

DOCKETED

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APPENDIX 8.1D

Modeling Analysis

**Table 8.1D-1
Emission Rates and Stack Parameters for Screening Level Modeling (all emissions/operating data for a single new gas turbine/HRSG)**

Gas Turbine/HRSG Operating Case	Emission Rates, g/s									
	Ambient Temp. (deg. F)	Stack D (m)	Exhaust Temp. (deg. K)	Exhaust Flow (m3/s)	Exhaust Velocity (m/s)	NOx Port	NOx Ten(annual)	SO2	CO	PM10
100% load, DB off, PA off	104	5.639	360.22	453.71	18.17	1.95	1.56	0.15	2.85	1.13
50% load, DB off, PA off	104	5.639	345.22	278.12	11.14	1.16	0.93	0.09	1.69	1.13
100% load, DB off, PA off	61	5.639	358.00	468.51	18.76	2.04	1.63	0.16	2.98	1.13
50% load, DB off, PA off	61	5.639	342.44	296.96	11.89	1.30	1.04	0.10	1.90	1.13
100% load, DB off, PA off	34	5.639	356.33	487.08	19.50	2.13	1.70	0.17	3.11	1.13
50% load, DB off, PA off	34	5.639	341.89	302.18	12.10	1.36	1.09	0.10	1.98	1.13

**Table 8.1D-2
Results of Gas Turbine/HRSG Screening Analysis (combined impacts for four gas turbines/HRSGs)**

Gas Turbine/HRSG Operating Case	Modeling Impacts (ug/m3)										
	Ambient Temp. (deg. F)	NO2 1-hr	NO2 Annual	SO2 1-hr	SO2 3-hr	SO2 24-hr	SO2 Annual	CO 1-hr	CO 8-hr	PM10 24-hr	PM10 Annual
100% load, DB off, PA off	104	20.180	0.144	1.318	0.737	0.244	0.0139	24.890	11.220	1.833	0.105
50% load, DB off, PA off	104	19.700	0.164	1.274	0.939	0.365	0.0157	24.240	11.630	4.651	0.200
100% load, DB off, PA off	61	20.650	0.150	1.345	0.731	0.252	0.0145	25.460	11.660	1.813	0.104
50% load, DB off, PA off	61	21.030	0.172	1.401	1.014	0.380	0.0167	26.390	12.380	4.273	0.188
100% load, DB off, PA off	34	20.850	0.155	1.366	0.761	0.259	0.0150	25.680	11.960	1.773	0.103
50% load, DB off, PA off	34	21.810	0.178	1.446	1.040	0.386	0.0172	27.360	12.750	4.177	0.186

**Table 8.1D-3
Emission Rates and Stack Parameters for Refined Modeling**

Averaging Period: One hour NOx	Emission Rates, g/s											Emission Rates, lb/hr				
	Stack Diam, m	Temp, deg K	Exhaust Flow, m3/s	Exhaust Velocity, m/s	NOx	SO2	CO	PM10	Stack Diam, ft	Exh Temp, Deg F	Exh Flow Rate, ft3/m	Exhaust Velocity, ft/s	NOx	SO2	CO	PM10
Gas Turbine 1/HRSG	5.639	341.89	302.18	12.10	1.358	n/a	n/a	n/a	18.50	156	640,284	39.70	10.78	n/a	n/a	n/a
Gas Turbine 2/HRSG	5.639	341.89	302.18	12.10	1.358	n/a	n/a	n/a	18.50	156	640,284	39.70	10.78	n/a	n/a	n/a
Gas Turbine 3/HRSG	5.639	341.89	302.18	12.10	1.358	n/a	n/a	n/a	18.50	156	640,284	39.70	10.78	n/a	n/a	n/a
Gas Turbine 4/HRSG	5.639	341.89	302.18	12.10	1.358	n/a	n/a	n/a	18.50	156	640,284	39.70	10.78	n/a	n/a	n/a
Cooling Tower 1	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	n/a	n/a	n/a
Cooling Tower 2	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	n/a	n/a	n/a
Averaging Period: One hour CO and SOx																
Gas Turbine 1/HRSG	5.639	341.89	302.18	12.10	n/a	0.105	1.984	n/a	18.50	156	640,284	39.70	n/a	0.83	15.75	n/a
Gas Turbine 2/HRSG	5.639	341.89	302.18	12.10	n/a	0.105	1.984	n/a	18.50	156	640,284	39.70	n/a	0.83	15.75	n/a
Gas Turbine 3/HRSG	5.639	341.89	302.18	12.10	n/a	0.105	1.984	n/a	18.50	156	640,284	39.70	n/a	0.83	15.75	n/a
Gas Turbine 4/HRSG	5.639	341.89	302.18	12.10	n/a	0.105	1.984	n/a	18.50	156	640,284	39.70	n/a	0.83	15.75	n/a
Cooling Tower 1	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	n/a	n/a	n/a
Cooling Tower 2	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	n/a	n/a	n/a
Averaging Period: Three hours SOx																
Gas Turbine 1/HRSG	5.639	341.89	302.18	12.10	n/a	0.105	n/a	n/a	18.50	156	640,284	39.70	n/a	0.83	n/a	n/a
Gas Turbine 2/HRSG	5.639	341.89	302.18	12.10	n/a	0.105	n/a	n/a	18.50	156	640,284	39.70	n/a	0.83	n/a	n/a
Gas Turbine 3/HRSG	5.639	341.89	302.18	12.10	n/a	0.105	n/a	n/a	18.50	156	640,284	39.70	n/a	0.83	n/a	n/a
Gas Turbine 4/HRSG	5.639	341.89	302.18	12.10	n/a	0.105	n/a	n/a	18.50	156	640,284	39.70	n/a	0.83	n/a	n/a
Cooling Tower 1	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	n/a	n/a	n/a
Cooling Tower 2	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	n/a	n/a	n/a

**Table 8.1D-3 (cont.)
Emission Rates and Stack Parameters for Refined Modeling**

	Stack Diam m	Temp deg K	Exhaust Flow, m3/s	Exhaust Velocity, m/s	Emission Rates, g/s				Stack Diam ft	Exh Temp Deg F	Exh Flow Rate, ft3/m	Exhaust Velocity, ft/s	Emission Rates, lb/hr			
					NOx	SO2	CO	PM10					NOx	SO2	CO	PM10
Averaging Period: Eight hours CO																
Gas Turbine 1/HRSG	5.639	341.89	302.18	12.10	n/a	n/a	43.860	n/a	18.50	156	640,284	39.70	n/a	n/a	348.09	n/a
Gas Turbine 2/HRSG	5.639	341.89	302.18	12.10	n/a	n/a	43.860	n/a	18.50	156	640,284	39.70	n/a	n/a	348.09	n/a
Gas Turbine 3/HRSG	5.639	341.89	302.18	12.10	n/a	n/a	43.860	n/a	18.50	156	640,284	39.70	n/a	n/a	348.09	n/a
Gas Turbine 4/HRSG	5.639	341.89	302.18	12.10	n/a	n/a	43.860	n/a	18.50	156	640,284	39.70	n/a	n/a	348.09	n/a
Cooling Tower 1	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	n/a	n/a	n/a
Cooling Tower 2	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	n/a	n/a	n/a
Averaging Period: 24-hour SOx																
Gas Turbine 1/HRSG	5.639	341.89	302.18	12.10	n/a	0.112	n/a	n/a	18.50	156	640,284	39.70	n/a	0.89	n/a	n/a
Gas Turbine 2/HRSG	5.639	341.89	302.18	12.10	n/a	0.112	n/a	n/a	18.50	156	640,284	39.70	n/a	0.89	n/a	n/a
Gas Turbine 3/HRSG	5.639	341.89	302.18	12.10	n/a	0.112	n/a	n/a	18.50	156	640,284	39.70	n/a	0.89	n/a	n/a
Gas Turbine 4/HRSG	5.639	341.89	302.18	12.10	n/a	0.112	n/a	n/a	18.50	156	640,284	39.70	n/a	0.89	n/a	n/a
Cooling Tower 1	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	n/a	n/a	n/a
Cooling Tower 2	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	n/a	n/a	n/a
Averaging Period: 24-hour PM10																
Gas Turbine 1/HRSG	5.639	345.22	278.12	11.14	n/a	n/a	n/a	1.134	18.50	162	589,300	36.54	n/a	n/a	n/a	9.00
Gas Turbine 2/HRSG	5.639	345.22	278.12	11.14	n/a	n/a	n/a	1.134	18.50	162	589,300	36.54	n/a	n/a	n/a	9.00
Gas Turbine 3/HRSG	5.639	345.22	278.12	11.14	n/a	n/a	n/a	1.134	18.50	162	589,300	36.54	n/a	n/a	n/a	9.00
Gas Turbine 4/HRSG	5.639	345.22	278.12	11.14	n/a	n/a	n/a	1.134	18.50	162	589,300	36.54	n/a	n/a	n/a	9.00
Cooling Tower 1	10.973	293.00	677.84	7.17	n/a	n/a	n/a	0.019	36.00	68	1,436,258	23.52	n/a	n/a	n/a	0.15
Cooling Tower 2	10.973	293.00	677.84	7.17	n/a	n/a	n/a	0.019	36.00	68	1,436,258	23.52	n/a	n/a	n/a	0.15
Averaging Period: Annual NOx and SOx																
Gas Turbine 1/HRSG	5.639	341.89	302.18	12.10	1.806	0.158	n/a	n/a	18.50	156	640,284	39.70	14.33	1.25	n/a	n/a
Gas Turbine 2/HRSG	5.639	341.89	302.18	12.10	1.806	0.158	n/a	n/a	18.50	156	640,284	39.70	14.33	1.25	n/a	n/a
Gas Turbine 3/HRSG	5.639	341.89	302.18	12.10	1.806	0.158	n/a	n/a	18.50	156	640,284	39.70	14.33	1.25	n/a	n/a
Gas Turbine 4/HRSG	5.639	341.89	302.18	12.10	1.806	0.158	n/a	n/a	18.50	156	640,284	39.70	14.33	1.25	n/a	n/a
Cooling Tower 1	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	n/a	n/a	n/a
Cooling Tower 2	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	n/a	n/a	n/a
Averaging Period: Annual PM10																
Gas Turbine 1/HRSG	5.639	345.22	278.12	11.14	n/a	n/a	n/a	1.134	18.50	162	589,300	36.54	n/a	n/a	n/a	9.00
Gas Turbine 2/HRSG	5.639	345.22	278.12	11.14	n/a	n/a	n/a	1.134	18.50	162	589,300	36.54	n/a	n/a	n/a	9.00
Gas Turbine 3/HRSG	5.639	345.22	278.12	11.14	n/a	n/a	n/a	1.134	18.50	162	589,300	36.54	n/a	n/a	n/a	9.00
Gas Turbine 4/HRSG	5.639	345.22	278.12	11.14	n/a	n/a	n/a	1.134	18.50	162	589,300	36.54	n/a	n/a	n/a	9.00
Cooling Tower 1	10.973	293.00	677.84	7.17	n/a	n/a	n/a	0.019	36.00	68	1,436,258	23.52	n/a	n/a	n/a	0.15
Cooling Tower 2	10.973	293.00	677.84	7.17	n/a	n/a	n/a	0.019	36.00	68	1,436,258	23.52	n/a	n/a	n/a	0.15

**Table 8.1D-4
Fumigation Screening Analysis**

Emission Rates for Unit Impacts Analysis (g/sec per stack)						
TURBINES	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
NOx	1.95	1.16	2.04	1.30	2.13	1.36
SO2	0.15	0.09	0.16	0.10	0.17	0.10
CO	2.85	1.69	2.98	1.90	3.11	1.98
PM10	1.13	1.13	1.13	1.13	1.13	1.13

Modeled Maximum 1-Hr Avg Cavity Concs (ug/m3)						
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
ug/m3 for 1 g/s/stack	1.24	1.91	1.234	1.891	1.221	1.882
NOx (ug/m3)	2.416	2.217	2.518	2.455	2.598	2.556
SO2 (ug/m3)	0.187	0.170	0.194	0.190	0.202	0.197
CO (ug/m3)	3.529	3.240	3.680	3.587	3.797	3.734
PM10 (ug/m3)	1.404	2.162	1.394	2.137	1.380	2.127
Dist. To Max. (m)	16,099	11,662	16,131	11,751	16,257	11,804

Modeled Simple Terrain 1-Hr Avg. Concs (ug/m3)						
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
ug/m3 for 1 g/s/stack	1.08	2.022	1.075	1.99	1.058	1.977
NOx (ug/m3)	2.107	2.344	2.194	2.584	2.251	2.685
SO2 (ug/m3)	0.163	0.180	0.169	0.200	0.175	0.207
CO (ug/m3)	3.079	3.425	3.205	3.775	3.290	3.923
PM10 (ug/m3)	1.225	2.285	1.215	2.249	1.196	2.234
Max.Impact Dist (m)	1,155	952	1,157	957	1,162	959
		(a)		(a)		(a)

(a) Maximum simple terrain impacts exceed fumigation impacts so simple terrain concentrations are conservative and controlling.

Max. Modeled Fumigation 1-Hr Avg. Concs (ug/m3)						
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
NOx (ug/m3)	2.416	2.344	2.518	2.584	2.598	2.685
SO2(ug/m3)	0.187	0.180	0.194	0.200	0.202	0.207
CO (ug/m3)	3.529	3.425	3.680	3.775	3.797	3.923
Max. Modeled Fumigation 3-Hr Avg. Concs (ug/m3)						
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
SO2(ug/m3)	0.157	0.162	0.164	0.180	0.170	0.187
Max. Modeled Fumigation 8-Hr Avg. Concs (ug/m3)						
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
CO (ug/m3)	2.214	2.397	2.306	2.643	2.369	2.746
Max. Modeled Fumigation 24-Hr Avg. Concs (ug/m3)						
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
SO2(ug/m3)	0.066	0.072	0.068	0.080	0.071	0.083
PM10 (ug/m3)	0.494	0.914	0.490	0.899	0.483	0.894

NOTES TO TABLE 8.1D-4

FUMIGATION IMPACTS ANALYSIS

INVERSION BREAKUP FUMIGATION

Inversion breakup fumigation is generally a short-term phenomenon but was evaluated here as persisting for up to 24 hours. SCREEN3 was used to model one-hour unit impacts from the turbines under 2.5 m/s winds and F stability (for fumigation impacts) and under all meteorological conditions (shown in the table as “Max. 1-hr Unit Impact from SCREEN3”).

For averaging periods longer than one hour, impacts were adjusted using standard EPA persistence factors (3 hours, 0.9; 8 hours, 0.7; 24 hours, 0.4). A sample calculation for 24-hour average PM₁₀ for Case 3 is as follows:

- For four turbines, Case 3, max. 1-hour average unit impact from SCREEN3 under fumigation conditions = 1.234 ug/m³ per 4.0 g/s and the PM10 emission rate is 1.134 g/s per stack, so the total PM10 emissions for two turbines is 1.234 ug/m³ per 4.0 g/s * 1.134 g/s * 4 = 1.399 ug/m³
- For four turbines, Case 3, max. 1-hour average unit impact from SCREEN3 in simple terrain (no fumigation) = 1.075 ug/m³ per 4.0 g/s and the PM10 emission rate is 1.134 g/s per stack, so the total PM10 emissions for two turbines is 1.075 ug/m³ per 4.0 g/s * 1.134 g/s * 4 = 1.219 ug/m³
- For a the turbines, 24-hour unit impact is calculated as 1.5 hours of inversion breakup fumigation plus 22.5 hours of operation under typical conditions (from SCREEN3): [(1.5 * 1.399 ug/m³) + (22.5 * 1.219 ug/m³ per g/s)] * 24 hrs * 0.4 [persistence factor for converting 1-hour average screening impact into 24-hour average concentration] = 0.492 ug/m³.

**TABLE 8.1-6
Dimensions for Structures Included in Modeling Analysis¹**

Building	Length (feet)	Width (feet)	Height (feet)
HRSGs	158.8	34.3	80.0
GTG Buildings	89.7	49.1	63.0
STG Buildings	272.0	50.3	28.0
Fire Pump	24.0	13.7	20.0
Switchgear Buildings	65.1	61.7	21.0
Control/Conference	109.1	99.4	25.0
Maintenance	200.5	78.8	21.0
Ammonia Tank	38.3	12.0	10.0
DI Water Treatment	120.6	49.7	21.0
Cooling Towers	431.4	52.6	34.0
DI Water Tanks		D=30.3	23.0
Raw/Fire Water Tanks		D=102.8	41.0

Note: ¹ Largest dimension(s) shown for multitiered buildings.