APPENDIX A

DETAILED EMISSIONS CALCULATIONS

Potrero Power Plan t 7 Project
Turbine/HRSG Stack Emission Calculations - Rev. 1

Ambient Temperature	35°F			55°F			80°F				
CTG Load Level	100%	75%	50%	100%	75%	50%	100%	75%	50%	100%	100%
Over pressure	No	No	No	No	No	No	No	No	No	Yes	Yes
Power Augmentation	No	No	No	No	No	No	No	No	No	Yes	Yes
Duct Burner Heat Input (MMBTU/hr)										355.6	391.1[a]
Stack Outlet Temperature (°F)	194	186	177	192	184	175	191	182	174	176	178
Average Emission Rates from each Gas Turbine (lbs/hr/turbine) - Normal Operation											
(Reference: GE Turbine/Site Specific Information)											
Fuel Flow (MMBTU/hr)	1858	1502	1200	1793	1455	1167	1745	1420	1139	2059.5	2225.5
Oxygen	521873.93	424757.01	357310.32	497689.43	410862.14	348178.86	482923.2	407802.23	344825.33	408696.46	402852.7
CO_2	220308.62	176785.75	139937.33	212642.73	171014.8	135719.25	207100.51	166835.56	132522.16	258123.89	262197.94
H_2O	183061.64	146725.44	116360.93	192960.1	155426.98	124160.74	204618.06	156940.6	125444.27	364883.68	368151.38
N_2	2727457.18	2206708.6	1815624.57	2612518.03	2135777.56	1767434.81	2538099.63	2106329.34	1740758.87	2539067	2539100.5
Ar	46298.62	37023.19	30766.85	45189.72	36918.52	30506.33	43258.59	36092.28	29449.37	43547.857	43547.851
NO_x	16.99	13.61	10.78	16.4	13.19	10.48	15.96	12.87	10.22	19.96	20.27
CO	24.83	19.89	15.75	23.96	19.27	15.31	23.32	18.8	14.92	29.16	29.62
Hydrocarbon as CH_4	15	12	10	14	11	9	14	11	9	44.8704	47.8524
VOC	4.73	3.79	3	4.56	3.67	2.92	4.44	3.58	2.84	5.55	5.64
SO_2	2.58	2.08	1.66	2.49	2.02	1.62	2.42	1.97	1.58	2.86	3.09
PM	11	11	11	11	11	11	11	11	11	13	13
NH_3 (@10 ppm slip)	25.12	20.12	15.94	24.24	19.5	15.48	23.6	19.02	15.1	29.5	29.98
% of HC as VOC	31.5	31.6	30.0	32.6	33.4	32.4	31.7	32.5	31.6	12.4	11.8
Total Inerts	3698999.99	2991999.99	2460000	3561000.01	2910000	2405999.99	3475999.99	2874000.01	2373000	3614318.887	3615850.371
Total	3699100.237	2992082.483	2460068.134	3561096.657	2910079.648	2406065.799	3476094.73	2874078.249	2373064.66	361[illegible]463.784	3615999.82
Total Inerts (lbmol/hr/turbine)	130052.316	105179.529	86423.74337	125539.5479	102561.7071	84748.26671	122893.7299	101382.814	83662.97884	130679.1927	130771.9024
Total Inerts(1atm;outlet T) (cfm)	1034634.972	826518.5144	669666.3884	995677.8815	803450.8753	654620.9518	973197.7819	791747.971	645219.6853	1014176.255	1014895.757
sulfur content in gas:	0.5	gr total S / 100 scf									

(a) Maximum Capability of Duct Burner

Rev.1 Reduced total hours of plant operation and hours of duct burner operation.
All Rev. 1 changes shown in shaded cells.

07/11/2003

Potrero Power Plan .t 7 Project
Turbine/HRSG Stack Emission Calculations - Rev. 1

Startup / Shutdown Emissions from Turbine (1CT)

Cold Startup			Warm Startup			Hot Startup			Shutdown		
256 minutes	Max 1-hr.	Total	130 min.	Max 1-hr.	Total	90 min.	Max 1-hr.	Total	23 min.	Max 1-hr.	Total
	lb/hr	lb/256 min		lb/hr	lb/130 min		lb/hr	lb/90 min		lb/hr	lb/23 min
NO_X	170.19	452.07	NOx	162.49	249.31	NOx	163.79	188.90	NOx	71.63	58.80
CO	547.94	990.26	CO	446.46	572.26	CO	268.01	290.78	CO	91.12	72.86
UHC		334.70	UHC		153.84	UHC		80.38	UHC		17.39
VOC		111.79	VOC		51.38	VOC		26.85	VOC		5.81
SO_2	1.62	6.91	SO2	1.62	3.51	SO2	1.62	2.43	SO2	1.6	0.62
PM	11.00	46.93	PM	11.00	23.83	PM	11.00	16.50	PM	11.00	4.22

Assumptions:

Startup and Shutdown Emissions for CO, NO_2, and UHC integrated from data provided by Southern Energy California. "GT1+GT2" data is conservatively used as emission rate data from ONE turbine.

VOC Emissions are assumed to be 33.4% of UHC emissions. This fraction is the maximum fraction seen in the operating conditions.

SO_2 emissions assume complete conversion of all sulfur to SO_2.

SO_2 and PM_{10} startup and shutdown cases for annual emission rates are based on the average temperature, low load operating emission rate (60°F/50%).

SO_2 and PM_{10} emission rates for 1, 3, or 24-hour averages area based upon operating conditions at given load and temperature.

Average Annual Emissions

Duct Burner Emission Rates are based on the maximum duct burner capability scenario (80°F; 100% load; overpressure; power augmentation; duct burner duty = 391.1 MMBTU/hr)

Average Operation Emission Rates are based on the average operation scenario (55°F; 100% load; no overpressure; no power augmentation)

Total Hours of Operation	7446
Total Number of Cold Starts	14.0
Cold Start Duration (hr)	4.27
Total Number of Warm Starts	0
Warm Start Duration (hr)	2.17
Total Number of Hot Starts	5.5
Hot Start Duration (hr)	1.50
Total Number of Shutdowns	19.5
Shutdown Duration (hr)	0.38
Duct Burner Operation (hr)	2200
Average Operation (hr)	5170.54

	Turbine Emissions	Emissions for Both Turbines
	lb/yr/CT	ton/yr/2CT
NO_X	137905.41	137.9
CO	205933.88	205.9
VOC	37811.65	37.8
SO_2	19771.07	19.8
PM	86306.00	86.3

Rev.1 Reduced total hours of plant operation and hours of duct burner operation.
All Rev. 1 changes shown in shaded cells.

07/11/2003

Potrero Power Plant 7 Project
Turbine/HRSG Stack Emission Calculations - Rev. 1

Worst-Case 1-Hour Emissions per Turbine

Worst-Case 1-Hour Emissions for NO_2 and CO are equal to Cold Startup emission rates. Worst-Case 1-Hour emission rates for SO_2 are equal to operating emission rates.

Ambient Temperature	35°F			55°F			80°F				
CTG Load Level	100%	75%	50%	100%	75%	50%	100%	75%	50%	100%	100%
(lb/hr/turbine)											
NO_2	170.19	170.19	170.19	170.19	170.19	170.19	170.19	170.19	170.19	170.19	170.19
CO	547.94	547.94	547.94	547.94	547.94	547.94	547.94	547.94	547.94	547.94	547.94
SO_2	2.58	2.08	1.66	2.49	2.02	1.62	2.42	1.97	1.58	2.86	3.09
(g/sec/turbine)											
NO_2	21.44	21.44	21.44	21.44	21.44	21.44	21.44	21.44	21.44	21.44	21.44
CO	69.04	69.04	69.04	69.04	69.04	69.04	69.04	69.04	69.04	69.04	69.04
SO_2	0.32	0.26	0.21	0.31	0.25	0.20	0.30	0.25	0.20	0.36	0.39

Worst-Case 3 Hour Emission Rate per Turbine

Only SO_2 is considered for an average 3-hour Ambient Air Quality Standard. Emission rates are equal to the operating emission rates.

Ambient Temperature	35°F			55°F			80°F				
CTG Load Level	100%	75%	50%	100%	75%	50%	100%	75%	50%	100%	100%
SO_2 (lb/hr/CT)	2.58	2.08	1.66	2.49	2.02	1.62	2.42	1.97	1.58	2.86	3.09
SO_2 (g/sec/CT)	0.32	0.26	0.21	0.31	0.25	0.20	0.30	0.25	0.20	0.36	0.39

Worst-Case 8-Hour Emission Rates

Only CO is considered for an average 8-hour Ambient Air Quality Standard.
Worst-case 8-Hour Scenario includes one Cold Startup and one Shutdown. Remainder of 8 hours is at normal operating emission rates.

Total Hours of Operation	8
Cold Startup Duration (hours)	4.27
Shutdown (hours)	0.38
Hours of Baseline Operation (hr)	3.35

Ambient Temperature	35°F			55°F			80°F				
CTG Load Level	100%	75%	50%	100%	75%	50%	100%	75%	50%	100%	100%
CO (lb/hr/CT)	143.29	141.22	139.49	142.92	140.96	139.30	142.66	140.76	139.14	145.10	145.29
CO (g/s/CT)	18.05	17.79	17.57	18.01	17.76	17.55	17.97	17.74	17.53	18.28	18.31

Worst-Case 24 Hour Emission Rate

Only SO_2 and PM_{10} are considered for an average 24-hour Ambient Air Quality Standard.
Startup and Shutdown emission rates for SO2 and PM10 are considered to be equal to operating emission rates.
Therefore, including Startup and Shutdown scenarios does not increase the 24-hour average emission rate.
Normal operating load is conservatively assumed for the entirety of the 24 hours.

Ambient Temperature	35°F			55°F			80°F				
CTG Load Level	100%	75%	50%	100%	75%	50%	100%	75%	50%	100%	100%
SO_2 (lb/hr/CT)	2.58	2.08	1.66	2.49	2.02	1.62	2.42	1.97	1.58	2.86	3.09
SO_2 (g/s/CT)	0.32	0.26	0.21	0.31	0.25	0.20	0.30	0.25	0.20	0.36	0.39
PM (lb/hr/CT)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	13.00	13.00
PM (g/s/CT)	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.64	1.64

Rev.1 Reduced total hours of plant operation and hours of duct burner operation.
All Rev. 1 changes shown in shaded cells.

07/11/2003

Cooling Tower Emission Rates
Potrero Unit 7 Project

PM10 Emissions from Cooling Tower			
Water Rate	140000	gpm	
Drift Rate	0.0005	%	
Number of Cells	14		
Maximum TDS+TSS	7015	ppmw	
	Emission Rate		
	lb/hr/cell	g/s/cell	tons/yr
PM_{10}[a]	0.176	2.2E-02	9.16
PM_{10}[b]	0.149	1.9E-02	9.16

a: Maximum Emission Rate.

b: Assumes annualized usage of 7446 hrs/year.

Cooling Tower and Odor Control System Emission Rates
Potrero Unit 7 Project

HAP Emissions from Cooling Tower				
Water Rate	140000	gpm		
Drift Rate	0.0005	%		
Number of Cells	14			
			Emission Rate	
Maximum Conc.[1]			lb/hr	g/s/cell
Chrome	6.5	ug/l	2.28E-06	2.05E-08
Copper	72.5	ug/l	2.54E-05	2.29E-07
Lead	0.0935	ug/l	3.28E-08	2.95E-10
Mercury	19.5	ug/l	6.84E-06	6.16E-08
Nickel	12.5	ug/l	4.38E-06	3.95E-08
Selenium	2.5	ug/l	8.77E-07	7.90E-09
Zinc	312	ug/l	1.09E-04	9.86E-07

1: See "Representative Water Analysis" page following.

HAP Emissions from Odor Control System						
Water Treated	4.7	million gal/day				
		Uncontrolled[1]		Controlled[2]		
Emissions[3]	lb/yr/mgd	lb/year	lb/day	lb/year	lb/day	gm/sec
Total VOC	190	893.00	2.45	446.50	1.22	6.43E-03
Benzene	1.7	7.99	0.02	4.00	0.01	5.75E-05
Ethyl Benzene	1.2	5.64	0.02	2.82	0.01	4.06E-05
Toluene	7.3	34.31	0.09	17.16	0.05	2.47E-04
Xylenes	7	32.90	0.09	16.45	0.05	2.37E-04
1,1,1 TCA	6.5	30.55	0.08	15.28	0.04	2.20E-04
Chloroform	4.7	22.09	0.06	11.05	0.03	1.59E-04
Methylene Chloride	4.3	20.21	0.06	10.11	0.03	1.45E-04
Tetrachloroethylene	8.5	39.95	0.11	19.98	0.05	2.88E-04
Acetone	3.20E-02	1.50E-01	4.12E-04	7.52E-02	2.06E-04	1.08E-06
MEK	6.40E-03	3.01E-02	8.24E-05	1.50E-02	4.12E-05	2.17E-07
MIBK	5.80E-03	2.73E-02	7.47E-05	1.36E-02	3.73E-05	1.96E-07

1: Assumes annualized usage of 8760 hours per year.
2: Control efficiency 50 percent
3: See "Conservative Screening Emission Factors" second page following.

Location: _____
Date: _____

REPRESENTATIVE WATER ANALYSIS

1. Makeup water to cooling tower (Recycled Water).
2. Estimated cooling tower water characteristics (5 concentration cycles).

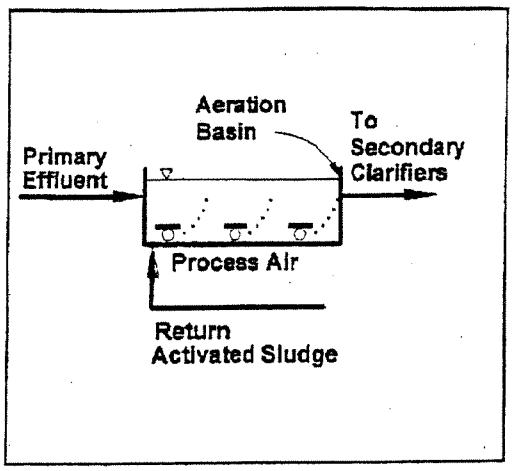
	Unit	1	2					
Calcium . . . . . (Ca^{++})	mg/l	29	145					
Magnesium . . . (Mg^{++})	mg/l	42	210					
Sodium . . . . . (Na^{+})	mg/l	361	1805					
Potassium . . . . . (K^{+})	mg/l	23	115					
TOTAL CATIONS								
Bicarbonate . ($HCO3^{-}$)	mg/l	225	225					
Carbonate . . . ($CO3^{--}$)	mg/l							
Hydroxide . . . . . (OH^{-})	mg/l							
Chloride . . . . . (Cl^{-})	mg/l	581	2905					
Sulfate . . . . . (SO_4^{--})	mg/l	120	1308					
Nitrates . . . . . (NO_3^{-})	mg/l							
TOTAL ANIONS								
Silica	mg/l	12.7	65					
Total Suspended Solids	mg/l	1	5 - 15					
pH	pH units	7.5	8 - 8.5					
Oil & Grease	mg/l	< 1.0	5					
Fluoride	mg/l	1.2	6					
TDS	mg/l	1390	7000					
Phosphorus (PO4)	mg/l	1 - 3	15 - 20					
Ammonia Nitrogen	mg/l	4 - 5	25					
BOD	mg/l	5 - 15	50					
Chromium*	ug/l	1.3	6.5					
Copper*.	ug/l	14.5	72.5					
Mercury*.	ug/l	0.0187	0.0935					
Nickel*	ug/l	3.9	19.5					
Lead*.	ug/l	2.5	12.5					
Selenium*.	ug/l	0.5	2.5					
Zinc*.	ug/l	62.4	312					

* Concentrations of metals was obtained from NPDES permitting information for the SEWPCP. Metals will not be added in the power plant cooling system. Evaporation of water in the cooling system will cause in increase in metal concentration in the cooling system.

Category: **Biological Treatment**

Source: **Diffused Air Activated Sludge**

Description: *The diffused air activated sludge process requires the use of large volumes of air (79 percent nitrogen, 21 percent oxygen), diffused through the liquid stream to achieve dissolution of the oxygen into the liquid. The aerobic biomass requires steady levels of dissolved oxygen to maintain optimum biodegradation activity. Many facilities employ fine bubble diffusers to increase oxygen transfer efficiency. Fine bubble diffusers can be designed with either grids of diffuser plates or domes on the floor of the aeration tank, or attached fine bubble diffusers on the air distribution arms on one side of the tank. Other facilities employ distinctive coarse patterns for each type.*



Emission Mechanisms: *Emission mechanisms include surface volatilization, transport within rising air bubbles, release from aerosol particles in high-shear (mixed) processes, and weir drop emissions. Other mechanisms compete for organic matter and will impact emissions. These include biodegradation and solids adsorption.*

Typical Air Stream Total VOC Concentrations:

1 to 10 ppmvC

Applicable Estimation Methods	
Mass Balance Emission Factor Modeling Direct Measurement	*Mass balance not appropriate due to extensive solids sorption and biological activity. Emission factors and modeling are acceptable. Direct measurement costly but accurate.*

Conservative Screening Emission Factors

Pollutant	Flow Based (lb/yr/mgd)	Conc. Based (lb/lb influent)	Comments
Total VOCs (Method 25.2)	*190*	*0.13*	*Emission factors may be affected by process operating characteristics. Consideration should be given to factors such as gas:liquid ratio and surface area per mgd.*
Volatile/Degradable			
Benzene	*1.7*	*0.18*	
Ethyl Benzene	*1.2*	*0.15*	
Toluene	*7.3*	*0.16*	
Xylenes	*7.0*	*0.11*	
Volatile/Non-Degradable			
1,1,1-Trichloroethane	*6.5*	*0.46*	
Chloroform	*4.7*	*0.26*	
Methylene Chloride	*4.3*	*0.13*	
Tetrachloroethylene	*8.5*	*0.33*	
Non-Volatile/Degradable			
Acetone	*3.2E-02*	*9.9E-06*	
MEK	*6.4E-3*	*1.7E-4*	
MIBK	*5.8E-03*	*1.7E-05*	