DOCKETED	
Docket Number:	01-AFC-19C
Project Title:	SMUD Cosumnes Power Plant - Compliance
TN #:	244288-22
Document Title:	Detailed Emission Calculations
Description:	N/A
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Submitter Role:	Applicant Consultant
Submission Date:	8/1/2022 5:08:59 PM
Docketed Date:	8/1/2022

APPENDIX 8.1B

Detailed Emission Calculations

Table 8.1B-1
Detailed Calculations for Maximum Hourly, Daily, and Annual Criteria Pollutant Emissions

	Base Load			Startup			NOx			SOx		CO		VOC		PM10	
							Base Load(1)	Base Load(2)	Startup	Base Load	Startup	Base Load	Startup	Base Load	Startup	Base Load	Startup
Equipment	max. hour	hrs/day	hrs/yr	max. hour	hrs/day	hrs/yr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Gas Turbine 1, 34F, w/o DB, w/o PA	1	21	0	0	0	0	16.89	13.51	0.00	1.31	0.00	24.68	0.00	3.30	0.00	9.00	0.00
Gas Turbine 2, 34F, w/o DB, w/o PA	0	21	0	0	0	0	16.89	13.51	0.00	1.31	0.00	24.68	0.00	3.30	0.00	9.00	0.00
Gas Turbine 3, 34F, w/o DB, w/o PA	1	21	0	0	0	0	16.89	13.51	0.00	1.31	0.00	24.68	0.00	3.30	0.00	9.00	0.00
Gas Turbine 4, 34F, w/o DB, w/o PA	0	21	0	0	0	0	16.89	13.51	0.00	1.31	0.00	24.68	0.00	3.30	0.00	9.00	0.00
Gas Turbine 1, 61F, w/o DB, w/o PA	0	0	8580	0	0	0	16.20	12.96	0.00	1.25	0.00	23.67	0.00	3.16	0.00	9.00	0.00
Gas Turbine 2, 61F, w/o DB, w/o PA	0	0	8580	0	0	0	16.20	12.96	0.00	1.25	0.00	23.67	0.00	3.16	0.00	9.00	0.00
Gas Turbine 3, 61F, w/o DB, w/o PA	0	0	8580	0	0	0	16.20	12.96	0.00	1.25	0.00	23.67	0.00	3.16	0.00	9.00	0.00
Gas Turbine 4, 61F, w/o DB, w/o PA	0	0	8580	0	0	0	16.20	12.96	0.00	1.25	0.00	23.67	0.00	3.16	0.00	9.00	0.00
Gas Turbine 1, startups	0	0	0	0	3	180	0.00	0.00	80.00	0.00	1.31	0.00	902.00	0.00	16.00	0.00	9.00
Gas Turbine 2, startups	0	0	0	1	3	180	0.00	0.00	80.00	0.00	1.31	0.00	902.00	0.00	16.00	0.00	9.00
Gas Turbine 3, startups	0	0	0	0	3	180	0.00	0.00	80.00	0.00	1.31	0.00	902.00	0.00	16.00	0.00	9.00
Gas Turbine 4, startups	0	0	0	1	3	180	0.00	0.00	80.00	0.00	1.31	0.00	902.00	0.00	16.00	0.00	9.00
Cooling Tower Number 1	1	24	8760	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00
Cooling Tower Number 2	1	24	8760	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00

Notes:
(1) Short term average - less than annual average.
(2) Long term average - annual average.

Table 8.1B-2
Detailed Calculations for Maximum Hourly, Daily, and Annual Criteria Pollutant Emissions

	NOx			SOx			CO			VOC			PM10		
	Max	Max	Total	Max	Max	Total	Max	Max	Total	Max	Max	Total	Max	Max	Total
Equipment	lb/hr	lb/day	tpy	lb/hr	lb/day	tpy	lb/hr	lb/day	tpy	lb/hr	lb/day	tpy	lb/hr	lb/day	tpy
Gas Turbine 1, 34F, w/o DB, w/o PA	16.9	354.7	0.0	1.3	27.6	0.0	24.7	518.3	0.0	3.3	69.3	0.0	9.0	189.0	0.0
Gas Turbine 2, 34F, w/o DB, w/o PA	0.0	354.7	0.0	0.0	27.6	0.0	0.0	518.3	0.0	0.0	69.3	0.0	0.0	189.0	0.0
Gas Turbine 3, 34F, w/o DB, w/o PA	16.9	354.7	0.0	1.3	27.6	0.0	24.7	518.3	0.0	3.3	69.3	0.0	9.0	189.0	0.0
Gas Turbine 4, 34F, w/o DB, w/o PA	0.0	354.7	0.0	0.0	27.6	0.0	0.0	518.3	0.0	0.0	69.3	0.0	0.0	189.0	0.0
Gas Turbine 1, 61F, w/o DB, w/o PA	0.0	0.0	55.6	0.0	0.0	5.4	0.0	0.0	101.5	0.0	0.0	13.6	0.0	0.0	38.6
Gas Turbine 2, 61F, w/o DB, w/o PA	0.0	0.0	55.6	0.0	0.0	5.4	0.0	0.0	101.5	0.0	0.0	13.6	0.0	0.0	38.6
Gas Turbine 3, 61F, w/o DB, w/o PA	0.0	0.0	55.6	0.0	0.0	5.4	0.0	0.0	101.5	0.0	0.0	13.6	0.0	0.0	38.6
Gas Turbine 4, 61F, w/o DB, w/o PA	0.0	0.0	55.6	0.0	0.0	5.4	0.0	0.0	101.5	0.0	0.0	13.6	0.0	0.0	38.6
Gas Turbine 1, startups	0.0	240.0	7.2	0.0	3.9	0.1	0.0	2,706.0	81.2	0.0	48.0	1.4	0.0	27.0	0.8
Gas Turbine 2, startups	80.0	240.0	7.2	1.3	3.9	0.1	902.0	2,706.0	81.2	16.0	48.0	1.4	9.0	27.0	0.8
Gas Turbine 3, startups	0.0	240.0	7.2	0.0	3.9	0.1	0.0	2,706.0	81.2	0.0	48.0	1.4	0.0	27.0	0.8
Gas Turbine 4, startups	80.0	240.0	7.2	1.3	3.9	0.1	902.0	2,706.0	81.2	16.0	48.0	1.4	9.0	27.0	0.8
Cooling Tower Number 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	3.6	0.6
Cooling Tower Number 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	3.6	0.6
Total	193.8 lb/hr	2378.7 lb/day	251.1 tpy	5.2 lb/hr	126.0 lb/day	21.9 tpy	1,853.4 lb/hr	12,897.1 lb/day	730.8 tpy	38.6 lb/hr	469.0 lb/day	60.0 tpy	36.3 lb/hr	871.1 lb/day	159.0 tpy

TABLE 8.1B-3
Summary of Startup Emissions Data - pounds per hour

Project	Notes	VOC	CO	NOx	SOx	PM10
Crockett Cogeneration	Source Tests					
6/96 avg	(Note 1)	54	46	59	-	-
6/97 avg		<1	31	41	-	-
min run		<1	27	9	-	-
max run		59	49	95	-	-
Crockett Cogeneration	FDOC (Note 2)	170	385	160	-	-
SF Energy	FDOC	299	437	77	-	-
Sutter	From					
Cold Start	Westinghouse	-	838	175	-	-
Hot Start		-	902	170	-	-
Sutter	FDOC					
Cold Start	(Note 3)	1.1	838	175	2.7	9.0
Hot Start		1.1	902	170	2.7	9.0
Westinghouse	Note 4					
Cold Start		292	1722	183	3	28
Warm Start		296	1625	221	3	25
Hot Start		442	2142	217	4	33
Bechtel - DEC	From					
Cold Start	Westinghouse	437	3317	168	-	7
Hot Start	Note 5	520	7343	189	-	8
Used in AFC	Note 6					
Cold Start		16	902	80	1.3	9

Notes:
1. Minimum and maximum values are based on the six individual runs that comprise the two sets of tests.
2. Permit conditions have not been carried forward into the permit to operate, and are no longer in effect.
3. Values shown are from the engineering analysis; there are no proposed permit conditions for startup emissions limits in the proposed FDOC.
4. Westinghouse provided data for the total plant (3 turbines) on a lbs/start basis. The above lbs/hr values were calculated assuming a 3 hour starting period per turbine for a cold start; 2 hours for a warm start; and 1 hour for a hot start. Data do not reflect the performance of oxidation catalysts or CO catalysts.
5. Bechtel estimates are 140 minutes for cold start for first engine; 40 minutes for cold start for second and third engines; and 30 minutes for hot start for each engine.
6. VOC values are three times full load emission rates. CO values are expected average values. NOx values are 30% higher than the higher of the two Crockett test averages, rounded up to the nearest 5 lbs/hr. SOx and PM10 values are the full load emission rates.

TABLE 8.1B-4
Summary of Startup Emissions Data - pounds per start per turbine

Project	Notes	VOC	CO	NOx	SOx	PM10
Crockett Cogeneration	Source Tests					
6/96 avg	(Note 1)	71	62	79	-	-
6/97 avg		1	41	54	-	-
min run		<1	36	12	-	-
max run		79	66	127	-	-
Crockett Cogeneration	FDOC (Note 2)	340	770	320	-	-
SF Energy	FDOC (Note 3)	299	437	77	-	-
Sutter	From					
Cold Start	Westinghouse	-	611	2932	-	-
Hot Start		-	339	1804	-	-
Sutter	Proposed FDOC					
Cold Start	(Note 4)	3	2514	525	8	27
Hot Start		1	902	170	3	9
Westinghouse	Note 5					
Cold Start		875	5167	550	8	83
Warm Start		592	3250	442	5	50
Hot Start		442	2142	217	4	33
Bechtel - DEC	From					
Cold Start	Westinghouse	1019	7740	391	-	17
Hot Start		520	3671	189	-	4
Used in AFC	Note 6					
Cold Start		48	2,706	240	3.9	27

Notes:
1. Data extrapolated from reported hourly values by ratio of 80/60.
2. Values based on maximum two hours per startup.
3. Values based on maximum one hour per startup.
4. Values based on maximum three hours per cold start, one hour per hot start.
5. Westinghouse provided data for the total plant (3 turbines). Data do not reflect the performance of oxidation catalysts or CO catalysts.
6. Based on maximum three hours per startup.

Table 8.1B-5
Cooling Towers

Number of cells =	9
Fan Stack Diameter (ft) =	36.0
Exhaust Temperature (F) =	68
Exhaust Flow per Cell (acfm) =	1,436,258
Water Flow Rate Per Tower (gal/min)	125,867
Drift Rate, %	0.0005
Drift Per Tower (lb water/hr)	315.07
TDS level (ppmw)	470
PM10 emissions per tower (lb/hr)	0.15

Table 8.1B-6
Emission Offset Calculations

	CO	VOC	PM10
Annual Emissions for Four Gas Turbines (tons/yr)	730.8	60.0	157.7
Quarterly Emissions for Four Gas Turbines (lbs/quarter)	365,407	30,016	78,840
Quarterly Emissions for Two Gas Turbines - Phase I (lbs/quarter)	182,704	15,008	39,420
Emission Offset Trigger Level (lbs/quarter)	49,500	7,500	7,500
Offsets Requirement Triggered?	No(1)	Yes	Yes

Notes:
(1) While the maximum expected quarterly CO emissions are greater than the offset trigger level, the project is exempt from CO offset requirements per District Rule 202-302.6.

Table 8.1B-7
Calculation of Noncriteria Pollutant Emissions for Gas Turbines/HRSGs

Compound	(each gas turbine) Emission Factor, lb/ MMscf (1)	Max Hourly Emissions, lb/hr (2)	Annual Emissions, ton/yr (3)	Emission Rates for Modeling (each gas turbine) One-hour Em Rates, g/s	Annual Em Rates, g/s
Ammonia	(4), (6)	25.0088	109.54	3.15E+000	3.15E+000
Propylene(5)	7.71E-001	1.4127	5.89	1.78E-001	1.70E-001
Hazardous Air Pollutants (HAPs)					
Acetaldehyde	4.08E-002	0.0748	0.31	9.42E-003	8.97E-003
Acrolein	3.69E-003	0.0068	0.03	8.52E-004	8.11E-004
Benzene	3.33E-003	0.0061	0.03	7.69E-004	7.32E-004
1,3-Butadiene	4.39E-004	0.0008	0.00	1.01E-004	9.65E-005
Ethylbenzene	3.26E-002	0.0597	0.25	7.53E-003	7.17E-003
Formaldehyde(7)	2.06E-001	0.3767	1.57	4.75E-002	4.52E-002
Hexane(5)	2.59E-001	0.4746	1.98	5.98E-002	5.69E-002
Naphthalene(5)	1.33E-003	0.0024	0.01	3.07E-004	2.92E-004
PAH - Anthracene(5)	3.38E-005	0.0001	0.00	7.80E-006	7.43E-006
PAH - Benzo(a)anthracene(5)	2.26E-005	0.0000	0.00	5.22E-006	4.97E-006
PAH - Benzo(a)pyrene(5)	1.39E-005	0.0000	0.00	3.21E-006	3.06E-006
PAH - Benzo(b)fluoranthrene(5)	1.13E-005	0.0000	0.00	2.61E-006	2.48E-006
PAH - Benzo(k)fluoranthrene(5)	1.10E-005	0.0000	0.00	2.54E-006	2.42E-006
PAH - Chrysene(5)	2.52E-005	0.0000	0.00	5.82E-006	5.54E-006
PAH - Dibenz(a,h)anthracene(5)	2.35E-005	0.0000	0.00	5.43E-006	5.17E-006
PAH - Indeno(1,2,3-cd)pyrene(5)	2.35E-005	0.0000	0.00	5.43E-006	5.17E-006
Propylene oxide	2.96E-002	0.0542	0.23	6.83E-003	6.51E-003
Toluene	1.33E-001	0.2437	1.02	3.07E-002	2.92E-002
Xylene	6.53E-002	0.1196	0.50	1.51E-002	1.44E-002
Total HAPs (four turbines)			23.69		

Notes:
(1) From AP-42 (Table 3.1-3, 4/00) unless noted.
(2) Based on maximum hourly gas turbine fuel use of: 1.83 MMscf/hr
(3) Based on maximum annual gas turbine fuel use of: 15,285.86 MMscf/yr
(4) Maximum lbs/hr NH3 emissions based on 10 ppm @ 15% O2 ammonia slip from SCR system, 100% load, 34 F operating case.
(5) From CATEF database.
(6) Maximum annual NH3 emissions based on maximum hourly NH3 emission rate and maximum expected hours per year of gas turbine operation including startup periods.
(7) Based on 8/21/01 letter from Sims Roy at EPA.

Table 8.1B-8
Cooling Tower - Noncriteria Pollutant Emission Calculations

Constituent	Concentration in Cooling Tower(1) Recirulation Water	Units	Drift Rate Per Tower (lbs of water/hr)	Hourly Emissions Per Tower (lbs/hr)	Daily Emissions Per Tower (lbs/day)	Annual Emissions Per Tower (tons/yr)	Emissions For Modeling 1-Hour Impact (g/s) per cell	Annual Impact (g/s) per cell
Ammonia	1.0000	ppmw	315.07	3.15E-004	7.56E-003	1.38E-003	4.41E-006	4.41E-006
Arsenic	0.0000	ppmw	315.07	0.00E+000	0.00E+000	0.00E+000	0.00E+000	0.00E+000
Barium	0.1600	ppmw	315.07	5.04E-005	1.21E-003	2.21E-004	7.06E-007	7.06E-007
Beryllium	0.0000	ppmw	315.07	0.00E+000	0.00E+000	0.00E+000	0.00E+000	0.00E+000
Boron	0.2300	ppmw	315.07	7.25E-005	1.74E-003	3.17E-004	1.02E-006	1.02E-006
Cadmium	0.0000	ppmw	315.07	0.00E+000	0.00E+000	0.00E+000	0.00E+000	0.00E+000
Chromium	0.0230	ppmw	315.07	7.25E-006	1.74E-004	3.17E-005	1.02E-007	1.02E-007
Copper	0.1900	ppmw	315.07	5.99E-005	1.44E-003	2.62E-004	8.39E-007	8.39E-007
Cyanide	0.0000	ppmw	315.07	0.00E+000	0.00E+000	0.00E+000	0.00E+000	0.00E+000
Lead	0.0280	ppmw	315.07	8.82E-006	2.12E-004	3.86E-005	1.24E-007	1.24E-007
Manganese	0.2200	ppmw	315.07	6.93E-005	1.66E-003	3.04E-004	9.71E-007	9.71E-007
Mercury	0.0000	ppmw	315.07	0.00E+000	0.00E+000	0.00E+000	0.00E+000	0.00E+000
Nickel	0.0000	ppmw	315.07	0.00E+000	0.00E+000	0.00E+000	0.00E+000	0.00E+000
Selenium	0.0000	ppmw	315.07	0.00E+000	0.00E+000	0.00E+000	0.00E+000	0.00E+000
Zinc	0.4300	ppmw	315.07	1.35E-004	3.25E-003	5.93E-004	1.90E-006	1.90E-006

Notes:
1. Based on system design.