APPENDIX 5.1A

Emission Calculations and Support Data

APPENDIX 5.1A

Calculation of Maximum Hourly, Daily, and Annual Emissions

Tables presented in this Appendix are as follows:

5.1A-1	Ammonia Slip Emissions
5.1A-2	Fuel Use Estimates
5.1A-3	Turbine/HRSG Emissions Estimates and Performance
5.1A-4	Turbine/HRSG Air Toxic Emissions Estimates
5.1A-5	Startup and Commissioning Emissions and Misc Support Data
5.1A-6	Cooling Tower PM10 Emissions Estimates
5.1A-7	Cooling Tower Air Toxic Emissions Estimates
5.1A-8	Auxiliary Boiler Emissions Estimates
5.1A-9	Auxiliary Boiler HAP Emissions
5.1A-10	Typical Natural Gas Analysis Data
5.1A-11	Turbine/HRSG GHG Emissions Estimates
5.1A-12	Fire Pump Engine Emissions

In addition to the above tables, other miscellaneous support data for the device-specific emissions calculations may also be included in this Appendix.

Table 5.1A-1 Ammonia Slip Emissions

Unit	Lbs/hr	Lbs/Day	Tons/Yr
Turbine/HRSG 1	14	336	59.5
Turbine/HRSG 2	14	336	59.5
Aux Boiler	0.11	0.88	0.022

Table 5.1A-2 Fuel Use Estimates

Unit	Per hour	Per Day	Per Yr
Turbine/HRSG 1	2.104 mmscf	50.5 mmscf	17,526 mmscf
Turbine/HRSG 2	2.104 mmscf	50.5 mmscf	17,526 mmscf
Aux Boiler	0.0495 mmscf	0.396 mmscf	19.95 mmscf
Fire Pump Engine	20 gals	20 gals	1000 gals

Table 5.1A-3 (10 pages)

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Contra Costa Generating Station 2x1

Operating Emissions and Support Data

		ISO Conditions			Peak July Conditions			Minimum Ambient		
		Case B	Case D	Case R	Case H	Case J	Case X	Case 01C	Case 01F	Case 01E
		Max	Med Output	Min Output	Max	Med Output	Min Output	Max	Med Output	Min Output
		All Units	All Units	One Unit	All Units	All Units	One Unit	All Units	All Units	One Unit
Operating Conditions										
Ambient Dry Bulb Temp.	deg. F	59	59	59	104	104	104	34	34	34
Ambient Wet Bulb Temp.	deg. F	51	51	51	70	70	70	32	32	32
Relative Humidity	%	60%	60%	60%	18%	18%	18%	83%	83%	83%
Elevation	ft	21	21	21	21	21	21	21	21	21
Ambient Pressure	psia	14.68	14.68	14.68	14.68	14.68	14.68	14.68	14.68	14.68
Combustion Turbine Load	%	100%	80%	49%	100%	80%	52%	100%	80%	49%
Combustion Turbines Operating		2	2	1	2	2	1	2	2	1
Evap Cooling or Fogging? (Yes/No)		Yes	No	No	Yes	No	No	No	No	No
Evap Cooling/Fogging Effectiveness	%	85%	%	85%	85%	85%	85%	85%	85%	85%
Duct Firing? (Yes/No)		No	No	No	No	No	No	No	No	No
Steam or Water Injection? (Yes/No)		No	No	No	No	No	No	No	No	No
Fuel Input (each CT)										
Fuel Type		Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
CT Fuel (LHV)	MMBtu/hr	1,896	1,562	1,208	1,843	1,433	1,157	1,940	1,734	1,239
HRSG Fuel (LHV)	MMBtu/hr	0	0	0	0	0	0	0	0	0
Total Fuel (LHV)	MMBtu/hr	1,896	1,562	1,208	1,843	1,433	1,157	1,940	1,734	1,239
HHV/LHV =		1.1085	1.1085	1.1085	1.1085	1.1085	1.1085	1.1085	1.1085	1.1085
CT Fuel (HHV)	MMBtu/hr	2,102	1,731	1,339	2,043	1,589	1,283	2,150	1,923	1,373
HRSG Fuel (HHV)	MMBtu/hr	0	0	0	0	0	0	0	0	0
Total Fuel (HHV)	MMBtu/hr	2,102	1,731	1,339	2,043	1,589	1,283	2,150	1,923	1,373
CT Fuel	lb/hr	90,871	74,840	57,896	88,330	68,681	55,452	92,955	83,126	59,382
HRSG Fuel	lb/hr	0	0	0	0	0	0	0	0	0
Total Fuel	lb/hr	90,871	74,840	57,896	88,330	68,681	55,452	92,955	83,126	59,382
Inlet Air (each CT)										
N_2	mole % dry	78.04%	78.04%	78.04%	78.04%	78.04%	78.04%	78.04%	78.04%	78.04%
O_2	mole % dry	20.99%	20.99%	20.99%	20.99%	20.99%	20.99%	20.99%	20.99%	20.99%
CO_2	mole % dry	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%
Ar	mole % dry	0.94%	0.94%	0.94%	0.94%	0.94%	0.94%	0.94%	0.94%	0.94%
Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Molecular Weight, dry air		28.97	28.97	28.97	28.97	28.97	28.97	28.97	28.97	28.97
Dry Bulb Temperature	deg. F	53.5	59.0	59.0	75.5	104.4	104.4	34.0	34.0	34.0
Moisture Content of Ambient Air	lb H_2O/lb air	0.0064	0.0064	0.0064	0.0082	0.0082	0.0082	0.0034	0.0034	0.0034
Moisture Content of Inlet Air	lb H_2O/lb air	0.0076	0.0064	0.0064	0.0149	0.0082	0.0082	0.0034	0.0034	0.0034
Relative Humidity of Inlet Air	%	88%	60%	60%	78%	18%	18%	83%	83%	83%
Moisture Content	moles H_2O/mole air	0.012	0.010	0.010	0.024	0.013	0.013	0.005	0.005	0.005
N_2	mole %	77.09%	77.25%	77.25%	76.22%	77.02%	77.02%	77.61%	77.61%	77.61%
O_2	mole %	20.74%	20.78%	20.78%	20.50%	20.72%	20.72%	20.88%	20.88%	20.88%
CO_2	mole %	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%
H_2O	mole %	1.21%	1.01%	1.01%	2.34%	1.30%	1.30%	0.55%	0.55%	0.55%
Ar	mole %	0.93%	0.93%	0.93%	0.92%	0.93%	0.93%	0.93%	0.93%	0.93%
Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Molecular Weight		28.83	28.86	28.86	28.71	28.82	28.82	28.91	28.91	28.91
Inlet Air Flow	lb/hr	4,025,259	3,241,369	2,687,064	3,984,360	3,087,806	2,713,728	4,069,355	3,554,946	2,675,348
Pagging/Injection Steam/Water (each CT)										
Steam or Water/Fuel Ratio		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steam or Water Injection Flow	lb/hr	0	0	0	0	0	0	0	0	0
Combustion Turbine Exhaust (each CT)										
Excess Combustion Air	%	163.8%	158.3%	176.7%	166.7%	167.6%	191.3%	161.8%	155.8%	169.4%

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Table 5.1A-3 (12 pages)

Contra Costa Generating Station 2x1
Operating Emissions and Support Data

		ISO Conditions			Peak July Conditions			Minimum Ambient		
		Case B	Case D	Case R	Case H	Case J	Case X	Case 01C	Case 01F	Case 01E
		Max	Med Output	Min Output	Max	Med Output	Min Output	Max	Med Output	Min Output
		All Units	All Units	One Unit	All Units	All Units	One Unit	All Units	All Units	One Unit
N_2	lb/hr	3,016,114	2,431,819	2,015,898	2,964,181	2,312,374	2,032,170	3,061,989	2,674,949	2,013,044
O_2	lb/hr	575,145	457,642	395,396	569,015	444,768	409,850	581,175	500,285	388,772
CO_2	lb/hr	246,642	203,099	157,200	239,767	186,434	150,625	252,287	225,572	161,202
H_2O	lb/hr	226,443	181,896	141,853	248,832	173,208	141,642	214,285	191,339	137,148
Ar	lb/hr	51,786	41,753	34,613	50,894	39,703	34,893	52,573	45,927	34,564
Total Exhaust Flow	lb/hr	4,116,130	3,316,209	2,744,960	4,072,690	3,156,487	2,769,180	4,162,310	3,638,072	2,734,730
Manufacturer's Exhaust Flow	lb/hr	**4,116,130**	**3,316,209**	**2,744,960**	**4,072,690**	**3,156,487**	**2,769,180**	**4,162,310**	**3,638,072**	**2,734,730**
N_2	mass %	73.28%	73.33%	73.44%	72.78%	73.26%	73.39%	73.56%	73.53%	73.61%
O_2	mass %	13.97%	13.80%	14.40%	13.97%	14.09%	14.80%	13.96%	13.75%	14.22%
CO_2	mass %	5.99%	6.12%	5.73%	5.89%	5.91%	5.44%	6.06%	6.20%	5.89%
H_2O	mass %	5.50%	5.49%	5.17%	6.11%	5.49%	5.11%	5.15%	5.26%	5.02%
Ar	mass %	1.26%	1.26%	1.26%	1.25%	1.26%	1.26%	1.26%	1.26%	1.26%
Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
N_2	moles/hr	107,667	86,809	71,962	105,813	82,545	72,543	109,304	95,488	71,860
O_2	moles/hr	17,974	14,302	12,357	17,782	13,899	12,808	18,162	15,634	12,150
CO_2	moles/hr	5,620	4,628	3,582	5,463	4,248	3,432	5,749	5,140	3,673
H_2O	moles/hr	12,569	10,097	7,874	13,812	9,614	7,862	11,895	10,621	7,613
Ar	moles/hr	1,296	1,045	866	1,274	994	873	1,316	1,150	865
Total	moles/hr	145,126	116,881	96,641	144,145	111,301	97,519	146,426	128,033	96,161
N_2	mole %	74.19%	74.27%	74.46%	73.41%	74.16%	74.39%	74.65%	74.58%	74.73%
O_2	mole %	12.38%	12.24%	12.79%	12.34%	12.49%	13.13%	12.40%	12.21%	12.63%
CO_2	mole %	3.87%	3.96%	3.71%	3.79%	3.82%	3.52%	3.93%	4.01%	3.82%
H_2O	mole %	8.66%	8.64%	8.15%	9.58%	8.64%	8.06%	8.12%	8.30%	7.92%
Ar	mole %	0.89%	0.89%	0.90%	0.88%	0.89%	0.90%	0.90%	0.90%	0.90%
Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Molecular Weight		28.37	28.38	28.41	28.26	28.36	28.40	28.43	28.42	28.44
CT Emissions (each CT) - Expected										
NO_x, @ 15% O_2	ppmvd	**9.0**	9.0	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**
CO	ppmvd	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**
VOC	ppmvw	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**
NO_x, as NO_2	lb/hr	68.3	56.2	43.5	66.4	51.6	41.6	69.8	62.5	44.6
CO	lb/hr	33.4	26.9	22.4	32.9	25.6	22.6	33.9	29.6	22.3
VOC, as CH_4	lb/hr	3.3	2.6	2.2	3.2	2.5	2.2	3.3	2.9	2.2
PM_{10}	lb/hr	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**
Portion of PM_{10} from Sulfur Particulates	lb/hr	0.61	0.51	0.39	0.60	0.46	0.37	0.63	0.56	0.40
Portion of PM_{10} from Soot/Ash	lb/hr	8.4	8.5	8.6	8.4	8.5	8.6	8.4	8.4	8.6
Maximum SO_2	lb/hr	5.9	4.8	3.7	5.7	4.4	3.6	6.0	5.4	3.8
Annual Average SO_2	lb/hr	1.5	1.2	0.9	1.4	1.1	0.9	1.5	1.3	1.0
Duct Burner Emissions (each CT) - Expected										
NO_x, as NO_2	lb/hr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO	lb/hr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VOC, as CH_4	lb/hr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PM_{10}	lb/hr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Portion of PM_{10} from Sulfur Particulates	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Portion of PM_{10} from Soot/Ash	lb/hr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum SO_2	lb/hr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual Average SO_2	lb/hr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Table 5.1A-3 (12 pages)

Contra Costa Generating Station 2x1

Operating Emissions and Support Data

		ISO Conditions			Peak July Conditions			Minimum Ambient		
		Case B	Case D	Case R	Case H	Case J	Case X	Case 01C	Case 01F	Case 01E
		Max	Med Output	Min Output	Max	Med Output	Min Output	Max	Med Output	Min Output
		All Units	All Units	One Unit	All Units	All Units	One Unit	All Units	All Units	One Unit
Dilution Air (each CT)										
Moisture Content	lb H_2O/lb air	0.0064	0.0064	0.0064	0.0082	0.0082	0.0082	0.0034	0.0034	0.0034
Moisture Content	moles H_2O/mole air	0.010	0.010	0.010	0.013	0.013	0.013	0.005	0.005	0.005
N_2	mole %	77.25%	77.25%	77.25%	77.02%	77.02%	77.02%	77.61%	77.61%	77.61%
O_2	mole %	20.78%	20.78%	20.78%	20.72%	20.72%	20.72%	20.88%	20.88%	20.88%
CO_2	mole %	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%
H_2O	mole %	1.01%	1.01%	1.01%	1.30%	1.30%	1.30%	0.55%	0.55%	0.55%
Ar	mole %	0.93%	0.93%	0.93%	0.93%	0.93%	0.93%	0.93%	0.93%	0.93%
Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Molecular Weight		28.86	28.86	28.86	28.82	28.82	28.82	28.91	28.91	28.91
N_2	mass %	74.99%	74.99%	74.99%	74.86%	74.86%	74.86%	75.21%	75.21%	75.21%
O_2	mass %	23.04%	23.04%	23.04%	23.00%	23.00%	23.00%	23.11%	23.11%	23.11%
CO_2	mass %	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%
H_2O	mass %	0.63%	0.63%	0.63%	0.81%	0.81%	0.81%	0.34%	0.34%	0.34%
Ar	mass %	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%
Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
CT Exhaust Temperature	deg. F	**1,116**	**1,173**	**1,215**	**1,124**	**1,203**	**1,215**	**1,110**	**1,153**	**1,215**
Stack Temperature (if have HRSG)	deg. F	**191**	**178**	**171**	**213**	**196**	**180**	**192**	**184**	**171**
C_p N_2	Btu/lb-deg. F	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.271
C_p O_2	Btu/lb-deg. F	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254
C_p CO_2	Btu/lb-deg. F	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281
C_p H_2O	Btu/lb-deg. F	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750
C_p Ar	Btu/lb-deg. F	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124
C_p Exhaust	Btu/lb-deg. F	0.309	0.309	0.307	0.314	0.309	0.306	0.307	0.307	0.306
C_p Dilution Air	Btu/lb-deg. F	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240
Minimum Dilution Air Required	lb/hr	-	-	-	-	-	-	-	-	-
Minimum Dilution Air Required	cfm	-	-	-	-	-	-	-	-	-
Actual Dilution Air	cfm	-	-	-	-	-	-	-	-	-
Actual Dilution Air	lb/hr	-	-	-	-	-	-	-	-	-
Total Emissions Upstream of Catalyst (each CT)										
NO_x, as NO_2	lb/hr	68.3	56.2	43.5	66.4	51.6	41.6	69.8	62.5	44.6
CO	lb/hr	33.4	26.9	22.4	32.9	25.6	22.6	33.9	29.6	22.3
VOC, as CH_4	lb/hr	3.3	2.6	2.2	3.2	2.5	2.2	3.3	2.9	2.2
PM_{10}	lb/hr	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Portion of PM_{10} from Sulfur Particulates	lb/hr	0.6	0.5	0.4	0.6	0.5	0.4	0.6	0.6	0.4
Portion of PM_{10} from Soot/Ash	lb/hr	8.4	8.5	8.6	8.4	8.5	8.6	8.4	8.4	8.6
SO_2 Converted to PM_{10} w/in CT & HRSG	lb/hr	0.29	0.24	0.19	0.28	0.22	0.18	0.30	0.27	0.19
Maximum SO_2	lb/hr	5.9	4.8	3.7	5.7	4.4	3.6	6.0	5.4	3.8
Annual Average SO_2	lb/hr	1.5	1.2	0.9	1.4	1.1	0.9	1.5	1.3	1.0
CO Catalyst Performance (each CT)										
Required CO Reduction	lb/hr	24.2	19.3	16.5	23.9	18.6	17.0	24.5	21.1	16.3
Required CO Reduction (mass basis)	%	72%	72%	74%	73%	73%	75%	72%	71%	73%
Required VOC Reduction	lb/hr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Required VOC Reduction (mass basis)	%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PM_{10} Increase from Sulfur Particulates	lb/hr	9.3	7.7	5.9	9.1	7.0	5.7	9.5	8.5	6.1
SO_2 Converted to PM_{10} w/in CO Catalyst	lb/hr	4.46	3.67	2.84	4.33	3.37	2.72	4.56	4.08	2.91
NOx Catalyst Performance (each CT)										

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Table 5.1A-3 (12 pages)

Contra Costa Generating Station 2x1

Operating Emissions and Support Data

		ISO Conditions			Peak July Conditions			Minimum Ambient		
		Case B	Case D	Case R	Case H	Case J	Case X	Case 01C	Case 01F	Case 01E
		Max	Med Output	Min Output	Max	Med Output	Min Output	Max	Med Output	Min Output
		All Units	All Units	One Unit	All Units	All Units	One Unit	All Units	All Units	One Unit
Required NO_x Reduction, as NO_2	lb/hr	56.9	46.9	36.2	55.3	43.0	34.7	58.2	52.1	37.2
Required NO_x Reduction (mass basis)	%	83%	83%	83%	83%	83%	83%	83%	83%	83%
PM_{10} Increase from Sulfur Particulates	lb/hr	0.23	0.19	0.15	0.23	0.18	0.14	0.24	0.21	0.15
NH_3 Slip	lb/hr	14.0	11.6	8.9	13.6	10.6	8.6	14.4	12.8	9.2
NH_3 Reacted	lb/hr	22.1	18.2	14.1	21.5	16.7	13.5	22.6	20.2	14.4
Total NH_3 Added	lb/hr	36.2	29.8	23.0	35.1	27.3	22.0	37.0	33.1	23.6
Stack Exhaust Analysis (each CT)										
N_2	lb/hr	3,016,114	2,431,819	2,015,898	2,964,181	2,312,374	2,032,170	3,061,989	2,674,949	2,013,044
O_2	lb/hr	575,145	457,642	395,396	569,015	444,768	409,850	581,175	500,285	388,772
CO_2	lb/hr	246,642	203,099	157,200	239,767	186,434	150,625	252,287	225,572	161,202
H_2O	lb/hr	226,443	181,896	141,853	248,832	173,208	141,642	214,285	191,339	137,148
Ar	lb/hr	51,786	41,753	34,613	50,894	39,703	34,893	52,573	45,927	34,564
Total	lb/hr	4,116,130	3,316,209	2,744,960	4,072,690	3,156,487	2,769,180	4,162,310	3,638,072	2,734,730
N_2	mass %	73.3%	73.3%	73.4%	72.8%	73.3%	73.4%	73.6%	73.5%	73.6%
O_2	mass %	14.0%	13.8%	14.4%	14.0%	14.1%	14.8%	14.0%	13.8%	14.2%
CO_2	mass %	6.0%	6.1%	5.7%	5.9%	5.9%	5.4%	6.1%	6.2%	5.9%
H_2O	mass %	5.5%	5.5%	5.2%	6.1%	5.5%	5.1%	5.1%	5.3%	5.0%
Ar	mass %	1.3%	1.3%	1.3%	1.2%	1.3%	1.3%	1.3%	1.3%	1.3%
Total	mass %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
N_2	moles/hr	107,649	86,794	71,950	105,796	82,532	72,532	109,286	95,472	71,848
O_2	moles/hr	17,971	14,299	12,355	17,779	13,897	12,806	18,159	15,632	12,148
CO_2	moles/hr	5,619	4,627	3,581	5,462	4,247	3,432	5,748	5,139	3,672
H_2O	moles/hr	12,567	10,095	7,873	13,810	9,613	7,861	11,893	10,619	7,612
Ar	moles/hr	1,296	1,045	866	1,274	994	873	1,316	1,149	865
Total	moles/hr	145,102	116,861	96,625	144,121	111,283	97,504	146,401	128,011	96,145
N_2	mole%	74.2%	74.3%	74.5%	73.4%	74.2%	74.4%	74.6%	74.6%	74.7%
O_2	mole%	12.4%	12.2%	12.8%	12.3%	12.5%	13.1%	12.4%	12.2%	12.6%
CO_2	mole%	3.9%	4.0%	3.7%	3.8%	3.8%	3.5%	3.9%	4.0%	3.8%
H_2O	mole%	8.7%	8.6%	8.1%	9.6%	8.6%	8.1%	8.1%	8.3%	7.9%
Ar	mole%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
Total	mole%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Molecular Weight		28.37	28.38	28.41	28.26	28.36	28.40	28.43	28.42	28.44
Stack Temperature	deg. F	191	178	171	213	196	180	192	184	171
Stack Temperature	deg. K	361.43	354.45	350.59	373.59	364.46	355.21	361.82	357.47	350.54
Stack Flow	cf/hr	69,006,000	54,502,000	44,575,000	70,845,000	53,366,000	45,572,000	69,698,000	60,211,000	44,346,000
Stack Velocity	ft/sec	72.3	57.1	46.7	74.3	55.9	47.8	73.0	63.1	46.5
Stack Velocity	m/sec	22.0	17.4	14.2	22.6	17.0	14.6	22.3	19.2	14.2
Calculated Stack Emissions (each CT)										
NO_x, @ 15% O_2	ppmvd	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
CO, @ 15% O_2	ppmvd	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
VOC, as CH_4 @ 15% O_2	ppmvd	1.2	1.2	1.3	1.3	1.3	1.4	1.2	1.2	1.2
NH_3 slip, @ 15% O_2	ppmvd	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NO_x, as NO_2	lb/hr	11.4	9.4	7.2	11.1	8.6	6.9	11.6	10.4	7.4
CO	lb/hr	9.2	7.6	5.9	9.0	7.0	5.6	9.5	8.5	6.0
VOC, as CH_4	lb/hr	3.3	2.6	2.2	3.2	2.5	2.2	3.3	2.9	2.2
Total PM_{10} from Sulfur Particulates	lb/hr	9.8	8.1	6.3	9.6	7.4	6.0	10.1	9.0	6.4
Total PM_{10}	lb/hr	**18.6**	**16.9**	**15.1**	**18.3**	**16.2**	**14.8**	**18.8**	**17.7**	**15.2**

RADBACK ENERGY

Table 5.1A-3 (12 pages)

Contra Costa Generating Station 2x1

Operating Emissions and Support Data

		ISO Conditions			Peak July Conditions			Minimum Ambient		
		Case B	Case D	Case R	Case H	Case J	Case X	Case 01C	Case 01F	Case 01E
		Max All Units	Med Output All Units	Min Output One Unit	Max All Units	Med Output All Units	Min Output One Unit	Max All Units	Med Output All Units	Min Output One Unit
NH_3	lb/hr	14.0	11.6	8.9	13.6	10.6	8.6	14.4	12.8	9.2
Maximum SO_2	lb/hr	5.9	4.8	3.7	5.7	4.4	3.6	6.0	5.4	3.8
Annual Average SO_2	lb/hr	1.5	1.2	0.9	1.4	1.1	0.9	1.5	1.3	1.0
Permitted Stack Emissions (each CT)										
NO_x, @ 15% O_2	ppmvd	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**
CO, @ 15% O_2	ppmvd	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**
VOC, as CH_4 @ 15% O_2	ppmvd	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**
NH_3 Slip, @ 15% O_2	ppmvd	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**
NO_x, as NO_2	lb/hr	15.17	12.50	9.66	14.75	11.47	9.25	15.52	13.88	9.91
CO	lb/hr	9.24	7.61	5.88	8.98	6.98	5.63	9.45	8.45	6.04
VOC, as CH_4	lb/hr	5.29	4.36	3.37	5.14	4.00	3.22	5.41	4.84	3.46
Total PM_{10}	lb/hr	**7.50**	**6.18**	**4.78**	**7.50**	**5.67**	**4.58**	**7.50**	**6.86**	**4.90**
NH_3	lb/hr	14.04	11.57	8.94	13.65	10.61	8.56	14.36	12.85	9.17
Maximum SO_2	lb/hr	5.90	4.80	3.70	5.70	4.40	3.60	6.00	5.40	3.80
Annual Average SO_2	lb/hr	1.50	1.20	0.90	1.40	1.10	0.90	1.50	1.30	1.00
NO_x, as NO_2	lb/MMBtu(HHV)	0.00722	0.00722	0.00721	0.00722	0.00722	0.00721	0.00722	0.00722	0.00722
CO	lb/MMBtu(HHV)	0.00440	0.00440	0.00439	0.00439	0.00439	0.00439	0.00440	0.00440	0.00439
VOC, as CH_4	lb/MMBtu(HHV)	0.00252	0.00252	0.00252	0.00252	0.00252	0.00251	0.00252	0.00252	0.00252
		0.00455	0.00455	0.00455	0.00455	0.00455	0.00455	0.00455	0.00455	0.00455
Total PM_{10}	lb/MMBtu(HHV)	0.00357	0.00357	0.00357	0.00367	0.00357	0.00357	0.00349	0.00357	0.00357
Maximum SO_2	lb/MMBtu(HHV)	0.00281	0.00277	0.00276	0.00279	0.00277	0.00281	0.00279	0.00281	0.00277
Annual Maximum SO_2	lb/MMBtu(HHV)	0.00071	0.00069	0.00067	0.00069	0.00069	0.00070	0.00070	0.00068	0.00073
CO_2	lb/MMBtu(HHV)	117.35	117.33	117.39	117.36	117.36	117.44	117.34	117.32	117.37

Contra Costa Generating Station 2x1
Evaporative Fluid Cooler

Operating Conditions		Peak July Conditions
		Case H
Ambient Dry Bulb Temp.	deg. F	104.4
Ambient Wet Bulb Temp.	deg. F	70.4
Relative Humidity	%	18%
Elevation	ft	21.0
Ambient Pressure	psia	14.68
Combustion Turbine Load	%	100%
Combustion Turbines Operating		2
Evaporative Cooling or Fogging? (Yes/No)		Yes
Duct Firing? (Yes/No)		No
Steam or Water Injection? (Yes/No)		No
Evaporative Fluid Cooler Performance		
Allowance to WB Temp to Account for Recirculation	deg. F	-
EFC Design Wet Bulb Temperature	deg. F	70.4
Closed Loop Cooling Water Flow	gpm	**5,610**
EFC Circulating Flow	gpm	**5,880**
Heat Rejected from Closed Loop Cooling Water	MMBtu/hr	43.2
Closed Loop Cooling Water Outlet Temperature	deg. F	105.0
Closed Loop Cooling Water Inlet Temperature	deg. F	120.4
Require Approach Temperature	deg. F	34.6
Makeup Water Temperature	deg. F	**70.0**
Number of Cells		**3**
Number of Fans Operating		**3**
Fan Stack Diameter	ft	**11.00**
Leaving Air Flow/Fan	acfm	**190,600**
Total Leaving Air Flow	acfm	571,800
Stack Velocity	ft/sec	33.4
Wet Bulb Temperature of Leaving Air	deg. F	**87.91**
Enthalpy of Leaving Air	Btu/lb	53.1
Moisture Content of Leaving Air	grains/lb dry air	204
Humidity Ratio of Leaving Air	lb water/lb dry a	0.0291
Density of Leaving Air	lbs/cf	0.0712
Total Dry Air Flow	lb/min	39,536
L/G Ratio		1.239
Enthalpy of Entering Air	Btu/lb	34.1
Moisture Content of Entering Air	grains/lb dry air	57
Humidity Ratio of Entering Air	lb water/lb dry a	0.0082
Heat Removed by Air	MMBtu/hr	43
Qair/Qcw		100%
Evaporation	gpm	99
Drift, percent of circulating water flow	%	**0.0030%**
Drift	gpm	0.18
Drift	lb/hr	0.17
EFC Circulating Water TDS	mg/l	**1,500**
% PM_{10} Emissions	% of total	**100%**
PM_{10} Emissions	lbs/hr	0.132

Contra Costa Generating Station 2x1

Expected Auxiliary Boiler Emissions

Auxiliary Boiler		
Operating Conditions		
Ambient Dry Bulb Temp.	deg. F	59.0
Ambient Wet Bulb Temp.	deg. F	51.5
Relative Humidity	%	60%
Elevation	ft	21.0
Ambient Pressure	psia	14.68
Auxiliary Boiler Firing Rate	%	**100%**
Fuel Input		
Fuel (LHV)	MMBtu/hr	45.7
HHV/LHV =	1.1085	
Fuel (HHV)	MMBtu/hr	50.6
Fuel	lb/hr	2,188
Combustion Air		
N_2	mole % dry	78.04%
O_2	mole % dry	20.99%
CO_2	mole % dry	0.03%
Ar	mole % dry	0.94%
Total		100.00%
Molecular Weight, dry air		28.97
Inlet Air Dry Bulb Temperature	deg. F	59.0
Moisture Content of Inlet Air	lb H_20/lb air	0.0064
Moisture Content	moles H_20/mole a	0.010
N_2	mole %	77.25%
O_2	mole %	20.78%
CO_2	mole %	0.03%
H_2O	mole %	1.01%
Ar	mole %	0.93%
Total		100.00%
Molecular Weight		28.86
Inlet Air Flow	lb/hr	42,208
Boiler Exhaust		
Excess Combustion Air	%	**15.0%**
N_2	lb/hr	31,683
O_2	lb/hr	1,270
CO_2	lb/hr	5,915
H_2O	lb/hr	4,985

Ar	lb/hr	544
Total Exhaust Flow	lb/hr	44,396
Manufacturer's Exhaust Flow	lb/hr	**44,396**
N_2	mass %	71.36%
O_2	mass %	2.86%
CO_2	mass %	13.32%
H_2O	mass %	11.23%
Ar	mass %	1.22%
Total		100.00%
N_2	moles/hr	1,131
O_2	moles/hr	40
CO_2	moles/hr	135
H_2O	moles/hr	277
Ar	moles/hr	14
Total	moles/hr	1,596
N_2	mole %	70.87%
O_2	mole %	2.49%
CO_2	mole %	8.45%
H_2O	mole %	17.34%
Ar	mole %	0.85%
Total		100.00%
Molecular Weight		27.83
Boiler Emissions Upstream of Catalyst		
NO_x, @ 3% O_2	ppmvd	**83.0**
CO, @ 3% O_2	ppmvd	**50.0**
VOC, @ 3% O_2	ppmvd	**0.24**
NO_x, as NO_2	lb/hr	5.0
CO	lb/hr	1.8
VOC, as CH_4	lb/hr	0.0051
PM_{10}	lb/hr	**0.52**
PM_{10} Increase from Sulfur Particulates	lb/hr	0.01
SO_2 Converted to PM_{10} within Boiler	lb/hr	0.01
SO_2	lb/hr	0.14
CO Catalyst Performance		
Required CO Reduction	lb/hr	0.0
Required CO Reduction (mass basis)	%	0%
Required VOC Reduction	lb/hr	0.0
Required VOC Reduction (mass basis)	%	0%
PM_{10} Increase from Sulfur Particulates	lb/hr	0.2
SO_2 Converted to PM_{10} within CO Catalyst	lb/hr	0.1
NO_x Catalyst Performance		
Required NO_x Reduction, as NO_2	lb/hr	4.5

Required NO_x Reduction (mass basis)	%	89%
PM_{10} Increase from Sulfur Particulates	lb/hr	0.01
NH_3 Slip	lb/hr	0.1
NH_3 Reacted	lb/hr	1.7
Total NH_3 Added	lb/hr	1.9
Boiler Stack Exhaust Analysis		
N_2	lb/hr	31,683
O_2	lb/hr	1,270
CO_2	lb/hr	5,915
H_2O	lb/hr	4,985
Ar	lb/hr	544
Total	lb/hr	44,396
N_2	mass %	71.4%
O_2	mass %	2.9%
CO_2	mass %	13.3%
H_2O	mass %	11.2%
Ar	mass %	1.2%
Total	mass %	100.0%
N_2	moles/hr	1,131
O_2	moles/hr	40
CO_2	moles/hr	135
H_2O	moles/hr	277
Ar	moles/hr	14
Total	moles/hr	1,595
N_2	mole%	70.9%
O_2	mole%	2.5%
CO_2	mole%	8.4%
H_2O	mole%	17.3%
Ar	mole%	0.9%
Total	mole%	100.0%
Molecular Weight		27.83
Stack Temperature	deg. F	**290**
Stack Temperature	deg. K	416
Stack Flow	acfh	874,000
Stack Flow	acfm	14,566.67
Stack Velocity	ft/sec	49.46
Stack Velocity	m/sec	15.08
Calculated Boiler Stack Emissions		
NO_x, @ 3% O_2	ppmvd	9.0
CO, @ 3% O_2	ppmvd	50.0
VOC, as CH_4 @ 3% O_2	ppmvd	0.24
NH_3 slip, @ 3% O_2	ppmvd	5.0

NOx, as NO_2	lb/hr	0.5
CO	lb/hr	1.8
VOC, as CH_4	lb/hr	0.0051
Total PM_{10} from Sulfur Particulates	lb/hr	0.23
Total PM_{10}	lb/hr	0.75
NH_3	lb/hr	0.11
SO_2	lb/hr	0.14
Permitted Boiler Stack Emissions		
NO_x, @ 3% O_2	ppmvd	**9.0**
CO, @ 3% O_2	ppmvd	**50.0**
VOC, as CH_4 @ 3% O_2	ppmvd	**5.0**
Total PM_{10}	lbs/MMBtu HHV	**0.00450**
NH_3 Slip, @ 3% O_2	ppmvd	**5.0**
NO_x, as NO_2	lb/hr	0.55
CO	lb/hr	1.85
VOC, as CH_4	lb/hr	0.11
Total PM_{10}	lb/hr	0.228
Total PM_{10}	lbs/MMscf	4.6
NH_3	lb/hr	0.11
SO_2	lb/hr	0.14
SO_2	lbs/MMscf	2.85
NO_x, as NO_2	g/s	0.069
CO	g/s	0.233
VOC, as CH_4	g/s	0.013
Total PM_{10}	g/s	0.029
NH_3	g/s	0.014
SO_2	g/s	0.018

Contra Costa Generating Station 2x1

Fuel Gas Analysis

		Fuel Gas Composition (mole %)	Mole % x Molecular Weight	Fuel Gas Composition (mass %)	Molecular Weight	Density (lbs/scf)	Specific Gravity	Heat of Combustion Btu/lb Gross	Heat of Combustion Btu/lb Net	Lb/lb Fuel Required for Combustion N2	O2	CO2	Ar	Dry Air	Lb/lb Fuel Exhaust Products N2	CO2	SO2	H2O	Ar
Methane	CH_4	95.619%	15.340	91.4%	16.043	0.0422	0.5558	23,879	21,520	11.86	3.64	0.01	0.20	15.72	11.86	2.51	0.00	2.05	0.20
Ethane	C_2H_6	2.647%	0.796	4.7%	30.070	0.0792	1.0418	22,320	20,432	0.57	0.18	0.00	0.01	0.76	0.57	0.14	0.00	0.09	0.01
Propane	C_3H_8	0.300%	0.132	0.8%	44.097	0.1161	1.5277	21,661	19,944	0.09	0.03	0.00	0.00	0.12	0.09	0.02	0.00	0.01	0.00
n-Butane	C_4H_{10}	0.043%	0.025	0.1%	58.124	0.1530	2.0137	21,308	19,680	0.02	0.01	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00
Isobutane	C_4H_{10}	0.033%	0.019	0.1%	58.124	0.1530	2.0137	21,257	19,629	0.01	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00
n-Pentane	C_5H_{12}	0.008%	0.006	0.0%	72.151	0.1900	2.4997	21,091	19,517	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Isopentane	C_5H_{12}	0.011%	0.008	0.0%	72.151	0.1900	2.4997	21,052	19,478	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
Neopentane	C_5H_{12}	0.000%	0.000	0.0%	72.151	0.1900	2.4997	20,970	19,396	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n-Hexane	C_6H_{14}	0.008%	0.007	0.0%	86.178	0.2269	2.9856	20,940	19,403	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Ethylene	C_2H_4	0.000%	0.000	0.0%	28.054	0.0739	0.9719	21,644	20,295	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Propylene	C_3H_6	0.000%	0.000	0.0%	42.081	0.1108	1.4579	21,041	19,691	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n-Butene	C_4H_8	0.000%	0.000	0.0%	56.108	0.1477	1.9439	20,840	19,496	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Isobutene	C_4H_8	0.000%	0.000	0.0%	56.108	0.1477	1.9439	20,730	19,382	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n-Pentene	C_5H_{10}	0.000%	0.000	0.0%	70.135	0.1847	2.4298	20,712	19,363	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzene	C_6H_6	0.000%	0.000	0.0%	78.115	0.2057	2.7063	18,210	17,480	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Toluene	C_7H_8	0.000%	0.000	0.0%	92.142	0.2426	3.1922	18,440	17,620	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Xylene	C_8H_{10}	0.000%	0.000	0.0%	106.169	0.2795	3.6782	18,650	17,760	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acetylene	C_2H_2	0.000%	0.000	0.0%	26.038	0.0686	0.9021	21,500	20,776	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Napthalene	$C_{10}H_8$	0.000%	0.000	0.0%	128.175	0.3375	4.4406	17,298	16,708	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methly alcohol	CH_3OH	0.000%	0.000	0.0%	32.042	0.0844	1.1101	10,259	9,078	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethyl alcohol	C_2H_5OH	0.000%	0.000	0.0%	46.070	0.1213	1.5961	13,161	11,929	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	NH_3	0.000%	0.000	0.0%	17.031	0.0448	0.5900	9,668	8,001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen	H_2	0.000%	0.000	0.0%	2.016	0.0053	0.0698	61,100	51,623	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitrogen	N_2	0.815%	0.228	1.4%	28.013	0.0738	0.9712	0	0	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Carbon Dioxide	CO_2	0.516%	0.227	1.4%	44.010	0.1159	1.5247	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Total		100.0%		100.0%	16.789	0.0442	0.5820	23,130	20,865	12.58	3.86	0.01	0.22	16.66	12.59	2.70	0.00	2.16	0.22
Sulfur Compounds										N2	O2	CO2	Ar	Dry Air	N2	CO2	SO2	H2O	Ar
Maximum Sulfur	S	1.00 grains/100scf		0.00323%	32.060	N/A	N/A	3,983	3,983	1.0E-04	3.2E-05	6.3E-08	1.8E-06	1.4E-04	1.0E-04	6.3E-08	6.5E-05	0.0E+00	1.8E-06
Annual Average Sulfur	S	0.25 grains/100scf		0.00081%	32.060	N/A	N/A	3,983	3,983	2.6E-05	8.1E-06	1.6E-08	4.5E-07	3.5E-05	2.6E-05	1.6E-08	1.6E-05	0.0E+00	4.5E-07
Hydrogen Sulfide	H_2S	0 ppmv		0.000%	34.076	0.0897	1.1806	7,100	6,545	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Maximum Total				0.00323%						1.0E-04	3.2E-05	6.3E-08	1.8E-06	1.4E-04	1.0E-04	6.3E-08	6.5E-05	0.0E+00	1.8E-06
Annual Average Total				0.00081%						2.6E-05	8.1E-06	1.6E-08	4.5E-07	3.5E-05	2.6E-05	1.6E-08	1.6E-05	0.0E+00	4.5E-07

Table 5.1A-4
Calculation of Hazardous and Toxic Pollutant Emissions

# of Units:	2
Fuel HHV:	1022 btu/scf

Calculation of Noncriteria Pollutant Emissions from Gas Turbines

		(each turbine)			All Turbines			
Compound	Emission Factor, lb/MMscf	Maximum Hourly Emissions, lb/hr	Maximum Daily Emissions, lb/day	Annual Emissions, lb/yr	Maximum Hourly Emissions, lb/hr	Maximum Daily Emissions, lb/day	Annual Emissions, lb/yr	Annual Emissions, tons/yr
Acetaldehyde	1.37E-01	2.88E-01	6.92E+00	2.40E+03	5.76E-01	1.38E+01	4.80E+03	2.40E+00
Acrolein	1.89E-02	3.98E-02	9.54E-01	3.31E+02	7.95E-02	1.91E+00	6.62E+02	3.31E-01
Ammonia	(3)	1.40E+01	3.36E+02	1.19E+05	2.80E+01	6.72E+02	2.39E+05	1.19E+02
Benzene	1.33E-02	2.80E-02	6.72E-01	2.33E+02	5.60E-02	1.34E+00	4.66E+02	2.33E-01
1,3-Butadiene	1.27E-04	2.67E-04	6.41E-03	2.23E+00	5.34E-04	1.28E-02	4.45E+00	2.23E-03
Ethylbenzene	1.79E-02	3.77E-02	9.04E-01	3.14E+02	7.53E-02	1.81E+00	6.27E+02	3.14E-01
Formaldehyde	9.17E-01	1.93E+00	4.63E+01	1.61E+04	3.86E+00	9.26E+01	3.21E+04	1.61E+01
Hexane	2.59E-01	5.45E-01	1.31E+01	4.54E+03	1.09E+00	2.62E+01	9.08E+03	4.54E+00
Naphthalene	1.66E-03	3.49E-03	8.38E-02	2.91E+01	6.99E-03	1.68E-01	5.82E+01	2.91E-02
Total PAHs	2.41E-04	5.07E-04	1.22E-02	4.22E+00	1.01E-03	2.43E-02	8.45E+00	4.22E-03
Propylene	7.71E-01	1.62E+00	3.89E+01	1.35E+04	3.24E+00	7.79E+01	2.70E+04	1.35E+01
Propylene oxide	4.78E-02	1.01E-01	2.41E+00	8.38E+02	2.01E-01	4.83E+00	1.68E+03	8.38E-01
Toluene	7.10E-02	1.49E-01	3.59E+00	1.24E+03	2.99E-01	7.17E+00	2.49E+03	1.24E+00
Xylene	2.61E-02	5.49E-02	1.32E+00	4.57E+02	1.10E-01	2.64E+00	9.15E+02	4.57E-01
*	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Notes:

(1) Provided by CATEF database.
(2) Based on maximum hourly turbine fuel use of: 2.1040E+00 mmscf/hr

Based on a maximum daily turbine fuel use of: 5.0496E+01 mmscf/day

Based on maximum annual turbine fuel use of: 1.7526E+04 mmscf/yr
Fuel use values from Fuel Calculation Sheet
(3) Values from ammonia slip calculations.
(4) Fuel use values include HRSG duct burner(s) Yes or No: No

Each Turbine	24	Max hrs/day
Each Turbine	8521	Max Hrs/yr

Contra Costa Generating Station 2x1

Startup Emissions Summary

Calculated Values		Proposed Limits
Hot Start		
Start Duration, minutes	14.0	**14.0**
Total per Start (per turbine)		
NO_x, lbs	22.0	**22.0**
CO, lbs	138.0	**138.0**
VOC, lbs	31.0	**31.0**
PM_{10}, lbs	1.1	
SO_2, lbs	0.2	
Warm Start		
Start Duration, minutes	14.0	**14.0**
Total per Start (per turbine)		
NO_x, lbs	22.0	**22.0**
CO, lbs	138.0	**138.0**
VOC, lbs	31.0	**31.0**
PM_{10}, lbs	1.1	
SO_2, lbs	0.2	
Cold Start		
Start Duration, minutes	45.0	**45.0**
Total per Start (per turbine)	5.0	
NO_x, lbs	96.0	**96.0**
CO, lbs	540.0	**540.0**
VOC, lbs	67.0	**67.0**
PM_{10}, lbs	3.7	
SO_2, lbs	0.8	
Shutdown		
Shutdown Duration, minutes	14.0	**14.0**
Total per Shutdown (per turbine)		
NO_x, lbs	39.0	**39.0**
CO, lbs	206.0	**206.0**
VOC, lbs	17.0	**17.0**
PM_{10}, lbs	1.1	
SO_2, lbs	0.2	

RADBACK ENERGY

Contra Costa Generating Station 2x1

Combustion Turbine Commissioning

Operating Mode	No.	Hours	Hourly Emissions (lbs/hr or lbs/start or shutdown)					Total Emissions (lbs)				
			NO_x	CO	VOC	PM_{10}	SO_2	NO_x	CO	VOC	PM_{10}	SO_2
CTG/HRSG 1 - No Load[1]		72	120.0	210.0	20.0	7.5	6.0	8,640	15,120	1,440	540	432
CTG/HRSG 2 - No Load[1]		72	120.0	210.0	20.0	7.5	6.0	8,640	15,120	1,440	540	432
CTG/HRSG 1 - 49% Load[2]		144	113.0	22.0	2.0	7.5	6.0	16,272	3,168	288	1,080	864
CTG/HRSG 2 - 49% Load[2]		144	113.0	22.0	2.0	7.5	6.0	16,272	3,168	288	1,080	864
CTG/HRSG 1 - Full Load - No SCR[3]		48	68.3	33.4	3.3	7.5	6.0	3,277	1,604	156	360	288
CTG/HRSG 2 - Full Load - No SCR[3]		48	68.3	33.4	3.3	7.5	6.0	3,277	1,604	156	360	288
CTG/HRSG 1 - Full Load - Partial SCR[4]		24	41.7	21.3	4.3	7.5	6.0	1,001	512	103	180	144
CTG/HRSG 2 - Full Load - Partial SCR[4]		24	41.7	21.3	4.3	7.5	6.0	1,001	512	103	180	144
CTG/HRSG 1 - Full Load - Full SCR[5,6]		336	15.2	9.2	5.3	7.5	6.0	5,098	3,104	1,778	2,520	2,016
CTG/HRSG 2 - Full Load - Full SCR[5]		24	15.2	9.2	5.3	7.5	6.0	364	222	127	180	144
CTG/HRSG 1 - Cold Starts	1	0.8	96.0	540.0	67.0	3.7	6.0	96	540	67	4	6
CTG/HRSG 2 - Cold Starts	1	0.8	96.0	540.0	67.0	3.7	6.0	96	540	67	4	6
CTG/HRSG 1 - Hot Starts	5	1.2	22.0	138.0	31.0	1.1	6.0	110	690	155	6	30
CTG/HRSG 2 - Hot Starts	5	1.2	22.0	138.0	31.0	1.1	6.0	110	690	155	6	30
CTG/HRSG 1 - Shutdowns	6	1.4	39.0	206.0	17.0	1.1	6.0	234	1,236	102	7	36
CTG/HRSG 2 - Shutdowns	6	1.4	39.0	206.0	17.0	1.1	6.0	234	1,236	102	7	36
Total		943						64,723	49,065	6,527	7,053	5,760
CTG/HRSG 1 - Total Commissioning Time[7]		289										
CTG/HRSG 2 - Total Commissioning Time[7]		289										
Total Commissioning Duration		625										

Notes:

1. Full speed, no load tests including ignition system, synchronization, and overspeed checks.
2. Part load tests, combustor tuning, steam blows.
3. Full load tests with no catalyst installed, combustor tuning.
4. Full load tests with catalyst installed, SCR system tuning.
5. Full load operation with catalyst installed and operating as specified.
6. Assumes startup of second unit starts when catalyst is loaded on first unit and allows 2 days for catalyst installation.
7. Includes all time with uncontrolled emissions, including no load, 49% load, 100% load without SCR, and 100% load with partial SCR.

Operating Mode	Fuel MMBtu/hr	Hourly Emissions (lbs/MMBtu HHV)				
		NO_x	CO	VOC	PM_{10}	SO_2
CTG/HRSG 1 - No Load[1]	863	0.1391	0.2435	0.0232	0.0087	0.0070
CTG/HRSG 2 - No Load[1]	863	0.1391	0.2435	0.0232	0.0087	0.0070
CTG/HRSG 1 - 49% Load[2]	1,339	0.0844	0.0164	0.0015	0.0056	0.0045
CTG/HRSG 2 - 49% Load[2]	1,339	0.0844	0.0164	0.0015	0.0056	0.0045
CTG/HRSG 1 - Full Load - No SCR[3]	2,102	0.0325	0.0159	0.0016	0.0036	0.0029
CTG/HRSG 2 - Full Load - No SCR[3]	2,102	0.0325	0.0159	0.0016	0.0036	0.0029
CTG/HRSG 1 - Full Load - Partial SCR[4]	2,102	0.0199	0.0101	0.0020	0.0036	0.0029
CTG/HRSG 2 - Full Load - Partial SCR[4]	2,102	0.0199	0.0101	0.0020	0.0036	0.0029
CTG/HRSG 1 - Full Load - Full SCR[5,6]	2,102	0.0072	0.0044	0.0025	0.0036	0.0029
CTG/HRSG 2 - Full Load - Full SCR[5]	2,102	0.0072	0.0044	0.0025	0.0036	0.0029

Table 5.2A-6 Cooling Tower

Cooling Tower Particulate Emissions

				Per Tower	Per Cell	All Towers
# of Identical Towers:	1					
Operational Schedule:	Hrs/day	Days/Yr	Hrs/Yr			
	11	0	1500			
Pumping rate of recirculation pumps (gal/min)				5,880.0		
Flow of cooling water (lbs/hr)				2,938,824.0		
Avg TDS of circ water (mg/l or ppmw)				1,500.0		
Flow of dissolved solids (lbs/hr)				4408.24		
Fraction of flow producing drift*				1.00		
Control efficiency of drift eliminators (gal drift/gal flow)				0.000030		
Calculated drift rate (lbs water/hr)				88.2		
PM10 emissions from tower (lbs/hr)				**0.132**	**0.044**	**0.132**
PM10 emissions from tower (tpy)				**0.099**	**0.033**	**0.099**
PM2.5 fraction of PM10 per CARB CEIDARS App A.				0.60		
PM2.5 emissions from tower (lbs/hr)				**0.079**	**0.026**	**0.079**
PM2.5 emissions from tower (tpy)				**0.060**	**0.020**	**0.060**

Notes:
Based on Method AP 42, Section 13.4, Jan 1995
*Technical Report EPA-600-7-79-251a, Page 63
Effects of Pathogenic and Toxic Materials Transported Via Cooling Device Drift - Volume 1.

Cooling Tower Stack Parameters

Base Elevation	0	feet amsl
Number of Cells	3	
Length of Cooling Tower	0.00	feet
Width of Cooling Tower	0.00	feet
Height of Cooling Tower (to fan deck)	0.00	feet agl
Cell Release Height (fan shroud exit)	0.00	feet agl
Flow/Fan Discharge for each Cell	0	ACFM
Inlet air temperature (ambient):	variable	deg F
Discharge air temperature:	variable	deg F

Table 5.2A-7
Calculation of Hazardous and Toxic Pollutant Emissions from Cooling Tower

				Op Hrs/Day:	11		
Cells per Tower:	3	Max Tower Drift Rate:	88.2 lbs/hr	Op Hrs/Yr:	1500	Average Tower Cycles	
# of Identical Towers:	1					of Concentration:	3

			Total Single Tower			Single Cell			Total All Towers		
Constituent	Concentration in Cooling Tower Water		Emissions, lb/hr	Emissions, lb/day	Emissions, ton/yr	Emissions, lb/hr	Emissions, lb/day	Emissions, ton/yr	Emissions, lb/hr	Emissions, lb/day	Emissions, ton/yr
Manganese	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Magnesium	91	ppm	2.41E-02	2.65E-01	1.81E-02	8.03E-03	8.83E-02	6.02E-03	2.41E-02	2.65E-01	1.81E-02
Lead	0.0497	ppm	1.32E-05	1.45E-04	9.86E-06	4.38E-06	4.82E-05	3.29E-06	1.32E-05	1.45E-04	9.86E-06
Arsenic	0.069	ppm	1.83E-05	2.01E-04	1.37E-05	6.09E-06	6.69E-05	4.56E-06	1.83E-05	2.01E-04	1.37E-05
Aluminum	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chromium 6	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cadmium	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Selenium	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zinc	0.491	ppm	1.30E-04	1.43E-03	9.74E-05	4.33E-05	4.76E-04	3.25E-05	1.30E-04	1.43E-03	9.74E-05
Mercury	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Copper	0.177	ppm	4.68E-05	5.15E-04	3.51E-05	1.56E-05	1.72E-04	1.17E-05	4.68E-05	5.15E-04	3.51E-05
Silver	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nickel	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Notes: (1) Water analysis data supplied by project applicant.

Table 5.2A-8 Aux Boiler
Calculation of Criteria Pollutant Emissions for Boilers Firing Gaseous Fuels

Boiler Operation Mode:	Normal firing mode		# of Units:	1
Ops Hr/Day:	8	Worst Case	Fuel Type:	Nat Gas
Ops Hr/Yr:	403			

Calculation of Criteria Pollutant Emissions from Each Identical Unit

Compound	Emission Factor, lb/MMscf (1)	Maximum Hourly Emissions, lb/hr (2)	Maximum Daily Emissions, lb/day	Maximum Annual Emissions, lbs/yr	Annual Emissions, ton/yr (3)	All Units: Maximum Hourly Emissions, lb/hr	All Units: Maximum Daily Emissions, lb/day	All Units: Maximum Annual Emissions, lbs/yr	All Units: Annual Emissions, ton/yr
NOx	1.11E+01	5.50E-01	4.40E+00	2.22E+02	1.11E-01	5.50E-01	4.40E+00	2.22E+02	1.11E-01
CO	3.74E+01	1.85E+00	1.48E+01	7.46E+02	3.73E-01	1.85E+00	1.48E+01	7.46E+02	3.73E-01
VOC	2.22E+00	1.10E-01	8.80E-01	4.43E+01	2.22E-02	1.10E-01	8.80E-01	4.43E+01	2.22E-02
SOx	2.83E+00	1.40E-01	1.12E+00	5.64E+01	2.82E-02	1.40E-01	1.12E+00	5.64E+01	2.82E-02
PM10	4.61E+00	2.28E-01	1.82E+00	9.19E+01	4.60E-02	2.28E-01	1.82E+00	9.19E+01	4.60E-02
PM2.5	4.61E+00	2.28E-01	1.82E+00	9.19E+01	4.60E-02	2.28E-01	1.82E+00	9.19E+01	4.60E-02
NH3	2.22E+00	1.10E-01	8.80E-01	4.43E+01	2.22E-02	1.10E-01	8.80E-01	4.43E+01	2.22E-02
	lbs/mmbtu								
CO2	1.17E+02	5.92E+03	4.73E+04	2.38E+06	1.19E+03	5.92E+03	4.73E+04	2.38E+06	1.19E+03
Methane	1.30E-02	6.58E-01	5.26E+00	2.65E+02	1.33E-01	6.58E-01	5.26E+00	2.65E+02	1.33E-01
N2O	2.21E-04	1.12E-02	8.93E-02	4.50E+00	2.25E-03	1.12E-02	8.93E-02	4.50E+00	2.25E-03
CO2e									1.20E+03

Notes:
(1) natural gas criteria pollutant EF factors
(2) Based on maximum hourly boiler fuel use of 50.6 MMBtu/hr/boiler
and fuel HHV of 1022 Btu/scf gives 0.0495 MMscf/hr/boiler.
(3) Based on maximum annual boiler fuel use of 20,392 MMBtu/yr/boiler
and fuel HHV of 1022 Btu/scf gives 19.9528 MMscf/yr/boiler.
(4) LNBs with SCR and CO Cat
(5) PM2.5 = PM10

Refs:
(1) EFs from Radback Energy
(2) GHG EFs from CCAR General Protocol, June 2006.

Table 5.2A-9 Aux Boiler
Calculation of Noncriteria Pollutant Emissions for Boilers Firing Gaseous Fuels

Boiler Operation Mode: Normal firing mode

Ops Hr/Day: 8 Worst Case
Ops Hr/Yr: 403

# of Units: 1
Fuel Type: Nat Gas

Calculation of Noncriteria Pollutant Emissions from Each Identical Unit

Compound	Emission Factor, lb/MMscf (1)	Maximum Hourly Emissions, lb/hr (2)	Maximum Daily Emissions, lb/day	Maximum Annual Emissions, lbs/yr	Annual Emissions, ton/yr (3)	All Units: Maximum Hourly Emissions, lb/hr	All Units: Maximum Daily Emissions, lb/day	All Units: Maximum Annual Emissions, lbs/yr	All Units: Annual Emissions, ton/yr
Acetaldehyde	4.61E-03	2.28E-04	1.83E-03	9.20E-02	4.60E-05	2.28E-04	1.83E-03	9.20E-02	4.60E-05
Acrolein	4.51E-03	2.23E-04	1.79E-03	9.00E-02	4.50E-05	2.23E-04	1.79E-03	9.00E-02	4.50E-05
Ammonia	(5)	1.10E-01	8.80E-01	4.43E+01	2.22E-02	1.10E-01	8.80E-01	4.43E+01	2.22E-02
Benzene	2.43E-03	1.20E-04	9.62E-04	4.85E-02	2.42E-05	1.20E-04	9.62E-04	4.85E-02	2.42E-05
1,3-Butadiene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ethylbenzene	2.25E-03	1.11E-04	8.91E-04	4.49E-02	2.24E-05	1.11E-04	8.91E-04	4.49E-02	2.24E-05
Formaldehyde	4.75E-03	2.35E-04	1.88E-03	9.48E-02	4.74E-05	2.35E-04	1.88E-03	9.48E-02	4.74E-05
Hexane	6.30E-03	3.12E-04	2.50E-03	1.26E-01	6.29E-05	3.12E-04	2.50E-03	1.26E-01	6.29E-05
Naphthalene	2.37E-04	1.17E-05	9.39E-05	4.73E-03	2.36E-06	1.17E-05	9.39E-05	4.73E-03	2.36E-06
PAHs (4)	8.10E-05	4.01E-06	3.21E-05	1.62E-03	8.08E-07	4.01E-06	3.21E-05	1.62E-03	8.08E-07
Propylene	4.63E-01	2.29E-02	1.83E-01	9.24E+00	4.62E-03	2.29E-02	1.83E-01	9.24E+00	4.62E-03
Propylene oxide	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene	3.23E-02	1.60E-03	1.28E-02	6.44E-01	3.22E-04	1.60E-03	1.28E-02	6.44E-01	3.22E-04
Xylene	1.87E-02	9.26E-04	7.41E-03	3.73E-01	1.87E-04	9.26E-04	7.41E-03	3.73E-01	1.87E-04
		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Notes:
(1) natural gas HAPs emission factors
(2) Based on maximum hourly boiler fuel use of 50.6 MMBtu/hr/boiler
and fuel HHV of 1022 Btu/scf gives 0.0495 MMscf/hr/boiler.
(3) Based on maximum annual boiler fuel use of 20,392 MMBtu/yr/boiler
and fuel HHV of 1022 Btu/scf gives 19.9528 MMscf/yr/boiler.
(4) Polycyclic aromatic hydrocarbons, excluding naphthalene (treated separately).
(5) LNBs with SCR and CO Cat

Refs:
CARB Catef Database, Heater, NG, SCC 31000404
SDAPCD, B17, Toxics Efs Database

Table 5.1A-10 Natural Gas Analysis Data

Component Analysis (Average)	Chemical Analysis, % by Wt. (Average)
Methane - 95% Ethane - 2% Nitrogen - 2% Carbon Dioxide - 1%	Carbon - 72.8% Hydrogen - 23.79% Nitrogen - 1.08% Oxygen - 2.33% Sulfur - 0.25 gr/100 scf HHV 1020-1027 btu/scf HHV used 1022 btu/scf

Table 5.1A-11 GHG Emissions from Turbines/HRSGs

Combustion Turbines-Gaseous Fuels Emissions Analysis Period: Annual

Facility Name: CCGS Gas Type: Natural Gas

Turbine Device ID: 501 w/HRSG X 2 Op Hours: 8521

Turbine Heat Rating: 4300.6 mmbtu/hr

Gas Btu Content:	1022	btu/scf	Ref 1, Table C.5	Carbon Content:	14.47	kg/mmbtu
				Frac Oxidized:	0.995	
Annual Gas Usage:	35857	mmscf		CO2/C Ratio:	3.6667	
	36645413	mmbtu/yr		Adjusted EF:	52.7914	kg CO2/mmbtu

Emissions Factors:

CO2	53.05	kg/mmbtu	Ref 1, Table C.5
CH4	0.0059	kg/mmbtu	Ref 1, Table C.6
N2O	0.0001	kg/mmbtu	Ref 1. Table C.6

	kg/yr	**Emissions** metric tons/yr	IPCC GWP/SAR	CO2e metric tons/yr
CO2	1.93E+09	1934562	1	1934562
CH4	2.16E+05	216.2079	21	4540.367
N2O	3.66E+03	3.664541	310	1136.008
			Total	**1940238 CO2e metric tons**

Source Specific Emissions Factor References, Data Notes, or Calculation Notes:

1. ***
2. ***
3. ***
4. ***

Table 5.2A-12 EXPECTED INTERNAL COMBUSTION ENGINE EMISSIONS

Liquid Fuel

# of Identical Engines: 1

Emergency Fire Pump

Mfg:	Clarke	
Engine #:	JW6H-UFAD80	
Kw	0	approx.
BHP:	400	
RPM:	-	
Fuel:	#2 Diesel	
Fuel Use:	20	Gph (1)
FuelHHV:	139000	Btu/gal
mmbtu/hr:	2.78	HHV
EPA/CARB Tier #:	3	

Stack Data

Height:	16	Ft.
Diameter:	0.67	Ft.
Temp:	826	deg F
ACFM:	2214	

input the mfg ACFM or calculate per Exhaust sheet)

Area:	0.353	Sq.Ft.
Velocity:	105	Ft/Sec
Max Daily Op Hrs:	1	
Max Annual Op Hrs:	50	

Fuel Wt:	7	Lbs/gal
Fuel S:	0.0015	% wt.
Fuel S:	0.105	Lbs/1000 gal
SO2:	0.21	Lbs/1000 gal

		Single Engine				*All Engines*			
EFs (g/bhp-hr)		**Lb/Hr**	**Lb/Day**	**Lbs/Yr**	**Tons/Yr**	***Lb/Hr***	***Lb/Day***	***Lbs/Yr***	***Tons/Yr***
NOx	2.61	2.30	2.30	114.98	0.057	*2.30*	*2.30*	*114.98*	*0.06*
CO	0.84	0.74	0.74	37.00	0.019	*0.74*	*0.74*	*37.00*	*0.02*
VOC	0.104	0.09	0.09	4.58	0.002	*0.09*	*0.09*	*4.58*	*0.002*
PM10	0.103	0.09	0.09	4.54	0.002	*0.09*	*0.09*	*4.54*	*0.002*
SOx	NA	0.0042	0.0042	0.21	0.0001	*0.0042*	*0.0042*	*0.21*	*0.0001*
	lbs/gal								
CO2	22.38	448	448	22380	11	*448*	*448*	*22380*	*11*
Methane	0.0003	0.01	0.01	0.30	0.000	*0.01*	*0.01*	*0.30*	*0.000*
N2O	0.0001	0.00	0.00	0.10	0.0001	*0.00*	*0.00*	*0.10*	*0.0001*
CO2e					11.2				*11.2*

Notes:

1. fuel consumption based on 0.055 gal/hp-hr (avg EPA and SCAQMD values) if no value given by mfg for specific engine.
2. PM10 equals PM2.5.
3. PM10 used in HRA to represent DPM emissions.
4. GHG EFs from CCAR General Protocol, June 2006.

Typical Diesel Fuel Analysis Data

Support for Table 5.1A-12

Carbon %	85.86
Hydrogen %	13.35
Oxygen %	0.65
Nitrogen %	0.097
Sulfur %	0.047
Ash %	0.01

Btu/lb 19100-20572

Value used: 19857 Btu/lb

Ref: Avg of fuel samples from AB2588 fuel tests.
South Coast AQMD

CLARKE

Fire Protection Products

JW6H-UFAD80
INSTALLATION & OPERATION DATA

Basic Engine Description

Engine Manufacturer	John Deere Co.
Ignition Type	Compression (Diesel)
Number of Cylinders	6
Bore and Stroke - in.(mm)	4.66 (118) X 5.35 (136)
Displacement - in^3 (L)	496 (8.1)
Compression Ratio	16.0:1
Valves per cylinder - Intake	2
Exhaust	2
Combustion System	Direct Injection
Engine Type	In-Line, 4 Stroke Cycle
Aspiration	Turbocharged
Firing Order (CW Rotation)	1-5-3-6-2-4
Charge Air Cooling Type	Raw Water Cooled
Rotation (Viewed from Front) - Clockwise	Standard
Counter-Clockwise	Not Available
Engine Crankcase Vent System	Open
Installation Drawing	D-628
Weight - lb (kg)	2094 (948)

Cooling System	**1760**	**2100**
Engine H_2O Heat -Btu/sec.(kW)	97.2 (103)	97.6 (102)
Engine Radiated Heat - Btu/sec.(kW)	96 (101)	90.5 (95)
Heat Exchanger Minimium Flow		
60°F (15°C) Raw H_2O - gal/min. (L/min.)	38 (144)	40 (151)
95°F (35°C) Raw H_2O - gal/min. (L/min.)	47 (178)	50 (189)
Heat Exchanger Maximum Cooling H_2O		
Inlet Pressure - bar ($lb./in^2$) (kPa)	4 (60) (400)	
Flow - gal./min (L/min.)	80 (302)	
Thermostat, Start to Open - °F (°C)	180 (82)	
Fully Opened - °F (°C)	201 (94)	
Engine Coolant Capacity - qt. (L)	22 (20.8)	
Coolant Pressure Cap - $lb./in^2$(kPa)	15 (103)	
Maximum Engine H_20 Temperature - °F (°C)	221 (105)	
Minimum Engine H_20 Temperature - °F (°C)	160 (71)	

Electric System - DC

System Voltage (Nominal)	12 (Standard)	24 (Optional)
Battery Capacity for Ambients Above 32°F (0°C)		
Voltage (Nominal)	12	12
Qty. per Battery Bank	1	2
SAE size per J537	8D-900	8D-900
CCA @ 0°F (-18°C)	900	900
Reserve Capacity - Minutes	430	430
Battery Cable Circuit*, Max Resistance - ohm	0.0017	0.0017
Battery Cable Minimum Size		
0 -120 in. Circuit* Length	00	00
121 - 160 in. Circuit* Length	000	000
161 - 200 in. Circuit* Length	0000	0000
Charging Alternator Output - Amp	40	40
Starter Cranking Amps - @ 60°F (15°C)	495	326

**Positive and Negative Cables Combined Length*

NOTE: This engine is Intendend For Indoor Installation Or In A Weatherproof Enclosure. *(Continued)*

CLARKE

Fire Protection Products

JW6H-UFAD80
INSTALLATION & OPERATION DATA (Continued)

Exhaust System	**1760**	**2100**
Exhaust Flow - ft.^{3}/min. (m^3/min.)	2048 (58)	2214 (62.7)
Exhaust Temperature - °F (°C)	891 (477)	826 (441)
Maximum Allowable Back Pressure - in. H_20 (kPa)	30 (7.5)	30 (7.5)
Minimum Exhaust Pipe Dia. - in. (mm)**	6 (152)	
Fuel System		
Fuel Consumption - gal./hr. (L/hr.)	20 (75.6)	20 (75.6)
Fuel Return - gal./hr. (L/hr.)		
Total Supply Fuel Flow - gal./hr. (L/hr.)		
Fuel Pressure - lb./in.^{2} (kPa)		
Minimum Line Size - Supply - (in.)	.50 Schedule 40 Steel Pipe	
Pipe Outer Diameter in. (mm)	.848 (0.33)	
Minimum Line Size - Return - (in.)	.375 Schedule 40 Steel Pipe	
Pipe Outer Diameter in. (mm)	.675 (0.26)	
Maximum Allowable Fuel Pump Suction		
With Clean Filter - in. H_20 (mH_20)	80 (2.0)	
Maximum Allowable Fuel Head above Fuel pump, Supply or Retrun - ft.(m)	6.6 (2.0)	
Fuel Filter Micron Size	2 (Secondary)	
Heater System		
Jacket Water Heater	Standard	
Wattage (Nominal)	2500	
Voltage - AC, 1P	230 (+5%, -10%)	
Optional Voltage - AC, 1P	115 (+5%, -10%)	
Lube Oil Heater Wattage		
(Required Option When Ambient is Below 40°F (4°C)	150	
Induction Air System		
Air Cleaner Type	Indoors Service Only - Washable	
Air Intake Restriction Maximum Limit		
Dirty Air Cleaner - in. H_20 (kPa)	25 (6.25)	25 (6.25)
Clean Air Cleaner - in. H_20 (kPa)	15 (3.75)	15 (3.75)
Engine Air Flow - ft.^{3}/min. (m^3/min.)	848 (24)	971 (27.5)
Maximum Allowable Temperature (Air To Engine Inlet) - °F (°C)***	130 (54)	
Lubrication System		
Oil Pressure - normal - lb./in.^{2} (kPa)	37 (255)	41 (280)
In Pan Oil Temperature - °F (°C)	190-220 (88-104)	
Oil Pan Capacity - High - qt. (L)	48 (45)	
- Low - qt. (L)	39 (43)	
Total Oil Capacity with Filter - qt. (L)	41 (46)	
Performance		
BMEP - lb./in.^{2} (kPa)	346 (2386)	274 (1892)
Piston Speed - ft./min. (m/min.)	1570 (479)	1874 (571)
Mechanical Noise - dB(A) @ 1M	Consult Factory	
Power Curve	C132616	

Power Curve.....C132616

*** Based On Nominal System. Flow Analysis Must Be Done To Assure Adherance To System Limitations. (Minimum Exhaust pipe Diameter is based on 15 feet of pipe, one elbow, and a silencer pressure drop no greter than one half the max. allowable back pressure.)*

**** Review For Power Deration If Air Entering Engine Exceeds °77F (25°C)*

C132906 revA
DSP 10DEC08

Tier 3 Emissions Data - John Deere Power Systems

Nameplate Rating Information

Clarke Model	JW6H-UFAD80
Power Rating (BHP / kW)	400 / 298
Certified Speed (RPM)	2100

Certificate Data

John Deere Engine Rating	6090HFC47B
Engine Model Year *	2009
EPA Family Name	9JDXL09.0114
EPA Certificate Number	JDX-NRCI-09-23
CARB Executive Order Number	U-R-004-0369
Emissions Label Part Number	R528939

* The Engine Model Year is listed on the emissions label.

Emissions Data **

Units	g/hp-hr	g/kW-hr
CO	0.84	1.12
Pm	0.103	0.138
NOx	2.61	3.5
HC	0.104	0.14
NOx + HC	2.71	3.64
Test Engine	RG 6090L015278	

** The emission data listed is measured from the calibration engine under laboratory test conditions. It is intended to represent an "average" engine but is not a guarantee that all engines meet these values.

JOHN DEERE

John Deere Power Systems
3801 W. Ridgeway Ave., PO Box 5100
Waterloo, Iowa USA 50704-5100

JDPS 2/19/2009