APPENDIX 3.1A

Calculation of Maximum Hourly, Daily, and Annual Emissions

APPENDIX 3.1A

Calculation of Maximum Hourly, Daily, and Annual Emissions

The original AFC Appendix 8.1A is now Amendment Appendix 3.1A. Significant changes have occurred with respect to proposed emissions and operational scenarios, and as such this appendix presents updated emissions and operational data for the new facility site and configuration.

Tables presented in this Appendix are as follows:

3.1A-1 Ammonia Slip Emissions
3.1A-2 Turbine/HRSG Assumptions
3.1A-3 HRSG Stack Sizing
3.1A-4 Operating Emissions Scenarios and Support Data
3.1A-5 Startup Emissions Summary
3.1A-6 Combustion Turbine HAP Emissions
3.1A-7 Cooling Tower Operational Scenarios and Support Data
3.1A-8 Cooling Tower PM10 Emissions
3.1A-9 Cooling Tower HAP Emissions
3.1A-10 Fire Pump Engine Emissions and Specifications
3.1A-11 Fire Pump HAP Emissions
3.1A-12 Fuel Gas Analysis
3.1A-13 Fuel Oil Analysis
3.1A-14 Ambient Combustion Air Analysis Assumptions
3.1A-15 Fuel Use Calculation
3.1A-16 Short Term Emissions

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

Table 3.1A-1

Ammonia Slip Emissions Calculation

Project:	Russell City Energy Center		
Scenario:	Case 22		
# of Units:	2		
Op Hours:	24	hrs/day	
	8364	hrs/year	

Data Input:			
NH3 Limit, ppm @ 15% O2:	5		
Exhaust rate, lbs/hr:	4047646		
Exhaut MW:	28.39		
Mole% O2:	11.8	0.118	frac
Mole % H2O:	8.7	0.087	frac

Per Unit		All Units	
14.98	lbs/hr	29.97	lbs/hr
359.6	lbs/day	719.2	lbs/day
62.7	tons/yr	125.3	tons/yr

Ref: All input data from Calpine operational scenario list and technical data. See Table 3.1A-4.

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Table 3.1A-2

Russell City Energy Center
CTG/HRSG Assumptions

Plant Design Parameters		
Combustion Turbine Manufacturer	SWPC	
Combustion Turbine Model	501FD	
Stack Diameter, ft	18.00	
Stack Height, ft	145	
Sulfate Particulate Molecular Weight	134	
Sulfate Particulate Conversion Rate in CTG	5%	
Duct Burner Emissions		
	Without PAG	**With PAG**
NOx, lb/MMBtu as NO_2 (HHV)	0.080	0.080
CO, lb/MMBtu (HHV)	0.100	0.250
VOC, lb/MMBtu as CH_4 (HHV)	0.020	0.050
PM_{10}, lb/MMBtu (HHV)	0.015	0.015
Sulfate Particulate Conversion Rate in Duct Burner	0%	0%
Dilution Air		
Dilution Air Required? (Yes/No)	No	
Design Gas Temperature Upstream of Catalysts, deg. F	830	
CO Catalyst Design Parameters		
CO Catalyst Required? (Yes/No)	Yes	
Design Outlet CO, ppmvd @ 15% O_2	4.0	
Design Outlet VOC, ppmvd as CH_4 @ 15% O_2	2.0	
Minimum VOC Reduction across CO Catalyst	0%	
Sulfate Particulate Conversion Rate across CO Catalyst	80%	
NO_x Catalyst Design Parameters		
NO_x Catalyst Required? (Yes/No)	Yes	
Design Outlet NO_x, ppmvd @ 15% O_2	2.0	
Ammonia Slip, ppmvd @ 15% O_2	5	
Sulfate Particulate Conversion Rate across SCR Catalyst	10%	
CT PM_{10} Assumptions		
Natural Gas - lbs/MMBtu (HHV)	0.0087	
Fuel Oil - lbs/MMBtu (HHV)	0.0450	

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Table 3.1A-3

Russell City Energy Center
HRSG Stack Sizing

Stack Diameter, ft	
Exhaust Flow, lb/hr	4,038,946
Stack Temperature, deg. F	180
Exhaust Molecular Weight	28.39
Site Elevation, ft	9.5
Ambient Pressure, psia	14.69
Maximum Velocity, fps	75.0
Minimum Stack Diameter, ft	17.7
Selected Stack Diameter, ft	18.0
Actual Velocity, fps	72.6
Stack Height	
Finished Grade to Top of Foundation, ft	0.5
Top of Foundation to Top of Breeching, ft	80.0
Stack Damper, ft	10.0
Stack Silencer, ft	-
Last Disturbance to Test Ports, diameters	2.0
Test Ports to Stack Outlet, diameter	0.5
Minimum Stack Height, ft (above top of foundation)	135.0
Selected Stack Height, ft (above top of foundation)	145.0
Selected Stack Height, ft (above finshed grade)	145.5
Top of Stack Elevation, ft	155.0
Stack Height to HRSG Height Ratio	1.8

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Table 3.1A-4

Russell City Energy Center
Operating Emissions

Operating Conditions		ISO			July Peak			December		
		Case 1	Case 4	Case 13	Case 14	Case 15	Case 21	Case 22	Case 23	Case 25
		Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%	Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%	Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%
Ambient Dry Bulb Temp.	deg. F	59.0	59.0	59.0	88.0	88.0	88.0	38.0	38.0	38.0
Ambient Wet Bulb Temp.	deg. F	51.0	51.0	51.0	68.0	68.0	68.0	36.0	36.0	36.0
Relative Humidity	%	58%	58%	58%	36%	36%	36%	83%	83%	83%
Elevation	ft	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Ambient Pressure	psia	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69
Combustion Turbine Load	%	100%	100%	60%	100%	100%	60%	100%	100%	60%
Combustion Turbines Operating		2	2	1	2	2	1	2	2	1
Evaporative Cooling or Fogging? (Yes/No)		Yes	Yes	Yes	Yes	Yes	No	No	No	No
Evaporative Cooling/Fogging Effectiveness	%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Duct Firing? (Yes/No)		Yes	No	No	Yes	No	No	Yes	No	No
Steam or Water Injection? (Yes/No)		No	No	No	No	No	No	No	No	No
Fuel Input (each turbine)										
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	1,775	1,775	1,193.7748	1,688.4609	1,688.4609	1,092.2841	1,838.9853	1,838.9853	1,255.5562
HRSG Fuel (LHV)	MMBtu/hr	180	-	-	180.1788	-	-	180.1788	-	-
Total Fuel (LHV)	MMBtu/hr	1,956	1,775	1,194	1,869	1,688	1,092	2,019	1,839	1,256
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	1,968	1,968	1,323	1,872	1,872	1,211	2,038.6	2,038.6	1,392
HRSG Fuel (HHV)	MMBtu/hr	200	0	0	200	0	0	200	0	0
Total Fuel (HHV)	MMBtu/hr	2,168	1,968	1,323	2,071	1,872	1,211	2,238.3	2,038.6	1,392
CT Fuel	lb/hr	85,088	85,088	57,215	80,924	80,924	52,350	88,138	88,138	60,176
HRSG Fuel	lb/hr	8,636	0	0	8,636	0	0	8,636	0	0
Total Fuel	lb/hr	93,724	85,088	57,215	89,559	80,924	52,350	96,774	88,138	60,176
Inlet Air (each turbine)										
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	53.0	53.0	53.0	71.0	71.0	88.0	38.0	38.0	38.0
Moisture Content of Ambient Air	lb H_2O/lb air	0.0061	0.0061	0.0061	0.0101	0.0101	0.0101	0.0040	0.0040	0.0040
Moisture Content of Inlet Air	lb H_2O/lb air	0.0075	0.0075	0.0075	0.0141	0.0141	0.0101	0.0040	0.0040	0.0040
Relative Humidity of Inlet Air	%	88%	88%	88%	86%	86%	36%	83%	83%	83%
Moisture Content	moles H_2O/mole air	0.012	0.012	0.012	0.023	0.023	0.016	0.006	0.006	0.006
N_2	mole %	77.11%	77.11%	77.11%	76.31%	76.31%	76.79%	77.54%	77.54%	77.54%
O_2	mole %	20.74%	20.74%	20.74%	20.53%	20.53%	20.65%	20.86%	20.86%	20.86%
CO_2	mole %	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%
H_2O	mole %	1.19%	1.19%	1.19%	2.21%	2.21%	1.60%	0.64%	0.64%	0.64%
Ar	mole %	0.93%	0.93%	0.93%	0.92%	0.92%	0.92%	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		28.84	28.84	28.84	28.72	28.72	28.79	28.90	28.90	28.90
Inlet Air Flow	lb/hr	3,835,277	3,835,277	2,742,736	3,687,867	3,687,867	2,549,414	3,950,808	3,950,808	2,858,848
Pagging/Injection Steam/Water (each turbine)										
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 turbine)										
Excess Combustion Air	%	168.5%	168.5%	185.5%	169.7%	169.7%	189.3%	167.9%	167.9%	184.0%
N_2	lb/hr	2,874,140	2,874,140	2,055,346	2,745,785	2,745,785	1,905,495	2,971,033	2,971,033	2,149,824
O_2	lb/hr	553,894	553,894	410,152	530,567	530,568	382,929	571,865	571,865	427,726
CO_2	lb/hr	230,977	230,977	155,387	219,681	219,681	142,192	239,253	239,253	163,422
H_2O	lb/hr	212,005	212,005	143,775	225,613	225,613	138,430	205,782	205,782	141,140
Ar	lb/hr	49,348	49,348	35,291	47,145	47,145	32,718	51,012	51,012	36,913
Total Exhaust Flow	lb/hr	3,920,365	3,920,365	2,799,951	3,768,791	3,768,791	2,601,764	4,038,946	4,038,946	2,919,024
Manufacturer's Exhaust Flow	lb/hr	3,920,365	3,920,365	2,799,951	3,768,791	3,768,791	2,601,764	4,038,946	4,038,946	2,919,024
N_2	mass %	73.31%	73.31%	73.41%	72.86%	72.86%	73.24%	73.56%	73.56%	73.65%
O_2	mass %	14.13%	14.13%	14.65%	14.08%	14.08%	14.72%	14.16%	14.16%	14.65%
CO_2	mass %	5.89%	5.89%	5.55%	5.83%	5.83%	5.47%	5.92%	5.92%	5.60%
H_2O	mass %	5.41%	5.41%	5.13%	5.99%	5.99%	5.32%	5.09%	5.09%	4.84%
Ar	mass %	1.26%	1.26%	1.26%	1.25%	1.25%	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	102,599	102,599	73,370	98,017	98,017	68,021	106,058	106,058	76,743
O_2	moles/hr	17,310	17,310	12,818	16,581	16,581	11,967	17,871	17,871	13,367

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Russell City Energy Center
Operating Emissions

Table 3.1A-4

Operating Conditions		ISO			July Peak			December		
		Case 1	Case 4	Case 13	Case 14	Case 15	Case 21	Case 22	Case 23	Case 25
		Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%	Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%	Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%
CO_2	moles/hr	5,263	5,263	3,541	5,006	5,006	3,240	5,452	5,452	3,724
H_2O	moles/hr	11,768	11,768	7,981	12,523	12,523	7,684	11,423	11,423	7,834
Ar	moles/hr	1,235	1,235	883	1,180	1,180	819	1,277	1,277	924
Total	moles/hr	138,175	138,175	98,592	133,307	133,307	91,731	142,080	142,080	102,592
N_2	mole %	74.25%	74.25%	74.42%	73.53%	73.53%	74.15%	74.65%	74.65%	74.80%
O_2	mole %	12.53%	12.53%	13.00%	12.44%	12.44%	13.05%	12.58%	12.58%	13.03%
CO_2	mole %	3.81%	3.81%	3.59%	3.75%	3.75%	3.53%	3.84%	3.84%	3.63%
H_2O	mole %	8.52%	8.52%	8.09%	9.39%	9.39%	8.38%	8.04%	8.04%	7.64%
Ar	mole %	0.89%	0.89%	0.90%	0.89%	0.89%	0.89%	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		28.38	28.38	28.40	28.28	28.28	28.37	28.43	28.43	28.46
Combustion Turbine Emissions (each turbine) - Expected										
NO_x, @ 15% O_2	ppmvd	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
CO, @15% O_2	ppmvd	10.0	10.0	50.0	10.0	10.0	50.0	10.0	10.0	50.0
VOC, @15% O_2	ppmvd	1.2	1.2	3.0	1.2	1.2	3.0	1.2	1.2	3.0
NO_x, as NO_2	lb/hr	177.5	177.5	119.3	168.8	168.8	109.1	183.9	183.9	125.5
CO	lb/hr	43.2	43.2	145.3	41.1	41.1	132.9	44.8	44.8	152.8
VOC, as CH_4	lb/hr	3.0	3.0	5.0	2.8	2.8	4.6	3.1	3.1	5.3
PM_{10}	lb/hr	15.4	15.4	10.4	14.7	14.7	9.5	16.0	16.0	10.9
Portion of PM_{10} from Sulfur Particulates	lb/hr	0.57	0.57	0.39	0.55	0.55	0.35	0.59	0.59	0.41
Portion of PM_{10} from Soot/Ash	lb/hr	14.9	14.9	10.0	14.1	14.1	9.1	15.4	15.4	10.5
Maximum SO_2	lb/hr	5.5	5.5	3.7	5.2	5.2	3.4	5.7	5.7	3.9
Annual Average SO_2	lb/hr	1.4	1.4	0.9	1.3	1.3	0.8	1.4	1.4	1.0
Duct Burner Emissions (each HRSG) - Expected										
NO_x, as NO_2	lb/hr	16.0	0.0	0.0	16.0	0.0	0.0	16.0	0.0	0.0
CO	lb/hr	20.0	0.0	0.0	20.0	0.0	0.0	20.0	0.0	0.0
VOC, as CH_4	lb/hr	4.0	0.0	0.0	4.0	0.0	0.0	4.0	0.0	0.0
PM_{10}	lb/hr	3.0	0.0	0.0	3.0	0.0	0.0	3.0	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	3.0	0.0	0.0	3.0	0.0	0.0	3.0	0.0	0.0
Maximum SO_2	lb/hr	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0
Annual Average SO_2	lb/hr	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Dilution Air (each turbine)										
Moisture Content	lb H_2O/lb air	0.0061	0.0061	0.0061	0.0101	0.0101	0.0101	0.0040	0.0040	0.0040
Moisture Content	moles H_2O/mole air	0.010	0.010	0.010	0.016	0.016	0.016	0.006	0.006	0.006
N_2	mole %	77.28%	77.28%	77.28%	76.79%	76.79%	76.79%	77.54%	77.54%	77.54%
O_2	mole %	20.79%	20.79%	20.79%	20.65%	20.65%	20.65%	20.86%	20.86%	20.86%
CO_2	mole %	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%
H_2O	mole %	0.98%	0.98%	0.98%	1.60%	1.60%	1.60%	0.64%	0.64%	0.64%
Ar	mole %	0.93%	0.93%	0.93%	0.92%	0.92%	0.92%	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	28.79	28.79	28.79	28.90	28.90	28.90
N_2	mass %	75.01%	75.01%	75.01%	74.71%	74.71%	74.71%	75.17%	75.17%	75.17%
O_2	mass %	23.05%	23.05%	23.05%	22.95%	22.95%	22.95%	23.09%	23.09%	23.09%
CO_2	mass %	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%
H_2O	mass %	0.61%	0.61%	0.61%	1.00%	1.00%	1.00%	0.40%	0.40%	0.40%
Ar	mass %	1.29%	1.29%	1.29%	1.28%	1.28%	1.28%	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%
Combustion Turbine Exhaust Temperature	deg. F	1,091	1,091	1,098	1,102	1,102	1,117	1,082	1,082	1,086
Stack Temperature (if have HRSG)	deg. F	183	194	173	188	199	172	180	193	173
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	0.308	0.308	0.306	0.313	0.313	0.308	0.306	0.306	0.304
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	-	-	-	-	-	-	-	-	-

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Table 3.1A-4

Russell City Energy Center
Operating Emissions

Operating Conditions		ISO			July Peak			December		
		Case 1	Case 4	Case 13	Case 14	Case 15	Case 21	Case 22	Case 23	Case 25
		Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%	Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%	Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%
Actual Dilution Air	cfm	-	-	-	-	-	-	-	-	-
Actual Dilution Air	lb/hr	-	-	-	-	-	-	-	-	-
Total Emissions Upstream of Catalyst (each turbine)										
NO_x, as NO_2	lb/hr	193.5	177.5	119.3	184.8	168.8	109.1	199.9	183.9	125.5
CO	lb/hr	63.2	43.2	145.3	61.1	41.1	132.9	64.8	44.8	152.8
VOC, as CH_4	lb/hr	7.0	3.0	5.0	6.8	2.8	4.6	7.1	3.1	5.3
PM_{10}	lb/hr	18.4	15.4	10.4	17.7	14.7	9.5	19.0	16.0	10.9
Portion of PM_{10} from Sulfur Particulates	lb/hr	0.6	0.6	0.4	0.5	0.5	0.4	0.6	0.6	0.4
Portion of PM_{10} from Soot/Ash	lb/hr	17.9	14.9	10.0	17.1	14.1	9.1	18.4	15.4	10.5
SO_2 Converted to PM_{10} within CTG and HRSG	lb/hr	0.27	0.27	0.18	0.26	0.26	0.17	0.28	0.28	0.19
Maximum SO_2	lb/hr	6.0	5.5	3.7	5.8	5.2	3.4	6.2	5.7	3.9
Annual Average SO_2	lb/hr	1.5	1.4	0.9	1.4	1.3	0.8	1.6	1.4	1.0
CO Catalyst Performance (each turbine)										
Required CO Reduction	lb/hr	44.1	25.9	133.6	42.9	24.7	122.3	45.1	26.9	140.6
Required CO Reduction (mass basis)	%	70%	60%	92%	70%	60%	92%	70%	60%	92%
Required VOC Reduction	lb/hr	1.5	0.0	1.7	1.6	0.0	1.5	1.4	0.0	1.8
Required VOC Reduction (mass basis)	%	22%	0%	33%	23%	0%	33%	20%	0%	33%
PM_{10} Increase from Sulfur Particulates	lb/hr	9.7	8.7	5.9	9.2	8.3	5.4	10.0	9.0	6.2
SO_2 Converted to PM_{10} within CO Catalyst	lb/hr	4.62	4.17	2.81	4.41	3.97	2.57	4.77	4.32	2.95
NO_x Catalyst Performance (each turbine)										
Required NO_x Reduction, as NO_2	lb/hr	177.9	163.3	109.7	169.9	155.3	100.4	183.7	169.2	115.4
Required NO_x Reduction (mass basis)	%	**92%**	**92%**	**92%**	**92%**	**92%**	**92%**	**92%**	**92%**	**92%**
PM_{10} Increase from Sulfur Particulates	lb/hr	0.24	0.22	0.15	0.23	0.21	0.13	0.25	0.23	0.15
NH_3 Slip	lb/hr	14.5	13.1	8.8	13.9	12.5	8.1	15.0	13.6	9.3
NH_3 Reacted	lb/hr	69.1	63.5	42.7	66.0	60.4	39.0	71.4	65.8	44.9
Total NH_3 Added	lb/hr	83.6	76.6	51.5	79.9	72.9	47.1	86.4	79.4	54.2
Stack Exhaust Analysis (each turbine)										
N_2	lb/hr	2,874,258	2,874,140	2,055,346	2,745,902	2,745,785	1,905,495	2,971,151	2,971,033	2,149,824
O_2	lb/hr	520,527	553,894	410,152	497,200	530,568	382,929	538,498	571,865	427,726
CO_2	lb/hr	254,309	230,977	155,387	243,012	219,681	142,192	262,584	239,253	163,422
H_2O	lb/hr	230,624	212,005	143,775	244,232	225,613	138,430	224,401	205,782	141,140
Ar	lb/hr	49,348	49,348	35,291	47,145	47,145	32,718	51,012	51,012	36,913
Total	lb/hr	3,929,066	3,920,365	2,799,951	3,777,491	3,768,791	2,601,764	4,047,646	4,038,946	2,919,024
N_2	mass %	73.2%	73.3%	73.4%	72.7%	72.9%	73.2%	73.4%	73.6%	73.6%
O_2	mass %	13.2%	14.1%	14.6%	13.2%	14.1%	14.7%	13.3%	14.2%	14.7%
CO_2	mass %	6.5%	5.9%	5.5%	6.4%	5.8%	5.5%	6.5%	5.9%	5.6%
H_2O	mass %	5.9%	5.4%	5.1%	6.5%	6.0%	5.3%	5.5%	5.1%	4.8%
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	102,586	102,582	73,359	98,005	98,001	68,010	106,044	106,040	76,731
O_2	moles/hr	16,264	17,307	12,816	15,535	16,578	11,965	16,826	17,868	13,365
CO_2	moles/hr	5,792	5,262	3,540	5,535	5,005	3,239	5,981	5,451	3,723
H_2O	moles/hr	12,800	11,766	7,979	13,555	12,521	7,683	12,454	11,421	7,833
Ar	moles/hr	1,235	1,235	883	1,180	1,180	819	1,277	1,277	924
Total	moles/hr	138,677	138,152	98,577	133,810	133,285	91,717	142,582	142,057	102,576
N_2	mole%	74.0%	74.3%	74.4%	73.2%	73.5%	74.2%	74.4%	74.6%	74.8%
O_2	mole%	11.7%	12.5%	13.0%	11.6%	12.4%	13.0%	11.8%	12.6%	13.0%
CO_2	mole%	4.2%	3.8%	3.6%	4.1%	3.8%	3.5%	4.2%	3.8%	3.6%
H_2O	mole%	9.2%	8.5%	8.1%	10.1%	9.4%	8.4%	8.7%	8.0%	7.6%
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		28.33	28.38	28.40	28.23	28.28	28.37	28.39	28.43	28.46
Stack Temperature	deg. F	183	194	173	188	199	172	180	193	173
Stack Flow	cf/hr	65,084,000	66,021,000	45,593,000	63,308,000	64,161,000	42,304,000	66,648,000	67,780,000	47,407,000
Stack Velocity	ft/sec	71.0	72.1	49.8	69.1	70.0	46.2	72.8	74.0	51.7
Calculated Stack Emissions (each turbine)										
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	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
VOC, as CH_4 @ 15% O_2	ppmvd	**2.0**	**1.2**	**2.0**	**2.0**	**1.2**	**2.0**	**2.0**	**1.2**	**2.0**

CALPINE

Table 3.1A-4

Russell City Energy Center
Operating Emissions

Operating Conditions		ISO			July Peak			December		
		Case 1	Case 4	Case 13	Case 14	Case 15	Case 21	Case 22	Case 23	Case 25
		Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%	Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%	Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%
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
NOx, as NO_2	lb/hr	15.7	14.2	9.5	15.0	13.5	8.7	16.2	14.7	10.0
CO	lb/hr	19.1	17.3	11.6	18.2	16.4	10.6	19.7	17.9	12.2
VOC, as CH_4	lb/hr	5.5	3.0	3.3	5.2	2.8	3.0	5.6	3.1	3.5
Total PM_{10} from Sulfur Particulates	lb/hr	10.2	9.2	6.2	9.7	8.8	5.7	10.5	9.6	6.5
Total PM_{10}	lb/hr	28.3	24.4	16.4	27.2	23.2	15.0	29.2	25.3	17.3
NH_3	lb/hr	14.5	13.1	8.8	13.9	12.5	8.1	15.0	13.6	9.3
Maximum SO_2	lb/hr	6.0	5.5	3.7	5.8	5.2	3.4	6.2	5.7	3.9
Annual Average SO_2	lb/hr	1.5	1.4	0.9	1.4	1.3	0.8	1.6	1.4	1.0
Permitted Stack Emissions (each turbine)										
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	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
VOC, as CH_4 @ 15% O_2	ppmvd	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
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	15.66	14.20	9.54	14.97	13.51	8.73	16.17	14.71	10.04
CO	lb/hr	19.07	17.30	11.62	18.23	16.45	10.63	19.69	17.92	12.22
VOC, as CH_4	lb/hr	2.73	2.48	1.66	2.61	2.36	1.52	2.82	2.57	1.75
Total PM_{10}	lb/hr	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
NH_3	lb/hr	14.50	13.14	8.83	13.85	12.50	8.08	14.97	13.62	9.29
Maximum SO_2	lb/hr	6.00	5.50	3.70	5.80	5.20	3.40	6.20	5.70	3.90
Annual Average SO_2	lb/hr	1.50	1.40	0.90	1.40	1.30	0.80	1.60	1.40	1.00
NO_x, as NO_2	lb/MMBtu(HHV)	0.00723	0.00722	0.00721	0.00723	0.00722	0.00721	0.00723	0.00722	0.00721
CO	lb/MMBtu(HHV)	0.00880	0.00879	0.00878	0.00880	0.00879	0.00878	0.00880	0.00879	0.00878
VOC, as CH_4	lb/MMBtu(HHV)	0.00126	0.00126	0.00126	0.00126	0.00126	0.00126	0.00126	0.00126	0.00126
Total PM_{10}	lb/MMBtu(HHV)	0.00415	0.00457	0.00680	0.00434	0.00481	0.00743	0.00402	0.00441	0.00647
Maximum SO_2	lb/MMBtu(HHV)	0.00277	0.00279	0.00280	0.00280	0.00278	0.00281	0.00277	0.00280	0.00280
Annual Maximum SO_2	lb/MMBtu(HHV)	0.00069	0.00071	0.00068	0.00068	0.00069	0.00066	0.00071	0.00069	0.00072
CO_2	lb/MMBtu(HHV)	117.31	117.36	117.42	117.31	117.37	117.43	117.31	117.36	117.41

Calpine Proprietary and Confidential

CALPINE

Table 3.1A-5

Russell City Energy Center
Startup Emissions Summary

Russell City Calculated Values	
Cold Start	
Start Duration, hours	6.0
Maximum Hour (worst-case turbine)	
NO_x, lb/hr	97.2
CO, lb/hr	1,348.8
VOC, lb/hr	14.9
PM_{10}, lb/hr	9.0
SO_2, lb/hr	5.5
Total per Start (worst-case turbine)	
NO_x, lbs	480.0
CO, lbs	5,028.0
VOC, lbs	96.0
PM_{10}, lbs	54.0
SO_2, lbs	33.0
Warm Start	
Start Duration, hours	3.0
Maximum Hour (worst-case turbine)	
NO_x, lb/hr	97.2
CO, lb/hr	1,348.8
VOC, lb/hr	14.9
PM_{10}, lb/hr	9.0
SO_2, lb/hr	5.5
Total per Start (worst-case turbine)	
NO_x, lbs	240.0
CO, lbs	2,514.0
VOC, lbs	48.0
PM_{10}, lbs	27.0
SO_2, lbs	16.5
Hot Start	
Start Duration, hours	3.0
Maximum Hour (worst-case turbine)	
NO_x, lb/hr	83.8
CO, lb/hr	1,154.2
VOC, lb/hr	14.8
PM_{10}, lb/hr	9.0
SO_2, lb/hr	5.5
Total per Start (worst-case combined)	
NO_x, lbs	240.0
CO, lbs	2,514.0
VOC, lbs	48.0
PM_{10}, lbs	27.0
SO_2, lbs	16.5
Shutdown	
Start Duration, hours	0.5
Maximum Hour (worst-case turbine)	
NO_x, lb/hr	28.9
CO, lb/hr	224.2
VOC, lb/hr	6.7
PM_{10}, lb/hr	9.0
SO_2, lb/hr	5.5
Total per Shutdown (worst-case combined)	
NO_x, lbs	80.0
CO, lbs	902.0
VOC, lbs	16.0
PM_{10}, lbs	4.5
SO_2, lbs	2.8

Table 3.1A-6
Calculation of Hazardous and Toxic Pollutant Emissions

# of Units:	2
Fuel HHV:	1023 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	6.86E-02	1.50E-01	3.41E+00	1.17E+03	3.00E-01	6.83E+00	2.33E+03	1.17E+00
Acrolein	6.43E-03	1.41E-02	3.20E-01	1.09E+02	2.82E-02	6.40E-01	2.19E+02	1.09E-01
Ammonia	(3)	1.50E+01	3.60E+02	1.25E+05	3.00E+01	7.20E+02	2.51E+05	1.25E+02
Benzene	1.36E-02	2.98E-02	6.77E-01	2.31E+02	5.95E-02	1.35E+00	4.62E+02	2.31E-01
1,3-Butadiene	1.27E-04	2.78E-04	6.32E-03	2.16E+00	5.56E-04	1.26E-02	4.32E+00	2.16E-03
Ethylbenzene	1.79E-02	3.92E-02	8.91E-01	3.04E+02	7.84E-02	1.78E+00	6.09E+02	3.04E-01
Formaldehyde	1.10E-01	2.41E-01	5.47E+00	1.87E+03	4.82E-01	1.09E+01	3.74E+03	1.87E+00
Hexane	2.59E-01	5.67E-01	1.29E+01	4.40E+03	1.13E+00	2.58E+01	8.81E+03	4.40E+00
Naphthalene	1.66E-03	3.63E-03	8.26E-02	2.82E+01	7.27E-03	1.65E-01	5.64E+01	2.82E-02
Total PAHs	6.60E-04	1.44E-03	3.28E-02	1.12E+01	2.89E-03	6.57E-02	2.24E+01	1.12E-02
Propylene	7.70E-01	1.69E+00	3.83E+01	1.31E+04	3.37E+00	7.66E+01	2.62E+04	1.31E+01
Propylene oxide	4.78E-02	1.05E-01	2.38E+00	8.13E+02	2.09E-01	4.76E+00	1.63E+03	8.13E-01
Toluene	7.10E-02	1.55E-01	3.53E+00	1.21E+03	3.11E-01	7.07E+00	2.41E+03	1.21E+00
Xylene	2.61E-02	5.71E-02	1.30E+00	4.44E+02	1.14E-01	2.60E+00	8.87E+02	4.44E-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
*	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 BAAQMD from Ventura County APCD and CATEF databases.
(2) Based on maximum hourly turbine fuel use of: 2.19E+00 mmscf/hr

Based on a maximum daily turbine fuel use of: 4.98E+01 mmscf/day

Based on maximum annual turbine fuel use of: 1.70E+04 mmscf/yr
Fuel use values from Fuel Calculation Sheet
(3) Values from Table 8.1A.-1
(4) Fuel use values include HRSG duct burner(s) Yes or No: Yes

CALPINE

Russell City Energy Center
Cooling Tower

Table 3.1A-7

Operating Conditions		ISO			July Peak			December		
		Case 1	Case 4	Case 13	Case 14	Case 15	Case 21	Case 22	Case 23	Case 25
		Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%	Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%	Max. w/ Fire	Max. w/o Fire	Min. - 1 CT 60%
Ambient Dry Bulb Temp.	deg. F	59.0	59.0	59.0	88.0	88.0	88.0	38.0	38.0	38.0
Ambient Wet Bulb Temp.	deg. F	51.0	51.0	51.0	68.0	68.0	68.0	36.0	36.0	36.0
Relative Humidity	%	58%	58%	58%	36%	36%	36%	83%	83%	83%
Elevation	ft	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Ambient Pressure	psia	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69
Combustion Turbine Load	%	100%	100%	60%	100%	100%	60%	100%	100%	60%
Combustion Turbines Operating		2	2	1	2	2	1	2	2	1
Evaporative Cooling or Fogging? (Yes/No)		Yes	Yes	Yes	Yes	Yes	No	No	No	No
Duct Firing? (Yes/No)		Yes	No	No	Yes	No	No	Yes	No	No
Steam or Water Injection? (Yes/No)		No	No	No	No	No	No	No	No	No
Cooling Tower Performance (each cooling tower)										
Allowance to WB Temp to Account for Recirculation	deg. F	-	-	-	-	-	-	-	-	-
Cooling Tower Design Wet Bulb Temperature	deg. F	51.0	51.0	51.0	68.0	68.0	68.0	36.0	36.0	36.0
Condenser Circulating Water Flow	gpm	141,352	141,352	141,352	141,352	141,352	141,352	141,352	141,352	141,352
Auxiliary Cooling Water Flow	gpm	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Cooling Tower Circulating Water Flow	gpm	141,352	141,352	141,352	141,352	141,352	141,352	141,352	141,352	141,352
Condenser Inlet Temperature	deg. F	67.9	66.3	69.3	80.3	78.9	76.0	58.8	56.7	68.6
Condenser Outlet Temperature	deg. F	87.5	82.9	76.0	99.7	95.3	82.3	78.9	73.8	75.3
Condenser Heat Rejection	MMBtu/hr	1,389.6	1,173.8	469.2	1,374.1	1,157.2	447.8	1,420.7	1,210.8	472.7
Aux. Cooling Water Heat Exchanger Inlet Temperature	deg. F	67.1	65.5	68.6	79.5	78.2	75.3	58.0	55.9	67.8
Aux. Cooling Water Heat Exchanger Outlet Temperature	deg. F	71.6	70.0	73.1	84.0	82.7	79.8	62.5	60.4	72.3
Aux. Cooling Water Heat Exchanger Heat Rejection	MMBtu/hr	54.6	53.6	49.2	54.3	53.6	51.2	54.7	53.6	52.0
Cooling Tower Outlet Temperature	deg. F	67.1	65.5	68.6	79.5	78.2	75.3	58.0	55.9	67.8
Cooling Tower Inlet Temperature	deg. F	87.5	82.9	76.0	99.7	95.3	82.3	78.9	73.8	75.3
Heat Rejected from CW	MMBtu/hr	1,444.2	1,227.4	518.4	1,428.4	1,210.8	498.9	1,475.4	1,264.4	524.7
Makeup Water Temperature	deg. F	67.1	65.5	68.6	79.5	78.2	75.3	58.0	55.9	67.8
Number of Cells		9	9	9	9	9	9	9	9	9
Number of Fans Operating		9	9	5	9	9	9	9	9	4
Fan Stack Diameter	ft	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00
Leaving Air Flow/Fan	acfm	1,632,000	1,632,000	1,632,000	1,632,000	1,632,000	1,632,000	1,632,000	1,632,000	1,632,000
Total Leaving Air Flow	acfm	14,688,000	14,688,000	8,160,000	14,688,000	14,688,000	14,688,000	14,688,000	14,688,000	6,528,000
Stack Velocity	ft/sec	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8
Wet Bulb Temperature of Leaving Air	deg. F	80.81	77.20	71.96	90.71	87.79	77.03	73.21	69.07	67.52
Enthalpy of Leaving Air	Btu/lb	44.6	40.8	35.8	56.9	53.0	40.6	36.9	33.3	32.0
Moisture Content of Leaving Air	grains/lb dry air	161	142	119	224	203	141	124	107	102
Humidity Ratio of Leaving Air	lb water/lb dry air	0.0230	0.0203	0.0170	0.0319	0.0290	0.0202	0.0177	0.0153	0.0145
Density of Leaving Air	lbs/cf	0.0724	0.0730	0.0738	0.0707	0.0712	0.0730	0.0736	0.0743	0.0746
Total Dry Air Flow	lb/min	1,039,210	1,050,504	592,456	1,006,497	1,016,405	1,051,024	1,062,695	1,075,007	479,797
L/G Ratio		0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Enthalpy of Entering Air	Btu/lb	20.8	20.8	20.8	32.3	32.3	32.3	13.4	13.4	13.4
Moisture Content of Entering Air	grains/lb dry air	43	43	43	71	71	71	28	28	28
Humidity Ratio of Entering Air	lb water/lb dry air	0.0061	0.0061	0.0061	0.0101	0.0101	0.0101	0.0040	0.0040	0.0040
Heat Removed by Air	MMBtu/hr	1,444	1,227	518	1,428	1,211	499	1,475	1,264	525
Qair/Qcw		100%	100%	100%	100%	100%	100%	100%	100%	100%
Evaporation	gpm	1,090,097	928,490	399,754	1,368,711	1,196,586	659,666	907,601	758,747	314,322
Drift, percent of circulating water flow	%	0.0005%	0.0005%	0.0005%	0.0005%	0.0005%	0.0005%	0.0005%	0.0005%	0.0005%
Drift	gpm	0.71	0.71	0.39	0.71	0.71	0.71	0.71	0.71	0.31
Drift	lb/hr	0.68	0.68	0.38	0.68	0.68	0.68	0.68	0.68	0.30
Circulating Water TDS	mg/l	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
% PM_{10} Emissions	% of total	100%	100%	100%	100%	100%	100%	100%	100%	100%
PM_{10} Emissions	lbs/hr	2.83	2.83	1.57	2.83	2.83	2.83	2.83	2.83	1.26

Notes:
1. Performance shown is without plume abatement section in operation.

Table 3.1A-8

Expected Cooling Tower Particulate Matter Emissions

Project:	Calpine-RCEC		Tower Dimensions (optional)		
Mfg:	unk		Deck Height:	0	Ft. AGL
# Cells:	9		Length:	0	Ft.
acfm/Cell:	1632000		Width:	0	Ft.
Drift Loss:	0.0005	%	Fan Exit Height:	60	Ft. AGL
Drift Frac:	0.000005		Exhaust Fan Diam:	32	Ft.

GPM: 141352 water circulation rate thru tower
Lb/hr: 70647730 water circulation rate thru tower

Operation Hours: 24 hrs/day 8575 hrs/year

Scenario: Estimated TDS in circulating water

TDS (mg/l) * :	8000
Cycles of Concentration:	unk
Drift Loss (lb water/hr):	353.2
Circulating Water Rate (gpm):	141352

Total PM Emissions:	**lbs/hr:**	**2.83**	assumed to be PM10
	lbs/day:	**67.92**	
	tons/yr:	**12.12**	

Table 3.1A-9
Calculation of Hazardous and Toxic Pollutant Emissions from Cooling Towers

						Op Hrs/Day:	24
Total Cells:	9		Max Drift Rate:	353.2	lbs/hr	Op Hrs/Yr:	8760

Constituent	Concentration in Cooling Tower Water		Emissions, lb/hr	Total All Cells Emissions, lb/day	Emissions, ton/yr	Single Cell Emissions, lb/hr	Emissions, lb/day
Ammonia	60	ppm	2.12E-02	5.09E-01	9.28E-02	2.35E-03	5.65E-02
Arsenic	0.05	ppm	1.77E-05	4.24E-04	7.74E-05	1.96E-06	4.71E-05
Cadmium	0.08	ppm	2.83E-05	6.78E-04	1.24E-04	3.14E-06	7.53E-05
Chromium (III)	0.41	ppm	1.45E-04	3.48E-03	6.34E-04	1.61E-05	3.86E-04
Copper	0.61	ppm	2.15E-04	5.17E-03	9.44E-04	2.39E-05	5.75E-04
Lead	0.19	ppm	6.71E-05	1.61E-03	2.94E-04	7.46E-06	1.79E-04
Mercury	0.0006	ppm	2.12E-07	5.09E-06	9.28E-07	2.35E-08	5.65E-07
Nickel	0.47	ppm	1.66E-04	3.98E-03	7.27E-04	1.84E-05	4.43E-04
Silver	0.06	ppm	2.12E-05	5.09E-04	9.28E-05	2.35E-06	5.65E-05
Zinc	1.92	ppm	6.78E-04	1.63E-02	2.97E-03	7.53E-05	1.81E-03
PAHs	0	ppm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Boron	9	ppm	3.18E-03	7.63E-02	1.39E-02	3.53E-04	8.48E-03
Cyanide	0.26	ppm	9.18E-05	2.20E-03	4.02E-04	1.02E-05	2.45E-04
Fluoride	24	ppm	8.48E-03	2.03E-01	3.71E-02	9.42E-04	2.26E-02
Manganese	0.84	ppm	2.97E-04	7.12E-03	1.30E-03	3.30E-05	7.91E-04
Selenium	0.07	ppm	2.47E-05	5.93E-04	1.08E-04	2.75E-06	6.59E-05
Strontium	1	ppm	3.53E-04	8.48E-03	1.55E-03	3.92E-05	9.42E-04
Potassium	176	ppm	6.22E-02	1.49E+00	2.72E-01	6.91E-03	1.66E-01
Iron	7.7	ppm	2.72E-03	6.53E-02	1.19E-02	3.02E-04	7.25E-03
Bromide	30	ppm	1.06E-02	2.54E-01	4.64E-02	1.18E-03	2.83E-02
Aluminum	1.5	ppm	5.30E-04	1.27E-02	2.32E-03	5.89E-05	1.41E-03
*	0	ppm	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	ppm	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	ppm	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	ppm	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	ppm	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	ppm	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 3.1A-10 EXPECTED INTERNAL COMBUSTION ENGINE EMISSIONS
Emergency Fire Pump Set - Liquid Fuel

Mfg:	Clarke		Stack Data (per stack)		
Model:	JW6H-UF40		Height:	15	Ft.
Capacity:	2500	Gpm	Diameter:	0.5	Ft.
BHP:	300	(useable HP)	Temp:	738	deg F
RPM:	2350		ACFM:	2058	at stack temp
Fuel:	#2 Diesel		O2:	unk	%
Fuel Use:	14.5	Gph	H2O:	unk	%
FuelHHV:	139350	Btu/gal	DSCFM:	unk	at STP
mmbtu/hr:	2.02	HHV	Area:	0.197	Sq.Ft.
# of Cyl:	6		Velocity:	10437	Ft/Min
Engine Design:		CI	Max Daily Op Hrs:		1
# of Exhaust Stacks:		1	Max Annual Op Hrs:		52
Fuel Wt:	6.87	Lbs/gal			
Fuel S:	0.0015	% wt.			
Fuel S:	0.10305	Lbs/1000 gal			
SO2:	0.2061	Lbs/1000 gal			

Efs (g/bhp/hr) (1)		Lb/Hr	Lb/Day	Tons/Yr
NOx	4.27	2.82	2.82	0.0734
CO	0.33	0.22	0.22	0.0057
VOC	0.32	0.21	0.21	0.0055
PM10	0.12	0.08	0.08	0.0021
SOx	0.005	0.00	0.00	0.0001
SOx (fuel S Calc)		0.00	0.00	0.0001

Efs(lb/mmbtu)		Lb/Hr	Lb/Day	Tons/Yr
NOx	0	0	0	0
CO	0	0	0	0
VOC	0	0	0	0
PM10	0	0	0	0

(1) EFs differ from Calpine sheet. Values used represent the latest values for this engine model.

Table 3.1A-11
Liquid Fuel IC Engine Air Toxics Emissions Calculations

Engine Service:		Fire Pump		
Fuel Type:	Diesel		Max Hrs/Day:	1
Gal/Hr:	14.5		Max Hrs/Yr:	52
Mgal/Hr:	0.0145			
Mgal/Yr:	0.754			

Substance	EF lbs/Mgal	lbs/hr	lbs/yr	tons/yr
Acenaphtene	6.71E-04	9.73E-06	5.06E-04	2.53E-07
Acenapthylene	1.02E-03	1.48E-05	7.69E-04	3.85E-07
Anthracene	2.23E-04	3.23E-06	1.68E-04	8.41E-08
Benzo-a-anthracene	9.60E-05	1.39E-06	7.24E-05	3.62E-08
BaP	7.90E-05	1.15E-06	5.96E-05	2.98E-08
Benzo-a-fluoranthene	1.12E-04	1.62E-06	8.44E-05	4.22E-08
Benzo-ghi-perylene	9.00E-05	1.31E-06	6.79E-05	3.39E-08
Benzo-k-fluoranthene	7.83E-05	1.14E-06	5.90E-05	2.95E-08
Chrysene	1.30E-04	1.89E-06	9.80E-05	4.90E-08
Dibenz-ah-anthracene	8.20E-05	1.19E-06	6.18E-05	3.09E-08
Fluoranthene	3.30E-04	4.79E-06	2.49E-04	1.24E-07
Fluorene	9.65E-04	1.40E-05	7.28E-04	3.64E-07
Indeno-123cd-pyrene	8.45E-05	1.23E-06	6.37E-05	3.19E-08
Naphthalene	1.60E-02	2.32E-04	1.21E-02	6.03E-06
Phenanthrene	3.54E-03	5.13E-05	2.67E-03	1.33E-06
Pyrene	2.64E-04	3.83E-06	1.99E-04	9.95E-08
Ethylbenzene	6.76E-03	9.80E-05	5.10E-03	2.55E-06
13 Butadiene	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Acetaldehyde	3.47E-03	5.03E-05	2.62E-03	1.31E-06
Acrolein	1.07E-03	1.55E-05	8.07E-04	4.03E-07
Benzene	1.81E-01	2.62E-03	1.36E-01	6.82E-05
Formaldehyde	5.10E-02	7.40E-04	3.85E-02	1.92E-05
Propylene	3.41E-01	4.94E-03	2.57E-01	1.29E-04
Toluene	6.10E-02	8.85E-04	4.60E-02	2.30E-05
Xylenes	2.10E-02	3.05E-04	1.58E-02	7.92E-06
Hexane	1.39E-03	2.02E-05	1.05E-03	5.24E-07
Arsenic	1.60E-03	2.32E-05	1.21E-03	6.03E-07
Beryllium	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cadmium	1.50E-03	2.18E-05	1.13E-03	5.66E-07
Hex Chromium	1.00E-04	1.45E-06	7.54E-05	3.77E-08
Copper	4.10E-03	5.95E-05	3.09E-03	1.55E-06
Lead	8.30E-03	1.20E-04	6.26E-03	3.13E-06
Manganese	3.10E-03	4.50E-05	2.34E-03	1.17E-06
Mercury	2.00E-03	2.90E-05	1.51E-03	7.54E-07
Nickel	3.90E-03	5.66E-05	2.94E-03	1.47E-06
Selenium	2.20E-03	3.19E-05	1.66E-03	8.29E-07
Zinc	2.24E-02	3.25E-04	1.69E-02	8.44E-06
Diesel PM	see IC Engine calc sheet for PM10 emissions			

EFs: CARB-CATEF Database (mean values for source type and category)
Metals EFs from VCAPCD, 1/8/96

JW6H-UF40 (JDFP-06WR)

FIRE PUMP DRIVER

EMISSION DATA

To complete an application for a Permit to Operate, the following data is provided.

6 *Cylinders*
Four *Cycle*
Lean *Burn*
Turbocharged & Aftercooled
Diesel Oil - *Fuel*
No - *Energy Recovery from Exhaust*
No - *Emission Control Device*

RPM	BHP	FUEL GAL/HR (L/HR)	AIR/FUEL RATIO	GRAMS / HP / HR HC**	NOx	CO	SO_2	PART.***	% O_2	EXHAUST °F (°C)	CFM (m^3/min)	TIMING RETARD*
1470	240	13.0 (49.2)	22.79	0.10	5.6	0.24	0.17	0.07	7.6	1030 (554)	1276 (36)	9.7
1760	290	13.5 (51.1)	29.35	0.08	5.7	0.25	0.14	0.07	10.8	855 (457)	1506 (43)	9.7
2100	300	14.2 (53.8)	34.47	0.15	5.2	0.27	0.14	0.09	12.3	770 (410)	1740 (49)	9.7
2350	300	14.5 (54.9)	40.97	0.15	5.2	0.27	0.15	0.09	13.6	738 (392)	2058 (58)	9.7

For specific RPM & BHP ratings, some of the above data may have been extrapolated from the best available test data.

Sulfur Dioxide based on 0.05% sulfur content in fuel (by weight).

**Degrees of Timing RETARD for "Beginning of Injection" based on comparison with pre-emission controlled engines.*

***HC is a measure of total hydrocarbons, including Non Methane Hydrocarbons (NMHC).*

****Part. is a measure of total particulates, including PM_{10}.*

6081H Base Model Engine Manufactured by John Deere Co.

CLARKE

FIRE PROTECTION PRODUCTS
3133 EAST KEMPER ROAD
CINCINNATI, OH 45241

C13429 REV.B AUG01 KJK

JW6H-UF40 (JDFP-06WR)
INSTALLATION & OPERATION DATA

Basic Engine Description

Engine Manufacturer	John Deere Co
Ignition Type	Compression (Diesel)
Number of Cylinders	6
Bore and Stroke - in.(mm)	4.56 (116) x 5.06 (129)
Displacement - in.^{3} (L)	496 (8.1)
Compression Ratio	16.5:1
Valves per cylinder - Intake	1
Exhaust	1
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-495

Cooling System

	1470	1760	2100	2350
Engine H_2O Heat -Btu/sec (kW)	147 (155)	154 (162)	162 (171)	156 (164)
Engine Radiated Heat - Btu/sec.(kW)	26 (27)	30 (32)	32 (34)	32 (34)
Heat Exchanger Minimium Flow				
60°F (15°C) Raw H_2O - gal/min. (L/min.)	12 (45)	15 (57)	17 (64)	21 (79)
95°F (35°C) Raw H_2O - gal/min. (L/min.)	19 (72)	23 (87)	29 (110)	31 (117)

Heat Exchanger Maximum Cooling H_2O	
Inlet Pressure - lb./in.^{2} (kPa)	60 (414)
Flow - gal./min (L/min.)	80 (302)
Thermostat, Start to Open - °F (°C)	180 (82)
Fully Opened - °F (°C)	202 (94)
Engine Coolant Capacity - qt. (L)	23 (22)
Coolant Pressure Cap - lb./in.^{2}(kPa)	10 (69)
Maximum Engine H_20 Temperature - °F (°C)	200 (93)
Minimum Engine H_20 Temperature - °F (°C)	160 (71)

Electric System - DC

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

**Positive and Negative Cables Combined Length*

NOTE: This engine is Intendend For Indoor Installation Or In A Weatherproof Enclosure.

(Continued)

JW6H-UF40 (JDFP-06WR)
INSTALLATION & OPERATION DATA (Continued)

Exhaust System	1470	1760	2100	2350
Exhaust Flow - ft.^{3}/min. (m^3/min.)	1276 (36)	1506 (43)	1740 (49)	2058 (58)
Exhaust Temperature - °F (°C)	1030 (540)	855 (443)	770 (396)	738 (392)
Maximum Allowable Back Pressure - in. H_2O (kPa)	19 (4.7)	26 (6.6)	28 (7.1)	30 (7.5)
Minimum Exhaust Pipe Dia. - in. (mm)**	5.0 (127)	5.0 (127)	5.0 (127)	5.0 (127)

Fuel System				
Fuel Consumption - gal./hr. (L/hr.)	13 (49)	13.5 (51)	14 (53)	14.5 (55)
Fuel Return - gal./hr. (L/hr).	63 (238)	62.5 (237)	62 (235)	61.5 (233)
Total Supply Fuel Flow - gal./hr (L/hr.)	76 (288)	76 (288)	76 (288)	76 (288)
Fuel Pressure - lb./in.^{2} (kPa)	25-35 (172-241)			
Minimum Line Size - Supply - in. (mm)**	.50 Sch. 40 - Black			
Minimum Line Size - Return - in. (mm)**	.37 Sch. 40 - Black			
Maximum Allowable Fuel Pump Suction				
With Clean Filter - in. H_20 (mH_20)	31 (0.8)			
Maximum Allowable Fuel Head above Fuel pump, Supply or Retrun - ft(m)..	9 (2.7)			
Fuel Filter Micron Size	8			

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)	13 (3.2)	14 (3.5)	15 (3.7)	16 (4.0)
Clean Air Cleaner - in. H_20 (kPa)	3 (0.7)	4 (1.0)	6 (1.5)	7 (1.7)
Engine Air Flow - ft.^{3}/min. (m^3/min.)	460 (13)	615 (17)	760 (22)	923 (26)
Maximum Allowable Temperature (Air To Engine Inlet) - °F (°C)***	130 (54)			

Lubrication System	
Oil Pressure - normal - lb./in.^{2} (kPa)	30-55 (207-379)
In Pan Oil Temperature - °F (°C)	190-220 (88-104)
Oil Pan Capacity - High - qt. (L)	32 (30)
Total Oil Capacity with Filter - qt. (L)	34 (32)

Performance				
BMEP - lb./in.^{2} (kPa)	261 (1800)	263 (1813)	228 (1572)	204 (1406)
Piston Speed - ft./min. (m/min.)	1240 (378)	1484 (452)	1771 (540)	1982 (604)
Sound Pressure Level - dB(A) @ 1m				
Power Curve	CDDA - W064 - 02			

*** 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 Doration If Air Entering Engine Exceeds °77F (25°C)*

C13427 R C
KJK JUL01

NOTE: This engine is Intendend For Indoor Installation Or In A Weatherproof Enclosure.

(Continued)

CALPINE

Russell City Energy Center

Fuel Gas Analysis

Table 3.1A-12

		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 N_2	O_2	CO_2	Ar	Dry Air	Lb/lb Fuel Exhaust Products N_2	CO_2	SO_2	H_2O	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										N_2	O_2	CO_2	Ar	Dry Air	N_2	CO_2	SO_2	H_2O	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

CALPINE

Table 3.1A-13

Russell City Energy Center
Fuel Oil Analysis

		Fuel Gas Composition (mass %)	Molecular Weight	Lb/lb Fuel									
				Required for Combustion					Exhaust Products				
				N_2	O_2	CO_2	Ar	Dry Air	N_2	CO_2	SO_2	H_2O	Ar
Carbon	C	86.820%	12.011	7.53	2.31	0.00	0.13	9.98	7.53	3.19	0.00	0.00	0.13
Hydrogen	H_2	13.115%	2.016	3.39	1.04	0.00	0.06	4.49	3.39	0.00	0.00	1.17	0.06
Oxygen	O_2	0.000%	31.999	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitrogen	N_2	0.015%	28.013	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sulfur	S	0.050%	32.060	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ash		0.000%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		100.0%		10.92	3.35	0.01	0.19	14.47	10.92	3.19	0.00	1.17	0.19
H/C Ratio		1.8											
Density	lb/gal	7.092											
Fuel Heating Value (HHV)	Btu/lb	19,649											
Fuel Heating Value (LHV)	Btu/lb	18,450											

CALPINE

Table 3.1A-14

Russell City Energy Center

Assumed Ambient Air Analysis

Ambient Air				
	Mole % (dry)	Mole % x Molecular Weight	Mass % (dry)	Molecular Weight
N_2	78.04%	21.862	75.47%	28.013
O_2	20.99%	6.717	23.19%	31.999
CO_2	0.03%	0.013	0.05%	44.010
Ar	0.94%	0.376	1.30%	39.948
Total	100.00%		100.00%	28.967

Table 3.1A-15 FUEL USE CALCULATIONS
Russell City Energy Center
Turbines and HRSG Duct Burners

Fuel Type: Natural Gas
Btu/scf: 1023 HHV

Heat Input Ratings				Equivalent mmscf/hr	
	Turbine:	2039	mmbtu/hr	1.993	
	HRSG:	200	mmbtu/hr	0.196	
				2.189	Subtotal
Operating Hours		hrs/day	hrs/yr		
	Turbine:	24	8364	(includes startup/shutdown hours)	
	HRSG:	10	4000		
Fuel Use		mmscf/day	mmscf/yr		
	Turbine:	4.78E+01	1.67E+04		
	HRSG:	1.96E+00	7.82E+02		
		4.98E+01	1.75E+04	Subtotals	

Number of Units: 2

Total	mmscf/hr	mmscf/day	mmscf/yr
Fuel Use	4.38E+00	9.96E+01	3.49E+04

Annual fuel use for the turbines/HRSGs will meet the previous facility limit of 33899.4213 mmscf/yr.

CALPINE

Table 3.1A-16

Russell City Energy Center
Short-Term Emissions

Maximum Hour Excluding Startups		Notes
Combustion Turbines/HRSGs (each unit)		
NO_x, lbs as NO_2	16.17	Cold day with duct firing
CO, lbs	19.69	Cold day with duct firing
SO_2, lbs	6.20	Cold day with duct firing, maximum S content
Fire Pump		
NO_x, lbs as NO_2	2.82	Full load test
CO, lbs	0.22	Full load test
SO_2, lbs	0.00	Full load test
Total		
NO_x, lbs as NO_2	35.17	Two CTGs, HRSG duct firing, & fire pump
CO, lbs	39.61	Two CTGs, HRSG duct firing, & fire pump
SO_2, lbs	12.40	Two CTGs, HRSG duct firing, & fire pump, max S
Maximum Hour Including Startups		**Notes**
Combustion Turbines/HRSGs (each unit)		
NO_x, lbs as NO_2	97.19	Cold start
CO, lbs	1,348.78	Cold start
SO_2, lbs	6.20	Cold day with duct firing, maximum S content
Fire Pump		
NO_x, lbs as NO_2	-	Fire pump will not be tested during CTG startups
CO, lbs	-	Fire pump will not be tested during CTG startups
SO_2, lbs	0.00	Full load test
Total		
NO_x, lbs as NO_2	194.39	Two CTGs in startup
CO, lbs	2,697.56	Two CTGs in startup
SO_2, lbs	12.40	Two CTGs, HRSG duct firing, & fire pump, max S
Maximum 3-Hours Including Startups		**Notes**
Combustion Turbines/HRSGs (each unit)		
SO_2, lbs	18.60	Cold day with duct firing, maximum S content
Fire Pump		
SO_2, lbs	0.00	Full load test (test limited to 1 hour)
Total		
SO_2, lbs	37.20	Two CTGs, HRSG duct firing, & fire pump, max S
Maximum 8-Hours Including Startups		**Notes**
Combustion Turbines/HRSGs (each unit)		
CO, lbs	5,067.39	Cold start (at MEC permit limit) with remaining hrs at cold day with duct firing
Fire Pump		
CO, lbs	0.22	Full load test (test limited to 1 hour)
Total		
CO, lbs	10,135.00	Two CTGs cold start w/ remaining hrs at cold day with duct firing, & fire pump
Maximum 24-Hours Including Startups		**Notes**
Combustion Turbines/HRSGs (each unit)		
PM_{10}, lbs	216.00	Cold day with duct firing
SO_2, lbs	148.80	Cold day with duct firing, maximum S content
Cooling Tower		
PM_{10}, lbs	67.82	
Fire Pump		
PM_{10}, lbs	0.08	Full load test (test limited to 1 hour)
SO_2, lbs	0.00	Full load test (test limited to 1 hour)
Total		
PM_{10}, lbs	499.90	Two CTGs, HRSG duct firing, cooling tower & fire pump
SO_2, lbs	297.60	Two CTGs, HRSG duct firing, & fire pump, max S