Appendix 5.1B
Emissions and Operating Parameters

Table 5.1B-1
Emissions and Operating Parameters for the Auxiliary Boilers
Hidden Hills Solar Electric Generating System

Boiler Emission Characteristics				
		Normal	Hot Standby	Cold Startup
Heat Input, MMBtu/hr (HHV)		500.0	25.0	62.5
Boiler Rating, lb/hr		350,000	--	--
NOx, ppmvd @ 3% O2		9	100	75
CO, ppmvd @ 3% O2		50	250	300
VOC (as CH4), ppmvd @ 3% O2		12.6	25	60
NOx (as NO2), lb/hr		5.4	3.0	5.6
NOx, lb/MMBtu		0.0108	0.1201	0.0901
CO, lb/hr		18.3	4.57	13.7
CO, lb/MMBtu		0.0366	0.1828	0.2194
VOC (as CH4), lb/hr		2.64	0.26	1.57
VOC, lb/MMBtu		0.0053	0.0105	0.0251
PM10, lb/hr		2.5	0.25	0.63
PM10, lb/MMBtu		0.005	0.01	0.01
SO2, grains/100 scf		0.75	0.75	0.75
SO2, lb/hr		1.1	0.05	0.13
SO2, lb/MMBtu		0.0021	0.0021	0.0021
Boiler Stack Parameters				
Exhaust temp	deg F	360	358	345
Exhaust volume	cfm	156,695	17,626	21,271
Stack diameter	inches	82	82	82
Exhaust velocity	ft/sec	71	8	10

Table 5.1B-2
Emissions and Operating Parameters for Startup Boilers
Hidden Hills Solar Electric Generating System

Boiler Emission Characteristics			
		Normal	Cold Startup
Heat Input, MMBtu/hr (HHV)		249.0	31
Boiler Rating, lb/hr		200,000	--
NOx, ppmvd @ 3% O2		9	75
CO, ppmvd @ 3% O2		25	300
VOC (as CH4), ppmvd @ 3% O2		12.6	60
NOx (as NO2), lb/hr		2.7	2.8
NOx, lb/MMBtu		0.0108	0.090
CO, lb/hr		4.6	6.8
CO, lb/MMBtu		0.0183	0.219
VOC (as CH4), lb/hr		1.3	0.78
VOC, lb/MMBtu		0.0053	0.025
PM10, lb/hr		1.25	0.31
PM10, lb/MMBtu		0.005	0.01
SO2, grains/100 scf		0.75	0.75
SO2, lb/hr		0.52	0.07
SO2, lb/MMBtu		0.0021	0.0021
Boiler Stack Parameters			
Exhaust temp	deg F	360	345
Exhaust volume	cfm	78,035	10,593
Stack diameter	inches	60	60
Exhaust velocity	ft/sec	66	9.0

Table 5.1B-3
Emissions and Operating Parameters for Nighttime Preservation Boilers
Hidden Hills Solar Electric Generating System

Boiler Emission Characteristics			
		Normal	**Cold Startup**
Heat Input, MMBtu/hr (HHV)		12.2	1.5
Boiler Rating, lb/hr		8,000	--
NOx, ppmvd @ 3% O2		9	70
CO, ppmvd @ 3% O2		50	275
VOC (as CH4), ppmvd @ 3% O2		10	55
NOx (as NO2), lb/hr		0.13	0.13
NOx, lb/MMBtu		0.0108	0.084
CO, lb/hr		0.45	0.31
CO, lb/MMBtu		0.0366	0.201
VOC (as CH4), lb/hr		0.05	0.04
VOC, lb/MMBtu		0.0042	0.023
PM10, lb/hr		0.06	0.02
PM10, lb/MMBtu		0.005	0.01
SO2, grains/100 scf		0.75	0.75
SO2, lb/hr		0.03	0.003
SO2, lb/MMBtu		0.0021	0.0021
Boiler Stack Parameters			
Exhaust temp	deg F	325	300
Exhaust volume	cfm	3,679	492
Stack diameter	inches	20	20
Exhaust velocity	ft/sec	28	4

Table 5.1B-4
Emissions from Diesel Emergency Generators
Hidden Hills Solar Electric Generating System

Engine				
Engine Mfr		Caterpillar		
Model		C175-16 SCAC		
Useable Horsepower	hp	3354		
Generator Power Output	kW	2500		
Fuel		CA Diesel		
Specific Gravity		0.825		
Fuel Sulfur Content	wt %	0.0015%		
Fuel Consumption	gph	175		
	MMBtu/hr	23.8		
	Btu/bhp-hr	7,096		
Emissions				
NOx	g/bhp-hr	5.48		
CO	g/bhp-hr	0.79		
VOC	g/bhp-hr	0.13		
PM10	g/bhp-hr	0.05		
NOx	lb/hr	40.5	lb/yr	2026
CO	lb/hr	5.8	lb/yr	292
VOC	lb/hr	1.0	lb/yr	48
PM10	lb/hr	0.4	lb/yr	18
SO2	lb/hr	0.04	lb/yr	2
Exhaust Parameters				
Exhaust temp	deg F	831.4		
Exhaust volume	cfm	20,461		
Stack diameter	inches	20		
Exhaust velocity	ft/sec	156		

Table 5.1B-5
Emergency Diesel Generator, Common Area
Hidden Hills Solar Electric Generating System

Engine				
Engine Mfr		Caterpillar		
Model		C9 ATAAC		
Emissions Cert		Tier 3		
Useable Horsepower	hp	335.4		
Generator Power Output	kW	250		
Fuel		CA Diesel		
Specific Gravity		0.825		
Fuel Sulfur Content	wt %	0.0015%		
Fuel Consumption	gph	19.4		
	MMbtu/hr	2.6		
	Btu/bhp-hr	7,866		
Emissions				
NOx	g/bhp-hr	2.99		
CO	g/bhp-hr	0.36		
VOC	g/bhp-hr	0.1		
PM10	g/bhp-hr	0.08		
NOx	lb/hr	2.2	lb/yr	111
CO	lb/hr	0.27	lb/yr	13
VOC	lb/hr	0.07	lb/yr	4
PM10	lb/hr	0.06	lb/yr	3
SO2	lb/hr	0.004	lb/yr	0
Exhaust Parameters				
Exhaust temp	deg F	853.9		
Exhaust volume	cfm	2,243		
Stack diameter	inches	7		
Exhaust velocity	ft/sec	140		

Table 5.1B-6
Diesel Fire Pump Engines, Power Blocks
Hidden Hills Solar Electric Generating System

Engine				
Engine Mfr		Cummins		
Model		CFP9E-F40		
Emissions Cert		Tier 3		
Useable Horsepower	hp	271		
Pump Speed	rpm	1470		
Fuel		CA Diesel		
Specific Gravity		0.825		
Fuel Sulfur Content	wt %	0.0015%		
Fuel Consumption	gph	14.0		
	MMbtu/hr	1.9		
	Btu/bhp-hr	7,026		
Emissions				
NOx	g/bhp-hr	2.2		
CO	g/bhp-hr	1.417		
VOC	g/bhp-hr	0.123		
PM10	g/bhp-hr	0.118		
NOx	lb/hr	1.3	lb/yr	66
CO	lb/hr	0.85	lb/yr	42
VOC	lb/hr	0.07	lb/yr	4
PM10	lb/hr	0.07	lb/yr	4
SO2	lb/hr	0.003	lb/yr	0
Exhaust Parameters				
Exhaust temp	deg F	1083		
Exhaust volume	cfm	1,584		
Stack diameter	inches	4		
Exhaust velocity	ft/sec	303		

Table 5.1B-7
Diesel Fire Pump Engine, Common Area
Hidden Hills Solar Electric Generating System

Engine				
Engine Mfr		Cummins		
Model		CFP9E-F20		
Emissions Cert		Tier 3		
Useable Horsepower	hp	233		
Pump Speed	rpm	1470		
Fuel		CA Diesel		
Specific Gravity		0.825		
Fuel Sulfur Content	wt %	0.0015%		
Fuel Consumption	gph	12.0		
	MMbtu/hr	1.6		
	Btu/bhp-hr	7,004		
Emissions				
NOx	g/bhp-hr	2.2		
CO	g/bhp-hr	1.417		
VOC	g/bhp-hr	0.123		
PM10	g/bhp-hr	0.118		
NOx	lb/hr	1.1	lb/yr	57
CO	lb/hr	0.73	lb/yr	36
VOC	lb/hr	0.06	lb/yr	3
PM10	lb/hr	0.06	lb/yr	3
SO2	lb/hr	0.003	lb/yr	0
Exhaust Parameters				
Exhaust temp	deg F	1033		
Exhaust volume	cfm	1,527		
Stack diameter	inches	4		
Exhaust velocity	ft/sec	292		

Table 5.1B-8
Typical Annual Operating Schedule, Each Plant
Hidden Hills Solar Electric Generating System

Auxiliary boiler operation	**June - Sept.**		
	(2)	**(3)**	**Oct.-May**
days	86	36	243
operation, hours/day (average) (1)	4.6	0	0
Total hours/year			**400**

Start-up boiler operation	**June - Sept.**	**October-May**	**Hot restart mode (4)**
days	122	243	
operation , hours/day (average)	2	2	
Subtotal hours/yr	244	486	70
Total hours/yr			**800**

Nighttime boiler operation	**June - Sept.**		
	(2)	**(3)**	**Oct.-May**
days	86	36	243
operation, average hours/day	8	10	12
Total hours/year			**4000**

Notes:

1. Hours shown are annual average equivalent full load hours; boilers may operate more hours on some days and/or at lower loads (including hot standby). See text.
2. Typical summer weekday operation.
3. Typical summer weekend operation.
4. During cloudy periods or in case of emergency shutdown, the startup boilers may also be used to keep the system hot or to facilitate the plant restart

Table 5.1B-9
Calculation of Daily and Annual Fuel Use
Hidden Hills Solar Electric Generating System

	Number of Units	Operating Hours, Each Unit					Rated Hourly Fuel Use, MMBtu
		hrs/day	hrs/Q1	hrs/Q2	hrs/Q3	hrs/Q4	
Aux Boilers	6	7	0	100	300	0	500.0
Startup Boilers	2	2	200	200	200	200	249.0
Nighttime Boilers	2	12	1080	1040	800	1080	12.2
Em Gens, Power Blocks	2	0.5	50	50	50	50	23.8
Em Gen, Common Area	1	0.5	50	50	50	50	2.6
Fire Pump Engines, Power Blocks	2	0.5	50	50	50	50	1.9
Fire Pump Engine, Common Area	1	0.5	50	50	50	50	1.6
	Total Fuel Use, all units						
	MMBtu/hr	MMBtu/day	MMBtu/Q1	MMBtu/Q2	MMBtu/Q3	MMBtu/Q4	MMBtu/yr
Aux Boilers	**3000.0**	21,000.0	0	300,000	900,000	0	1,200,000
Startup Boilers	**498.0**	996.0	99,600	99,600	99,600	99,600	398,400
Nighttime Boilers	**24.5**	293.9	26,454	25,474	19,595	26,454	97,976
Em Gens, Power Blocks	**23.8**	23.8	2,380	2,380	2,380	2,380	9,520
Em Gen, Common Area	**1.3**	1.3	132	132	132	132	528
Fire Pump Engines, Power Blocks	**1.9**	1.9	190	190	190	190	762
Fire Pump Engine, Common Area	**0.8**	0.8	82	82	82	82	326
Total							**1,707,512**
Total natural gas		**22,289.9**					1,696,376
Total diesel							11,136

Table 5.1B-10
Calculation of Wet Surface Air Cooler Emissions
Hidden Hills Solar Electric Generating System

Typical Worst-Case Design Parameters	
Water Flow Rate, 10E6 lbm/hr	1.64
Water Flow Rate, gal/min	3,276
Drift Rate, %	0.0005
Drift, lbm water/hr	8.19
PM10 Emissions based on TDS Level	
TDS level, ppm	400
PM10, lb/hr	0.003
PM10, lb/day	0.04
PM10, tpy	0.003

Based on 2000 hrs/yr
12 hrs/day

Table 5.1B-11
Emissions from Mirror Cleaning Activities
Hidden Hills Solar Electric Generating System

Pollutant	Emission Factor	Emissions (lb/year) HHR 1	HHR 2
Tractor-pulled trailers	VMT/yr	8,800	8,800
(DZ and NDZ MWMs)	gal/yr	781,672	781,672
NOx (lb/1000 gal)	11.77	9,200	9,200
VOC (lb/1000 gal)	5.6	4,377	4,377
SO2 (lb/1000 gal)	0.21	164	164
CO (lb/1000 gal)	3.58	2,798	2,798
PM10/PM2.5 (combustion)	0.39	305	305
PM10 (road dust) (lb/VMT)	0.30	2,622	2,622
PM2.5 (road dust) (lb/VMT)	0.03	262	262
Smaller vehicles	VMT/yr	3,700	3,700
(Near Tower MWMs)	Gal/yr	379,600	379,600
NOx (lb/1000 gal)	11.77	4,468	4,468
VOC (lb/1000 gal)	5.6	2,126	2,126
SO2 (lb/1000 gal)	0.21	80	80
CO (lb/1000 gal)	3.2	1,215	1,215
PM10/PM2.5 (combustion)	0.39	148	148
PM10 (road dust) (lb/VMT)	0.17	633	633
PM2.5 (road dust) (lb/VMT)	0.02	63	63

Total lb/yr, all activities	HHR1	HHR2	Total	ton/yr	lb/day	lb/hr
NOx	13,668	13,668	27,336	13.7	74.9	7.1
VOC	6,503	6,503	13,006	6.5	35.6	3.4
SO2	244	244	488	0.24	1.3	0.13
CO	4,013	4,013	8,026	4.0	22.0	2.1
PM10	3,708	3,708	7,416	3.7	20.3	1.9
PM2.5	778	778	1,557	0.8	4.3	0.4
DPM	453	453	906	0.5	2.5	0.2
GHG			51,345,397	25,673		

Notes:
1. Emission factors from EPA Nonroad Model documentation, Tier 4 engines: >300-600 for NDZ/ 175-300 bhp for NTZ (available at http://www.epa.gov/otaq/models/nonrdmdl/nonrdmdl2010/420r10018.pdf)
2. Assume all combustion PM10 is <2.5 um in size
3. Assume all trucks are diesel fueled so all combustion PM is DPM
4. GHG emission factors from CARB Regulation for the Mandatory reporting of Greenhouse Gas Emissions, December 2, 2008; distillate fuel
5. Unpaved road dust factors from construction emissions calculations; 90% control

CO2 EF, kg/MMBtu	CH4 EF, kg/MMBtu	N2O EF, kg/MMBtu	GWP for CO2	GWP for CH4	GWP for N2O	Weighted CO2e, kg/MMBtu	Weighted CO2e, lb/MMBtu	Diesel HHV, MMBtu/gal	Weighted CO2e, lb/1000 gal
73.1	0.003	0.0006	1	21	310	73.349	161.4	0.137	22107.39

Table 5.1B-12
Calculations for Maximum Hourly Criteria Pollutant Emissions
Hidden Hills Solar Electric Generating System

Equipment	Hourly Emission Rates, Each Unit				
	NOx	SOx	CO	VOC	PM10/PM2.5
Auxiliary Boilers					
Normal operation	5.41	1.05	18.28	2.64	2.50
Hot standby	3.00	0.05	4.57	0.26	0.25
Cold startup	5.63	0.13	13.71	1.57	0.63
Startup Boilers					
Normal operation	2.69	0.52	4.55	1.31	1.25
Cold startup	2.80	0.07	6.83	0.78	0.31
Nighttime Preservation Boilers					
Normal operation	0.13	0.03	0.45	0.05	0.06
Cold startup	0.13	0.003	0.31	0.04	0.02
Power Block Emergency Generators	40.52	0.04	5.84	0.96	0.37
Common Area Emergency Generator	2.21	0.004	0.27	0.07	0.06
Power Block Fire Pump Engines	1.31	0.003	0.85	0.07	0.07
Common Area Fire Pump Engine	1.13	0.003	0.73	0.06	0.06
WSAC	0	0	0	0	0.003

Maximum Hourly Emissions, Normal Boiler Operation

Equipment	Total Number of Units (1)	Max Hour	Emissions, pounds/hr					
			NOx	SO2	CO	VOC	PM10	PM2.5
Auxiliary Boilers	6	1	32.4	6.3	109.7	15.8	15.0	15.0
Startup Boilers	2	1	5.4	1.0	9.1	2.6	2.5	2.5
Nighttime Preservation Boilers	2	1	0.3	0.1	0.9	0.1	0.1	0.1
Power Block Emergency Generators	2	0	0.0	0.0	0.0	0.0	0.0	0.0
Common Area Emergency Generator	1	0	0.0	0.0	0.0	0.0	0.0	0.0
Power Block Fire Pump Engines	2	0	0.0	0.0	0.0	0.0	0.0	0.0
Common Area Fire Pump Engine	1	0	0.0	0.0	0.0	0.0	0.0	0.0
WSAC	2	1	0.0	0.0	0.0	0.0	6.5E-03	6.5E-03
Total Emissions, lb/hr			**38.1**	**7.4**	**119.7**	**18.6**	**17.6**	**17.6**

Maximum Hourly Emissions, Engine Testing

Equipment	Total Number of Units (1)	Max Hour	Emissions, pounds/hr					
			NOx	SO2	CO	VOC	PM10	PM2.5
Auxiliary Boilers	6	0	0.0	0.0	0.0	0.0	0.0	0.0
Startup Boilers	2	0	0.0	0.0	0.0	0.0	0.0	0.0
Nighttime Preservation Boilers	2	0	0.0	0.0	0.0	0.0	0.0	0.0
Power Block Emergency Generators	2	0.5	40.5	0.037	5.8	1.0	0.4	0.4
Common Area Emergency Generator	1	0.5	1.1	0.002	0.1	0.04	0.03	0.03
Power Block Fire Pump Engines	2	0.5	1.3	0.003	0.8	0.1	0.1	0.1
Common Area Fire Pump Engine	1	0.5	0.6	0.001	0.4	0.03	0.03	0.03
WSAC	2	0	0	0	0	0	0	0
Total Emissions, lb/hr			**43.5**	**0.0**	**7.2**	**1.1**	**0.5**	**0.5**

Maximum Daily Emissions, Auxiliary Boiler Operating Day

Equipment	Total Number of Units (1)	Operating Hours/Day	Emissions, pounds/day					
			NOx	SO2	CO	VOC	PM10	PM2.5
Auxiliary Boilers	6	7	227.0	44.1	767.9	110.8	105.0	105.0
Startup Boilers	2	2	10.8	2.1	18.2	5.3	5.0	5.0
Nighttime Preservation Boilers	2	8	2.1	0.4	7.2	0.8	1.0	1.0
Power Block Emergency Generators	2	0	0.0	0.0	0.0	0.0	0.0	0.0
Common Area Emergency Generator	1	0	0.0	0.0	0.0	0.0	0.0	0.0
Power Block Fire Pump Engines	2	0	0.0	0.0	0.0	0.0	0.0	0.0
Common Area Fire Pump Engine	1	0	0.0	0.0	0.0	0.0	0.0	0.0
WSAC	2	12	0.0	0.0	0.0	0.0	0.08	0.08
Total Emissions, lb/hr			**239.9**	**46.6**	**793.3**	**116.9**	**111.0**	**111.0**

Maximum Daily Emissions, Auxiliary Boiler Startup Day

Equipment	Total Number of Units (1)	Operating Hours/Day	Emissions, pounds/day					
			NOx	SO2	CO	VOC	PM10	PM2.5
Auxiliary Boilers-- startup	2	6	67.6	1.6	164.6	18.9	7.5	7.5
Auxiliary Boilers-- normal operations	6	5	162.2	31.5	548.5	79.2	75.0	75.0
Startup Boilers	2	2	10.8	2.1	18.2	5.3	5.0	5.0
Nighttime Preservation Boilers	2	8	2.1	0.4	7.2	0.8	1.0	1.0
Power Block Emergency Generators	2	0	0.0	0.0	0.0	0.0	0.0	0.0
Common Area Emergency Generator	1	0	0.0	0.0	0.0	0.0	0.0	0.0
Power Block Fire Pump Engines	2	0	0.0	0.0	0.0	0.0	0.0	0.0
Common Area Fire Pump Engine	1	0	0.0	0.0	0.0	0.0	0.0	0.0
WSAC	2	12	0.0	0.0	0.0	0.0	0.08	0.08
Total Emissions, lb/hr			**242.6**	**35.6**	**738.4**	**104.1**	**88.5**	**88.5**

Maximum Daily Emissions, Startup Boiler Startup Day

Equipment	Total Number of Units (1)	Operating Hours/Day	Emissions, pounds/day					
			NOx	SO2	CO	VOC	PM10	PM2.5
Auxiliary Boilers	6	6	194.6	37.8	658.2	95.0	90.0	90.0
Startup Boilers-- startup	2	5	28.0	0.7	68.3	7.8	3.1	3.1
Startup Boilers-- normal operations	2	2	10.8	2.1	18.2	5.3	5.0	5.0
Nighttime Preservation Boilers	2	8	2.1	0.4	7.2	0.8	1.0	1.0
Power Block Emergency Generators	2	0	0.0	0.0	0.0	0.0	0.0	0.0
Common Area Emergency Generator	1	0	0.0	0.0	0.0	0.0	0.0	0.0
Power Block Fire Pump Engines	2	0	0.0	0.0	0.0	0.0	0.0	0.0
Common Area Fire Pump Engine	1	0	0.0	0.0	0.0	0.0	0.0	0.0
WSAC	2	12	0.0	0.0	0.0	0.0	0.1	0.08
Total Emissions, lb/hr			**235.5**	**41.1**	**751.9**	**108.9**	**99.2**	**99.2**

Maximum Daily Emissions, Nighttime Boiler Startup Day

Equipment	Total Number of Units (1)	Operating Hours/Day	Emissions, pounds/day					
			NOx	SO2	CO	VOC	PM10	PM2.5
Auxiliary Boilers	6	7	227.0	44.1	767.9	110.8	105.0	105.0
Startup Boilers	2	2	10.8	2.1	18.2	5.3	5.0	5.0
Nighttime Pres. Boilers-- startup	2	4	1.0	0.0	2.5	0.3	0.1	0.1
Nighttime Pres. Boilers-- normal ops	2	6	1.6	0.3	5.4	0.6	0.7	0.7
Power Block Emergency Generators	2	0	0.0	0.0	0.0	0.0	0.0	0.0
Common Area Emergency Generator	1	0	0.0	0.0	0.0	0.0	0.0	0.0
Power Block Fire Pump Engines	2	0	0.0	0.0	0.0	0.0	0.0	0.0
Common Area Fire Pump Engine	1	0	0.0	0.0	0.0	0.0	0.0	0.0
WSAC	2	12	0.0	0.0	0.0	0.0	0.1	0.08
Total Emissions, lb/hr			**240.4**	**46.5**	**794.0**	**117.0**	**110.9**	**110.9**

Maximum Daily Emissions, Engine Testing Day (No Aux Boiler Operation)

Equipment	Total Number of Units (1)	Operating Hours/Day	Emissions, pounds/day					
			NOx	SO2	CO	VOC	PM10	PM2.5
Auxiliary Boilers	6	0	0.0	0.0	0.0	0.0	0.0	0.0
Startup Boilers	2	2	8.0	4.0	1.1	0.2	3.6	3.6
Nighttime Preservation Boilers	2	12	48.0	0.0	0.0	0.0	0.0	0.0
Power Block Emergency Generators	2	0.5	40.5	0.037	5.8	1.0	0.37	0.37
Common Area Emergency Generator	1	0.5	1.1	0.002	0.1	0.04	0.03	0.03
Power Block Fire Pump Engines	2	0.5	1.3	0.003	0.8	0.07	0.07	0.07
Common Area Fire Pump Engine	1	0.5	0.6	0.001	0.4	0.03	0.03	0.03
WSAC	2	12	0.0	0.0	0.0	0.0	0.08	0.08
Total Emissions, lb/hr			**99.5**	**4.0**	**8.2**	**1.3**	**4.2**	**4.2**

Maximum Annual Emissions

Equipment	Total Number of Units (1)	Operating Hours/Yr	Cold Startup Hours/Yr	Emissions, tons/yr					
				NOx	SO2	CO	VOC	PM10	PM2.5
Auxiliary Boilers	6	400	48	7.3	1.3	23.9	3.4	3.1	3.1
Startup Boilers	2	800	65	2.3	0.4	4.1	1.1	1.0	1.0
Nighttime Preservation Boilers	2	4000	52	0.5	0.1	1.8	0.2	0.2	0.2
Power Block Emergency Generators	2	50	0	2.0	0.002	0.3	0.05	0.02	0.02
Common Area Emergency Generator	1	50	0	0.1	1.0E-04	0.01	0.002	0.001	0.001
Power Block Fire Pump Engines	2	50	0	0.1	1.5E-04	0.04	0.004	0.004	0.004
Common Area Fire Pump Engine	1	50	0	0.03	6.3E-05	0.02	0.002	0.002	0.002
WSAC	2	2000	0	0.0	0.0	0.0	0.0	0.01	0.01
Total Emissions, tons/yr				**12.3**	**1.8**	**30.2**	**4.8**	**4.4**	**4.4**

Note:

1. Total, 2x250 MW plants.

Table 5.1B-13
Greenhouse Gas Emissions Calculations
Hidden Hills Solar Electric Generating System

Unit	Total Number of Units (1)	Rated Heat Input, MMBtu/hr	Rated Capacity, MW (Note 1)	Operating Hours per year	Fuel Use, MMBtu/yr (1)	Estimated Gross MWh	Maximum Emissions, metric tonnes/yr				Max. Emissions, tons/yr CO2e	CO2 lb/MWh
							CO2	CH4	N2O	SF6		
Auxiliary Boilers	6	500	300	400	1,200,000	1,512,000	63,444	1.08	0.12	--		
Startup Boilers	2	249	n/a	800	398,400	n/a	21,063	0.36	0.04	--		
Nighttime Preservation Boilers	2	12.2	n/a	4000	97,976	n/a	5,180	0.09	0.01	--		
Power Block Emergency Generators	2	23.8	n/a	200	9,520	n/a	696	0.03	0.01	--		
Common Area Emergency Generator	1	2.64	n/a	200	528	n/a	39	1.6E-03	3.2E-04	--		
Power Block Fire Pump Engines	2	1.90	n/a	200	762	n/a	56	2.3E-03	4.6E-04	--		
Common Area Fire Pump Engine	1	1.63	n/a	200	326	n/a	24	9.8E-04	2.0E-04	--		
WSACs	2	--	n/a	2000	0	n/a	0	0.00	0.00	--		
Circuit breakers	4	--	n/a	8760	0	n/a	--	--	--	2.0E-03		
Total			--	--	1,598,400	1,512,000	90,501	1.56	0.18	2.0E-03		
CO2-Equivalent							90,501	32.76	54.66	47.82	99,700	132

Natural Gas GHG Emission Rates (2)

Fuel	Emission Factors, kg/MMBtu			Emission Factor
	CO2 (3)	CH4 (4)	N2O (5)	SF6 (6)
Natural Gas	52.870	9.00E-04	1.00E-04	n/a
Diesel Fuel	73.100	3.00E-03	6.00E-04	n/a
Global Warming Potential (4)	1	21	310	23,900

Notes:

1. Rated capacity and heat input from heat balance at annual average conditions, annual fuel use and gross generation based on 100% capacity factor.
2. Calculation methods and emission factors from ARB, "Regulation for the Mandatory Reporting of Greenhouse Gas Emissions," December 5, 2007 (Staff's Suggested Modifications to the Originally Proposed Regulation Order Released October 19, 2007).
3. Appendix A, Table 4; heat content 1000 to 1025 Btu/scf.
4. Appendix A, Table 6.
5. Appendix A, Table 2.
6. Sulfur hexafluoride (SF6) will be used as an insulating medium in four new 230 kV breakers in the common area and in one generator circuit breaker (GCB) at each power block. Estimates of the SF6 contained in a 230 kV breaker range from 161 to 208 lbs, depending on the manufacturer. The GCBs will each contain 24.2 lb of SF6. The IEC standard for SF6 leakage is less than 0.5%; the NEMA leakage standard for new circuit breakers is 0.1%. A maximum leakage rate of 0.5% per year is assumed.

Table 5.1B-14
Calculation of Noncriteria Pollutant Emissions from Auxiliary Boilers
Hidden Hills Solar Electric Generating System

Compound	Emission Factor, lb/MMcf (1)	Maximum Hourly Emissions, lb/hr per boiler(2)	Annual Emissions (3)	
			tpy per boiler	tpy, all boilers
Propylene	1.55E-02	7.61E-03	1.52E-03	9.14E-03
Hazardous Air Pollutants				
Acetaldehyde	9.0E-04	4.41E-04	8.82E-05	5.29E-04
Acrolein	8.0E-04	3.92E-04	7.84E-05	4.71E-04
Benzene	1.7E-03	8.33E-04	1.67E-04	1.00E-03
Ethylbenzene	2.0E-03	9.80E-04	1.96E-04	1.18E-03
Formaldehyde	3.6E-03	1.76E-03	3.53E-04	2.12E-03
Hexane	1.3E-03	6.37E-04	1.27E-04	7.65E-04
Naphthalene	3.0E-04	1.47E-04	2.94E-05	1.76E-04
PAHs (except naphthalene) (4)	1.0E-04	4.90E-05	9.80E-06	5.88E-05
Toluene	7.8E-03	3.82E-03	7.65E-04	4.59E-03
Xylene	5.8E-03	2.84E-03	5.69E-04	3.41E-03
Total HAPs		1.19E-02	2.38E-03	1.43E-02

Notes:

(1) All factors from Ventura County APCD, "AB2588 Combustion Emission Factors," Natural Gas Fired External Combustion Equipment >100 MMBtu/hr. Available at http://www.vcapcd.org/pubs/Engineering/AirToxics/combem.pdf

(2) Based on maximum hourly boiler heat input of 0.49 MMscf/hr

(3) Based on total annual heat input of 196.1 MMscf/yr

(4) Total PAHs, excluding naphthalene. See speciation below.

(5) Emission factors for individual PAHs obtained from AP-42, Table 1.4-3, then adjusted proportionally so that total of "Adjusted EF" equals Total PAH EF of 1.0 E-04 lb/MMscf per Ventura County factors.

Speciated PAHs (except naphthalene)

	Mean EF (Note 1)	Adjusted EF (Note 5)	Emissions per boiler	
			lb/hr	tpy
Benzo(a)anthracene	1.80E-06	1.58E-05	7.74E-06	1.55E-06
Benzo(a)pyrene	1.20E-06	1.05E-05	5.16E-06	1.03E-06
Benzo(b)fluoranthrene	1.80E-06	1.58E-05	7.74E-06	1.55E-06
Benzo(k)fluoranthrene	1.80E-06	1.58E-05	7.74E-06	1.55E-06
Chrysene	1.80E-06	1.58E-05	7.74E-06	1.55E-06
Dibenz(a,h)anthracene	1.20E-06	1.05E-05	5.16E-06	1.03E-06
Indeno(1,2,3-cd)pyrene	1.80E-06	1.58E-05	7.74E-06	1.55E-06
Total	1.14E-05	1.00E-04	4.90E-05	9.80E-06

Table 5.1B-15
Calculation of Noncriteria Pollutant Emissions from Startup Boilers
Hidden Hills Solar Electric Generating System

Compound	Emission Factor, lb/MMcf (1)	Maximum Hourly Emissions, lb/hr per boiler(2)	Annual Emissions (3)	
			tpy per boiler	tpy, all boilers
Propylene	1.55E-02	3.79E-03	1.52E-03	3.03E-03
Hazardous Air Pollutants				
Acetaldehyde	9.00E-04	2.20E-04	8.79E-05	1.76E-04
Acrolein	8.00E-04	1.95E-04	7.81E-05	1.56E-04
Benzene	1.70E-03	4.15E-04	1.66E-04	3.32E-04
Ethylbenzene	2.00E-03	4.88E-04	1.95E-04	3.91E-04
Formaldehyde	3.60E-03	8.79E-04	3.52E-04	7.03E-04
Hexane	1.30E-03	3.17E-04	1.27E-04	2.54E-04
Naphthalene	3.00E-04	7.32E-05	2.93E-05	5.86E-05
PAHs (except naphthalene) (4)	1.00E-04	2.44E-05	9.76E-06	1.95E-05
Toluene	7.80E-03	1.90E-03	7.62E-04	1.52E-03
Xylene	5.80E-03	1.42E-03	5.66E-04	1.13E-03
Total HAPs		5.93E-03	2.37E-03	4.75E-03

Notes:

(1) All factors from Ventura County APCD, "AB2588 Combustion Emission Factors," Natural Gas Fired External Combustion Equipment >100 MMBtu/hr. Available at http://www.vcapcd.org/pubs/Engineering/AirToxics/combem.pdf

(2) Based on maximum hourly boiler heat input of 0.24 MMscf/hr

(3) Based on total annual heat input of 195.3 MMscf/yr

(4) Total PAHs, excluding naphthalene. See speciation below.

(5) Emission factors for individual PAHs obtained from AP-42, Table 1.4-3, then adjusted proportionally so that total of "Adjusted EF" equals Total PAH EF of 1.0 E-04 lb/MMscf per Ventura County factors.

Speciated PAHs (except naphthalene)

	Mean EF (Note 1)	Adjusted EF (Note 5)	Emissions	
			lb/hr	tpy
Benzo(a)anthracene	1.80E-06	1.58E-05	3.85E-06	1.54E-06
Benzo(a)pyrene	1.20E-06	1.05E-05	2.57E-06	1.03E-06
Benzo(b)fluoranthrene	1.80E-06	1.58E-05	3.85E-06	1.54E-06
Benzo(k)fluoranthrene	1.80E-06	1.58E-05	3.85E-06	1.54E-06
Chrysene	1.80E-06	1.58E-05	3.85E-06	1.54E-06
Dibenz(a,h)anthracene	1.20E-06	1.05E-05	2.57E-06	1.03E-06
Indeno(1,2,3-cd)pyrene	1.80E-06	1.58E-05	3.85E-06	1.54E-06
Total	1.14E-05	1.00E-04	2.44E-05	9.76E-06

Table 5.1B-16
Calculation of Noncriteria Pollutant Emissions from Nighttime Preservation Boilers
Hidden Hills Solar Electric Generating System

Compound	Emission Factor, lb/MMscf (1)	Maximum Hourly Emissions, lb/hr per boiler(2)	Annual Emissions (3) tpy per boiler	Annual Emissions (3) tpy, all boilers
Propylene	5.30E-01	6.36E-03	1.27E-02	2.55E-02
Hazardous Air Pollutants				
Acetaldehyde	3.10E-03	3.72E-05	7.44E-05	1.49E-04
Acrolein	2.70E-03	3.24E-05	6.48E-05	1.30E-04
Benzene	5.80E-03	6.96E-05	1.39E-04	2.79E-04
Ethylbenzene	6.90E-03	8.28E-05	1.66E-04	3.31E-04
Formaldehyde	1.23E-02	1.48E-04	2.95E-04	5.91E-04
Hexane	4.60E-03	5.52E-05	1.10E-04	2.21E-04
Naphthalene	3.00E-04	3.60E-06	7.20E-06	1.44E-05
PAHs (4)	1.00E-04	1.20E-06	2.40E-06	4.80E-06
Toluene	2.65E-02	3.18E-04	6.36E-04	1.27E-03
Xylene	1.97E-02	2.37E-04	4.73E-04	9.46E-04
Total HAPs		9.85E-04	1.97E-03	3.94E-03

Notes:

(1) All factors from Ventura County APCD, "AB2588 Combustion Emission Factors," Natural Gas Fired External Combustion Equipment 10-100 MMBtu/hr. Available at http://www.vcapcd.org/pubs/Engineering/AirToxics/combem.pdf

(2) Based on maximum hourly heat input of 0.012 MMscf/hr

(3) Based on total annual fuel use of 48.0 MMscf/yr

(4) Total PAHs, excluding naphthalene. See speciation below.

(5) Emission factors for individual PAHs obtained from AP-42, Table 1.4-3, then adjusted proportionally so that total of "Adjusted EF" equals Total PAH EF of 1.0 E-04 lb/MMscf per Ventura County factors.

<u>Speciated PAHs (except naphthalene)</u>

	Mean EF (Note 1)	Adjusted EF (Note 5)	Emissions lb/hr	Emissions tpy
Benzo(a)anthracene	1.80E-06	1.58E-05	1.90E-07	3.79E-07
Benzo(a)pyrene	1.20E-06	1.05E-05	1.26E-07	2.53E-07
Benzo(b)fluoranthrene	1.80E-06	1.58E-05	1.90E-07	3.79E-07
Benzo(k)fluoranthrene	1.80E-06	1.58E-05	1.90E-07	3.79E-07
Chrysene	1.80E-06	1.58E-05	1.90E-07	3.79E-07
Dibenz(a,h)anthracene	1.20E-06	1.05E-05	1.26E-07	2.53E-07
Indeno(1,2,3-cd)pyrene	1.80E-06	1.58E-05	1.90E-07	3.79E-07
Total	1.14E-05	1.00E-04	1.20E-06	2.40E-06

Table 5.1B-17
Calculation of Noncriteria Pollutant Emissions from WSACs
Hidden Hills Solar Electric Generating System

Constituent	Concentration in Cooling Tower Return Water (2)	Emissions (1) Emissions, lb/hr	Emissions, ton/yr	Emissions, lbs/year
Ammonia	0 ppm	0.00E+00	0.00E+00	0.0
Copper	0.01 ppm	8.19E-08	3.59E-07	0.0
Silver	0 ppm	0.00E+00	0.00E+00	0.0
Zinc	0 ppm	0.00E+00	0.00E+00	0.0
Hazardous Air Pollutants				
Arsenic	0 ppm	0.00E+00	0.00E+00	0.000
Beryllium	0.0025 ppm	2.05E-08	8.96E-08	0.0
Cadmium	0 ppm	0.00E+00	0.00E+00	0.000
Chromium (III)	0 ppm	0.00E+00	0.00E+00	0.000
Lead	0 ppm	0.00E+00	0.00E+00	0.000
Mercury	0 ppm	0.00E+00	0.00E+00	0.000
Nickel	0 ppm	0.00E+00	0.00E+00	0.000
Dioxins/furans	-- ppm	--	--	--
PAHs	--	--	--	--
Total HAPs			8.96E-08	1.79E-04

Notes:
1. Emissions calculated from maximum drift rate 8.19 lb/hr.
2. 20 cycles of concentration

Table 5.1B-18
Detailed Emission Calculations for Boiler Commissioning
Hidden Hills Solar Electric Generating System

Units	Activity	Days	Daily Operation (hrs/day)	Heat Input Rate (MMBtu/hr)	Pollutant	Emission Factor (lbs/MMBtu)	Hourly Emissions (lbs/hr)	Daily Emissions (lbs/day)	Total Emissions During Test (lbs)	Notes
Auxiliary Boilers	Cold start/ Tuning	6	5	62.5	NOx	0.09	5.63	28.2	168.9	1 day per boiler. Use cold start emission rates
					CO	0.22	13.71	68.6	411.4	
					VOC	0.025	1.57	7.9	47.1	
					SOx	0.0021	0.13	0.7	3.9	
					PM10	0.01	0.63	3.1	18.8	
Auxiliary Boilers	Warm start/ Tuning	6	5	62.5	NOx	0.09	5.6	28.2	168.9	1 day per boiler. Assume same as cold start emission rates
					CO	0.22	13.7	68.6	411.4	
					VOC	0.025	1.6	7.9	47.1	
					SOx	0.0021	0.1	0.7	3.9	
					PM10	0.01	0.6	3.1	18.8	
Auxiliary Boilers	Part Load Operation	36	5	188	NOx	0.0108	2.03	10.1	364.9	6 days per boiler. Assume fully controlled levels based on 25% minimum compliant load
					CO	0.0366	6.86	34.3	1,234.2	
					VOC	0.0053	0.99	4.9	178.1	
					SOx	0.0021	0.39	2.0	70.9	
					PM10	0.005	0.94	4.7	168.8	
Auxiliary Boilers	Full Load Operation	12	5	500	NOx	0.0108	5.4	27.0	324.3	2 days per boiler
					CO	0.0366	18.3	91.4	1,097.0	
					VOC	0.0053	2.6	13.2	158.3	
					SOx	0.0021	1.1	5.3	63.0	
					PM10	0.0050	2.5	12.5	150.0	
Startup Boilers	Cold start/tuning	2	4	31.1	NOx	0.09	2.80	11.2	22.4	1 day per boiler. Use cold start emission rates
					CO	0.22	6.83	27.3	54.6	
					VOC	0.025	0.78	3.1	6.3	
					SOx	0.0021	0.07	0.3	0.5	
					PM10	0.01	0.31	1.2	2.5	

Startup Boilers	Warm start/tuning	2	4	31.1	NOx	0.09	2.8	11.2	22.4	1 day per boiler. Assume same as cold start emission rates
					CO	0.22	6.8	27.3	54.6	
					VOC	0.03	0.8	3.1	6.3	
					SOx	0.0021	0.1	0.3	0.5	
					PM10	0.01	0.3	1.2	2.5	
Startup Boilers	Part Load Operation	8	6	93	NOx	0.0108	1.01	6.1	48.5	4 days per boiler. Assume fully controlled levels based on 25% minimum compliant load
					CO	0.018	1.71	10.2	81.9	
					VOC	0.0053	0.49	3.0	23.7	
					SOx	0.0021	0.20	1.2	9.4	
					PM10	0.005	0.47	2.8	22.4	
Startup Boilers	Full Load Operation	4	4	249	NOx	0.0108	2.7	10.8	43.1	2 days per boiler.
					CO	0.0183	4.6	18.2	72.8	
					VOC	0.0053	1.3	5.3	21.0	
					SOx	0.0021	0.5	2.1	8.4	
					PM10	0.01	1.2	5.0	19.9	
Nighttime Pres. Boilers	Cold Start Operation	2	4	1.5	NOx	0.0216	0.03	0.1	0.3	1 day per boiler. Assume cold start emissions are 2x normal emissions
					CO	0.0731	0.11	0.4	0.9	
					VOC	0.0084	0.01	0.1	0.1	
					SOx	0.0021	0.00	0.0	0.0	
					PM10	0.01	0.02	0.1	0.1	
Nighttime Pres. Boilers	Part Load Operation	2 2	6 4	4.6	NOx	0.011	0.05	0.3	1.0	2 days per boiler. Assume fully controlled levels based on 25% minimum compliant load
					CO	0.037	0.17	1.0	3.4	
					VOC	0.004	0.02	0.1	0.4	
					SOx	0.0021	0.01	0.1	0.2	
					PM10	0.005	0.02	0.1	0.5	
Nighttime Pres. Boilers	Full Load Operation	2	6	12	NOx	0.0108	0.1	0.8	1.6	1 day per boiler
					CO	0.0366	0.4	2.7	5.4	
					VOC	0.0042	0.1	0.3	0.6	
					SOx	0.0021	0.0	0.2	0.3	
					PM10	0.005	0.1	0.4	0.7	
Maximum/Total for the Commissioning Period		84	420		NOx		5.6	28.2	1,166.3	Maximum hourly, maximum daily and total commissioning period emissions
					CO		18.3	91.4	3,427.6	
					VOC		2.6	13.2	489.0	
					SOx		1.1	5.3	161.2	
					PM10		2.5	12.5	404.9	