,369.0	2,161.0	1,081.0	15,355.0	40,150.0	42,766.0
150.0	20	8,758.0	2,673.0	11,943.0	5,118.0	1,877.0	796.0	13,080.0	34,918.0	37,193.0
75.0	10	6,938.0	2,218.0	8,417.0	2,787.0	1,308.0	398.0	8,530.0	24,909.0	26,501.0

EMISSIONS DATA

```
 EPA      TIER-2   2006 - -    ************************************************** B5
Gaseous emissions data measurements are consistent with those described in
EPA 40 CFR PART 89 SUBPART D and ISO 8178 for measuring HC, CO, PM, and NOx

Gaseous emissions values are WEIGHTED CYCLE AVERAGES and are in compliance
with the following non-road regulations:

LOCALITY              AGENCY/LEVEL              MAX LIMITS - g/kW-hr
-----------------     ------------      ------------------------------------
U.S. (incl Calif)     EPA/TIER-2        CO:3.5    NOx + HC:6.4       PM:0.2
```

EXHAUST STACK DIAMETER	--
WET EXHAUST MASS	9,385.1 LB/HR
WET EXHAUST FLOW (950.00 F STACK TEMP)	5,650.35 CFM
WET EXHAUST FLOW RATE (32 DEG F AND 29.98 IN HG)	1,924.00 STD CFM
DRY EXHAUST FLOW RATE (32 DEG F AND 29.98 IN HG)	1,762.56 STD CFM
FUEL FLOW RATE	54 GAL/HR

RATED SPEED "Not to exceed data"

GEN PWR EKW	PERCENT LOAD	ENGINE POWER BHP	TOTAL NOX (AS NO2) LB/HR	TOTAL CO LB/HR	TOTAL HC LB/HR	PART MATTER LB/HR	OXYGEN IN EXHAUST PERCENT
750.0	100	1141	16.2000	1.1400	.1300	.1100	8.5000
562.5	75	879	9.2700	1.5000	.1800	.1300	9.6000
375.0	50	618	5.8400	1.4500	.2100	.3200	10.7000
187.5	25	362	4.0500	1.2300	.2000	.2500	12.6000
75.0	10	201	2.8900	1.2200	.2200	.1700	14.8000

RATED SPEED "Nominal Data"

GEN PWR EKW	PERCENT LOAD	ENGINE POWER BHP	TOTAL NOX (AS NO2) LB/HR	TOTAL CO LB/HR	TOTAL HC LB/HR	TOTAL CO2 LB/HR	PART MATTER LB/HR	OXYGEN IN EXHAUST PERCENT
750.0	100	1141	13.3900	.6100	.0700	1,168.3	.0500	8.5000
562.5	75	879	7.6600	.8000	.1000	929.1	.0700	9.6000
375.0	50	618	4.8300	.7700	.1100	659.8	.1600	10.7000
187.5	25	362	3.3400	.6600	.1100	398.4	.1300	12.6000
75.0	10	201	2.3900	.6500	.1200	246.4	.0900	14.8000

Altitude Capability Data(Corrected Power Altitude Capability)

Ambient Operating Temp. / Altitude	50 F	68 F	86 F	104 F	122 F	NORMAL
0 F	1,141 hp	1,141 hp	1,141 hp	1,141 hp	1,141 hp	1,141 hp
984 F	1,141 hp	1,141 hp	1,141 hp	1,141 hp	1,141 hp	1,141 hp
1,640 F	1,141 hp	1,141 hp	1,141 hp	1,141 hp	1,141 hp	1,141 hp
3,281 F	1,141 hp	1,141 hp	1,141 hp	1,141 hp	1,141 hp	1,141 hp
4,921 F	1,141 hp	1,141 hp	1,141 hp	1,141 hp	1,141 hp	1,141 hp
6,562 F	1,141 hp	1,141 hp	1,141 hp	1,141 hp	1,139 hp	1,141 hp
8,202 F	1,141 hp	1,141 hp	1,141 hp	1,104 hp	1,070 hp	1,141 hp
9,843 F	1,141 hp	1,108 hp	1,071 hp	1,037 hp	1,004 hp	1,141 hp
11,483 F	1,075 hp	1,039 hp	1,004 hp	972 hp	943 hp	1,085 hp
13,123 F	1,008 hp	974 hp	941 hp	912 hp	884 hp	1,029 hp
14,764 F	944 hp	912 hp	882 hp	854 hp	827 hp	975 hp

The powers listed above and all the Powers displayed are Corrected Powers

Identification Reference and Notes

Engine Arrangement:	2671232	**Lube Oil Press @ Rated Spd(PSI):**	71.4
Effective Serial No:	MJE00001	**Piston Speed @ Rated Eng SPD(FT/Min):**	1,773.6
Primary Engine Test Spec:	0K7492	**Max Operating Altitude(FT):**	9,881.9
Performance Parm Ref:	TM5739	**PEEC Elect Control Module Ref**	
Performance Data Ref:	DM9071	**PEEC Personality Cont Mod Ref**	
Aux Coolant Pump Perf Ref:			
Cooling System Perf Ref:		**Turbocharger Model**	GT5008
Certification Ref:	EPA TIER 2	**Fuel Injector**	
Certification Year:	2006	**Timing-Static (DEG):**	--
Compression Ratio:	16.5	**Timing-Static Advance (DEG):**	--
Combustion System:	DI	**Timing-Static (MM):**	--
Aftercooler Temperature (F):	120	**Unit Injector Timing (MM):**	--
Crankcase Blowby Rate(CFH):	--	**Torque Rise (percent)**	--
Fuel Rate (Rated RPM) No Load(Gal/HR):	--	**Peak Torque Speed RPM**	--
Lube Oil Press @ Low Idle Spd(PSI):	68.2	**Peak Torque (LB/FT):**	--

Reference Number: DM9071

Core Arrn: 258-8773
EPA TIER-2 2006- B5

Parameters Reference: TM5739

GEN SET - PACKAGED - DIESEL
TOLERANCES:
AMBIENT AIR CONDITIONS AND FUEL USED WILL AFFECT THESE VALUES. EACH OF THE VALUES MAY VARY IN ACCORDANCE WITH THE FOLLOWING TOLERANCES.

ENGINE POWER	+/-	3%
EXHAUST STACK TEMPERATURE	+/-	8%
GENERATOR POWER	+/-	5%
INLET AIR FLOW	+/-	5%
INTAKE MANIFOLD PRESSURE - GAGE	+/-	10%
EXHAUST FLOW	+/-	6%
SPECIFIC FUEL CONSUMPTION	+/-	3%
FUEL RATE	+/-	5%
HEAT REJECTION	+/-	5%
HEAT REJECTION EXHAUST ONLY	+/-	10%

CONDITIONS:
ENGINE PERFORMANCE IS CORRECTED TO INLET AIR STANDARD CONDITIONS OF 99 KPA (29.31 IN HG) AND 25 DEG C (77 DEG F).

THESE VALUES CORRESPOND TO THE STANDARD ATMOSPHERIC PRESSURE AND TEMPERATURE IN ACCORDANCE WITH SAE J1995. ALSO INCLUDED IS A CORRECTION TO STANDARD FUEL GRAVITY OF 35 DEGREES API HAVING A LOWER HEATING VALUE OF 42,780 KJ/KG (18,390 BTU/LB) WHEN USED AT 29 DEG C (84.2 DEG F) WHERE THE DENSITY IS 838.9 G/L (7.002 LB/GAL).

THE CORRECTED PERFORMANCE VALUES SHOWN FOR CATERPILLAR ENGINES WILL APPROXIMATE THE VALUES OBTAINED WHEN THE OBSERVED PERFORMANCE DATA IS CORRECTED TO SAE J1995, ISO 3046-2 & 8665 & 2288 & 9249 & 1585, EEC 80/1269 AND DIN70020 STANDARD REFERENCE CONDITIONS.

ENGINES ARE EQUIPPED WITH STANDARD ACCESSORIES; LUBE OIL, FUEL PUMP AND JACKET WATER PUMP. THE POWER REQUIRED TO DRIVE AUXILIARIES MUST BE DEDUCTED FROM THE GROSS OUTPUT TO ARRIVE AT THE NET POWER AVAILABLE FOR THE EXTERNAL (FLYWHEEL) LOAD. TYPICAL AUXILIARIES INCLUDE COOLING FANS, AIR COMPRESSORS, AND CHARGING ALTERNATORS.

RATINGS MUST BE REDUCED TO COMPENSATE FOR ALTITUDE AND/OR AMBIENT TEMPERATURE CONDITIONS ACCORDING TO THE APPLICABLE DATA SHOWN ON THE PERFORMANCE DATA SET.

GEN SET - PACKAGED - DIESEL
ALTITUDE:
ALTITUDE CAPABILITY - THE RECOMMENDED REDUCED POWER VALUES FOR SUSTAINED ENGINE OPERATION AT SPECIFIC ALTITUDE LEVELS AND AMBIENT TEMPERATURES.

COLUMN "N" DATA - THE FLYWHEEL POWER OUTPUT AT NORMAL AMBIENT TEMPERATURE.

AMBIENT TEMPERATURE - TO BE MEASURED AT THE AIR CLEANER AIR INLET DURING NORMAL ENGINE OPERATION.
NORMAL TEMPERATURE - THE NORMAL TEMPERATURE AT VARIOUS SPECIFIC ALTITUDE LEVELS IS FOUND ON TM2001.

THE GENERATOR POWER CURVE TABULAR DATA REPRESENTS THE NET ELECTRICAL POWER OUTPUT OF THE GENERATOR.

GENERATOR SET RATINGS
EMERGENCY STANDBY POWER (ESP)

OUTPUT AVAILABLE WITH VARYING LOAD FOR THE DURATION OF AN EMERGENCY OUTAGE. AVERAGE POWER OUTPUT IS 70% OF THE ESP RATING. TYPICAL OPERATION IS 50 HOURS PER YEAR, WITH MAXIMUM EXPECTED USAGE OF 200 HOURS PER YEAR.

STANDBY POWER RATING

OUTPUT AVAILABLE WITH VARYING LOAD FOR THE DURATION OF AN EMERGENCY OUTAGE. AVERAGE POWER OUTPUT IS 70% OF THE STANDBY POWER RATING. TYPICAL OPERATION IS 200 HOURS PER YEAR, WITH MAXIMUM EXPECTED USAGE OF 500 HOURS PER YEAR.

PRIME POWER RATING

OUTPUT AVAILABLE WITH VARYING LOAD FOR AN UNLIMITED TIME. AVERAGE POWER OUTPUT IS 70% OF THE PRIME POWER RATING. TYPICAL PEAK DEMAND IS 100% OF PRIME RATED EKW WITH 10% OVERLOAD CAPABILITY FOR EMERGENCY USE FOR A MAXIMUM OF 1 HOUR IN 12. OVERLOAD OPERATION CANNOT EXCEED 25 HOURS PER YEAR.

CONTINUOUS POWER RATING

OUTPUT AVAILABLE WITH NON-VARYING LOAD FOR AN UNLIMITED TIME. AVERAGE POWER OUTPUT IS 70-100% OF THE CONTINUOUS POWER RATING. TYPICAL PEAK DEMAND IS 100% OF CONTINUOUS RATED EKW FOR 100% OF OPERATING HOURS.

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Emissions from Black Start Engine Generator

Rated Horsepower	1141	**bhp**	
Max Engine Power	750	Kw	
Total Efficiency	100	%	
Testing duration	1	**hr/month**	
Expected non-emergency usage	12	**hr/yr**	
Diesel Fuel Fired	Emision Factor	Emission Rate per Testing	Yearly Emission Rate
	g/Kw/Hr	lb/hr	lb/yr
NO_X	6.400	10.58	126.99
CO	3.500	5.79	69.45
VOC (Total Hydrocarbons)	1.000	1.65	19.84
SO_2		0.006	0.07
PM_{10}	0.200	0.33	3.97

Emission rates based on EPA Tier 2 emission limits
NO_x emission rate = maximum NO_x + HC emission limit
PM_{10} emission rate includes filterable and condensable emissions.
SO_2 emission rate calculation based on sulfur content in the fuel.

Engine parameters

Flow Rate (acfm)	5,647	
Exhaust Temp (degrees F)	949.8	
Stack Diameter (feet)	0.833	10 inches
Stack height (feet)	20	(12 ft building + 8 ft stack)
fuel rate (gal/hr)	53.5	
Data from Vendor		
Diesel Sulfur content (ppm)	15	
diesel density (lb/gal)	7.1	
Satck height (m)	6.096	
Exhaust Temp (K)	783.04	
Exit velocity (m/s)	52.59	
Stack diameter (m)	0.254	

Stack diameter based on CARB Table 1 of "Risk Management Guidance for the Permitting of New Stationary Diesel-Fuel

Chiller - Cooling Tower Drift Calculation

Chiller - Cooling Tower						
design circulating water rate		7,740	gallons/min			
cycles of concentration		10	already included in TDS value			
TDS		922	ppm			
		922	mg/liter			
		7.69	lb/1000 gallons			
Drift Eliminator Control		0.000010				
Operating hours per year		4006				
Drift PM emissions	total	0.04	lb/hr	0.009	lb/hr	per cell (4)
		143.1	lb/yr	35.782	lb/yr	
		0.07	**tpy**			

water = 1000 g/liter
g/l = water * ppm/10^6
mg/l = water * ppm/10^6 * 1000 mg/g

Chiller cooling tower data provide by PB Engineering:

Fan diameter:	13	Feet 7 blades each fan
Exhaust flow	230,750	ACFM per each fan
Exhaust flow	3,800,961	pph total for 4 fans
Exhaust temp	87.7	DB deg F
Circulating water rate	7740	gpm for all 4 units
	3,870,000	pph
Cycles	10	
TDS	922	ppm after cycling maximum GWRS
Drift	0.0010%	
Exhaust stream solids	0.0357	pph

Note: conditions are for design day of 89 F DB, 36% RH

Exit velocity (m/s) 8.831

ESTIMATED Fired Hours, Fuel Usage, Emissions and Exhaust Parameters for Start-up and Commissioning [a]
LM6000PC SPRINT

	Description	Power Level	Corrected Operating Hours	% Output at ISO	Estimated kW Output at ISO	Estimated Fuel Rate MMBtu/hr	Estimated Fuel Usage MMBtu's	Total Estimated Emission per Event [b] NOx lbs	CO lbs	VOC lbs	PM10 lbs	Exhaust Temperature deg F	Exhaust Flow lb/sec
	Estimated Non-Fired Hours During Commissioning												
(1)	Dry fire GTG	Non-Fired	12	0	0	0	0	0	0	0	0	Not Applicable	Not Applicable
	Estimated Fired Hours During Commissioning												
(2)	**First Fire the unit & then shutdown to check for leaks, etc**												
	First fire the unit & then shutdown to check for leaks, etc	Core / Sync Idle	16	CI	0	77.5 [c]	1160	133	548	18	64	594	114
	Sub-Total		**16**										
(3)	**Synch & Check E-Stop**												
	Fire the unit and bring to synchronous load... ... do a system check out (check E-stop, etc)	Sync Idle	12	SI	0	77.5	890	100	411	13	48	594	114
	Sub-Total		**12**										
(5)	**Additional AVR Commissioning**												
	Sync to the grid... continue commissioning of the AVR		12	5%	2600	95.9	1120	174	219	5	48	726	125
	Sub-Total		**12**										
(6)	**Break-In Run**												
	Controlled "Break-In Run"		8	5%	2600	95.9	750	116	146	3	32	726	125
	Sub-Total		**8**										
4)(9)	**Dynamic Commissioning of AVR & Commission Water Injection & SPRINT** Bring back up to synchronous speed... ... begin dynamic commissioning of the AVR												
	Load Step 1		4	10%	5000	111	670	82.8	46.2	0.6	16	733	137
	Load Step 2		4	20%	9900	144	990	57.6	25.8	0.3	16	713	161
	Load Step 3		4	30%	14800	175	1260	70.2	36.2	0.4	16	733	178
	Load Step 4		4	40%	19800	206	1560	82.8	46.6	0.6	16	753	194
	Load Step 5		4	50%	24600	240	1830	96.4	57.8	0.7	16	762	209
	Load Step 6		4	60%	29700	276	2100	110.9	68.4	0.8	16	781	232
	Load Step 7		4	70%	34700	312	2370	125.4	74.6	0.9	16	766	255
	Load Step 8		4	80%	39700	348	2640	139.7	57.3	0.8	16	766	276
	Load Step 9		4	90%	44600	384	2920	154.2	64.8	0.9	16	792	288
	Load Step 10		4	100%	49500	424	3200	170.5	68.1	1.0	16	843	294
	Sub-Total		**40**										
(8)	**Base load AVR Commissioning**												
	Once at base load, complete AVR commissioning		16	100%	49500	424	3200	682.1	272.5	20.0	64	843	294
	Sub-Total		**16**										
(10)	**Complete - Total Estimated Fired Hours**		**104**				**26700**	**2296**	**2141**	**66**	**416**		

Assumptions:
a) Site Conditions are 59F, 60% RH, Sea Level, 4/6 Inch H20 Losses, Natural Gas
b) All data shown is before any catalyst system reduction.
c) Fuel Rate is the same as Sync. Idle (SI)

GE Energy 10/26/2007

NOTE:

actual stack emissions incurred during startup, the following information was developed in conjunction with SCR suppliers.
The catalyst (SCR & CO) would be installed after GE completes their task (2), First Fire for the unit (16 hours).
Therefore no emission reduction on the 133 # NOx and 548 # CO in task (2).
After catalyst installation, the SCR catalyst would average an 82% removal effectiveness (taking into account starts, etc.)
After catalyst installation, the CO catalyst would average an 85% removal effectiveness (considering starts, etc.)
Therefore the stack emissions for GE tasks (3) – (9) would be as follows:
NOx emissions – 389 #
CO emissions – 238 #
Other emissions remain unaffected by catalyst introduction.
Please Notes:
1. Based on GE's commissioning estimates.
2. These values are for a single unit.
3. These are best estimates only, considerable variation may occur for actual commissioning activities.

CALCULATION (MODEL INPUT)
worst case CO emission rate (commissioning - first fire the unit & then shutdown to check for leaks, etc.)
34.25 (lb/hr)
worst case NO2 emission rate (commissioning - first fire the unit & then shutdown to check for leaks, etc.) due to test of SCR condition
8.3125 (lb/hr)
with exhaust Temp 694 deg F, = 640.9278 K
with exhaust flow rate 114 lb/sec, = 410400 lb/hr, = 199271.4 acfm, = 9.46405299 m/s

1-Hour Worst-Case Emission Scenario for Ocotillo

Only NO_2, CO and SO_2 are considered for the 1-hour Ambient Air Quality Standard.
Worst-Case 1-Hour turbine emissions consists of the maximum of an hour with 1 startup & normal operations; an hour with 1 shutdown and normal operations; or normal operations.
Turbine SO_2 emission rate based on peak short-term sulfur content
Black Start engine operates 1 hour per month.

Emissions per Turbine	lb/hr	g/s
NO_2	9.66	1.22
CO	8.66	1.09
SO_2	1.36	0.17
Emissions from Black Start Engine		
NO_2	10.58	1.33
CO	5.79	0.73
SO_2	0.006	0.0007

3 Hour Emissions Scenarios for Ocotillo

Only SO_2 is considered for an average 3-hour Ambient Air Quality Standard.
The worst-case 3-hour emission rate is the maximum SO_2 rate for 100% load, normal operations
Turbine SO_2 emission rate based on peak short-term sulfur content
Black Start engine operates 1 hour per month.

Emissions per Turbine	lb/hr	g/s
SO_2	1.357	0.17
Emissions from Black Start Engine		
SO_2	0.0019	0.0002

8-Hour Emissions Scenarios for Ocotillo

Only CO is considered for an average 8-hour Ambient Air Quality Standard.
Worst-case 8-Hour Scenario includes 1 startup & 1 shutdown and remaining time at normal rate.
Black Start engine operates 1 hour per month.

Emissions per Turbine	lb/hr	g/s
CO	6.85	0.86
Emissions from Black Start Engine		
CO	0.72	0.091

24-Hour Emissions Scenarios for Ocotillo

Only SO_2 and PM_{10} are considered for an average 24-hour Ambient Air Quality Standard.
Worst-case 24-Hour Scenario includes 1 Startup, 1 Shutdown, and remaining time at normal opera
normal operating rate, whichever is higher.
Turbine SO_2 emission rate based on peak short-term sulfur content
Black Start engine operates 1 hour per month.

Emissions per Turbine	lb/hr	g/s
NO_2	4.38	0.55
CO	6.52	0.82
VOC	1.19	0.15
SO_2	1.36	0.17
PM_{10}	3.04	0.38
Emissions per Cooling Tower Cell	**lb/hr**	**g/s**
PM_{10}	0.0089	0.0011
Emissions from Black Start Engine		
NO_2	0.441	0.0556
CO	0.241	0.0304
VOC	0.069	0.0087
SO_2	0.0002	2.99E-05
PM_{10}	0.014	0.0017

Average Annual Emissions for Ocotillo

Average turbine operation emission rates are based on the annual operation scenario for a total of
514 startup/shutdown events for all 4 turbines.
Cooling tower operates 4 cells @ 4,006 hours per year.
Annual SO_2 assumes 0.25 grains S/scf of natural gas.
Black Start engine operates 1 hour per month.

Emissions per Turbine	lb/hr	g/s
NO_X	0.61	0.08
CO	0.83	0.10
VOC	0.14	0.02
SO_2	0.16	0.02
PM_{10}	0.36	0.05
Emissions per Cooling Tower Cell		
PM_{10}	0.004	5.15E-04
Emissions from Black Start Engine		
NO_2	1.45E-02	1.83E-03
CO	7.93E-03	9.99E-04
VOC	2.27E-03	2.85E-04
SO_2	7.81E-06	9.83E-07
PM_{10}	4.53E-04	5.71E-05

Note: Worst-case annual lb/hr is the total emissions (lbs) over 8,760 hours/year

GREENHOUSE EMISSIONS

The calculation below is referred to the "*Power/Utility Reporting Protocol Version 1.0 April 2005*", California Climate Action Registry

Step 1. Identify the annual consumption of each fossil and non-fossil fuel

Natural Gas for all turbines and the black start engine

Step 2. Determine annual consumption of the fuel

	Max Fuel Flow HHV (MMBtu/hr)	Hours of Operation (hr/yr)	Fuel Consumed (MMBtu)	number of unit	Total Annual Fuel Consumed (MMBtu)
One Turbine (LMS6000 simple cycle)	480.60	1,061.00	509,916.60	1	509,917
Black start engine	2.91	12.00	34.87	1	35
Total					509,951

note:
1. Max Fuel Flow HHV: used 480.60 MMBtu/hr for each turbine (100% load operation at 59ºF ambient temperature);
2. Max Fuel Flow HHV: used 2.91 MMBtu/hr for the balckstart engine (1141 bhp)
3. turbine operation hours = normal operation hours + startup/warmup + shutdown = 1001.5 + 42.83 + 17.13 = 1061

Step 3. Apply or Derive an Appropriate CO_2 Emission Factors for Each Fuel

Find the emission factors for natural gas and diesel

Natural gas	Diesel (Distillate Oil)	Unit
53.05	73.14	(kg CO2/MMBtu)
0.003901	0.000907	(kg CH4/MMBtu)
0.001361	0.000358	(kg N2O/MMBtu)

Step 4. Calculate fuel's carbon dioxide (CO_2) emissions

(1) One Turbine
Total Emissions (metric tons) = Adjusted Emission Factor (kg CO_2/MMBtu) x Fuel Consumed (MMBtu) x 0.001 metric tons/kg
= 27,051.08 metric tons

(2) Black start engine
Total Emissions (metric tons) = Adjusted Emission Factor (kg CO_2/MMBtu) x Fuel Consumed (MMBtu) x 0.001 metric tons/kg
= 1.849821458 metric tons

Step 5a . Calculate each fuel's methane (CH_4) emissions.

(1) One turbine
Total Emissions (metric tons) = Adjusted Emission Factor (kg CH_4/MMBtu) x Fuel Consumed (MMBtu) x 0.001 metric tons/kg
= 1.989184657 metric tons

(2) Black start engine
Total Emissions (metric tons) = Adjusted Emission Factor (kg CH_4/MMBtu) x Fuel Consumed (MMBtu) x 0.001 metric tons/kg
= 0.000136026 metric tons

Step 5b. Calculate each fuel's N_2O emissions

(1) One turbine
Total Emissions (metric tons) = Adjusted Emission Factor (kg N_2O/MMBtu) x Fuel Consumed (MMBtu) x 0.001 metric tons/kg
= 0.693996493 metric tons

(2) Black start engine
Total Emissions (metric tons) = Adjusted Emission Factor (kg N_2O /MMBtu) x Fuel Consumed (MMBtu) x 0.001 metric tons/kg
= 4.74572E-05 metric tons

Step 6. Convert CH_4 and N_2O emissions to CO_2 equivalents and sum all subtotals

Greenhouse Gas GWP (SAR, 1996)
Source: Intergovernmental Panel on Climate Change, Second Assessment Report (1996)

Greenhouse Gas	GWP (SAR, 1996)
CO2	1
CH4	21
N2O	310

RESULTS

One Turbine : Total Metric Tons of CO_2e = Total Metric Tons of CO_2 + CH_4 Tons of CO_2e + N_2O Tons of CO_2e
= 27,307.99

Equipment / Cases	Turbine	Black start engine	Total Metric Tons of CO_2e
4 turbines and 1 blackstart engine	109,232	1.87	109,233.82

MODELING PROTOCOL

AIR QUALITY MODELING PROTOCOL FOR THE ANAHEIM MUNICIPAL POWER STATION PROJECT ANAHEIM, CALIFORNIA

Prepared For:

- South Coast Air Quality Management District

- California Energy Commission

Prepared on behalf of

Southern California Public Power Authority

October 4, 2007

URS

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San Diego, CA 92108-4314
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October 4, 2007

Mr. Mark Liu
Air Quality Analysis and Compliance Supervisor
South Coast Air Quality Management District
21865 E. Copley Drive
Diamond Bar, CA 91765-4182

Subject: Modeling Protocol for the Anaheim Municipal Power Station Project
Anaheim, California
URS Project No.: 28906973.01010

Dear Mr. Liu,

Please find enclosed for SCAQMD review and comment two copies of the air quality modeling protocol for the Anaheim Municipal Power Station Project, which is being proposed by Southern California Public Power Authority (SCPPA). Copies of the protocol are also being provided for review and comment to the California Energy Commission (CEC) air modeling staff. Please provide one of the enclosed copies to the District's air modeling specialist who is being assigned to this project.

The Project will consist primarily of four simple cycle LM6000 peaker turbines with a combined maximum generating capacity of approximately 200 MW. The project site is located in northeastern Anaheim, approximately 1 mile northeast of the CA-91 and CA-57 interchange, at 3071 East Miraloma Avenue, Anaheim, California.

An Application for Certification for the proposed power generation facility will be submitted to CEC in the near future. We would thus appreciate receiving your review comments as soon as possible, so that any changes that may be required can be incorporated. Please distribute the protocol among your colleagues as appropriate.

Thank you in advance for your review of this protocol. Do not hesitate to contact Julie Mitchell (619-294-9400) with any questions or concerns regarding any aspect of our intended modeling methodology.

Sincerely,

URS CORPORATION

John Lague
Senior Air Quality Consultant

JL:ml

Enclosures

cc: Keith Golden, California Energy Commission (w/enclosures)

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Figure 2-1 Anaheim Municipal Power Station Plot Plan and Fenceline

Appendices

Appendix A Annual Windrose for the John Wayne Airport (2002-2006)

$\mu g/m^3$	Micrograms per cubic meter
°C	degrees Celsius
AAQS	Ambient Air Quality Standards
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AFC	Application for certification
AQRV	Air quality related values
ARB	Air Resources Board
ARM	Ambient Ratio Method
ATC	Authority to construct
BACT	Best available control technology
BPIP	Building profile input program
BPIP-Prime	Building Parameter Input Program – Prime
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CEC	California Energy Commission
CO	Carbon monoxide
CTG	Combustion turbine generator
ERC	Emission reduction credit
g/s	Gram per second
GEP	Good engineering practice
HARP	Hotspots analysis and reporting program
HHV	Higher heating value
HRA	Health risk assessment
ISCST3	Industrial Source Complex Short Term 3rd version
km	Kilometers
MEI	Maximally exposed individual
mm	Millimeter
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NNSR	Non-attainment New Source Review
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NSR	New source review
O_3	Ozone
OEHHA	Office of Environmental Health Hazard Assessment
OLM	Ozone limiting method
Pb	Lead
PM_{10}	Particulate matter less than 10 μm in diameter
$PM_{2.5}$	Particulate matter less than 2.5 μm in diameter
PMS	Particulate Matter Speciation
ppb	Parts per billion
ppm	Parts per million
PSD	Prevention of significant deterioration
ROC	Reactive organic compound

SCAQMD	South Coast Air Quality Management District
SCPPA	Southern California Public Power Authority
SCR	Selective catalytic reduction
SIL	Significant impact level
SO_2	Sulfur dioxide
TAC	Toxic air contaminants
T-BACT	Best available control technology for toxics
tpy	Tons per year
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTM	Universal Transverse Mercator

SECTION 1 INTRODUCTION

1.1BACKGROUND

The Anaheim Municipal Power Station (AMPS) Project will be a nominal 200-megawatt (MW) simple cycle peaker power plant to be constructed in the city of Anaheim, California. The Project will be owned by Southern California Public Power Authority (SCPPA) and operated by the City of Anaheim. The AMPS will be permitted as a peaker plant consisting of four General Electric (GE) LM6000 natural gas-fired combustion turbine-electrical generators (CTGs).

The AMPS site is located at 3071 East Miraloma Avenue, Anaheim, California. The nearest major cross streets are Miraloma Avenue and Kraemer Boulevard. The AMPS will occupy approximately four and a half of a nine acre parcel in the Anaheim Canyon Business Center, the remaining four and a half acres will be used for construction laydown (see Figure 1-1).

The project is subject to the site licensing requirements of the California Energy Commission (CEC). The CEC will coordinate its independent air quality evaluations with the South Coast Air Quality Management District (SCAQMD) through the Determination of Compliance (DOC) process. Annual emissions of all criteria pollutants will be below the emission level thresholds specified by the United States Environmental Protection Agency's (USEPA) Prevention of Significant Deterioration (PSD) regulations for Major Sources. Specifically, the AMPS Facility will emit less than: 250 tons per year (tpy) of nitrogen oxides (NO_x), carbon monoxide (CO), reactive organic compounds (ROC) and sulfur dioxide (SO_2), less than 0.6 tons per year of lead (Pb) and less than 7.0 tons per year of sulfuric acid mist.

SCAQMD new source review (NSR) and non-attainment NSR (NNSR) regulations are potentially applicable to all criteria pollutants emitted by a new source, depending on the quantities of pollutants that will be emitted. The area around the AMPS site is classified as national attainment/unclassified for nitrogen dioxide (NO_2), CO and SO_2, and non-attainment for ozone (O_3), particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$), and PM_{10}. With respect to the California Ambient Air Quality Standards (CAAQS), the area around the AMPS is classified as attainment for CO, NO_2, sulfates, Pb, and SO_2, unclassified for hydrogen sulfide, and non-attainment for O_3, $PM_{2.5}$, and PM_{10}. NO_2 and SO_2 are regulated as PM_{10} precursors, and NO_2 and ROC as O_3 precursors. Project emissions of non-attainment pollutants and their precursors will be offset to satisfy state and local NNSR regulations.

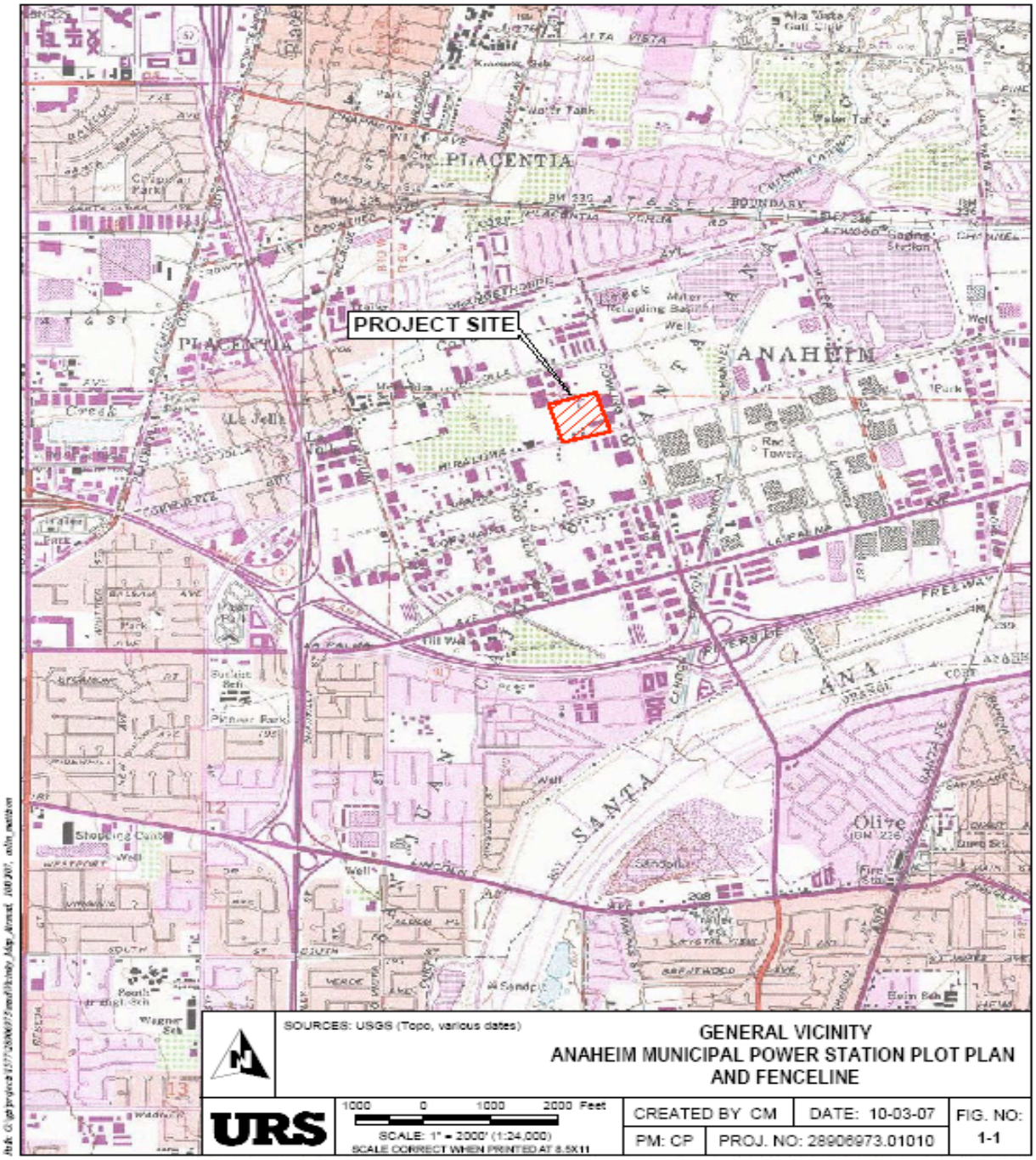
1.2 PURPOSE

The CEC and SCAQMD require the use of atmospheric dispersion modeling to demonstrate that a new power generation facility or modification to an existing facility will comply with applicable air quality standards. These agencies also require an assessment of the potential impacts on human health from the toxic air contaminants that may be emitted by such projects. In addition, CEC power plant siting regulations require modeling to evaluate the cumulative impacts of the proposed project with other new and reasonably foreseeable projects within 6 miles of the project site.

This document summarizes the procedures that are proposed for the air dispersion modeling for project certification and permitting. Modeling of both operational and construction emissions from to the proposed Project will be performed in accordance with CEC guidance (CEC, 1997). This protocol is

being submitted to the CEC and SCAQMD for their review and comment prior to completion of the applicable permit applications. The proposed model selection and modeling approach is based on review of applicable regulations, agency guidance documents, and recent discussions with staffs of the responsible agencies.

Figure 1-1
General Vicinity – Anaheim Municipal Power Station Project



SECTION 2 PROJECT DESCRIPTION

2.1PROJECT LOCATION

The location of the proposed project is shown on Figure 1-1, which also illustrates the project site, and nearby roads and other features. The AMPS site is approximately 9 acres in size, and is located in Anaheim, California, at 3071 East Miraloma Avenue. This location is northeast-east of the CA-57 and CA-91 interchange. Approximately half of the proposed 9 acre site will be used for the turbines and ancillary equipment, and the other half will be used for the laydown area during construction. The site is accessible from Miraloma Avenue.

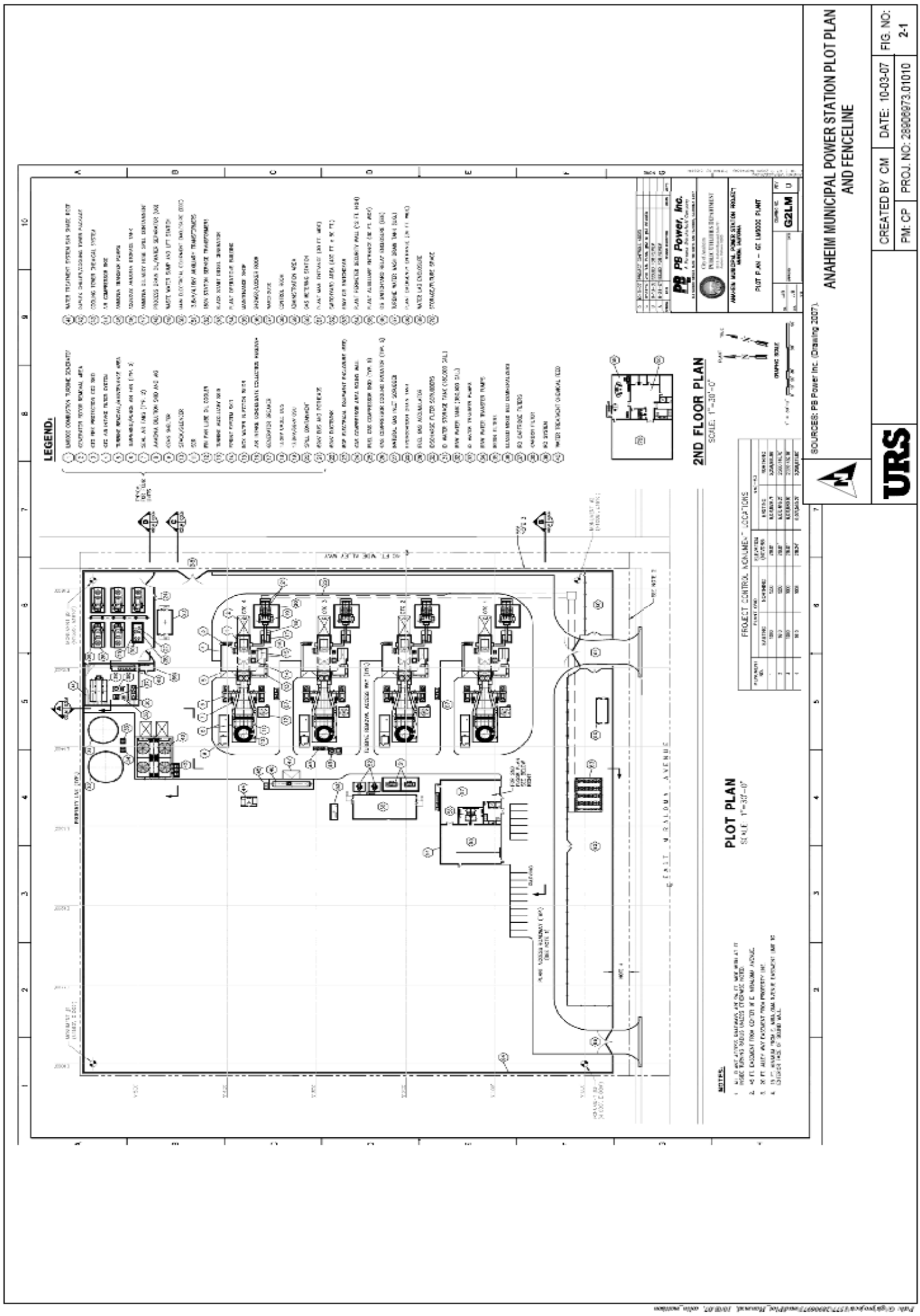
2.2 DESCRIPTION OF THE PROPOSED SOURCES

The proposed AMPS project will consist of four simple cycle GE LM6000 CTGs, each with an ISO baseload gross output of approximately 50 MW for a total output of 200 MW.

The gas turbines will be fired exclusively on pipeline-quality natural gas and will be equipped with water injection and selective catalytic reduction (SCR) for the control of NO_x emissions. An oxidation catalyst system will also be incorporated into the air quality control system to control emissions of CO and VOC. Aqueous ammonia will be used in the SCR system.

Other sources of emissions will include one 750 kilowatt diesel black start generator, and a 4-cell wet cooling tower which is a relatively small source of PM_{10} and TACs (drift). Figure 2-1 is a scaled plot plan showing the layout of Project facilities.

Figure 2-1
Anaheim Municipal Power Station Plot Plan and Fenceline



SECTION 3 REGULATORY SETTING

3.1CALIFORNIA ENERGY COMMISSION REQUIREMENTS

For projects with electrical power generation capacity greater than 50 MW, CEC requires that applicants prepare a comprehensive Application for Certification (AFC) document addressing the proposed project's environmental and engineering features. An AFC must include the following air quality information (CEC, 1997):

- A description of the project, including project emissions of air pollutants and greenhouse gases, fuel type(s), control technologies and stack characteristics;
- The basis for all emission estimates and/or calculations;
- An analysis of Best Available Control Technology (BACT) according to SCAQMD Rules;
- Existing baseline air quality data for all regulated pollutants;
- Existing meteorological data, including temperature, wind speed and direction;
- A listing of applicable laws, ordinances, regulations, standards (LORS), and a determination of compliance with all applicable LORS;
- An emissions offset strategy;
- An air quality impact assessment (i.e., national and state ambient air quality standards [AAQS]) and protocol for the assessment of cumulative impacts of the proposed project along with permitted and under construction projects within a 10 km radius; and
- An analysis of human exposure to air toxics (i.e., health risk assessment [HRA]).

For the AMPS project, the air quality impact assessment, the cumulative impacts assessment, and the HRA will be performed using dispersion models.

3.2SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT REQUIREMENTS

The SCAQMD has promulgated new source review permitting requirements under Rule 1303. In general, all equipment with the potential to emit air pollutants is subject to the requirements of this rule, which has the following major requirements that potentially apply to new sources such as the AMPS:

- Installation of BACT,
- Ambient air quality impact modeling to demonstrate compliance with NAAQS,
- Emission offsets,
- Statewide compliance for all applicant-owned or operated facilities in California,

Plume visibility modeling will not be conducted for AMPS since it is not a PSD source and the nearest Class I area is San Gabriel Wilderness Area, approximately 42 kilometers from AMPS, a greater distance than the distance specified in SCAQMD Rule 1303.

Assembly Bill 2588, California Air Toxics Hot Spots Program and SCAQMD Rule 1401 (New Source Review of Toxic Air Contaminants [TAC]) establishes allowable risks for new or modified sources of TAC emissions. This rule specifies limits for maximum individual cancer risk (MICR), cancer burden, and non-carcinogenic acute and chronic hazard indices (HI) for new or modified sources of TAC emissions. The health risks resulting from project emissions, as determined by a health risk assessment using approved modeling methods, must not exceed established threshold values. While Rule 1401 does not specifically require the application of best available control technology for toxics (T-BACT) to a new or modified source that emits carcinogenic TACs, the rule relaxes the MICR risk threshold when T-BACT is applied. In order to have access to the emission reduction credits in the SCAQMD Priority Reserve (Rule 1309.1) projects within an Environmental Justice Area (EJA) must meet stricter MICR, cancer burden, and non-carcinogenic acute and chronic HIs.

3.3 U.S. ENVIRONMENTAL PROTECTION AGENCY REQUIREMENTS

USEPA has promulgated PSD regulations applicable to new Major Sources and Major Modifications to existing Major Sources. The AMPS facility will not be a major source for criteria pollutants; thus a PSD analysis will not be conducted. The applicant will accept a permit condition limiting the annual operating hours of the proposed plant to a level that will avoid triggering PSD requirements.

SECTION 4 AIR QUALITY IMPACT ANALYSIS

This section describes the dispersion models and modeling techniques that will be used in performing the criteria pollutant impact analysis for the AMPS. The objectives of the modeling are to demonstrate that air emissions from the AMPS will not contribute to exceedances of state and federal ambient air quality standards.

In November 2005, the USEPA officially recognized the American Meteorological Society/ Environmental Protection Agency Regulatory Model (AERMOD) as the preferred dispersion model for regulatory applications, replacing the Industrial Source Complex Short Term 3 (ISCST3) model. Also, CEC and EPA staff supports the use of AERMOD for power plant licensing/permitting analyses. Accordingly, AERMOD (Version 07026) will be used for the dispersion modeling associated with the AMPS.

4.1TURBINE SCREENING MODELING

An initial screening modeling analysis will be conducted to determine the turbine stack parameters for the most important project sources, i.e., the CTGs that correspond to maximum ground-level pollutant concentrations. This information will be obtained by running a series of AERMOD simulations with the full meteorological input data set (see Section 4.6) with source inputs representing a range of different load conditions and ambient temperatures. The AERMOD screening runs will be setup with unit emission rate (1 g/s per turbine) to obtain the unit concentration (χ/Q) in ($\mu g/m^3$)/(g/s) per averaging time. The unit concentration will then be multiplied by the actual emission rate for that scenario to obtain the pollutant concentration. The stack parameters that align with the highest offsite impact from these sources for each pollutant and averaging time will be used in the subsequent refined modeling simulations.

4.2REFINED MODELING

The purpose of the refined modeling analysis is to demonstrate that air emissions from the AMPS will not cause or contribute to an ambient air quality violation. The AERMOD model (version 07026) will be used for the refined modeling of criteria pollutants. Specific modeling procedures that will be used for evaluating project impacts versus the state and federal ambient air quality standards and applicable health risk criteria are discussed below. Table 4-1 shows the regulatory criteria that will be used to evaluate the significance of predicted pollutant concentrations.

Analysis of land uses adjacent to the AMPS was conducted in accordance with Section 8.2.8 of the Guideline on Air Quality Models (EPA-450/2-78-027R and Auer [1978]), EPA AERMOD implementation guide (2005), and its addendum (2006).

Based on the Auer land use procedure, more than 50 percent of the area within a 3-km radius of the AMPS site is classified as urban. Since the Auer classification scheme requires more than 50 percent of the area within the 3-km radius around a proposed new source to be non-rural for an urban classification, the urban mode will be used in the AERMOD modeling analyses. All regulatory default options will be used, including building and stack tip downwash, default wind speed profiles, exclusion of deposition and gravitational settling, consideration of buoyant plume rise, and complex terrain.

Table 4-1
Relevant Ambient Air Quality Standards and Significance Levels

Pollutant	Averaging Time	CAAQS[a,c]	NAAQS[b,c]	SCAQMD Significant Change in Air Quality Concentration ($\mu g/m^3$)	PSD Significant Emission Rates (TPY)
CO	8-hour	9.0 ppm (10,000 $\mu g/m^3$)	9.0 ppm (10,000 $\mu g/m^3$)	500	250
	1-hour	20 ppm (23,000 $\mu g/m^3$)	35 ppm (40,000 $\mu g/m^3$)	1,100	
NO_2[d]	Annual	-	0.053 ppm (100 $\mu g/m^3$)	1	250
	1-hour	0.25 ppm (470 $\mu g/m^3$)	-	(20)[e]	
SO_2	Annual	-	0.03 ppm (80 $\mu g/m^3$)	-	250
	24-hour	0.04 ppm (105 $\mu g/m^3$)	0.14 ppm (365 $\mu g/m^3$)	-	
	3-hour	-	0.5 ppm (1,300 $\mu g/m^3$)	-	
	1-hour	0.25 ppm (655 $\mu g/m^3$)	-	-	
PM_{10}	Annual	20 $\mu g/m^3$	-	1	250
	24-hour	50 $\mu g/m^3$	150 $\mu g/m^3$	2.5[f]	
$PM_{2.5}$	Annual	12 $\mu g/m^3$	15 $\mu g/m^3$	-	-
	24-hour	-	35 $\mu g/m^3$	-	-
O_3	8-hour	0.07 ppm (137 $\mu g/m^3$)	0.08 ppm (157 $\mu g/m^3$)	-	250 (of ROCs)
	1-hour	0.09 ppm (180 $\mu g/m^3$)	See footnote[g]	-	-

[a] California standards for ozone (as volatile organic compounds, carbon monoxide, sulfur dioxide (1-hour), nitrogen dioxide, and PM_{10}, are values that are not to be exceeded.

[b] National standards, other than those for ozone, particulate matter, and those based on annual averages, are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest eight hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM_{10}, the 24 hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 $\mu g/m^3$ is equal to or less than one. For $PM_{2.5}$, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard.

[c] Concentrations are expressed first in units in which they were promulgated. Equivalent units are given in parentheses and based on a reference temperature of 25° Celsius (C) and a reference pressure of 760 millimeters (mm) of mercury (1,013.2 millibar).

[d] Nitrogen dioxide (NO_2) is the compound regulated as a criteria pollutant; however, emissions are usually based on the sum of all oxides of nitrogen (NO_x). On February 27, 2007 the California Air Resources Board recommended that the NO_2 1-hour and annual standards be lowered. The proposed levels are 0.18 ppm (338 $\mu g/m^3$) for 1-hour and 0.3 ppm (56 $\mu g/m^3$) for annual. These standards have not yet been approved by the Office of Administrative Law but are expected to be promulgated later in 2007.

Table 4-1
Relevant Ambient Air Quality Standards and Significance Levels
(Continued)

[e] Previous SCAQMD 1-hour NO_2 Significant Impact Level in Rule 1303 rescinded for NO_2 attainment areas on April 20, 2001.
[f] Per SCAQMD Rule 1303 this threshold applies to each emission unit.
[g] New federal 8-hour ozone and fine particulate matter ($PM_{2.5}$) standards were promulgated by USEPA on July 18, 1997. The federal 1-hour ozone standard was revoked by USEPA on June 15, 2005.

-	=	Not applicable
CAAQS	=	California Ambient Air Quality Standard
NAAQS	=	National Ambient Air Quality Standard
Ppm	=	parts per million by volume, or micromoles of pollutant per mole of gas
TPY	=	ton per year
$\mu g/m^3$	=	micrograms per cubic meter

4.2.1 Ambient Air Quality Standards Analysis

In accordance with SCAQMD Rule 1303(b)(1), the proposed AMPS will be required to demonstrate compliance with one of the following requirements:

- The project impact plus background must not exceed the most stringent applicable ambient air quality standard for each attainment pollutant (NO_2, SO_2, CO).
- The incremental effect of each permit unit of the AMPS may not exceed the Significant Change in Air Quality Concentration standards (listed in Table 4-1 as SCAQMD Significance Levels) for non-attainment pollutants (PM_{10}).

Compliance with these modeling requirements for attainment pollutants will be demonstrated by determining the maximum impact of the proposed Project at any receptor and adding a conservative background concentration based on recent data from the SCAQMD air quality monitoring station determined to be most representative of pre-project conditions in the project area.

Initially, the modeling will assume full conversion of NO_x to NO_2. If required, a 75% conversion rate of NO_x to NO_2 will be assumed for purposes of modeling annual NO_2 impacts. [EPA Ambient Ratio Method (ARM)]. Alternatively the AERMOD option to employ the ozone limiting method (OLM) may be used for estimating hourly and annual concentrations of NO_2. If 1-hour and annual concentrations do not exceed the applicable ambient air quality standard, then compliance is demonstrated and no further modeling is necessary for NO_2.

For PM_{10}, which is a non-attainment pollutant in the project area, the maximum incremental contribution from each individual turbine of the proposed AMPS will be compared directly with the SCAQMD 24-hour and annual Significant Change in Air Quality Concentration thresholds shown in Table 4-1. If the maximum predicted values are below these significant change thresholds, no further demonstration of compliance for this pollutant is required.

Note that emissions reduction credits will be obtained by the applicant to provide at least a one-to-one offsetting of all Project emissions increases of all non-attainment pollutants and their precursors, i.e. NO_x,

ROC, PM_{10} and SO_2. Some pollutant emission reduction credits will be obtained from the Priority Reserve, South Coast Air Quality Management District Rule 1309.1.

AMPS is considered an In-District Electric Generating Facility (EGF) under 1309.1(5)(A)(iii). The AMPS site is in an Environmental Justice Area (EJA) and has a maximum capacity of 500 MW or less, therefore, in order to draw credits from the Priority Reserve, AMPS must demonstrate the following:

a) The rate of PM_{10} emissions from each new or modified electrical generating units at full load does not exceed 0.060 lb/MW-hr, corrected to 59°F, 60% relative humidity, and 14.7 psia, except during startups and shutdowns as specified in the permit; and

b) The rate of NO_x emissions from each new or modified electrical generating units at full load does not exceed 0.080 lb/MW-hr, corrected to 59°F, 60% relative humidity, and 14.7 psia, except during startups and shutdowns as specified in the permit; and

c) The applicant substantiates with modeling that the 24-hour impact of the total combined PM_{10} emissions from the new or modified electrical generating units shall not exceed 5.0 $\mu g/m^3$; and

d) The applicant substantiates with modeling that the annual impact of the total combined PM_{10} emissions from the new or modified electrical generating units shall not exceed 0.75 $\mu g/m^3$; and

e) For simple cycle electric generating units, the unit shall operate a maximum of 4000 hours per year or less.

4.2.2 Health Risk Assessment Analysis

Both CEC and SCAQMD require a health risk assessment (HRA) to evaluate potential health effects of TAC emissions from the operation of the project. Contaminants emitted by the project with potential carcinogenic effects or chronic and/or acute non-carcinogenic effects will be considered. This health risk assessment will be performed following the SCAQMD Risk Assessment Procedures for Rules 1401 and 212 (SCAQMD, 2005), Supplemental Guidelines for Preparing Risk Assessments for the Toxics "Hot Spots" Information and Assessment Act (AB2588) (SCAQMD, 2005) and Office of Environmental Health Hazard Assessment (OEHHA), Air Toxics Hot Spots Program Risk Assessment Guidelines (OEHHA, 2003). As recommended by the SCAQMD guideline, the California Air Resources Board (CARB) Hotspots Analysis and Reporting Program (HARP) (CARB, 2005) will be used to perform a refined SCAQMD Tier 4 and OEHHA Tier 1 health risk assessment for the project. HARP includes two modules: a dispersion module and a risk module. The HARP dispersion module incorporates the USEPA ISCST3 air dispersion model, and the HARP risk module implements the latest Risk Assessment Guidelines developed by OEHHA. CARB is currently working on a HARP interface with AERMOD, but this is still in early development and not ready for use by the general public. Thus HARP as presently designed with ISCST3 will be used to conduct the required HRA modeling.

First, ground-level concentrations from the AMPS emissions will be estimated using the ISCST3 dispersion model within HARP. The HARP modeling analysis will be consistent with, and use similar source parameters, as the modeling approach discussed above for the AAQS analyses using AERMOD, except that the ISCST3 control parameter NOCALMS will be selected per SCAQMD requirements for HRAs. The meteorological data used in the HRA will be obtained from the SCAQMD for the Anaheim

station for 1981. Based on the impacts determined by the ISCST3 model, the HARP model will be used to estimate the corresponding health risks. The maximum 1-hour and annual impacts determined by the ISCST3 will be used in the HARP model to estimate the corresponding health risks. Receptor spacing will be described later in this document. The HARP simulations will also include the census receptors out to 10 km, and additional receptors will be placed at all sensitive locations (e.g., schools, hospitals, etc.) where infants, children, elderly, chronically ill or populations more susceptible to exposure are located, out to a distance of 3 miles. Receptors will also be placed at nearby residents.

Per SCAQMD guidelines, cancer risk will be determined using the "Derived (Adjusted)" calculation method. Chronic non-cancer risks will be calculated with the "Derived (OEHHA)" method. Since the AMPS site is surrounded by urban development, the dairy milk and local meat ingestion and drinking water consumption pathways will not be included in this analysis.

The HRA performed by means of the HARP model will follow the following steps:

- Define the location of the point of maximum impact (PMI) for cancer risk (i.e., the location where the highest carcinogenic risk may occur);
- Define the location of the maximally exposed individual resident (MEIR) (i.e., the resident where the highest carcinogenic risk may occur);
- Define the locations of the maximum chronic non-carcinogenic adverse health effects and the maximum acute adverse health effects;
- Calculate concentrations and adverse health effects at locations of maximum impact for each pollutant;
- Calculate cancer burden if the maximum cancer risk is predicted to be greater than one in ten million;
- Determine the zone of impact for cancer risk if the maximum cancer risk is predicted to be greater than or equal to one in a million; and
- Determine the zone of impact for acute and chronic health risks if the acute or chronic health index is predicted to be greater than or equal to 0.5.

To qualify for SCAQMD Rule 1309.1 stricter HRA criteria have been established, as described below:

a) The cancer risk from the combined new or modified electrical generating units is less than 1 in one million; and

b) The non-cancer risk (acute and chronic) Hazard Index from the combined new or modified electrical generating units is less than 0.5; and

c) The cancer burden from the combined new or modified electrical generating units is less than 0.1, based on a 1 in 10 million risk level.

4.3 MODELING EMISSIONS INVENTORY

4.3.1 Operational Project Sources

Operational emissions from the project will be dominated by the turbines. Conceptual plant design includes SCR for NO_x and oxidation catalysts for CO that will comply with recent BACT determinations for similar projects in California and elsewhere. Emissions of SO_2 and PM_{10} will be maintained at low levels, owing to the exclusive use of interstate pipeline quality natural gas as fuel for the gas turbines. Table 4-2 summarizes the estimated annual emissions from the project sources for each criteria pollutant, the 4 turbines, the 4-cell cooling tower and diesel blackstart engine. The diesel blackstart engine will normally operate only a few hours per year in order to test operability in the event of an emergency situation. However, emissions from this engine will be included in the dispersion modeling conducted for the AMPS.

Short-term turbine emissions to be used in the modeling analyses will incorporate the maximum number of startups and/or shutdown during the averaging time of concern. These emissions may be higher than normal full load operations.

Separate modeling will be conducted using AERMOD to evaluate the maximum short-term effects of commissioning for the impacts on offsite 1-hour NO_2 concentrations and 1-hour and 8-hour CO concentrations.

Table 4-2
Approximate Annual Pollutant Emissions from the AMPS Project

Pollutant	Annual Emissions (tpy)		
	4 Turbines	Cooling Tower	Blackstart Engine
NO_x	38	0	0.05
CO	57	0	0.03
SO_2	3	0	0.01
PM_{10}	25	0.5	0.002
VOC	7	0	0.01

4.3.2 Project Construction Sources

Temporary construction emissions will result from heavy equipment exhaust (primarily NO_x and diesel particulate emissions) and fugitive dust (PM_{10}) from earthmoving activities and vehicle traffic on paved and unpaved surfaces. Equipment-specific emissions factors will be used to estimate mass emissions for all criteria pollutants from diesel-fueled construction equipment and vehicles using SCAQMD OFFROAD Emission Factors. Fugitive dust emissions resulting from onsite soil disturbances and travel on unpaved roads will be estimated using SCAQMD CEQA Handbook (SCAQMD, 1993) emission factors. A dust control efficiency of 85 percent for the construction area activities will be achieved for these activities by frequent watering or other measures when required. Emissions from on-road delivery

trucks and worker commute trips will be estimated using emission factors provided by SCAQMD for Onroad Vehicles from the EMFAC2007 model. An ultra-low fuel sulfur content of 0.0015 percent by weight (15 ppm) will be used in all diesel construction equipment.

A detailed Excel Workbook will be created to estimate criteria pollutant emissions for non-overlapping phases of Project construction, based on information from the Project design engineers on the equipment use by month throughout the construction schedule and the area extent of ground disturbance that will occur during different construction phases. Depending on the magnitude of emissions for different pollutants and the proximity of construction activities to the property boundary for each phase, one or more emission scenarios representing reasonable worst-case equipment activity and ground disturbance for each averaging time will be selected for subsequent dispersion modeling to ensure that maximum off-site air quality impacts due to these temporary activities will be assessed. The selected emissions scenarios will be modeled using AERMOD with the same near-field receptor grids and the same meteorological input data used for the modeling of the Project's operational emissions. The construction site, including the corridors for new transmission lines, gas lines or water pipelines, parking areas and lay-down areas will be modeled as area or volume sources.

4.3.3 Toxic Air Contaminant Sources

TACs will also be emitted from the operational AMPS project due to combustion of natural gas and diesel fuels. However, only small quantities of TACs will be emitted from these sources - primarily benzene, formaldehyde, and polycyclic aromatic hydrocarbons, since only natural gas will be used as fuel for the turbines. The 4-cell cooling tower will emit small quantities of TACs, primarily in the form of metals. One new diesel-fired blackstart engine is also proposed as part of the project. Emission estimates for TACs from these sources will be based on emission factors obtained from SCAQMD, CARB, EPA factors and/or vendor data, if available.

4.3.4 Greenhouse Gas Emissions

Potential greenhouse gas emissions from the proposed project will be calculated using the California Climate Action Registry power/utility protocol. The estimated greenhouse gas emissions from the Project will be presented in a table.

4.3.5 Cumulative Impact Analysis Including Off-Property Sources

A cumulative modeling analysis will be performed using AERMOD to evaluate the combined impacts of the AMPS Project emissions increases with those of any other new sources within 6 miles from the AMPS that are currently either under construction, undergoing permitting or expected to be permitted in the near future. Requests will be made to the SCAQMD and the City of Anaheim to request information that will be used to develop lists of all such new or planned emission sources. When received, these lists will be forwarded to CEC for review. Based on this information, and the CEC response, additional sources may be included in the cumulative source modeling analysis.

4.4BUILDING WAKE EFFECTS

The effect of building wakes (i.e., downwash) upon the stack plumes of emission sources at the facility will be evaluated in accordance with USEPA guidance (USEPA, 1985). Direction-specific building data will be generated for stacks below good engineering practice (GEP) stack height using the most recent version of USEPA Building Parameter Input Program – Prime (BPIP-Prime) for input into AERMOD. For the HRA analysis in HARP, ISCST3 incorporates the results from BPIP, the predecessor to BPIP-Prime. Appropriate information will be provided in the AFC and permit applications that describe the input assumptions and output results from the BPIP-Prime and BPIP model.

4.5RECEPTOR GRID

The receptor grids that will be used in the AERMOD modeling analyses described in this protocol for operational sources will be as follows:

- 25-meter spacing along the fenceline and extending from the fenceline out to 100 meters beyond the property line;
- 100-meter spacing from 100 m to 1 km beyond the property line;
- 500-meter spacing within 1 to 5 km of project sources; and
- 1,000-meter spacing within 5 to 10 km of project sources.

During the refined modeling analysis for operational Project emissions, if a maximum predicted concentration for a particular pollutant and averaging time is located within the portion of the receptor grid with spacing greater than 25 meters, a supplemental dense receptor grid will be placed around the original maximum concentration point and the model will be rerun. The dense grid will use 25-meter spacing and will extend to the next grid point in all directions from the original point of maximum concentration.

Due to the large computation time required to run AERMOD, this receptor grid, with the additional dense nested grid points, was determined to best balance the need to predict maximum pollutant concentrations and allow the all operational modeling runs to be completed in a timely manner.

Because construction emission sources release pollutants to the atmosphere from small equipment exhaust stacks or from soil disturbances at ground level, maximum predicted construction impacts for all pollutants and averaging times will occur within the first kilometer from the AMPS site boundary. Accordingly, only the portion of the above grid with 25 meter spacing out to a distance of 1 km will be used for the construction modeling.

For the HRA modeling, receptors will be placed at a 25-meter spacing around the facility fenceline and 100-meter spacing outside the fence out to 10 km. All receptors that HARP creates inside the fenceline will be excluded. The HARP simulations will also include the census receptors out to 10 km, these receptors are located in the populated areas nearest to the proposed facility. Receptors will be placed at all sensitive locations (e.g., schools, hospitals, etc.) out to a distance of 3 miles. Discrete receptors will also be placed at the locations of nearby residences.

A detailed project map including surrounding area will be provided in the AFC showing the locations of the grid receptors. Actual Universal Transverse Mercator (UTM) coordinates will be used. The CAAQS and NAAQS apply to all locations outside the applicant's facility, i.e. everywhere where public access is not under the control of the applicant. Therefore, the fenceline will be placed along the facility's property boundary, and the receptors will be placed on and outside of the fenceline.

4.6METEOROLOGICAL AND AIR QUALITY DATA

4.6.1 Meteorological Data

The most representative NWS surface station with adequate data collection to support the required modeling effort was determined to be the John Wayne Airport. The Fullerton Airport station is nearer, but had insufficient data collection. Hourly NWS surface data for 2002-2006 from John Wayne Airport and upper air data from Miramar Naval Air Station for the same time frame will be processed in AERMET for input into AERMOD.

The meteorological data recorded at John Wayne Airport are acceptable for use at AMPS for two reasons, proximity and terrain similarity. The terrain immediately surrounding the Project site can be categorized as a fairly flat industrial urban area. The terrain around the John Wayne Airport also consists of relatively flat urban areas. Thus the land use and the location with respect to near-field terrain features are similar. Additionally, there are no significant terrain features separating the John Wayne Airport from the AMPS site that would cause differences in wind or temperature conditions between these respective areas. Therefore the five years of meteorological data selected from the John Wayne Airport were determined to be representative for purposes of evaluating the Project's air quality impacts.

The land use characteristics for the entire 360 degrees out to a distance of 3 kilometers surrounding both the John Wayne Airport and the AMPS site are urban. The land-use parameter values show in Table 4-3 are proposed to be used in AERMET for purposes of processing the meteorological data, and represent the surface characteristics around both the John Wayne Airport and the AMPS site.

Table 4-3
Land Use Characteristics Surrounding John Wayne Airport and AMPS

Land Use Characteristic	Spring	Summer	Autumn	Winter
Albedo	0.14	0.16	0.18	0.14
Bowen Ratio	2.0	4.0	4.0	2.0
Surface Roughness (meters)	1.0	1.0	1.0	1.0

The meteorological input data to be used in the HARP/ISC modeling comes from SCAQMD. The data are from the SCAQMD Anaheim station for 1981, were processed by SCAQMD and are model ready.

The annual wind rose based on the five years of John Wayne Airport surface meteorological data is provided as Appendix A to this protocol document. Winds for all seasons and all years blow predominantly from the southwest.

4.6.2 Air Quality Monitoring Data

Air quality monitoring data to represent existing air quality in the Project area were obtained from the USEPA AirData (2006) and the CARB-California Air Quality Data website (2006). The most recent three years of data (2004-2006) from the Anaheim-Pampas Lane, La Habra, Costa Mesa-Mesa Verde Drive, and Mission Viejo, monitoring stations were collected to determine the most representative baseline concentrations for each air pollutant and averaging period addressed in the California and National ambient air quality standards. The maximum concentration recorded at these monitoring stations over the three-year period will be used as a conservative representation of existing air quality condition at the proposed Project site.

The monitoring stations within Orange County that are closest to the proposed project site are the Anaheim-Pampas station, located approximately 4.8 miles west-southwest of the proposed project site, and the La Habra station, located about 6.8 miles to the northwest of the proposed site. The Anaheim-Pampas station measures all criteria pollutant concentrations except sulfur dioxide (SO_2). The La Habra station only measures carbon monoxide (CO), and nitrogen dioxide (NO_2). The closest station that measures SO_2 is the Costa Mesa-Mesa Verde Drive station, located approximately 13.2 miles south southwest of the project site. The Costa Mesa station also measures CO, and NO_2. The Mission Viejo station is the second closest station (the first being the Anaheim-Pampas station) that measures PM_{10} and $PM_{2.5}$. The Mission Viejo station is about 19.1 miles south southeast of the AMPS site.

The selected maximum baseline concentrations for all pollutants are summarized in Table 4-4. These data will be added to the modeled maximum impacts due to project emissions for each pollutant and averaging time, and the totals will then be compared with the applicable AAQS. This is a conservative approach because it assumes that the highest recorded background values and the modeled maximum impacts occur at the same time and location for each pollutant and averaging time, a highly unlikely scenario. Note that the maximum background concentrations of PM_{10} and $PM_{2.5}$ currently exceed the corresponding CAAQS and NAAQS.

Table 4-4
Highest Monitored Pollutant Concentrations near the Proposed AMPS Site (2004 – 2006)

Pollutant	Averaging Time	Highest Monitoring Concentration	Monitoring Station Address	Year
CO	8-hour	4.09 ppm (4,544 μg/m^3)	Anaheim Pampas Lane	2004
	1-hour	7.4 ppm (8,510 μg/m^3)	La Habra	2004
NO_2	Annual	0.025 ppm (46.7 μg/m^3)	La Habra	2004 and 2005
	1-hour	0.122 ppm (229.1 μg/m^3)	Anaheim Pampas Lane	2004
SO_2	Annual	0.002 ppm (5.33 μg/m^3)	Costa Mesa-Mesa Verde Drive	2004
	24-hour	0.008 ppm (21.0 μg/m^3)	Costa Mesa-Mesa Verde Drive	2004 and 2005
	3-hour	0.020 ppm (52.0 μg/m^3)	Costa Mesa-Mesa Verde Drive	2004
	1-hour	0.031 ppm (81.2 μg/m^3)	Costa Mesa-Mesa Verde Drive	2004
PM_{10} (Non-attainment area)	Annual	33.9 μg/m^3	Anaheim Pampas Lane	2004
	24-hour	104.0 μg/m^3	Anaheim Pampas Lane	2006
$PM_{2.5}$ (Non-attainment area)	Annual	19.0 μg/m^3	Anaheim Pampas Lane	2004
	24-hour	58.9 μg/m^3	Anaheim Pampas Lane	2004

4.7FUMIGATION MODELING

Fumigation occurs when a stable layer of air lies a short distance above the release point of a plume and unstable air lies below. Especially on sunny mornings with light winds, the heating of the earth's surface causes a layer of turbulence which grows in depth over time and may intersect an elevated exhaust plume, rapidly drawing it down to ground level and creating relatively high pollutant concentrations for a short period. Typically, fumigation analysis is conducted using SCREEN3 when the project site is rural and the stack height is greater than 10 meter. However, since the AMPS project site is urban, the SCREEN3 fumigation analysis is not considered to be valid.

SECTION 5 PRESENTATION OF MODELING RESULTS

5.1NAAQS AND CAAQS ANALYSES

The results of the AAQS analyses to evaluate the construction and operational impacts of the AMPS facility will be presented in summary tables. A figure indicating the locations of the maximum predicted pollutant concentrations for each applicable pollutant and averaging time will be provided. The maximum modeled values of the criteria pollutants from the AMPS sources will be added to the background concentrations (see Section 4.6.2) for each averaging time and compared with the NAAQS and CAAQS. PM_{10} impacts will be compared against the SCAQMD significance change thresholds. The cumulative impact values from combination of project sources in AMPS and new sources within 6 miles of the proposed project site will be added to the background concentrations for the corresponding pollutants and averaging times and will be compared with the NAAQS and CAAQS.

5.2HEALTH RISK ASSESSMENT ANALYSIS

Maps depicting the following data will be prepared:

- The locations of sensitive receptors, including schools, pre-schools, hospitals, etc., within a 3-mile radius of the project, and the nearby residences included in the HRA;
- Table listing all sensitive receptors within a 3-mile radius of the project;
- A map depicting current and future residential land uses;
- Isopleths for any areas where predicted exposures to air toxics result in estimated chronic non-cancer impacts and acute impacts equal to or exceeding a hazard index of 0.5; and
- Isopleths for any areas where exposures to air toxics lead to an estimated carcinogenic risk equal to or greater than one in one million.

Health risk assessment modeling results will be summarized to include maximum annual (chronic, carcinogenic, and non-carcinogenic) and hourly (acute) adverse health effects from the AMPS's toxic air contaminant emissions. The estimated cancer burden will be presented if the maximum off-site cancer risk is predicted to be greater than one in ten million. Health risk values will be calculated and presented in the summary table for the points of maximum impact and the sensitive receptors with the maximum risk values.

5.3DATA SUBMITTAL

Electronic copies of the modeling input and output files for all the analyses described in this protocol will be provided to SCAQMD and CEC.

SECTION 6 REFERENCES

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United States Environmental Protection Agency, 2004. User's Guide for the AMS/EPA Regulatory Model-AERMOD. September 2004.

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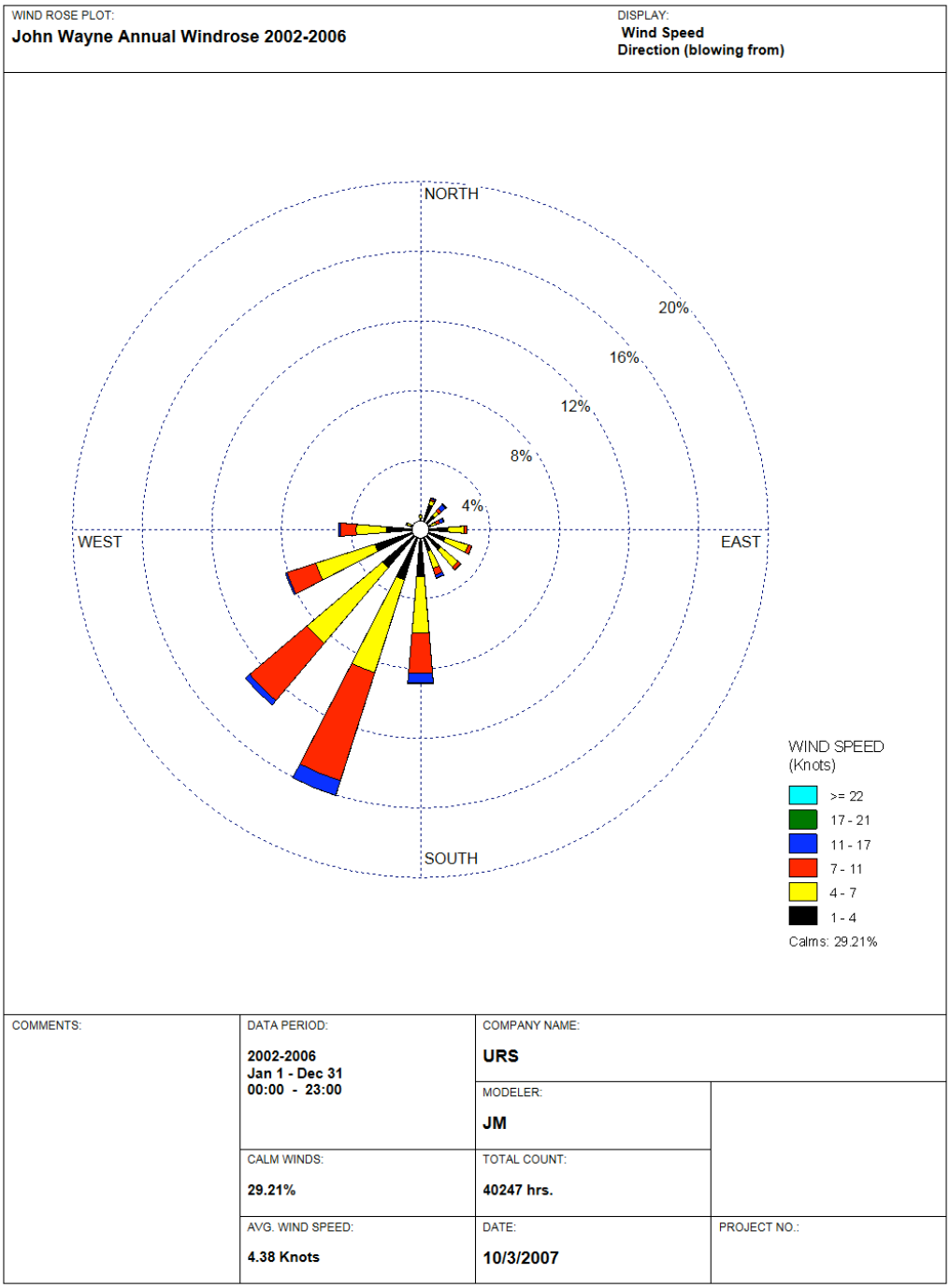
Figure A-1
Annual Windrose for John Wayne Airport based on Surface Data for 2002-2006



BACT ANALYSIS

1.0 INTRODUCTION

A Best Available Control Technology (BACT) assessment was conducted for the proposed Anaheim Municipal Power Station (AMPS). The primary emphasis of this assessment was consideration of all NO_x and CO control technologies currently proposed or in use on natural gas-fired combustion turbines with more than 40 MMBtu per hour fuel energy input. To identify feasible emission limits for comparable turbine units, several information sources were consulted, including the following:

- USEPA RACT/BACT/LAER Clearinghouse (USEPA 1985) and updates
- CARB BACT Clearinghouse database and CARB BACT Guidelines for Power Plants (Adopted 7/22/99)
- Recent California Energy Commission (CEC) Applications for Certification
- Research conducted by Anaheim Municipal Power Station design engineers

Table 1, Summary of Recent NO_x BACT Determinations for Combustion Turbine Generators Rated at Greater than 40 MW in Peaking Service, lists selected recent NO_x BACT proposals and determinations for natural gas-fired advanced technology combustion turbines in California. Nearly all recent simple-cycle turbine projects in California had a NO_x BACT level of 2.5 ppm dry volume basis (ppmvd) at 15 percent oxygen (O_2), to be achieved by means of either water injection or dry low-NO_x burners in combination with SCR and ammonia injection. The combustion turbines of AMPS will also achieve stack NO_x concentrations at or below this level except during maintenance, startup, and shutdown events, by using water injection and SCR,.

TABLE 1
SUMMARY OF RECENT NO_X BACT DETERMINATIONS FOR COMBUSTION TURBINE GENERATORS RATED AT GREATER THAN 40 MW IN PEAKING SERVICE

Name	Location	Rating	Vendor, Model	Emission Limit	Control(s)	Permit Date
Kings River Conservation District Peaking Plant	CA	40+ each, 2 turbines, 97 MW total	GE LM6000 Sprint PC	3.0 ppm	Water injection and SCR	5/04
Modesto Electric Generation Project	CA	40+ each, 2 turbines, 95 MW total	GE LM6000 Sprint	2.5 ppm	Water injection and SCR	2/04
Riverside Energy Resource Center	CA	40+ each, 2 turbines, 96 MW total	GE LM6000 Sprint PC NxGen	2.5 ppm	Water injection and SCR	12/04
San Francisco Electric Reliability Project	CA	40+ each, 3 turbines, 145 MW total	GE LM6000	2.5 ppm	Water injection and SCR	Tentative 4/06
Niland Gas Turbine Plant	CA	40+ each, 2 turbines, 96 MW total	GE LM6000 Sprint PC	2.5	Dry low-NOx burners and SCR	4/07

GE = General Electric
MW = megawatt
ppm = Parts per million by volume, dry basis, at 15 percent oxygen
SCR = Selective catalytic reduction

Similarly, nearly all recent simple-cycle turbine projects have been approved with a CO emissions limit of 6 ppmvd and a VOC emissions limit of 2 ppmvd (both at 15 percent O_2), based on the use of an oxidation catalyst. The AMPS natural gas turbines will achieve these same BACT concentrations for CO and VOC by application of oxidation catalysts. Exclusive use of natural gas fuel has been determined to be BACT for SO_x and PM_{10} in all other comparable projects for several years.

2.0 BACT FOR NATURAL GAS-FIRED COMBUSTION TURBINES

2.1 Assessment of NO_x Control Technologies

Based on a review of the materials described above, the following NO_x control technologies were evaluated to determine whether they are able to achieve BACT NO_x levels in practice:

- Dry Low Emissions (DLE) combustion technology and Goal Line EMx™
- Water injection and SCR

EMx™

EMx™ is a NO_x reduction system produced by Goal Line Environmental Technologies (now distributed by EmeraChem) for natural gas turbine applications within an exhaust temperature range significantly below the design operating parameters of the simple-cycle LM 6000 turbines that will be employed at the AMPS. This system uses a coated catalyst to oxidize both NO_x and CO, and thereby reduce plant emissions. As demonstrated by an initial installation on several gas turbines in co-generation (combined cycle) applications, EMx™ is capable of achieving NO_x emission concentrations of 2 ppm based on a maximum inlet concentration of 25 ppm, and 90 percent CO reduction based on a maximum inlet concentration of 50 ppm. CO emissions are reduced in EMx™ by the oxidation of CO to CO_2. A two-step process reduces NO_x emissions. First, NO_x emissions are oxidized to NO_2 and then adsorbed onto the catalyst. In the second step, a proprietary regenerative natural gas is passed through the catalyst periodically. This natural gas desorbs the NO_2 from the catalyst and reduces it to N_2. The system does not use ammonia as a reagent; rather, it uses natural gas as the basis for a proprietary catalyst regeneration process.

However, the EMx™ technology has not been sufficiently demonstrated on higher exhaust temperature simple-cycle peaking natural gas turbines such as those proposed for the AMPS project. The system consists of a catalyst that is installed in the flue gas at a point where the temperature is between 280°F and 650°F. The AMPS CTGs operate between 710 to 858 °F; therefore, the EMx™ technology is not appropriate for application to the high temperature turbine exhaust conditions of the proposed project.

Potential advantages of the EMx™ process include:

- **No Ammonia.** The EMx™ process does not use ammonia. This eliminates any ammonia storage and transportation safety issues and the potential for ammonia slip or ammonia-based particulate formation.
- **Carbon Monoxide Reduction.** EMx™ will reduce CO emissions as well as NO_x emissions.

Potential disadvantages of the EMx™ process include:

- **High Capital and Operating Cost.** EMx™ is significantly more expensive than SCR with ammonia injection, primarily due to the higher cost of initial and replacement catalyst. The EMx™ catalyst is a precious metal catalyst, which is very expensive.
- **Not Suitable for Exhaust Temperatures of Simple-Cycle Natural Gas Turbine Peaking Applications**. EMx™ has been primarily installed on small co-generation (combined cycle) systems. The AMPS facility will be a simple-cycle peaking operation. Peaking units require more rapid startup and more frequent load changes than typical co-generation systems. The main concerns are the damper systems that would be required with EMx™ for the units and assuring proper regeneration gas distribution. The effectiveness and longevity of these damper systems have not been demonstrated on simple-cycle natural gas turbines, and their cost of replacement would be substantial. In addition, steam is required to produce the EMx™ regeneration gas. The AMPS facility will have no steam production.
- **Catalyst "Washing."** A proprietary catalyst washing system must be used and an on-line catalyst washing system design has not yet been fully developed. If an on-line catalyst washing system is not used, then the facility must be shut down for cleaning.

Because the low NO_x emission rates attainable on natural gas turbines in co-generation systems with EMx™ have not been sufficiently demonstrated as "achieved in practice" on simple-cycle natural gas turbine applications and the other factors discussed above, EMx™ does not represent current, technically feasible BACT for the AMPS facility. Accordingly, a comparative cost analysis with the proposed NO_x control technologies is not required. However, SCAQMD staff has agreed with previous BACT evaluations that determined the use of EMx™ for simple-cycle CTGs is not a cost effective option. These findings reinforce the elimination of EMx™ on grounds of technical infeasibility.

SCR with Water Injection

SCR is a technology that achieves post-combustion reduction of NO_x from flue gas within a catalytic reactor. The SCR process involves the injection of ammonia (NH_3) into the exhaust gas upstream of a specialized catalyst module, promoting conversion of NO_x to molecular nitrogen. SCR with ammonia injection systems for reduction of NO_x emissions have been widely used in simple-cycle natural gas turbine applications for many years, and are considered a proven technology. SCR systems are commercially available from several vendors, unlike EMx™, which is available from a single vendor. The SCR process involves the injection of ammonia into the flue gas stream by means of

an ammonia injection grid upstream of the catalyst. The ammonia reacts with NO_x in the presence of the catalyst. The catalyst is not regenerated and requires periodic replacement. SCR vendors typically offer a 3-year guarantee on catalyst life. SCR with ammonia injection systems have been used in numerous simple-cycle applications in California and throughout the world.

Water or steam injection has been a proven NO_x control technique for many years. Injection of water or steam into the primary combustion zone of advanced combustors of a CTG reduces the formation of thermal NO_x by decreasing the peak combustion temperature. Water injection decreases the peak flame temperature by diluting the combustion gas stream and acting as a heat sink that absorbs heat necessary to: (a) vaporize the water (latent heat of vaporization), and (b) raise the vaporized water temperature to the combustion temperature. High purity water must be employed to prevent turbine corrosion and deposition of solids on the turbine blades. The use of water or steam injection in diffusion flame combustors firing natural gas can typically achieve NO_x exhaust concentrations of 25 ppmvd, corrected to 15 percent O_2.

The Project will use water injection and SCR with ammonia injection designed to achieve a NO_x emission limit of 2.5 ppm (at 15 percent O_2). As noted in Table 1, water injection and SCR have recently been permitted at a NO_x emission level of 2.5 ppmvd (at 15 percent O_2) for numerous California turbines that are similar in capacity to the proposed AMPS turbines. Accordingly, water injection with SCR with ammonia injection is considered to be BACT for the AMPS facility. Although the proposed BACT level for NO_x emissions from the simple-cycle units is 2.5 parts per million by volume, dry basis (ppmvd) at 15 percent oxygen, the applicant has agreed to meet a more stringent 2.3 ppmvd at 15 percent oxygen under certain ambient conditions (59 degrees F, 60% relative humidity and 14.7 psia pressure). This commitment has been made to comply with the applicable NO_x emission limit specified in SCAQMD's Priority Reserve Rule (1309.1), which was amended on August 3, 2007.

OTHER TECHNOLOGIES

Technologies that cannot achieve a NO_x emissions limit of 2.5 ppmvd (at 15 percent O_2) in practice were not considered as BACT candidates for the AMPS facility. These technologies include SCR without DLE, DLE without SCR, and water/steam injection without SCR.

2.2 Assessment of CO Control Technologies

The AMPS facility CTGs are guaranteed to emit no more than 6 ppm of CO (at 15 percent O_2), with natural gas fuel and use of a CO oxidation catalyst (except during startup and shutdown). SCAQMD has made BACT findings for other recent simple cycle gas turbines equipped with CO oxidation catalysts to achieve a BACT stack concentration of 6 ppmvd @15% O_2.

The following CO control technologies are evaluated:

- Combustion design/control
- Oxidizing catalyst

Combustion Design/Control

Natural gas turbine combustion technology has significantly improved over recent years with regard to lowering CO emissions. AMPS proposes to operate four LM 6000 turbines at the AMPS facility. For other installations, turbines have been guaranteed by the manufacturer to achieve a CO rate of 9 ppm (at 15 percent O_2) without post-combustion control technologies under a wide range of operating conditions (50 percent to 100 percent load) and ambient conditions (38°F to 109°F).

Oxidizing Catalyst

CO oxidizing catalysts have been used with natural gas-fired turbines for over a decade when uncontrolled CO emission levels are unacceptably high. CO catalysts operate at elevated temperatures within the exhaust stream. CO-oxidizing catalysts can be considered technically feasible for use in simple-cycle peaking applications. Thus, installation of a CO-oxidizing catalyst on the natural gas turbines is considered to be BACT for the AMPS facility.

2.3 Assessment of VOC Control Technologies

The proposed BACT level of 2 ppmvd (at 15 percent O_2) for VOC control with water injection, SCR, and an oxidation catalyst is consistent with the most stringent level found among recent BACT determinations for simple-cycle natural gas turbines, and is therefore considered to be BACT for the AMPS facility.

2.4 Assessment of SO_2 and PM_{10} Control Technologies

Sulfur dioxide and PM_{10} emissions will be controlled through the exclusive use of clean-burning pipeline quality natural gas. This control technology has been widely and uniformly implemented for control of SO_2 and PM_{10} emissions from combustion turbines in California and throughout the United States, and is considered to be BACT for the AMPS facility.

2.5 Assessment of Ammonia Slip Control Technologies

Ammonia emissions will be limited to 5 ppmvd (at 15 percent O_2). This proposed BACT is consistent with SCAQMD policy to control NO_x.

3.0 BACT FOR EMERGENCY DIESEL BLACK START ENGINE

The Project will include a diesel fuel driven engine for the black start generator. 40CFR part 89 and CCR Title 13 and Title 17 require certified EPA TEIR III emission rates for emergency internal combustion engines, which currently are commercially unavailable. The equipment proposed for the AMPS black start engine satisfies the EPA's emission requirements for TIER II engines rated at greater than 750 kW:

- NO_X + NMHC: 4.8 g/hp-hr

- CO: 2.6 g/hp-hr
- PM: 0.15 g/hp-hr

A summary of recent SCAQMD BACT determinations for compression ignition emergency engines greater than 750kW is shown in Table 2.

Table 2
Summary of Recent BACT Determinations in the SCAQMD for Compression Ignition Diesel Internal Combustion Engines

Name	Location	Application Date	Rating (Hp)	Control Technology	Emission Limit (g/bhp-hr)			
					ROG	NO_x	CO	PM_{10}
Walt Disney Pictures and Television	Glendale, CA	5/2000	1109	combustion modifications (turbocharged and aftercooled)	1.0	6.9	8.5	0.38
Homegrocer.com	Carson, CA	5/2000	1480	combustion modifications (turbocharged and aftercooled)	1.0	6.9	8.5	0.38
Homegrocer.com	Carson, CA	5/2000	883	turbocharged and aftercooled	1.0	6.9	8.5	0.38
Cucamonga County Water District	Rancho Cucamonga, CA	5/2000	890	turbocharged and aftercooled	1.0	6.9	8.5	0.38

Hp = horsepower
g/bhp-hr = grams per brake horsepower - hour

4.0 SUMMARY OF PROPOSED BACT

Table 3, Summary of Proposed BACT, presents the proposed BACT emission levels for the AMPS facility, based on the assessment described in the preceding subsections.

TABLE 3
SUMMARY OF PROPOSED BACT

Pollutant	Control Technology	Concentration
Combustion Turbines		
NO_x	Water injection and SCR with ammonia injection	2.5 ppmvd at 15 percent O_2 (1-hour average) [1]
CO	Catalytic oxidation	6.0 ppmvd at 15 percent O_2 (1-hour average)
VOC	Catalytic oxidation	2.0 ppmvd at 15 percent O_2 (1-hour average)
SO_2	Pipeline quality natural gas	NA
PM_{10}	Pipeline quality natural gas	NA

TABLE 3 SUMMARY OF PROPOSED BACT		
Pollutant	**Control Technology**	**Concentration**
Ammonia slip	Operational limitation	5.0 ppmvd at 15 percent O_2
Black Start Engine (1,141 horsepower)		
NO_x + NMHC	EPA Tier II	6.4 g/kW-hour (4.8 g/hp-hour)
CO	EPA Tier II	3.5 g/kW-hour (2.6 g/hp-hour)
SO_2	EPA Tier II	Diesel fuel with sulfur content no greater than 0.0015% by weight
PM_{10}	EPA Tier II	0.20 g/kW-hour (0.15 g/hp-hour)

Notes:

[1] Applicant has committed to meet 2.3 ppmvd NO_x at 15% O_2 for the specific ambient conditions of 59 degrees F, 60% relative humidity and 14.7 psia pressure, as required to comply with the applicable NO_x emission limit specified in SCAQMD's Priority Reserve Rule (1309.1)

BACT = Best Available Control Technology
CO = carbon monoxide
NA = not applicable
NO_x = nitrogen oxides
O_2 = oxygen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
ppm = parts per million
SCR = Selective catalytic reduction
VOC = volatile organic compounds
SO_2 = sulfur dioxide

MW = megawatt
ppm = Parts per million by volume, dry basis, at 15 percent oxygen
SCR = Selective catalytic reduction

Similarly, nearly all recent simple-cycle turbine projects have been approved with a CO emissions limit of 6 ppmvd and a VOC emissions limit of 2 ppmvd (both at 15 percent O_2), based on the use of an oxidation catalyst. The AMPS natural gas turbines will achieve these same BACT concentrations for CO and VOC by application of oxidation catalysts. Exclusive use of natural gas fuel has been determined to be BACT for SO_x and PM_{10} in all other comparable projects for several years.

2.0 BACT FOR NATURAL GAS-FIRED COMBUSTION TURBINES

2.1 Assessment of NO_x Control Technologies

Based on a review of the materials described above, the following NO_x control technologies were evaluated to determine whether they are able to achieve BACT NO_x levels in practice:

- Dry Low Emissions (DLE) combustion technology and Goal Line EMx™
- Water injection and SCR

EMx™

EMx™ is a NO_x reduction system produced by Goal Line Environmental Technologies (now distributed by EmeraChem) for natural gas turbine applications within an exhaust temperature range significantly below the design operating parameters of the simple-cycle LM 6000 turbines that will be employed at the AMPS. This system uses a coated catalyst to oxidize both NO_x and CO, and thereby reduce plant emissions. As demonstrated by an initial installation on several gas turbines in co-generation (combined cycle) applications, EMx™ is capable of achieving NO_x emission concentrations of 2 ppm based on a maximum inlet concentration of 25 ppm, and 90 percent CO reduction based on a maximum inlet concentration of 50 ppm. CO emissions are reduced in EMx™ by the oxidation of CO to CO_2. A two-step process reduces NO_x emissions. First, NO_x emissions are oxidized to NO_2 and then adsorbed onto the catalyst. In the second step, a proprietary regenerative natural gas is passed through the catalyst periodically. This natural gas desorbs the NO_2 from the catalyst and reduces it to N_2. The system does not use ammonia as a reagent; rather, it uses natural gas as the basis for a proprietary catalyst regeneration process.

However, the EMx™ technology has not been sufficiently demonstrated on higher exhaust temperature simple-cycle peaking natural gas turbines such as those proposed for the AMPS project. The system consists of a catalyst that is installed in the flue gas at a point where the temperature is between 280°F and 650°F. The AMPS CTGs operate between 710 to 858 °F; therefore, the EMx™ technology is not appropriate for application to the high temperature turbine exhaust conditions of the proposed project.

Potential advantages of the EMx™ process include:

- **No Ammonia.** The EMx™ process does not use ammonia. This eliminates any ammonia storage and transportation safety issues and the potential for ammonia slip or ammonia-based particulate formation.
- **Carbon Monoxide Reduction.** EMx™ will reduce CO emissions as well as NO_x emissions.

Potential disadvantages of the EMx™ process include:

- **High Capital and Operating Cost.** EMx™ is significantly more expensive than SCR with ammonia injection, primarily due to the higher cost of initial and replacement catalyst. The EMx™ catalyst is a precious metal catalyst, which is very expensive.
- **Not Suitable for Exhaust Temperatures of Simple-Cycle Natural Gas Turbine Peaking Applications**. EMx™ has been primarily installed on small co-generation (combined cycle) systems. The AMPS facility will be a simple-cycle peaking operation. Peaking units require more rapid startup and more frequent load changes than typical co-generation systems. The main concerns are the damper systems that would be required with EMx™ for the units and assuring proper regeneration gas distribution. The effectiveness and longevity of these damper systems have not been demonstrated on simple-cycle natural gas turbines, and their cost of replacement would be substantial. In addition, steam is required to produce the EMx™ regeneration gas. The AMPS facility will have no steam production.
- **Catalyst "Washing."** A proprietary catalyst washing system must be used and an on-line catalyst washing system design has not yet been fully developed. If an on-line catalyst washing system is not used, then the facility must be shut down for cleaning.

Because the low NO_x emission rates attainable on natural gas turbines in co-generation systems with EMx™ have not been sufficiently demonstrated as "achieved in practice" on simple-cycle natural gas turbine applications and the other factors discussed above, EMx™ does not represent current, technically feasible BACT for the AMPS facility. Accordingly, a comparative cost analysis with the proposed NO_x control technologies is not required. However, SCAQMD staff has agreed with previous BACT evaluations that determined the use of EMx™ for simple-cycle CTGs is not a cost effective option. These findings reinforce the elimination of EMx™ on grounds of technical infeasibility.

SCR with Water Injection

SCR is a technology that achieves post-combustion reduction of NO_x from flue gas within a catalytic reactor. The SCR process involves the injection of ammonia (NH_3) into the exhaust gas upstream of a specialized catalyst module, promoting conversion of NO_x to molecular nitrogen. SCR with ammonia injection systems for reduction of NO_x emissions have been widely used in simple-cycle natural gas turbine applications for many years, and are considered a proven technology. SCR systems are commercially available from several vendors, unlike EMx™, which is available from a single vendor. The SCR process involves the injection of ammonia into the flue gas stream by means of

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Water or steam injection has been a proven NO_x control technique for many years. Injection of water or steam into the primary combustion zone of advanced combustors of a CTG reduces the formation of thermal NO_x by decreasing the peak combustion temperature. Water injection decreases the peak flame temperature by diluting the combustion gas stream and acting as a heat sink that absorbs heat necessary to: (a) vaporize the water (latent heat of vaporization), and (b) raise the vaporized water temperature to the combustion temperature. High purity water must be employed to prevent turbine corrosion and deposition of solids on the turbine blades. The use of water or steam injection in diffusion flame combustors firing natural gas can typically achieve NO_x exhaust concentrations of 25 ppmvd, corrected to 15 percent O_2.

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combustion control technologies under a wide range of operating conditions (50 percent to 100 percent load) and ambient conditions (38°F to 109°F).

Oxidizing Catalyst

CO oxidizing catalysts have been used with natural gas-fired turbines for over a decade when uncontrolled CO emission levels are unacceptably high. CO catalysts operate at elevated temperatures within the exhaust stream. CO-oxidizing catalysts can be considered technically feasible for use in simple-cycle peaking applications. Thus, installation of a CO-oxidizing catalyst on the natural gas turbines is considered to be BACT for the AMPS facility.

2.3 Assessment of VOC Control Technologies

The proposed BACT level of 2 ppmvd (at 15 percent O_2) for VOC control with water injection, SCR, and an oxidation catalyst is consistent with the most stringent level found among recent BACT determinations for simple-cycle natural gas turbines, and is therefore considered to be BACT for the AMPS facility.

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Sulfur dioxide and PM_{10} emissions will be controlled through the exclusive use of clean-burning pipeline quality natural gas. This control technology has been widely and uniformly implemented for control of SO_2 and PM_{10} emissions from combustion turbines in California and throughout the United States, and is considered to be BACT for the AMPS facility.

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- NO_X + NMHC: 4.8 g/hp-hr
- CO: 2.6 g/hp-hr
- PM: 0.15 g/hp-hr

A summary of recent SCAQMD BACT determinations for compression ignition emergency engines greater than 750kW is shown in Table 2.

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Homegrocer.com	Carson, CA	5/2000	1480	combustion modifications (turbocharged and aftercooled)	1.0	6.9	8.5	0.38
Homegrocer.com	Carson, CA	5/2000	883	turbocharged and aftercooled	1.0	6.9	8.5	0.38
Cucamonga County Water District	Rancho Cucamonga, CA	5/2000	890	turbocharged and aftercooled	1.0	6.9	8.5	0.38

Hp = horsepower
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VOC	Catalytic oxidation	2.0 ppmvd at 15 percent O_2 (1-hour average)
SO_2	Pipeline quality natural gas	NA
PM_{10}	Pipeline quality natural gas	NA
Ammonia slip	Operational limitation	5.0 ppmvd at 15 percent O_2
Black Start Engine (1,141 horsepower)		
NO_x + NMHC	EPA Tier II	6.4 g/kW-hour (4.8 g/hp-hour)

TABLE 3 SUMMARY OF PROPOSED BACT		
Pollutant	**Control Technology**	**Concentration**
CO	EPA Tier II	3.5 g/kW-hour (2.6 g/hp-hour)
SO_2	EPA Tier II	Diesel fuel with sulfur content no greater than 0.0015% by weight
PM_{10}	EPA Tier II	0.20 g/kW-hour (0.15 g/hp-hour)

Notes:
BACT = Best Available Control Technology
CO = carbon monoxide
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