APPENDIX 6.2

AIR QUALITY

APPENDIX 6.2-1

EMISSIONS AND OPERATING PARAMETERS

Table 6.2-1.1
Emissions and Operating Parameters for New Turbines
Avenal Energy Project

	Case 1	Case 5	Case 9	Case 2	Case 6	Case 10	Case 4	Case 8	Case 12
	101°F	63°F	32°F	101°F	63°F	32°F	101°F	63°F	32°F
	Full Load w/ DB(1)	Full Load w/ DB(1)	Full Load w/ DB(1)	Full Load no DB	Full Load no DB	Full Load no DB	50% Load	50% Load	50% Load
Ambient Temp, °F	101	63	32	101	63	32	101	63	32
GT Load, %	100%	100%	100%	100%	100%	100%	50%	50%	50%
Both GTs Gross Power, MW	344.8	345.0	359.0	345.5	345.6	**359.5**	144.1	168.6	183.2
STG Gross Power, MW	290.8	273.3	254.7	171.6	176.1	177.7	118.3	127.6	130.6
Plant Gross Power Output, MW	635.6	**618.3**	613.7	517.2	**521.7**	537.2	262.5	296.2	313.9
Plant Net Power Output, MW	600.0	600.0	600.0	483.7	506.5	525.5	250.3	286.3	304.8
GTs Fuel Flow, kpph	156.4	156.4	161.8	156.4	156.4	161.8	87.2	96.2	102.2
DBs Fuel Flow, kpph	49.0	39.6	31.0	0.0	0.0	0.0	0.0	0.0	0.0
GTs Heat Input, MMBtu/hr (HHV)	1,794.2	1,794.3	1,855.4	1,795.6	1,795.4	1,856.3	1,001.4	1,104.3	1,171.9
DBs Heat Input, MMBtu/hr (HHV)	562.3	454.4	356.3	0.0	0.0	0.0	0.0	0.0	0.0
Total Heat Input, MMBtu/hr (HHV)	**2,356.5**	2,248.6	2,211.8	1,795.6	1,795.4	**1,856.3**	1,001.4	1,104.3	**1,171.9**
Stack Flow, lb/hr	3,653,000	3,650,000	3,759,000	3,628,000	3,630,000	3,743,000	2,232,700	2,336,800	2,413,300
Stack Flow, acfm	**1,044,365**	**1,025,495**	**1,059,836**	**1,051,531**	**1,037,822**	**1,071,653**	**620,528**	**644,316**	**666,146**
Stack Temp, °F	**195.3**	**184.9**	**189.0**	**207.4**	**198.8**	**200.9**	**180.2**	**175.8**	**177.4**
Stack exhaust, vol%									
O_2 (dry)	11.40%	11.87%	12.34%	13.76%	13.77%	13.78%	14.46%	14.11%	13.93%
CO_2 (dry)	5.42%	5.16%	4.89%	4.09%	4.08%	4.08%	3.70%	3.89%	3.99%
H_2O	10.54%	10.03%	9.12%	8.39%	8.28%	7.78%	8.07%	7.97%	7.63%
Emissions									
NO_x, ppmvd @ 15% O_2	**2.0**	2.0	2.0	2.0	2.0	**2.0**	2.0	2.0	2.0
NO_x, lb/hr(2)	**17.13**	**16.34**	**16.06**	**13.03**	**13.03**	**13.47**	**7.26**	**8.01**	**8.51**
NO_x, lb/MMBtu (HHV)	**0.0073**	0.0073	0.0073	0.0073	0.0073	**0.0073**	0.0073	0.0073	0.0073
SO_2, ppmvd @ 15% O_2 (3)	**0.139**	0.139	0.140	0.140	0.140	**0.140**	0.140	0.140	0.140
SO_2, lb/hr(2,3)	**1.66**	1.59	1.56	1.27	1.27	**1.31**	0.71	0.78	0.83
SO_2, lb/MMBtu (HHV)(3)	**0.0007**	0.0007	0.0007	0.0007	0.0007	**0.0007**	0.0007	0.0007	0.0007
CO, ppmvd @ 15% O_2	**4.0**	4.0	4.0	4.0	4.0	**4.0**	4.0	4.0	4.0
CO, lb/hr(2)	**20.86**	19.90	19.56	15.86	15.86	**16.39**	8.84	9.75	10.36
CO, lb/MMBtu (HHV)	**0.0089**	0.0088	0.0088	0.0088	0.0088	**0.0088**	0.0088	0.0088	0.0088
VOC, ppmvd @ 15% O_2(4)	**2.0**	2.0	2.0	1.4	1.4	**1.4**	1.4	1.4	1.4
VOC, lb/hr(2,4)	**5.96**	5.68	5.59	3.17	3.17	**3.28**	1.77	1.95	2.07
VOC, lb/MMBtu (HHV)(4)	**0.0025**	0.0025	0.0025	0.0018	0.0018	**0.0018**	0.0018	0.0018	0.0018
PM_{10}, lb/hr(2,5)	**11.81**	11.27	10.78	9.00	9.00	**9.00**	9.00	9.00	9.00
PM_{10}, lb/MMBtu (HHV)(5)	**0.0050**	0.0050	0.0049	0.0050	0.0050	**0.0048**	0.0090	0.0081	0.0077
PM_{10}, gr/SCF (dry)(5)	0.00189	0.00179	0.00165	0.00142	0.00142	0.00137	0.00230	0.00220	0.00212
NH_3, ppmvd @ 15% O_2	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
NH_3, lb/hr(2)	35.39	33.57	32.66	26.28	26.25	26.98	14.60	16.08	17.02
CO_2, lb/MMBtu (HHV)(7)	117.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0
CH_4, lb/MMBtu (HHV)(6)	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
N_2O, lb/MMBtu (HHV)(8)	0.00022	0.00022	0.00022	0.00022	0.00022	0.00022	0.00022	0.00022	0.00022
CO_2, lb/hr (5)	275,599	262,984	258,674	210,000	209,976	217,102	117,114	129,153	137,055
CH_4, lb/hr (5)	30.7	29.2	28.8	23.4	23.4	24.1	13.0	14.4	15.2
N_2O, lb/hr (5)	0.52	0.50	0.49	0.40	0.40	0.41	0.22	0.24	0.26

1) Includes duct burner firing only up to plant maximum output of 600 MW.

2) All mass flow values reported are on a per stack basis. Plant total mass flows are double these values.

3) All of the assumed 0.25 gr S in 100 scf of the fuel is assumed to be converted to SO_2 with no SO_3 conversion.

4) Based on an assumption that 20% of reported UHC emissions are VOCs.

5) Includes front-half (filterable) portion only. Back-half (condensible) portion is excluded.

6) CH_4 emission factor (kg/MMBtu) = **0.0059**

ARB. *Draft Emission Factors for Mandatory Reporting Program, T*able of Methane and Nitrous Oxide Emission Factors for Stationary Combustion by Sector and Fuel Type, August 10, 2007.

7) CO_2 emission factor (kg/MMBtu) = **53.05**

ARB. *Draft Emission Factors for Mandatory Reporting Program, T*able of Carbon Dioxide Emission Factors and Oxidation Rates for Stationary Combustion, August 10, 2007.

8) N_20 emission factor (kg/MMBtu) = **0.0001**

ARB. *Draft Emission Factors for Mandatory Reporting Program, T*able of Methane and Nitrous Oxide Emission Factors for Stationary Combustion by Sector and Fuel Type, August 10, 2007.

Table 6.2-1.2
Auxiliary Boiler Specifications

Parameter	Value
Auxiliary Boiler, MMBtu/hr (HHV)	37.4
Boiler Rating, hp	700
NOx, ppmvd @ 3% O_2	9.0
CO, ppmvd @ 3% O_2	50.0
VOC (as CH_4), ppmvd @ 3% O_2	10.0
NOx (as NO_2), lb/hr	0.411
NOx, lb/MMBtu	0.011
CO, lb/hr	1.38
CO, lb/MMBtu	0.037
POC [1](as CH4), lb/hr	0.16
POC, lb/MMBtu	0.0043
PM10, lb/hr	0.19
PM10, lb/MMBtu	0.0050
PM10, grains/scf	0.0027
SO_2, grains/100 scf	**1**
SO_2, lb/hr	0.105
SO_2, ppmvd @ 3% O_2	1.7
SO_2, lb/MMBtu	0.0028

1) Particulate organic carbon

Stack inside diameter (inches) =	32
Stack height (ft agl) =	37
Stack exhaust temperature (F) =	398
Stack exit velocity (fps) =	40
Stack exit flow rate (acfm) =	13,404

Table 6.2-1.3
Emergency Standby Natural Gas-Fueled Generator Engine Performance and Emissions
Avenal Energy Project

Engine				Parameters for Modeling	
Manufacturer		Caterpillar			
Model		G3512 LE			
Capacity (w/o fan)	kW	550			
Brake Horsepower	bhp	860			
Fuel		Natural gas			
Fuel Consumption (HHV)	Btu/bhp-hr	7,512			
Fuel Consumption	scfh	6,377			
Combustion Air Flow	acfm	4,899		2.312	m3/s
	scfm	2,027			
Exhaust Temperature	deg. F	797		698.00	deg K
Exhaust Pipe Diameter	in	8		0.2032	m
Number of Exhaust Pipes		1		71.30	m/s
Exhaust Stack Height	ft	10		3.048	m
Operating Profile					
Annual operation	hrs	50			
Stack Velocity	ft/sec	233.91			
Emissions					
NOx	g/bhp-hr	1.50			
CO	g/bhp-hr	2.10			
VOC	g/bhp-hr	0.330			
PM10	lbs/MMBtu	0.0099871	USEPA AP-42 Ch. 3.2		
PM10	g/bhp-hr	0.03403			
PM10	**gr/scf**	0.00371			
NOx	lb/hr	2.84			
CO	lb/hr	3.98			
VOC	lb/hr	0.63			
PM10	lb/hr	0.065			
SO_2	lb/hr	0.0182			
SO_2	gr S/dscf n.g.	0.0100			
SO_2	lb/MMBtu	0.0028			
Exhaust oxygen level	%	8.5			
CO_2 (1)	lb/hr	756			
CH_4 (2)	lb/hr	0.084			
N_2O (3)	lb/hr	0.0014			

1) CH_4 emission factor (kg/MMBtu) = **0.0059**

ARB. *Draft Emission Factors for Mandatory Reporting Program, T* able of Methane and Nitrous Oxide Emission Factors for Stationary Combustion by Sector and Fuel Type, August 10, 2007.

2) CO_2 emission factor (kg/MMBtu) = **53.05**

ARB. *Draft Emission Factors for Mandatory Reporting Program, T* able of Carbon Dioxide Emission Factors and Oxidation Rates for Stationary Combustion, August 10, 2007.

3) N_20 emission factor (kg/MMBtu) = **0.0001**

ARB. *Draft Emission Factors for Mandatory Reporting Program, T* able of Methane and Nitrous Oxide Emission Factors for Stationary Combustion by Sector and Fuel Type, August 10, 2007.

Table 6.2-1.4
Diesel-Fueled Fire Water Pump Engine Performance and Emissions
Avenal Energy Project

Engine			Parameters for Modeling
Manufacturer		Cummins	
Model		CFP83-F40 (1)	
Brake Horsepower	Bhp	288	
Speed	rpm	1760	
Fuel		CARB Diesel	
Specific Gravity		0.825	
Fuel Sulfur Content	ppmw	15	
Fuel Consumption	gph	14.5	
Exhaust Flow	acfm	1,632	0.770 m^3/s
	scfm	601	
Exhaust Temperature	deg. F	952	784.11 deg K
Exhaust Pipe Diameter	in	6	0.1524 m
			42.22 m/s
Exhaust Stack Height	ft	18	5.4864 m
Operating Profile			
Annual Operation	hrs	50	
Emissions			
Exhaust Velocity	ft/sec	138.5	
NOx	g/bhp-hr	3.4002	
CO	g/bhp-hr	0.447	
VOC	g/bhp-hr	0.3778	
PM10	g/bhp-hr	0.059	
PM10	**gr/scf**	**0.0073**	
NOx	lb/hr	2.16	
CO	lb/hr	0.28	
VOC	lb/hr	0.24	
PM10	lb/hr	0.037	
SO_2	lb/hr	0.0031	
CO_2 (2)	lb/hr	236	
CH_4 (3)	lb/hr	0.026	
N_2O (4)	lb/hr	0.00044	

1) California ATCM and EPA Tier 2 emission limit compliant
Energy content of Diesel fuel (Btu/lb) = 19,300

USEPA. Compilation of Air Pollutant Emission Factors, Volume I - Stationary Point and Area Sources, Chapter 3.3 - Gasoline and Diesel Industrial Engines, October 1996.

Energy content of Diesel fuel (Btu/gal) = 139,000

USEPA. Compilation of Air Pollutant Emission Factors, Volume I - Stationary Point and Area Sources, Chapter 3.1 - Stationary Gas Turbines, April 2000..

2) CH_4 emission factor (kg/MMBtu) = 0.0059
ARB. *Draft Emission Factors for Mandatory Reporting Program, T*able of Methane and Nitrous Oxide Emission Factors for Stationary Combustion by Sector and Fuel Type, August 10, 2007.
3) CO_2 emission factor (kg/MMBtu) = 53.05
ARB. *Draft Emission Factors for Mandatory Reporting Program, T*able of Carbon Dioxide Emission Factors and Oxidation Rates for Stationary Combustion, August 10, 2007.
4) N_20 emission factor (kg/MMBtu) = 0.0001
ARB. *Draft Emission Factors for Mandatory Reporting Program, T*able of Methane and Nitrous Oxide Emission Factors for Stationary Combustion by Sector and Fuel Type, August 10, 2007.

Table 6.2-1.5
Natural Gas Specifications

Component		Volume Percent	MW	Moles of Atom per 100 Moles Gas C	H	N	O	S	Weight Portion	Btu/ft^3 (2) (HHV)	(LHV)	lb/1000 ft^3 (1) --	Btu/lb (1) (HHV)	(LHV)	Volume-Weighted Average MW	HHV/LHV
CH_4	**Methane**	95.96%	16.043	95.96	383.84	0.00	0.00	0.00	0.919	1010.0	909.4	42.274	23,892.2	21,511.9	15.40	**1.1107**
C_2H_6	**Ethane**	1.95%	30.070	3.90	11.70	0.00	0.00	0.00	0.035	1769.7	1618.7	79.237	22,334.1	20,429.2	0.59	**1.0932**
C3H8	**Propane**	0.24%	44.097	0.72	1.92	0.00	0.00	0.00	0.006	2516.2	2314.9	116.199	21,654.1	19,922.2	0.11	**1.0869**
N-C4H10	**n-Butane**	0.07%	58.125	0.28	0.70	0.00	0.00	0.00	0.002	3241.1	2991.2	152.161	21,300.2	19,657.8	0.04	**1.0835**
iso-C4H10	**Iso-Butane**	0.00%	58.125	0.00	0.00	0.00	0.00	0.00	0.000	3230.7	2980.8	152.161	21,232.3	19,589.8	0.00	1.0838
N-C5H12	**n-Pentane**	0.02%	72.152	0.10	0.24	0.00	0.00	0.00	0.001	4008.7	3706.9	190.123	21,085.0	19,497.2	0.01	**1.0814**
iso-C5H12	**Iso-Pentane**	0.00%	72.152	0.00	0.00	0.00	0.00	0.00	0.000	4000.9	3699.0	190.123	21,043.7	19,455.9	0.00	1.0816
C6H14	**n-Hexane**	0.01%	86.179	0.06	0.14	0.00	0.00	0.00	0.001	4756.0	4403.8	227.085	20,943.8	19,392.9	0.01	**1.0800**
O_2		0.00%	31.998	0.00	0.00	0.00	0.00	0.00	0.000						0.00	
N_2		1.08%	28.014	0.00	0.00	2.16	0.00	0.00	0.018						0.30	
CO_2		0.67%	44.009	0.67	0.00	0.00	1.34	0.00	0.018						0.29	
H_2		0.00%	2.016	0.00	0.00	0.00	0.00	0.00	0.000						0.00	
H_2O		0.00%	18.015	0.00	0.00	0.00	0.00	0.00	0.000						0.00	
Ash		0.00%														
Total		100.00%							1.000							
Dry Basis, Ash Free																
Total		100.00%		101.69	398.54	2.16	1.34	0.00		**1013.3**	913.05		22,961	20,689	16.75	**1.1098**
			Mol Wt:	12.01	1.01	14.01	16.00	32.06								
		Gram atoms/100 moles:		1221.41	401.73	30.26	21.44	0.00	1674.8359							
		Chemical Analysis (wt%):		72.93	23.99	1.81	1.28	0	100.00							

Standard Molar Volume 379.69 ft^3/lb-mole at standard temperature defined by District

Molecular Weights

C	12.01
H	1.01
N	14.01
O	16.00
S	32.06
CH4	16.04
H2O	18.02
NO2	46.01
SO2	64.06
O2	32.00
CO2	44.01
NH3	17.03
CO	28.01
N2	28.01

1) American Society of Mechanical Engineers. *Performance Test Code 22 - Gas Turbines,* 2005.
Properties are for 60.0°F and 14.696 psia.
2) Calculated from Btu/lb x MW /molar volume at District standard temperature

Table 6.2-1.6
Summary of Startup Emissions Data - pounds per hour

Project	Notes	POC	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	11

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. POC 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 6.2-1.7
Summary of Startup Emissions Data - pounds per start per turbine

Project	Notes	POC	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		96	5,412	480	7.8	66

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 four hours per startup.

Table 6.2-1.8
Avenal Energy Project
Detailed Calculations for Maximum Hourly, Daily and Annual Criteria Pollutant Emissions
Maximum Scenarios by Pollutant

Emitting Unit and Operating Mode	Maximum CO Emiss. Scenario			Maximum NOx Emiss. Scenario			Max. PM10/SOx/GHG Emiss. Scenario			Maximum VOC Emiss. Scenario			NOx		SO_x [1]		CO		VOC		PM10	CO_2	CH_4	N_2O
	Max. CO Emission Hour (Startup)	Max. CO Emission Day (Startup + Duct Firing)	Max. CO Emission Year Scenario	Max. NOx Emission Hour (Startup)	Max. NOx Emission Day (Startup + Duct Firing)	Max. NOx Emission Year Scenario	Max. PM-10/SOx Emission Hour (Duct Firing)	Max. PM-10/SOx Emission Day (Duct Firing)	Max. PM-10/SOx Emission Year Scenario	Max. VOC Emission Hour (Startup)	Max. VOC Emission Day (Startup + Duct Firing)	Max. VOC Emission Year Scenario	Maximum Hourly Emission Rate (lb/hr)		Maximum Hourly Emission Rate (lb/hr)		Maximum Hourly Emission Rate (lb/hr)		Maximum Hourly Emission Rate (lb/hr)		Maximum Hourly Emission Rate (lb/hr)	Base Load	Base Load	Base Load
	(hrs)	(hrs/day)	(hrs/yr)	(hrs)	(hrs/day)	(hrs/yr)	(hrs)	(hrs/day)	(hrs/yr)	(hrs)	(hrs/day)	(hrs/yr)	Short Term	Long Term	Short Term	Long Term	Short Term	Long Term	Short Term	Long Term	lb/hr	lb/hr	lb/hr	lb/hr
Gas Turbine 1, baseload hot wo duct firing													13.03	13.03	5.07	1.82	15.86	15.86	3.17	3.17	9.00	210,000	23.36	0.40
Gas Turbine 2, baseload hot wo duct firing													13.03	13.03	5.07	1.82	15.86	15.86	3.17	3.17	9.00	210,000	23.36	0.40
Gas Turbine 1, baseload avg. wo duct firing			3,800			6,683			7,960			6,683	13.03	13.03	5.06	1.82	15.86	15.86	3.17	3.17	9.00	209,976	23.35	0.40
Gas Turbine 2, baseload avg. wo duct firing			3,800			6,683			7,960			6,683	13.03	13.03	5.06	1.82	15.86	15.86	3.17	3.17	9.00	209,976	23.35	0.40
Gas Turbine 1, baseload cold wo duct firing													13.47	13.47	5.24	1.89	16.39	16.39	3.28	3.28	9.00	217,102	24.15	0.41
Gas Turbine 2, baseload cold wo duct firing													13.47	13.47	5.24	1.89	16.39	16.39	3.28	3.28	9.00	217,102	24.15	0.41
Gas Turbine 1, duct firing, hot ambient temp.		18			18		1	24			18		17.13	17.13	6.65	2.39	20.86	20.86	5.96	5.96	11.81	275,599	30.65	0.52
Gas Turbine 2, duct firing, hot ambient temp.		18			18		1	24			18		17.13	17.13	6.65	2.39	20.86	20.86	5.96	5.96	11.81	275,599	30.65	0.52
Gas Turbine 1, duct firing, average ambient temp.			800			800			800			800	16.34	16.34	6.34	2.28	19.90	19.90	5.68	5.68	11.27	262,984	29.25	0.50
Gas Turbine 2, duct firing, average ambient temp.			800			800			800			800	16.34	16.34	6.34	2.28	19.90	19.90	5.68	5.68	11.27	262,984	29.25	0.50
Gas Turbine 1, duct firing, cold ambient temp.													16.06	16.06	6.24	2.25	19.56	19.56	5.59	5.59	10.78	258,674	28.77	0.49
Gas Turbine 2, duct firing, cold ambient temp.													16.06	16.06	6.24	2.25	19.56	19.56	5.59	5.59	10.78	258,674	28.77	0.49
Gas Turbine 1, startups (50% load), maximum	1	6	624.0	1	6	547.5		0	0	1	6	547.5	160	80	3.31	1.19	1,000	902	16.00	16.00	9.00	137,055	15.24	0.26
Gas Turbine 2, startups (50% load), maximum	1	6	624.0	1	6	547.5		0	0	1	6	547.5	160	80	3.31	1.19	1,000	902	16.00	16.00	9.00	137,055	15.24	0.26
Auxiliary Boiler (for startups)	1	12	1,248	1	12	1095		0	0	1	12	1095	0.41	0.41	0.105	0.038	1.38	1.38	0.16	0.16	0.19	4,374	0.48	0.00825
Emergency Generator Engine		1	50		1	50	1	1	50		1	50	1.90	1.90	0.018	0.007	1.14	1.14	0.63	0.63	0.06	756	0.08406	0.00142
Emergency Fire Water Pump Engine		1	50		1	50	1	1	50		1	50	2.16	2.16	0.0031	0.0031	0.28	0.28	0.24	0.24	0.037	236	0.02622	0.00044
Total Emitting Hours	1	24	5,224	1	24	8,030	1	24	8,760	1	24	8,030												

	Weekend Shutdown and Weekday Start Scenario			Weekend and Weekday Hotstart Scenario			Baseload Scenario			Weekend and Weekday Hotstart Scenario		
	Hourly	Daily	Annual	Hourly	Daily	Annual	Hourly	Daily	Annual	Hourly	Daily	Annual
Turbine (Each) Operation Scenario Max. Fuel use (MMBtu)	1,172	49,448	9,310,379	1,172	49,448	14,401,050	**2,356.5**	**56,555**	**16,090,028**	1,172	49,448	14,401,050
Auxiliary Boiler Operation Scenario Max. Fuel use (MMBtu)	37.4	449	46,652	37.4	449	40,933	0	0	0	37.4	449	40,933
Total Scenario Max. Fuel use (MMBtu)	2,381	99,344	18,667,410	2,381	99,344	28,843,034	**4,713**	**113,111**	**32,180,056**	2,381	99,344	28,843,034

1) Long-term sulfur concentration in natural gas reduced from tariff limit of 1 grS/100scf to (grS/100scf) = 0.36
Short-term sulfur concentration in natural gas is the tariff limit of (grS/100scf) = 1
Eng'g performance calcs used sulfur concentration in natural gas of (grS/100scf) = 0.25

Maximum Hourly, Daily, and Annual Criteria Pollutant Emissions

Emitting Unit and Operating Mode	NOx			SOx			CO			VOC			PM10			CO_2			CH_4			N_2O		
	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy
Gas Turbine 1, baseload hot wo duct firing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Turbine 2, baseload hot wo duct firing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Turbine 1, baseload avg. wo duct firing	0	0	43.54	0	0	7.26	0	0	30.14	0	0	10.60	0	0	35.82	0.00	0.00	835,703.03	0.00	0.00	92.94	0.00	0.00	1.58
Gas Turbine 2, baseload avg. wo duct firing	0	0	43.54	0	0	7.26	0	0	30.14	0	0	10.60	0	0	35.82	0.00	0.00	835,703.03	0.00	0.00	92.94	0.00	0.00	1.58
Gas Turbine 1, baseload cold wo duct firing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Turbine 2, baseload cold wo duct firing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Turbine 1, duct firing, hot ambient temp.	0	308.38	0	6.65	159.55	0	0	375.41	0	0	107.26	0	11.81	283.47	0	275,598.63	6,614,367.18	0.00	30.65	735.62	0.00	0.52	12.47	0.00
Gas Turbine 2, duct firing, hot ambient temp.	0	308.38	0	6.65	159.55	0	0	375.41	0	0	107.26	0	11.81	283.47	0	275,598.63	6,614,367.18	0.00	30.65	735.62	0.00	0.52	12.47	0.00
Gas Turbine 1, duct firing, average ambient temp.	0	0	6.54	0	0	0.91	0	0	7.96	0	0	2.27	0	0	4.51	0.00	0.00	105,193.79	0.00	0.00	11.70	0.00	0.00	0.20
Gas Turbine 2, duct firing, average ambient temp.	0	0	6.54	0	0	0.91	0	0	7.96	0	0	2.27	0	0	4.51	0.00	0.00	105,193.79	0.00	0.00	11.70	0.00	0.00	0.20
Gas Turbine 1, duct firing, cold ambient temp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Turbine 2, duct firing, cold ambient temp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Turbine 1, startups (50% load), maximum	160	960	21.90	0	0	0	1000	5412	281.42	16	96	4.38	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Turbine 2, startups (50% load), maximum [1]	80	960	21.90	0	0	0	1000	5412	281.42	16	96	4.38	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auxiliary Boiler (for startups)	0.41	4.93	0.23	0	0	0	1.38	16.60	0.86	0.16	1.93	0.088	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emergency Generator Engine	0	1.90	0.047	0.018	0.018	0.00016	0	1.14	0.03	0	0.63	0.016	0.065	0.065	0.0016	755.79	755.79	18.89	8.41E-02	8.41E-02	2.10E-03	1.42E-03	1.42E-03	3.56E-05
Emergency Fire Water Pump Engine	0	2.16	0.054	0.0031	0.0031	7.7213E-05	0	0.28	0.0071	0	0.24	0.0060	0.037	0.037	0.00094	235.72	235.72	5.89	2.62E-02	2.62E-02	6.55E-04	4.44E-04	4.44E-04	1.11E-05
Total	**240.41 lb/hr**	**2,545.74 lb/day**	**144.28 tpy**	**13.32 lb/hr**	**319.12 lb/day**	**16.34 tpy**	**2,001.38 lb/hr**	**11,592.85 lb/day**	**639.94 tpy**	**32.16 lb/hr**	**409.32 lb/day**	**34.62 tpy**	**23.72 lb/hr**	**567.05 lb/day**	**80.66 tpy**	552,189 lb/hr	13,229,726 lb/day	1,881,818 tpy	61.41 lb/hr	1471.35 lb/day	209.29 tpy	1.04 lb/hr	24.94 lb/day	3.55 tpy
Gas turbines=	240.00	2,536.75	143.95	13.30	319.10	16.34	2,000.00	11,574.83	639.05	32.00	406.52	34.51	23.62	566.95	80.66	551,197	13,228,734	1,881,794	61.30	1471.24	209.29	1.04	24.94	3.55
Engines and Boiler =	0.41	8.99	0.33	0.02	0.02	0.00	1.38	18.02	0.90	0.16	2.79	0.11	0.10	0.10	0.00	991.511	991.511	24.7878	0.110	0.110	0.0028	0.002	0.002	0.0000
1) Based on Gas Turbine 2 starting 1 hour after Gas Turbine 1.																				**CO_2e**			**CO_2e**	
CO_2e factor [2]																	1			23			296	
Global emission rate (teragrams per year)																								16.2
Global emission rate (metric tons per year)																	2.70E+10	2.70E+10		8.53E+09	3.71E+08		4.80E+09	1.62E+07
Global emission rate (tons per year)																		2.97E+10			4.08E+08			1.78E+07
Avenal portion (%)																		6.34E-03			5.13E-05			1.99E-05
Project (MMT CO_2e /yr)																		1.71E+00			4.38E-03			9.55E-04
Gas turbines (MMT CO_2e /yr)																		1.71E+00			4.38E-03			9.55E-04
Auxiliary Boiler (MMT CO_2e /yr)																		0.00E+00			0.00E+00			0.00E+00
Emergency Standby Generator Engine (MMT CO_2e /yr)																		1.72E-05			4.39E-08			9.58E-09
Emergency Standby Fire Water Pump Engine (MMT CO_2e /yr)																		5.36E-06			1.37E-08			2.99E-09

2) Table 5.4 in April 2005 Version 1.0 of Appendix to the General Reporting Protocol: Power/Utility Reporting Protocol of the California Climate Action Registry.
Source: Intergovernmental Panel on Climate Change, Third Assessment Report (2001).

Table 6.2-1.9
Detailed Emission Calculations for Each Turbine Commissioning
Avenal Energy Project

Commissioning Test	Activity	Days	Daily Operation (hrs/day)	GT Firing Rate (MMBtu/hr)	Pollutant	Emission Factor (lbs/MMBtu)	Hourly Emissions (lbs/hr)	Daily Emissions (lbs/day)	Total Emissions During Test (lbs)
FSNL + Ign. Tests	FSNL Operation	5	12	400	NOx	0.3125	125	1,500.0	7,500.0
					CO		1000	12,000.0	60,000.0
					VOC		16.00	192.0	960.0
					SOx	0.00282	1.13	13.5	67.7
					PM10		9.00	108.0	540.0
Part Load Tests	Part Load Operation	6	12	1,172	NOx	0.1088	127.47	1,529.7	9,177.9
					CO		385	4,620.0	27,720.0
					VOC		16.00	192.0	1,152.0
					SOx	0.00282	3.31	39.7	238.0
					PM10		9.00	108.0	648.0
Full Load Tests without SCR operational	Full Load Operation	4	12	1,856	NOx	0.0326	60.60	727.2	2,908.9
					CO	0.0088	16.39	196.7	786.9
					VOC	0.00177	3.28	39.3	157.4
					SOx	0.00282	5.24	62.8	251.4
					PM10		9.00	108.0	432.0
Full Load Tests with SCR at partial control	Startup/Shutdown	5	3	1,856	NOx		160.00	813.5	4,067.3
					CO		1000.00	3147.6	15,737.8
					VOC		16.00	77.5	387.6
					SOx	0.0028	5.24	62.8	314.2
					PM10		9.00	108.0	540.0
	Full Load Operation		9		NOx	0.0200	37.05	inc	inc
					CO	0.0088	16.39	inc	inc
					VOC	0.00177	3.28	inc	inc
					SOx	0.00282	5.24	inc	inc
					PM10		9.00	inc	inc
Full Load Tests with SCR at full control	Startup/Shutdown	14	3	1,856	NOx		160.00	601.2	8,416.8
					CO		1000.00	3147.6	44,065.7
					VOC		16.00	77.5	1,085.1
					SOx	0.00282	5.24	62.8	879.8
					PM10		9.00	108.0	1,512.0
	Full Load Operation		9		NOx	0.0073	13.47	inc	inc
					CO	0.0088	16.39	inc	inc
					VOC	0.00177	3.28	inc	inc
					SOx	0.0028	5.24	inc	inc
					PM10		9.00	inc	inc

Total Commissioning Hours per Turbine: 408

1. Emission factors during FSNL and ignition tests
   NOx - based on information for a GE 7FA turbine during FSNL (125 lbs/hr).
   CO - based on maximum startup emission rates of 1,000 lbs/hr.
   VOC, SOx and PM10 - based on startup emission rates and 1.0 grain S/100 dscf n.g.
2. Emission factors during part load tests
   NOx - based on estimate for part load test tuning combustor (ppm @ 15% O2) = 30
   CO - based on hourly emission rate used for Crockett Cogeneration plant commissioning period.
   VOC, SOx and PM10 - based on startup emission rates and 1.0 grain S/100 dscf n.g.
3. Emission factors during full load tests without SCR operational
   NOx level in ppmvd @ 15% O_2 = 9
   CO, VOC - based on combustor operating in pre-mix mode (4 ppmc CO and 1.4 ppmc for VOC).
   SOx and PM10 - emission factors based on fuel flow and 1.0 grain S/100 dscf n.g..
4. Emission factors during full load tests with SCR partially operational
   NOx - based information with combustor operating in pre-mix mode and SCR controlling NOx to 5.5 ppmc.
   CO, VOC - based on combustor operating in pre-mix mode (4 ppmc CO, 1.4 ppmc for VOC).
   SOx and PM10 - emission factors based on fuel flow and 1.0 grain S/100 dscf n.g..
5. Emission factors during full load tests with SCR fully operational
   NOx - based on combustor operating in pre-mix mode and SCR operational (2 ppmc NOx).
   CO, VOC - based on combustor operating in pre-mix mode and ox cat operational, 4 hours of startups
   (4 ppmc CO, 1.4 ppmc for VOC for 10 hours; 902 lb/hr for CO and 16 lb/hr for VOC during startups).
   SOx and PM10 - emission factors based on fuel flow and 1.0 grain S/100 dscf n.g..
6. Startup and shutdown emission rates unchanged.

Table 6.2-1.10 Maximum Hourly and Daily Emissions During Commissioning Avenal Energy										
	Peak Hour Emissions					Peak Day Emissions				
	NOx	CO	VOC	SOx	PM10	NOx	CO	VOC	SOx	PM10
Unit	(lbs/hr)					(lbs/day)				
One Gas Turbine in FSNL Test	160.0	1,000.0	16.0	5.2	9.0	1,530	12,000	192.0	62.8	108
One Gas Turbine in Max. Emission Operation	17.1	20.9	6.0	6.6	11.8	411	501	143	159.5	283
Total, one commissioning, one operatio	177.1	1,020.9	22.0	11.9	20.8	1,941	12,501	335	222	391

Total Commissioning Emissions Avenal Energy					
	NOx	CO	VOC	SOx	PM10
Unit	(lbs)				
Gas Turbine/HRSG #1	32,071	148,310	3,585	1,751	3,672
Gas Turbine/HRSG #2	32,071	148,310	3,585	1,751	3,672
Total =	64,142	296,621	7,169	3,502	7,344

Table 6.2-1.11
Avenal Energy Project
Detailed Calculations for Maximum Hourly, Daily and Annual Criteria Pollutant Emissions during the Commissioning Year
Maximum Scenarios by Pollutant

Emitting Unit and Operating Mode	Maximum CO Emiss. Scenario			Maximum NOx Emiss. Scenario			Max. PM10/SOx Emiss. Scenario			Maximum VOC Emiss. Scenario			NOx		SOx [1]		CO		VOC		PM10
	Max. CO Emission Hour (Comm.)	Max. CO Emission Day (Comm.)	Max. CO Emission Comm. Year Scenario	Max. NOx Emission Hour (Comm.)	Max. NOx Emission Day (Comm.)	Max. NOx Emission Comm. Year Scenario	Max. PM-10/SOx Emission Hour (Comm.)	Max. PM-10/SOx Emission Day (Comm.)	Max. PM-10/SOx Emission Comm. Year Scenario	Max. VOC Emission Hour (Comm.)	Max. VOC Emission Day (Comm.)	Max. VOC Emission Comm. Year Scenario	Maximum Hourly Emission Rate (lb/hr)		Maximum Hourly Emission Rate (lb/hr)		Maximum Hourly Emission Rate (lb/hr)		Maximum Hourly Emission Rate (lb/hr)		Maximum Hourly Emission Rate (lb/hr)
	(hrs)	(hrs/day)	(hrs/yr)	(hrs)	(hrs/day)	(hrs/yr)	(hrs)	(hrs/day)	(hrs/yr)	(hrs)	(hrs/day)	(hrs/yr)	Short Term	Long Term	Short Term	Long Term	Short Term	Long Term	Short Term	Long Term	lb/hr
Gas Turbine 1, baseload hot wo duct firing													13.03	13.03	5.07	1.82	15.86	15.86	3.17	3.17	9.00
Gas Turbine 2, baseload hot wo duct firing													13.03	13.03	5.07	1.82	15.86	15.86	3.17	3.17	9.00
Gas Turbine 1, baseload avg. wo duct firing [2]			3,600			**5,600**			5,600			5,600	13.03	13.03	5.06	1.82	15.86	15.86	3.17	3.17	9.00
Gas Turbine 2, baseload avg. wo duct firing [2]			3,600			**5,600**			5,600			5,600	13.03	13.03	5.06	1.82	15.86	15.86	3.17	3.17	9.00
Gas Turbine 1, baseload cold wo duct firing													13.47	13.47	5.24	1.89	16.39	16.39	3.28	3.28	9.00
Gas Turbine 2, baseload cold wo duct firing													13.47	13.47	5.24	1.89	16.39	16.39	3.28	3.28	9.00
Gas Turbine 1, duct firing, hot ambient temp.		0			0								17.13	17.13	6.65	2.39	20.86	20.86	5.96	5.96	11.81
Gas Turbine 2, duct firing, hot ambient temp.		18			18		1	24			18		17.13	17.13	6.65	2.39	20.86	20.86	5.96	5.96	11.81
Gas Turbine 1, duct firing, average ambient temp.			800			**800**			800			800	16.34	16.34	6.34	2.28	19.90	19.90	5.68	5.68	11.27
Gas Turbine 2, duct firing, average ambient temp.			800			**800**			800			800	16.34	16.34	6.34	2.28	19.90	19.90	5.68	5.68	11.27
Gas Turbine 1, duct firing, cold ambient temp.													16.06	16.06	6.24	2.25	19.56	19.56	5.59	5.59	10.78
Gas Turbine 2, duct firing, cold ambient temp.					0								16.06	16.06	6.24	2.25	19.56	19.56	5.59	5.59	10.78
Gas Turbine 1, startups (50% load), maximum			500			**500**		0	0			500	160	80	3.31	1.19	1,000	902	16.00	16.00	9.00
Gas Turbine 2, startups (50% load), maximum	1	6	500	1	6	**500**		0	0	1	6	500	160	80	3.31	1.19	1,000	902	16.00	16.00	9.00
Gas Turbine 1, commissioning	1	12	408	1	12	408	1	12	408	1	12	408	160.00	78.61	5.24	4.29	1,000	363.5	16.00	8.79	9.00
Gas Turbine 2, commissioning			408			408		0	408	0		408	160.00	78.61	5.24	4.29	1,000	363.5	16.00	8.79	9.00
Auxiliary Boiler (for startups)	1	12	2,064	1	12	1911	1	0	816	1	12	1911	0.41	0.41	0.105	0.038	1.38	1.38	0.16	0.16	0.19
Emergency Generator Engine		1	50		1	50		1	50		1	50	2.84	2.84	0.018	0.007	3.98	3.98	0.63	0.63	0.06
Emergency Fire Water Pump Engine		1	50		1	50		1	50		1	50	2.16	2.16	0.0031	0.0031	0.28	0.28	0.24	0.24	0.037
Total Emitting Hours	1	24	5,308	1	24	7,308	1	24	6,808	1	24	7,308									
	Weekend Shutdown and Weekday Start Scenario			Weekend and Weekday Hotstart Scenario			Baseload Scenario			Weekend and Weekday Hotstart Scenario											

1) Long-term sulfur concentration in natural gas reduced from tariff limit of 1 grS/100scf to (grS/100scf) = 0.36
Short-term sulfur concentration in natural gas is the tariff limit of (grS/100scf) = 1
Eng'g performance calcs used sulfur concentration in natural gas of (grS/100scf) = 0.25
2) Commissioning year normal operation after commissioning limited to 3,900 hours without duct firing.

Maximum Hourly, Daily, and Annual Criteria Pollutant Emissions

Emitting Unit and Operating Mode	NOx			SOx			CO			VOC			PM10		
	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy
Gas Turbine 1, baseload hot wo duct firing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Gas Turbine 2, baseload hot wo duct firing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Gas Turbine 1, baseload avg. wo duct firing (2)	0	0	36.48	0	0	5.11	0	0	28.55	0	0	8.88	0	0	25.20
Gas Turbine 2, baseload avg. wo duct firing (2)	0	0	36.48	0	0	5.11	0	0	28.55	0	0	8.88	0	0	25.20
Gas Turbine 1, baseload cold wo duct firing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Turbine 2, baseload cold wo duct firing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Turbine 1, duct firing, hot ambient temp.	0	0	0	0.00	0.00	0	0	0	0	0	0	0	0.00	0.00	0
Gas Turbine 2, duct firing, hot ambient temp.	0	308	0	6.65	159.55	0	0	375	0	0	107	0	11.81	283.47	0
Gas Turbine 1, duct firing, average ambient temp.	0	0	6.54	0	0	0.91	0	0	7.96	0	0	2.27	0	0	4.51
Gas Turbine 2, duct firing, average ambient temp.	0	0	6.54	0	0	0.91	0	0	7.96	0	0	2.27	0	0	4.51
Gas Turbine 1, duct firing, cold ambient temp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Turbine 2, duct firing, cold ambient temp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Turbine 1, startups (50% load), maximum	0	0	20.00	0	0	0	0	0	226	0	0	4	0	0	0
Gas Turbine 2, startups (50% load), maximum	160	960	20.00	0	0	0	1000	6000	226	16	96	4	0	0	0
Gas Turbine 1, commissioning	160	1920	16.04	5	63	1	1000	4362	74.16	16	192	1.79	9	108	1.836
Gas Turbine 2, commissioning	0	0	16.04	0	0	1	0	0	74.16	0	0	1.79	0	0	1.836
Auxiliary Boiler (for startups)	0.41	4.93	0.39	0	0	0.01549	1.38	16.60	1.43	0.16	1.93	0.154	0	0	0.0763
Emergency Generator Engine	0	2.84	0.071	0.000	0.018	0.00016	0	3.98	0.10	0	0.63	0.016	0.000	0.065	0.0016
Emergency Fire Water Pump Engine	0	2.16	0.054	0.0000	0.0031	7.7213E-05	0	0.28	0.0071	0	0.24	0.0060	0.000	0.037	0.00094
Total	**320.41 lb/hr**	**3,198.31 lb/day**	**158.63 tpy**	**11.99 lb/hr**	**222.41 lb/day**	**13.80 tpy**	**2,001.38 lb/hr**	**10,758.35 lb/day**	**673.87 tpy**	**32.16 lb/hr**	**398.06 lb/day**	**34.07 tpy**	**21.00 lb/hr**	**391.58 lb/day**	**63.17 tpy**
Gas turbines=	320.00	3,188.38	158.11	11.88	222.39	13.79	2,000.00	10,737.48	672.34	32.00	395.26	33.90	20.81	391.47	63.09
Engines and Boiler =	0.41	9.94	0.52	0.105	0.021	0.0157	1.38	20.86	1.53	0.16	2.79	0.18	0.187	0.102	0.0788

APPENDIX 6.2-2

MODELING ANALYSIS

sierra research

Air Dispersion Modeling and Health Risk Assessment Protocol

Avenal Energy Project
Kings County, California

Submitted to:

San Joaquin Valley Air Pollution Control District
California Energy Commission
U.S. Environmental Protection Agency, Region 9

prepared for:

Federal Power Avenal LLC

August 2007

prepared by:

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Air Dispersion Modeling and Health Risk Assessment Protocol
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Air Dispersion
Modeling and Health Risk Assessment Protocol
Avenal Energy Project

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Avenal Energy Project
Modeling Protocol
July 2007

1. Purpose and Background

On behalf of Federal Power Avenal LLC (Applicant), Sierra Research is submitting this modeling protocol to the San Joaquin Valley Air Pollution Control District (SJVAPCD or District), California Energy Commission (CEC), and U.S. Environmental Protection Agency (US EPA) for approval of the air dispersion and health risk assessment modeling proposed to be conducted in support of the Avenal Energy Project (Project) Application for a Determination of Compliance (DOC) from the District, Application for Certification (AFC) from the CEC, and Prevention of Significant Deterioration (PSD) Permit from the EPA.

The proposed air-cooled combined-cycle power plant project will consist of constructing and operating the following equipment:

- Two General Electric PG7241 (FA) combustion turbines (or equivalent), rated at 180 MW (nominal net, at site design conditions);
- Two heat recovery steam generators (HRSGs) equipped with duct burners;
- One 300-MW (nominal) condensing steam turbine;
- One natural gas-fueled auxiliary boiler;
- Three inlet air chillers with associated air cooling;
- One closed cooling water air cooler;
- One fire water pump engine; and
- One emergency generator engine.

The project site is located six miles northeast of the residential and business districts of the City of Avenal in Kings County, between the California Aqueduct and the Avenal Cutoff Road (see location figures in Appendix A).

Because the Project will generate more than 50 MW of electric power, certification by the CEC will be needed to satisfy requirements for public disclosure of potential environmental impacts under the California Environmental Quality Act (CEQA). Criteria pollutant emissions of nitrogen oxides (NOx), carbon monoxide (CO), and particulate matter with nominal aerodynamic diameter less than or equal to 10 microns (PM_{10}) will exceed 50 tons per year, and hence, classify the Project as a new major source under District New Source Review regulations, Rule 2201. Project emissions of these same pollutants are also expected to exceed the 100 ton-per-year major source threshold for the federal Prevention of Significant Deterioration (PSD) requirements (40 CFR 52.21) pertaining to federal attainment[1] pollutants nitrogen dioxide (NO_2),

[1] Sulfur dioxide (SO_2) is also an attainment pollutant, while ozone and particulate matter with nominal aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$) are nonattainment pollutants in the project area of the San Joaquin Valley Air Basin.

CO, and PM_{10} emitted from the fossil fuel-fired steam-electric plant category[2] listed in the federal PSD regulations. Therefore, the permit application will include a demonstration of compliance with all applicable portions of the PSD requirements. Emissions of volatile organic compounds (VOCs) and sulfur dioxide (SO_2) will be below major source levels.

The Applicant will submit air quality impact analyses to the SJVAPCD, CEC, and US EPA. The modeling analyses will include pollutants as required by District Rule 2201, Section 4.3.2;,CEC requirements[3] for evaluation of project air quality impacts; and applicable US EPA requirements for PSD permits. The purpose of this document is to establish the procedure for meeting District, CEC and US EPA air quality modeling requirements for the proposed project.

This protocol follows modeling guidance provided by the U.S. Environmental Protection Agency (USEPA) in its "*Guideline on Air Quality Models*" (including supplements), the National Park Service's "*Permit Application Guidance for New Air Pollution Sources*" (Bunyak, 1993), the Federal Land Managers' "*Air Quality Related Values Workgroup (FLAG) Draft Phase I Report*" (October 1999), the "*Interagency Workgroup on Air Quality Modeling (IWAQM) Phase II Recommendations*" (1998), and the SJVAPCD *Guidance for Air Dispersion Modeling, Version 1.2* (August 2006).

The air quality impact analysis will address the proposed facility operation in terms of the following modes:

- Baseload (100%) operation without duct firing
- Baseload (100%) operation with duct firing
- Startup/shutdown operations.

Impacts from operation of the facility will be compared to the thresholds shown in Table 1:

[2] Fossil fuel-fired steam-electric plant with heat input greater than 250 MMBtu/hour.
[3] Summarized in CEC Data Adequacy Worksheets, revised March 28, 2007, and available at *http://www.energy.ca.gov/sitingcases/documents/index.html*.

Table 1 Air Quality Impact Analysis Significance Thresholds						
Air Quality Criteria	VOC [a]	NO_2	PM_{10}	$PM_{2.5}$	CO	SO_2
PSD Significant Impact Levels	NA[b]	√	√	NA	√	NA
PSD Monitoring Exemption Levels	NA	√	√		√	NA
Ambient Air Quality Standards (AAQS)	√	√	√	√[c]	√	√
Class I and Class II Visibility		√	√			√
Impacts to Soils and Vegetation		√	√			√
Class I Area Acid Deposition		√	√			√

Notes:
a. VOC emissions are used as a surrogate for ozone impacts in the PSD review process; no ozone modeling will be carried out.
b. Not applicable.
c. USEPA guidance (71 FR 6727) provides that compliance with the federal $PM_{2.5}$ NAAQS should be evaluated using the PM_{10} NAAQS and not modeled directly. At the request of the California Air Resources Board (ARB), compliance with both the federal 24-hour average AAQS and the state and federal annual average AAQS for $PM_{2.5}$ will be addressed based on $PM_{2.5}$ for non-PSD purposes.

2. Project Location

The location of the site is approximately the following:

- Latitude: 36.088394° North
- Longitude: 120.061141° West

or, in Universal Transverse Mercator (UTM) coordinates,

- Northing: 3,997.742 kilometers (km) and
- Easting: 764.616 kilometers (North American Datum [NAD] 27, Zone 10).

The nominal site elevation is 340 feet (104 meters) above mean sea level.

3. Proposed Emission Sources

The new emission sources for the Project will be the two natural gas-fired combustion turbines in combined-cycle mode, one natural gas-fired auxiliary boiler, one natural gas-fueled emergency generator engine, and one Diesel-fueled fire water pump engine. The turbines will utilize advanced combustion design and emission controls to limit emissions of NOx, CO, and VOC. Emissions of PM_{10} and particulate matter with nominal aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), and SOx will be kept to a minimum through the exclusive use of natural gas in the turbines. The layout of the emitting units is shown in the last three figures in Appendix A.

4. METEOROLOGICAL DATA

The Project area has no on-site meteorological monitoring. The District has developed and posted on its website five years of meteorological data from its monitoring station at Hanford, CA, located 28 miles to the northeast of the project site (see Figure 1), and appropriate for use on this project with the model AERMOD[4] (current version 07026). Data from the Hanford station[5] have been processed by AERMET software, which formats the data for use in AERMOD. The meteorological data from the Hanford monitoring station are representative of conditions at the Project because the area is extremely flat both between the two locations and over a much larger area to the northwest and southeast along the alignment of the San Joaquin Valley. Air flow in the valley can be characterized by up-valley and down-valley winds. The down-valley winds are generally a result of airflow into the Valley from the Carquinez Strait and the Altamont Pass that then flow south. Strong diurnal wind regimes markedly affect the horizontal transport of air in the project area. This results in a pronounced north-northwest component to the wind roses shown in Figures 2A through 2E for 2000-2004, respectively. Modeling for each of the five years of available data[6] will not vary much because the meteorological data are so constant between the years.

It is expected that the main modeling for the project will be accomplished with AERMOD. If needed for supplemental modeling of air dispersion to receptors in terrain above stack-top height, Appendix A contains information on the following two additional models and the meteorological data needed to run them: Complex Terrain Screening Model (CTSCREEN) and the Complex Terrain Dispersion Model PLUS (CTDMPLUS).

5. SITE REPRESENTATION – METEOROLOGICAL DATA

USEPA defines the term "on-site data" to mean data that would be representative of atmospheric dispersion conditions at the source and at locations where the source may have a significant impact on air quality. Specifically, the meteorological data requirement originates in the Clean Air Act at Section 165(e)(1), which requires an analysis "of the ambient air quality at the proposed site and in areas which may be affected by emissions from such facility for each pollutant subject to regulation under [the Act] which will be emitted from such facility."

This requirement and USEPA's guidance on the use of on-site monitoring data are also outlined in the "*On-Site Meteorological Program Guidance for Regulatory Modeling Applications*" (1987a). The representativeness of the data depends on (a) the proximity of the meteorological monitoring site to the area under consideration, (b) the complexity of the topography of the area, (c) the exposure of the meteorological sensors, and (d) the period of time during which the data

---

[4] AERMOD stands for American Meteorological Society/Environmental Protection Agency Regulatory Model, and was developed by the American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC).

[5] SJVAPCD. Meteorological data from Hanford during 2000-2004, *http://www.valleyair.org/busind/pto/Tox_Resources/AirQualityMonitoring.htm.*

[6] SJVAPCD. Hanford meteorological data in AERMOD-compatible format, *http://www.valleyair.org/busind/pto/Tox_Resources/AirQualityMonitoring.htm*

are collected. The District's proposed Camp Pendleton meteorological data are representative of conditions at the project site.

Representativeness has also been defined in the "*Workshop on the Representativeness of Meteorological Observations*" (Nappo et. al., 1982) as "the extent to which a set of measurements taken in a space-time domain reflects the actual conditions in the same or different space-time domain taken on a scale appropriate for a specific application." Representativeness is best evaluated when sites are climatologically similar, as are the project site and the Camp Pendleton meteorological monitoring station. Representativeness has additionally been defined in the PSD Monitoring Guideline (USEPA 1987b) as data that characterize the air quality for the general area in which the proposed project would be constructed and operated. Because of the relative proximity of the Hanford meteorological data site to the proposed project site, the same large-scale topographic features that influence the meteorological data monitoring station also influence the proposed project site in the same manner.

6. EXISTING AMBIENT AIR QUALITY DATA

Background ambient air quality data for the project area during 2004-2006 will be obtained from the following monitoring sites that are nearest to the project site by pollutant:

- Corcoran- Patterson Avenue[7]: PM_{10} and $PM_{2.5}$
- Visalia-North Church Street: CO
- Hanford-South Irwin Street: O_3 and NO_2
- Sacramento-Del Paso Manor: SO_2

Modeled concentrations will be added to these representative background concentrations to determine compliance with the CAAQS and NAAQS.

For PM_{10} and $PM_{2.5}$, the following data will be used to represent project background:

- For PM_{10}, the highest 24-hour average and annual average values between 2004 and 2006 will be used to represent project background.
- For $PM_{2.5}$ 24-hour impacts, the three-year average of the 98th percentile 24-hour monitored levels for the period between 2004 and 2006 will be used to represent project background. For annual impacts, the highest monitored annual average between 2004 and 2006 will be used to represent project background. The maximum modeled 24-hr and annual $PM_{2.5}$ impacts for the project will be added to the above project background levels to confirm that the project will not cause or contribute to a violation of an air quality standard. The most recent three calendar-year period available, 2004-2006, is used to most accurately represent future background levels in the AQIA.
- If a more refined analysis of potential $PM_{2.5}$ impacts is needed, then the following procedure would be followed to combine background concentrations of 24-hour average $PM_{2.5}$ concentrations during the period 2000 through 2004 (contemporaneous with meteorological data) with modeled impact concentrations. Because $PM_{2.5}$ measurements

[7] *http://www.arb.ca.gov/adam/cgi-bin/db2www/adamtop4b.d2w/Branch*

are taken on a once-in-six-day basis, each $PM_{2.5}$ measurement would be presumed to represent the day of measurement and each of the five subsequent days. Missing data would be filled in by interpolation using data from the data immediately preceding and following the missing data point. These day-specific project background data would be combined with contemporaneous modeled project impacts to evaluate compliance with the $PM_{2.5}$ AAQS for non-PSD purposes. The highest three-year average of the combined project plus background 98th percentile 24-hour average concentrations would then be used to evaluate compliance with the 24-hour average $PM_{2.5}$ AAQS for non-PSD purposes. The highest three-year average of the combined project plus background annual average concentrations would be used to evaluate compliance with the annual average $PM_{2.5}$ AAQS for non-PSD purposes.

7. AIR QUALITY DISPERSION MODELS

Overview

The following USEPA air dispersion models are proposed for use to quantify pollutant impacts on the surrounding environment based on the emission sources' operating parameters and their locations:

- American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) model, also known as AERMOD (Version 07026);
- Building Profile Input Program – Plume Rise Model Enhancements (BPIP-PRIME, current version 04274); and
- SCREEN3 (Version 96043).

The following models are not expected to be used, but they are listed in the event that an optional specialized modeling analysis is necessary for the project. In addition to the information listed below, further information on the use of CTDMPLUS is provided in Appendix A.

- Complex Terrain SCREEN (CTSCREEN, Version 94111)
- Complex Terrain Dispersion Model (CTDMPLUS, Version 93228)
- Visibility Screening Model (VISCREEN (Version 88341)

The first three primary models listed above, and how they are used, are discussed below.

Simple, Complex, and Intermediate Terrain Impacts

For modeling project emissions in simple, complex, and intermediate terrain, the USEPA-recommended guideline model AERMOD will be used with the AERMET-processed hourly meteorological data from the Hanford monitoring station during 2000-2004 provided by the District on its website. The AERMOD model requires hourly meteorological data consisting of wind vector and speed (with reference height), temperature (with reference height), Monin-Obukhov length, surface roughness length, heights of the mechanically and convectively

generated boundary layers, surface friction velocity, convective velocity scale, and vertical potential temperature gradient in the 500-meter layer above the planetary boundary layer. The model assumes that there is no variability in meteorological parameters over a one-hour time period, hence the term "steady-state." The AERMOD model allows input of multiple sources and source groupings, eliminating the need for multiple model runs. Complex phenomena such as building-induced plume downwash are treated in this model.

Standard AERMOD control parameters will be used (stack tip downwash, non-screening mode, non-flat terrain, sequential meteorological data check employed). Stack-tip downwash, which adjusts the effective stack height downward following the methods of Briggs (1972) for cases where the stack exit velocity is less than 1.5 times the wind speed at stack top, will be selected per USEPA guidance. The rural default option will be used by not invoking the URBANOPT option.[8]

Ambient Ratio Method and Ozone Limiting Method

Annual NO_2 concentrations will be calculated using the Ambient Ratio Method (ARM), adopted in Supplement C to the Guideline on Air Quality Models (USEPA, 1995). The Guideline allows a nationwide default of 75% for the conversion of nitric oxide (NO) to NO_2 on an annual basis and the calculation of NO_2/NOx ratios.

If NO_2 concentrations need to be examined in more detail, the Plume Volume Molar Ratio Method (PVMRM) adaptation of the Ozone Limiting Method (Cole and Summerhays, 1979) will be used. AERMOD PVMRM calculates the NO_2 concentration using hourly ozone data. Hourly ozone data collected at the Hanford monitoring station during the years 2000-2004 will be used in conjunction with PVMRM to calculate hourly NO_2 concentrations from hourly NOx concentrations. Missing hourly ozone data will be substituted prior to use with day-appropriate values (e.g., from the previous day, or the next day, for the same hour). Any other missing hourly ozone data will be substituted with 40 ppb ozone (typical ozone tropospheric background level). The PVMRM involves an initial comparison of the estimated maximum NOx concentration and the ambient O_3 concentration left in the plume after reaction of NO with O_3 to determine which is the limiting factor to NO_2 formation. If the remaining O_3 concentration is greater than the maximum NOx concentration, total conversion is assumed. If the NOx concentration is greater than the remaining O_3 concentration, the formation of NO_2 is limited by the remaining ambient O_3 concentration. In this case, the NO_2 concentration is set equal to the O_3 concentration plus a correction factor that accounts for in-stack and near-stack thermal conversion.

Fumigation

The SCREEN3 model will be used to evaluate inversion breakup fumigation impacts for short-term averaging periods (24 hours or less), as appropriate. The methodology in USEPA, 1992 (Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised) will be followed for these analyses. Combined impacts for all sources under fumigation

[8] The rural vs. urban option in AERMOD is primarily designed to set the fraction of incident heat flux that is transferred into the atmosphere. This fraction becomes important in urban areas having an appreciable "urban heat island" effect due to a large presence of land covered by concrete, asphalt, and buildings. This situation does not exist for the proposed project site.

conditions will be evaluated, based on USEPA and any applicable SJVAPCD modeling guidelines.

8. GOOD ENGINEERING PRACTICE (GEP) STACK HEIGHT AND DOWNWASH

AERMOD can account for building downwash effects on dispersing plumes. Stack locations and heights and building locations and dimensions will be input to BPIP-PRIME. The first part of BPIP-PRIME determines and reports on whether a stack is being subjected to wake effects from a structure or structures. The second part calculates direction-specific building dimensions for each structure that are used by AERMOD to evaluate wake effects. The BPIP-PRIME output is formatted for use in AERMOD input files.

9. RECEPTOR SELECTION

Receptor and source base elevations will be determined from USGS Digital Elevation Model (DEM) data using the 7½-minute format (10- to 30-meter spacing between grid nodes). All coordinates will be referenced to UTM North American Datum 1927 (NAD27), Zone 10. The AERMOD receptor elevations will be interpolated among the DEM nodes according to standard AERMAP procedure. For determining concentrations in elevated terrain, the AERMAP terrain preprocessor receptor-output (ROU) file option will be chosen; hills will not be imported into AERMOD for CTDM-like processing.

Cartesian coordinate receptor grids will be used to provide adequate spatial coverage surrounding the project area for assessing ground-level pollution concentrations, to identify the extent of significant impacts, and to identify maximum impact locations. A 250-meter resolution coarse receptor grid will be developed and will extend outwards at least 10 km (or more as necessary to calculate the significant impact area).

For the full impact analyses, a nested grid will be developed to fully represent the maximum impact area(s). This nested grid will have the following resolutions:

- 25-meter resolution along the facility fence-line in a single tier of receptors composed of four segments extending out to 100 meters from the fenceline
- 100-meter resolution from 100 meters to 1,000 meters from the fenceline
- 250-meter resolution from 1 km out to at least 10 km from the site.

When maximum first-high or maximum second-high impacts occur in the 100- or 250-meter spaced areas, an additional refined receptor grid with 25-meter resolution will be placed around each maximum coarse grid impact and extended out 1,000 meters in all directions from that point of impact. Concentrations within the facility fenceline will not be calculated.

The following 7.5-minute USGS Digital Elevation Model (DEM) quadrangles in California will be employed for modeling the Project:

- Guijarral Hills,
- Huron,
- Westhaven,
- Avenal,

- La Cima,
- Kettleman City,
- Garza Peak,
- Kettleman Plain; and
- Los Viejos.

If more distant impacts are encountered in the AERMOD results, then other quadrangles that may be needed include the following (listed from approximately nearest, to farthest):

- The Dark Hole,
- Kreyenhaugen Hills,
- Coalinga,
- Domengine Ranch,
- Harris Ranch,
- Calflax,
- Vanguard,
- Lemoore,
- Stratford,
- Alcalde Hills,
- Joaquin Rocks,
- Lillis Ranch,
- Tres Picos Farms,
- Westside,
- Five Points,
- Burrel,
- Riverdale,
- Ciervo Mountain,
- Tumey Hills,
- Monocline Ridge,
- Levis,
- Cantua Creek,
- San Joaquin,
- Helm,
- Raisin,
- Mercey Hot Springs,
- Chounet Ranch,
- Chaney Ranch,
- Coit Ranch,
- Tranquility,
- Jamesan,
- Kerman,
- Kearney Park,
- Laguna Seca Ranch,
- Hammonds Ranch; and
- Charleston School.

10. MODELING SCENARIOS

Pollutant emissions to the atmosphere from the proposed project will be dominated by the products of combustion of natural gas in the combustion turbines. Emission rates will be included in the Application for Certification and Application for a Determination of Compliance for the project and will be based on vendor data and additional conservative assumptions of equipment performance. Turbine emissions and stack parameters, such as flow rate and exit temperature, depend on ambient temperature and operating load. To calculate the maximum air quality impacts, a screening analysis will be performed to determine which combination of operating load and atmospheric temperature produces the maximum ground-level concentration (i.e., impact) for each combination of pollutant and averaging time used in an ambient air quality standard.

In the modeling analysis, maximum impacts will be predicted for base load (100%) and reduced load (50%) conditions. In addition, design extreme hot, annual average, and extreme cold ambient temperatures will be evaluated for each load condition. Each of these conditions has unique performance characteristics that affect plume dispersion and thus predicted impacts. The results of this screening analysis will be used to select the maximum-impact operational scenarios for the modeling analyses. Refined modeling of these maximum-impact scenarios will be based on the five years of available meteorological data and will identify the general locations of maximum impacts on the coarse grid of receptors, around which fine grids will be used to identify the locations of maximum impacts within 25 meters.

Details of Operating Scenarios

Maximum emissions during normal operation would occur during periods of maximum fuel consumption, which would occur at peak load (with steam power augmentation). Besides normal operation, three other modes of operation would occur: commissioning (one initial period), startup, and shutdown. In addition to the impacts associated with normal operation, the modeling analysis for the project will examine the short-term impacts associated with commissioning and gas turbine startup/shutdown activities. Table 2 gives more detail on all four operating modes.

Table 2 Operating Modes of the Combustion Gas Turbines	
Mode	Description
Commissioning	The process of fine-tuning each of the turbines and their associated emission control systems. The facility will follow a systematic approach to optimize performance of the turbines and the associated control equipment. NOx, CO, and VOC emissions are expected to be greater during commissioning than during normal operation. This one-time mode affects only the initial year of operation.
Start-up	Startup NOx and CO emissions are higher because the combustors are not fully optimized, and catalyst systems have not reached optimal temperatures.
Normal Operation	Normal operation begins after the turbines and the control equipment are working optimally, at their designated levels. Emissions may vary between the extreme hot, annual average, and extreme cold ambient conditions.
Shutdown	Shutdown occurs at the initiation of the turbine shutdown sequence and ends with the cessation of turbine firing. Typically, the shutdown process will emit less than the start-up process, and thus this mode will be represented by the analysis of start-up emissions.

11. Class I Area Impact Analysis and Class II PSD Significance Thresholds

The project is not located within 100 km of Class I areas, the nearest being the following:

- Pinnacles National Monument: 113 km
- Sequoia National Park: 113 km
- Ventana Wilderness: 127 km

Therefore, the Project, although a major source, will not need to evaluate impacts to visibility and other air quality related values at Class I areas.

12. AMBIENT AIR QUALITY IMPACT ANALYSES

In evaluating the impacts of the proposed project on ambient air quality, we will model the ambient impacts of the project, add those impacts to background concentrations, and compare the results to the state and federal ambient standards for SO_2, NO_2, PM_{10}, $PM_{2.5}$,[9] and CO.

In accordance with USEPA guidelines,[10] the highest second-highest modeled concentrations will be used to demonstrate compliance with the short-term federal standards and the highest modeled concentration will be used to demonstrate compliance with the federal annual and all state standards.

Based on the results of the screening procedure, the operating case that produces the highest modeled ambient concentration for each individual pollutant and averaging period will be used in the refined air quality impact analysis. The screening analysis will identify the operating cases that produce the highest concentration for each pollutant and averaging period, and will provide the specific stack parameters (stack height, stack diameter, exhaust temperature and exhaust velocity) that will be used to evaluate compliance with applicable PSD increments and compliance with the AAQS for all applicable pollutants and averaging periods.

Compliance with ambient air quality standards will be demonstrated in accordance with the three-step process outlined in the October 1990 Draft NSR/PSD Workshop Manual (p. C.51, "The Compliance Demonstration"). The first step in the compliance demonstration is to determine, for each pollutant and averaging period, whether the proposed new equipment will cause a significant ambient impact anywhere. As indicated in the Workshop Manual, "If the significant net emissions increase[11] from a proposed source would not result in a significant ambient impact anywhere, the application is usually not required to go beyond a preliminary analysis in order to make the necessary showing of compliance for a particular pollutant." The significance levels for air quality impacts are shown in the Table 3. If the maximum modeled impact for any pollutant and averaging period is below the appropriate significance level, no further analysis is necessary.

If the modeled impacts from the Project are above the PSD significance thresholds shown in Table 3, the second step of the compliance demonstration is required to show that the proposed new source, in conjunction with existing sources, will not cause or contribute to a violation of any ambient air quality standard.[12]

---

[9] As noted above, comparisons to the federal $PM_{2.5}$ AAQS are for non-PSD purposes.
[10] 40 CFR part 51, Appendix W, Sections 11.2.3.2 and 11.2.3.3
[11] Note that this guidance requires modeling only for pollutants for which there is a significant net increase.
[12] Because the applicable EPA guidance does not define significance levels for $PM_{2.5}$, $PM_{2.5}$ impacts will be presumed to be above any applicable significance level regardless of the modeled concentration, and the second step of the process will be performed.

Table 3 Significance Levels for Air Quality Impacts in Class II Areas[a] ($\mu g/m^3$)					
	Averaging Period				
Pollutant	Annual	24-hour	8-hour	3-hour	1-hour
SO_2	1	5	--	25	--
PM_{10}	1	5	--	--	--
NOx	1	--	--	--	--
CO	--	--	500	--	2000
a. From 40 CFR 51.165, shown as Table C-4 in the 1990 draft PSD Workshop Manual.					

If the modeled impacts from the project alone are above the PSD significance thresholds shown in Table 3, the second step of the compliance demonstration is required to show that the proposed new source, in conjunction with existing sources, will not cause or contribute to a violation of any ambient air quality standard.[13] As discussed in more detail in Section 6 of this protocol, the impacts of existing sources are represented by the existing ambient air quality data. In accordance with Section 8.2.1 of Appendix W to 40 CFR Part 51,

> *Background concentrations are an essential part of the total air quality concentration to be considered in determining source impacts. Background air quality includes pollutant concentrations due to: (1) Natural sources; (2) nearby sources other than the one(s) currently under consideration; and (3) unidentified sources. Typically, air quality data should be used to establish background concentrations in the vicinity of the source(s) under consideration.*

Because ambient PM_{10} and $PM_{2.5}$ levels result from both secondary pollutant formation as well as directly emitted particulate matter, it is appropriate to rely on the locally monitored air quality data for PM_{10} and $PM_{2.5}$ to represent background concentrations in the project area.

The impact of the proposed new equipment will be modeled using the maximum allowable emission limits as proposed in the application and the design capacities of the turbines, assuming continuous operation, in accordance with the guidance in Table 8-2 of Appendix W. If the predicted total ground-level concentration obtained by adding the maximum impact of the proposed new equipment to the monitored background concentrations is below the state or federal ambient air quality standard for each pollutant and averaging period, no further analysis is required for that pollutant and averaging period.

If the proposed new equipment, combined with existing background concentrations, will result in predicted total ground-level concentration in excess of an applicable ambient air quality standard, then the third step of the compliance demonstration procedure will be undertaken. According to the 1990 draft Workshop Manual,

> *For a NAAQS violation to which an applicant contributes significantly, a PSD permit may be granted only if sufficient emissions reductions are obtained to compensate for the*

[13] Because the applicable EPA guidance does not define significance levels for $PM_{2.5}$, $PM_{2.5}$ impacts will be presumed to be above any applicable significance level regardless of the modeled concentration, and the second step of the process will be performed.

adverse ambient impacts caused by the proposed source. Emissions reductions are considered to compensate for the proposed source's adverse impact when, at a minimum, (1) the modeled net concentration, resulting from the proposed emissions increase and the federally enforceable emissions reduction, is less than the applicable significant ambient impact level at each affected receptor, and (2) no new violations will occur. [emphasis added]

In accordance with this guidance, only if the modeled impacts from the proposed new equipment, combined with existing background concentrations, are predicted to cause a new violation of a standard for which the District is currently in attainment will this netting procedure be used. The federally enforceable emissions reductions to be used in the netting procedure will be provided by emission reduction credits (ERCs) already acquired and certified by the District.

13. HEALTH RISK ASSESSMENT

A health risk assessment (HRA) will be performed according to the Office of Environmental Health Hazard Analysis "Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments" (August 2003). The HRA modeling will be prepared using the ARB's Hotspots Analysis and Reporting Program (HARP) computer program (Version 1.3, October 18, 2005). The HARP model will be used to assess cancer risk as well as non-cancer chronic and acute health hazards. The HRA will include the four following pathways: inhalation, dermal absorption, and soil and mother's milk ingestion.

Because the HARP model incorporates the previously USEPA-approved model ISCST3, a special methodology will be employed to be consistent with using AERMOD for the air dispersion modeling and retain the health values and risk computations provided by HARP Version 1.3. The methodology used to prepare the HRA has been described by the ARB[14] and is described below. Its use has been approved by the CEC, the SJVAPCD and several other Districts[15] on previous power plant projects.

The risk assessment module of the HARP model is run using unit ground level impacts to obtain derived cancer risks for each toxic air contaminant (TAC). Cancer risks are obtained for the derived (OEHHA) method, the derived (adjusted) method, average point estimate, high-end point estimate, and derived (OEHHA) method for worker exposure. The HARP model output is cancer risk by TAC and pathway for each type of analysis, based on an exposure of 1.0 $\mu g/m^3$. Individual cancer risks are expressed in units of risk per $\mu g/m^3$ of exposure. To calculate the weighted risk for each source, the annual average emission rate in grams per second for each TAC will be multiplied by the individual cancer risk for that TAC in units of $(\mu g/m^3)^{-1}$. The resulting weighted cancer risks for each TAC will then be summed for the source. The same approach will be used to determine the non-cancer acute and chronic health hazards associated with the Project.

[14] Procedure is described in Part B of Topic 8 of the HARP How-To Guides: How to Perform Health Analyses Using a Ground Level Concentration.
[15] San Diego APCD, Bay Area AQMD, North Coast Unified AQMD

Health risk from exposure to a carcinogenic TAC is calculated as the product of the exposure concentration times a factor representing the risk per unit concentration (i.e., unit risk) for the TAC. In the case of cancer risk, the unit risk depends on breathing rate, the cancer potency factor of the TAC, dimensional factors, and other terms involving non-inhalation pathways, when relevant. In the case of chronic and acute non-cancer impacts, the health hazard per unit concentration (i.e., unit impact) is normally calculated as 1 divided by the Reference Exposure Level (REL, expressed as a concentration in $\mu g/m^3$) for the TAC.

Exposure concentration is calculated as the product of the actual emission rate (in grams per second)[16] of the TAC times the concentration per unit of emission (i.e., χ/Q for an emission rate of 1 g/s), which is the output from the AERMOD air dispersion modeling calculation. This exposure concentration is the "Unit Concentration."

HARP automatically passes the "Unit Concentration" for a given source and receptor into its risk module where it is multiplied by the actual emission rate (in g/s) for each TAC and the "Unit Risk" for the TAC to produce the calculated risk for the TAC. This is done for all the TACs emitted by a source and the summed cancer risk, or non-cancer health impact for common toxic endpoints in the case of chronic and acute risk, is the total risk or non-cancer health impact at that receptor from that source. The total cancer risk or non-cancer health impact at a receptor is the sum of the risks or health impacts from all of the sources.

Because HARP is not designed to pass AERMOD "Unit Concentration" outputs to its Risk Module, an alternative procedure will be used. The calculation of cancer risk or non-cancer health impact does not require the variables to be multiplied in any particular order. Therefore, the final result will be the same if, for a given source, the "Unit Risk" for a TAC is multiplied by the actual emissions (g/s) for the TAC, and these products are added together to give a "Source Strength". The "Source Strength" is then used as the source emission rate in AERMOD.

This methodology thus uses HARP to calculate the "Unit Risks" for all carcinogenic TACs and unit chronic and acute health impacts for all non-carcinogenic TACs, including all required exposure pathways and toxic end points as well as receptor types, including residents and workers. The unit risk or unit health impact for each TAC from a source is multiplied by the emission rate of that TAC from the source. These products are summed for all the TACs emitted by the source. This is done for each source. Finally, the resulting "Source Strength" for all project sources are used as emission rates in AERMOD. The AERMOD output contains the resulting cancer risks and non-cancer chronic and acute health impacts.

[16] The annual emission rate is the actual long-term emission rate used for analysis of cancer risk and chronic non-cancer health impact, and the one-hour emission rate is the actual short-term emission rate used for analysis of acute non-cancer health impact.

14. CONSTRUCTION AIR QUALITY IMPACT ANALYSIS

The potential ambient impacts from air pollutant emissions during the construction of the Project will be evaluated by air quality modeling that will account for the construction site location and the surrounding topography; the sources of emissions during construction, including vehicle and equipment exhaust emissions; and fugitive dust.

Types of Emission Sources − Construction of the Project will require 27 months, and can be viewed as three main sequential phases: site preparation; construction of foundations; and installation and assembly of the Project turbines and associated equipment. The construction impacts analysis will include a schedule for construction operation activities. Site preparation includes site excavation, excavation of footings and foundations, and backfilling operations.

Fugitive dust emissions from the construction of the project result from the following activities:

- Excavation and grading at the construction site;
- Onsite travel on paved and unpaved roads and across the unpaved construction site;
- Aggregate and soil loading and unloading operations;
- Raw material transfer to and from material stockpiles; and
- Wind erosion of areas disturbed during construction activities.

Engine exhaust will be emitted from the following sources:

- Heavy equipment used for excavation, grading, and construction of onsite structures;
- Water truck used to control construction dust emissions;
- Diesel-fueled welding machines, gasoline-powered generators, air compressors, and water pumps;
- Gasoline-fueled pickup trucks and Diesel-fueled flatbed trucks used onsite to transport workers and materials around the construction site;
- Transport of mechanical and electrical equipment to the project site;
- Transport of rubble and debris from the site to an appropriate landfill; and
- Transport of raw materials to and from stockpiles.

Emissions from a peak activity day will be modeled. Annual average emissions over the 27-month construction period will also be calculated and modeled for comparison with annual standards.

Existing Ambient Levels – The background data discussed earlier will be used to represent existing ambient levels for the construction analysis as well as the analysis of the impacts of project operations.

Model Type − The USEPA model, ISCST3, has been approved by the CEC for use in construction modeling, and will be used to estimate ambient impacts from construction emissions. The modeling options and meteorological data described above will be used for the modeling analysis.

The construction site will be represented as both a set of volume sources and a separate set of area sources in the modeling analysis. Emissions will be divided into two categories: exhaust emissions and dust emissions. For exhaust emissions, a plume height of 4.6 meters (15 feet) will be used. Plume height refers to the distance measured from ground level to the centerline of the emissions plume. For dust emissions, a release height of two meters will be used due to the ambient plume temperatures and negligible plume velocities.

For the construction modeling analysis, the receptor grid will begin at the property boundary and will extend approximately one kilometer in all directions. Receptor spacing will be 60 meters, except for three tiers of receptors spaced along the project boundary at 25-meter spacing.

15. Cumulative Air Quality Impact Analysis

The CEC has defined this analysis as "a cumulative air quality modeling impacts analysis of the project's typical operating mode in combination with other stationary source emissions sources within a six-mile radius which have received construction permits but are not yet operating, or are in the permitting process." For each criteria pollutant the CEC staff considers facilities having an emission increase of less than five tons per year to be *de minimis*, so such facilities may be excluded. The District has already been requested to provide information on any sources that might be appropriate for a cumulative air quality impact analysis, as defined above.

Upon receipt of sufficient information from the District to allow air dispersion modeling of the non-project sources to be included in the cumulative air quality impact analysis, AERMOD will be used in a procedure similar to that described earlier in this protocol.

16. Final Modeling Submittal

The final modeling analyses will include the following materials:

- Summaries of maximum modeled impacts for each air quality scenario showing meteorological conditions and receptor location and elevation;
- All modeling inputs and outputs (including BPIP-PRIME and meteorological files) in electronic format, together with a description of all filenames;
- Plot plan showing emission points, nearby buildings (including dimensions), cross-section lines, property lines, fencelines, roads, and UTM coordinates; and
- A table showing building heights used in the modeling analysis.

The HRA results will include AERMOD output plot files, spreadsheets that relate the computed risks with UTM coordinates, and textual discussion that explains the methodology to the lay public.

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Figure 1
Locations of Project and Surface Meteorological Monitoring Station
Avenal Energy Project

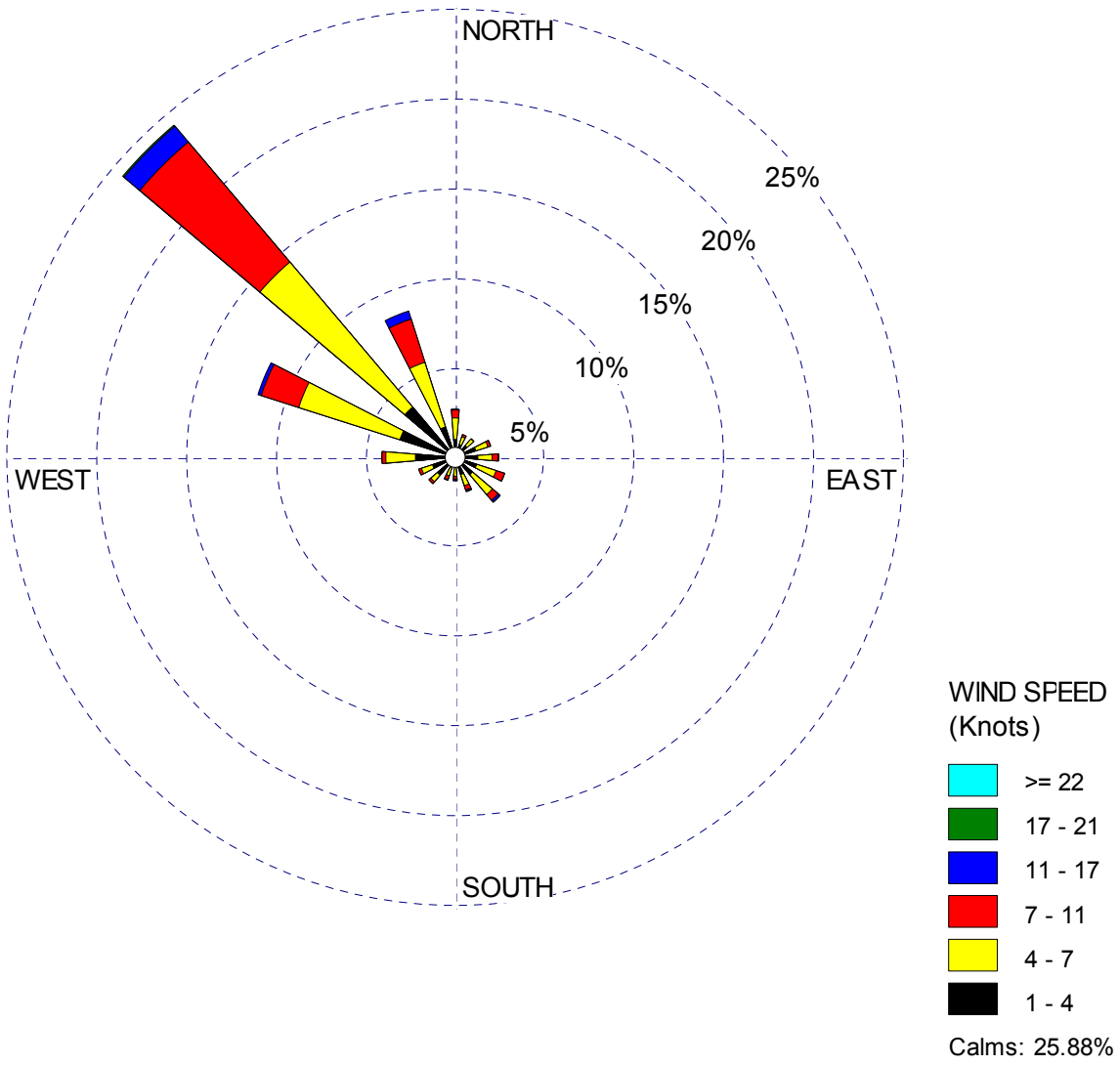


Figure 2A: Wind Rose for Hanford, CA – Calendar Year 2000

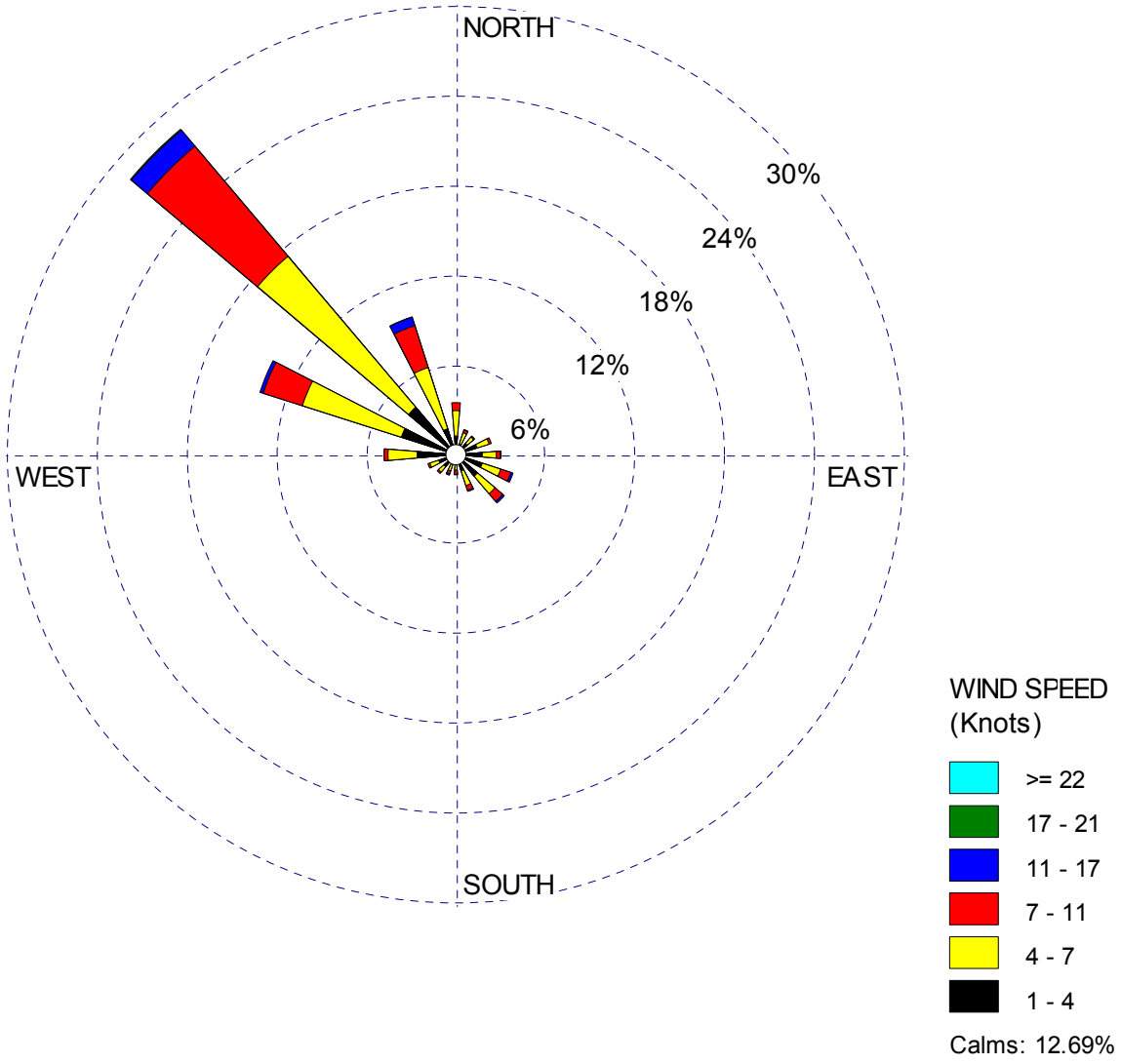


Figure 2B: Wind Rose for Hanford, CA – Calendar Year 2001

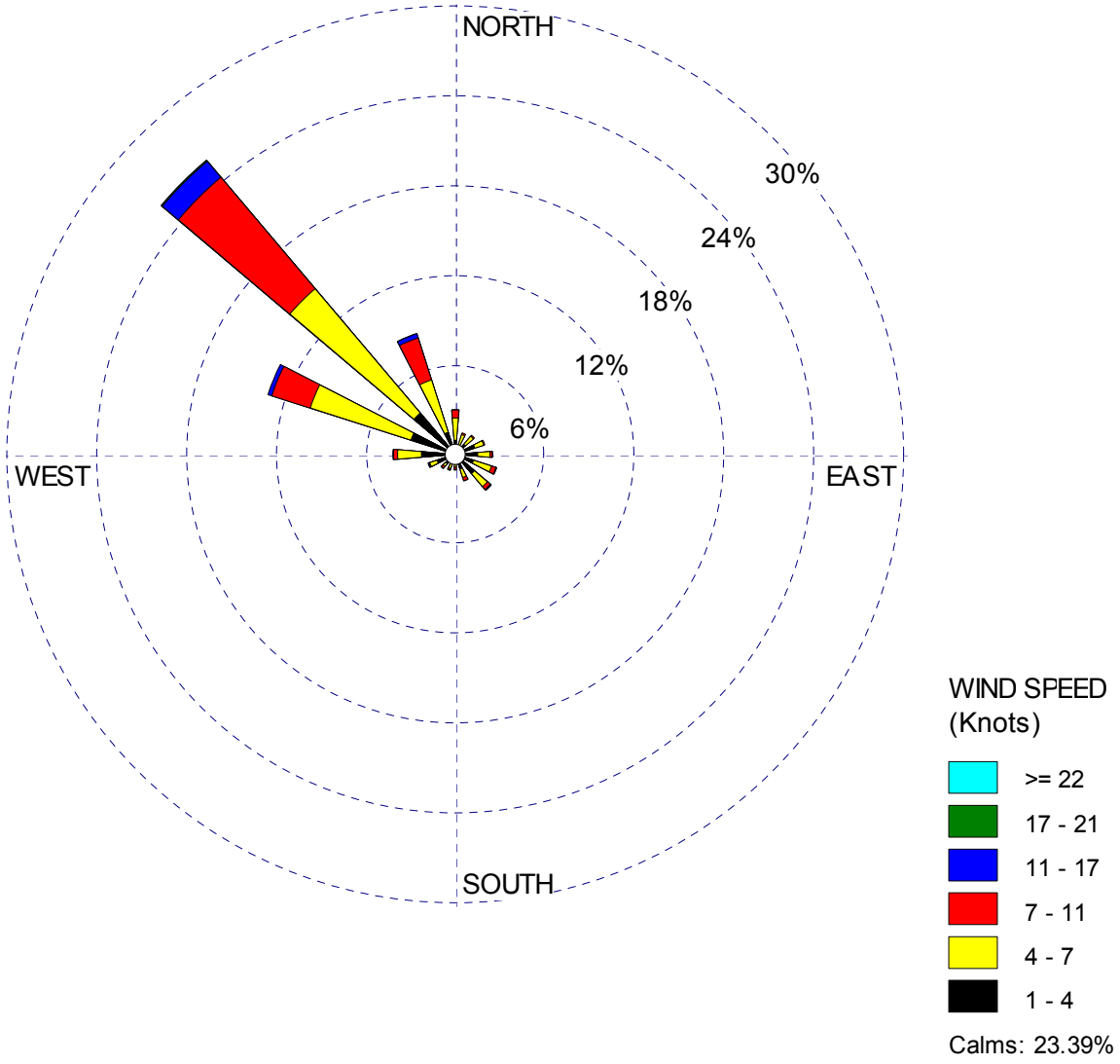


Figure 2C: Wind Rose for Hanford, CA – Calendar Year 2002

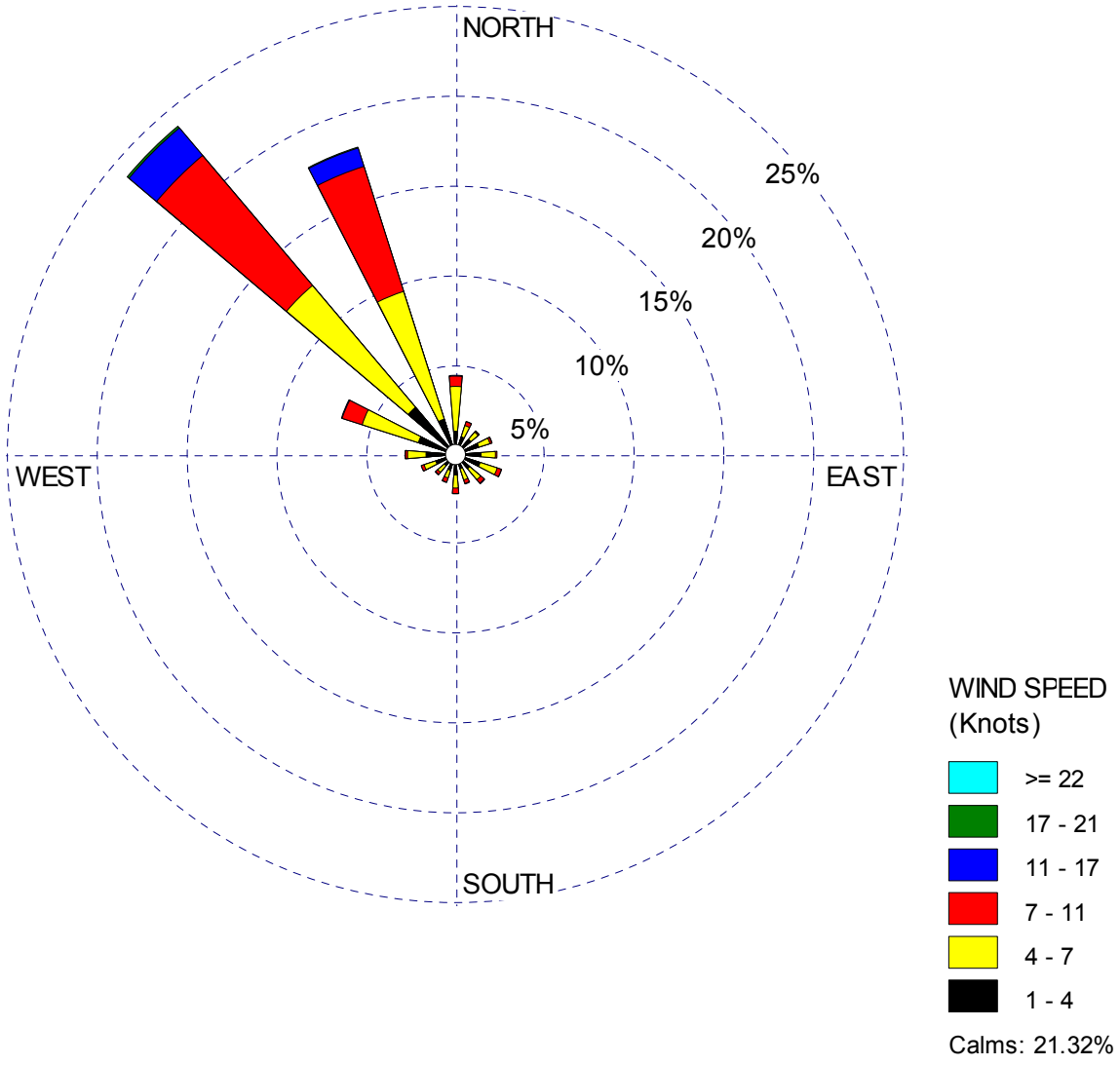


Figure 2D: Wind Rose for Hanford, CA – Calendar Year 2003

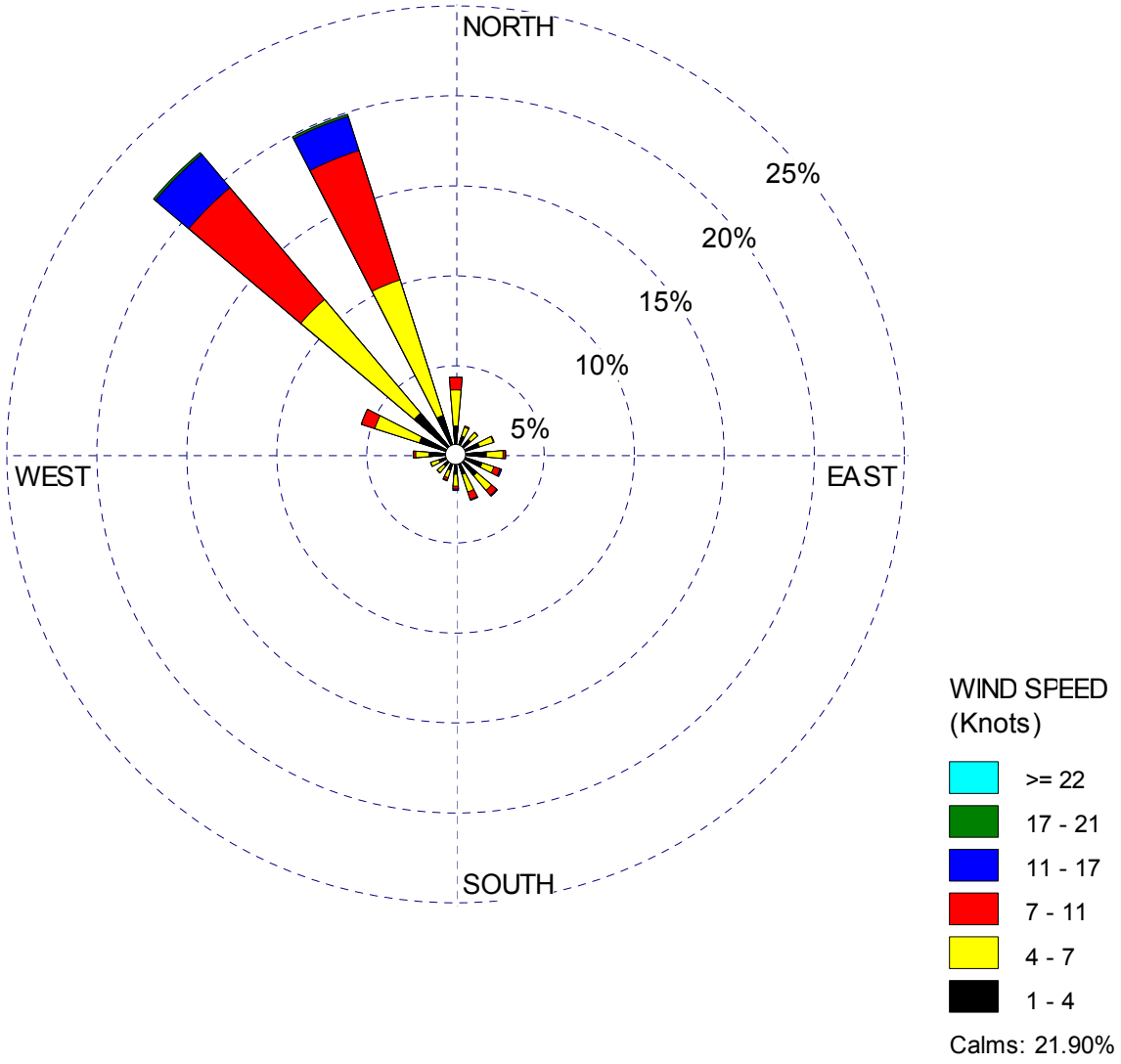
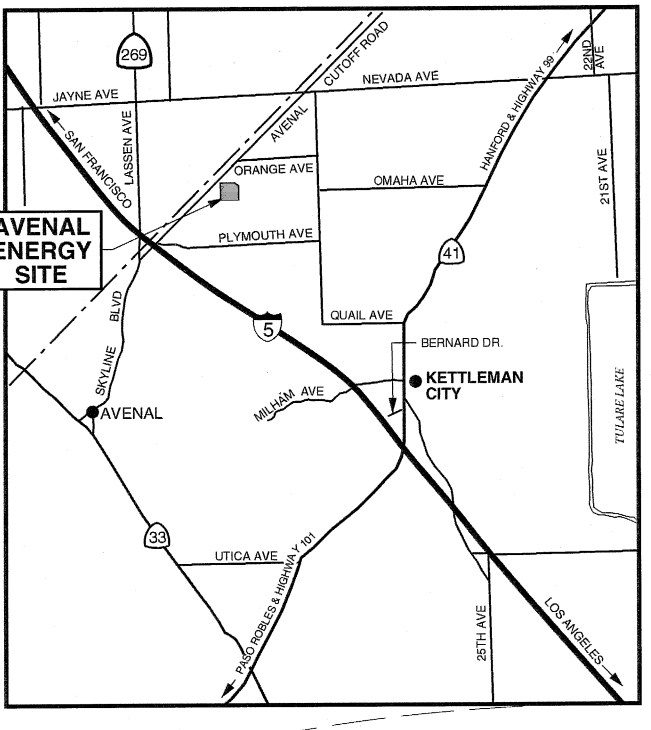


Figure 2E: Wind Rose for Hanford, CA – Calendar Year 2004

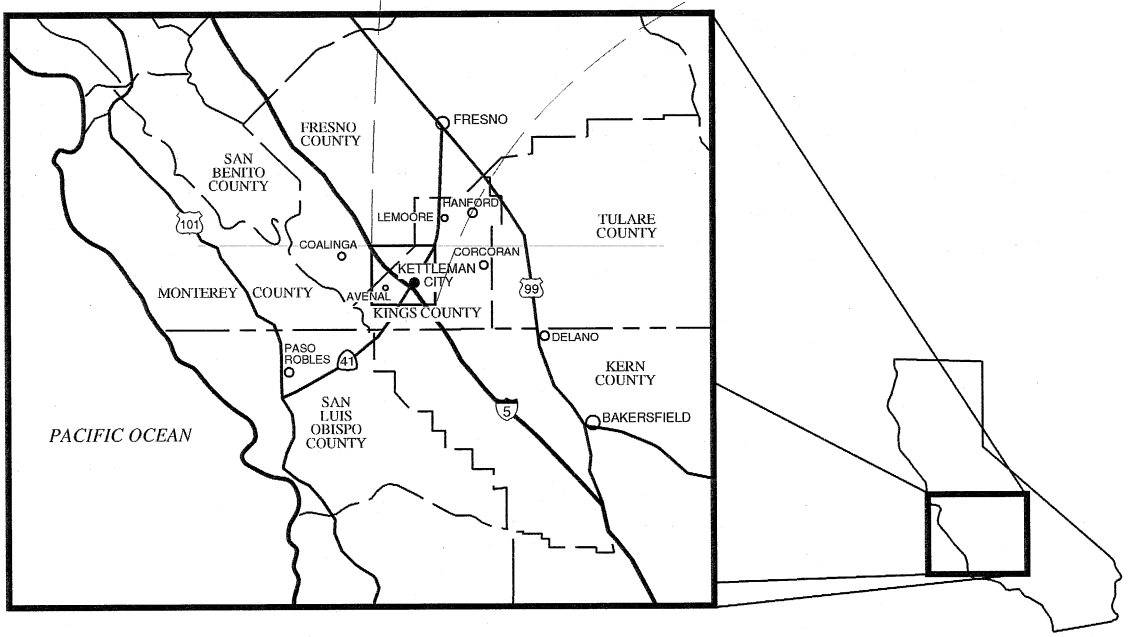
Appendix A

Location Figures

290317-AFC-2.0-1 REV1 09/05/06



VICINITY MAP
NOT TO SCALE



REGIONAL MAP

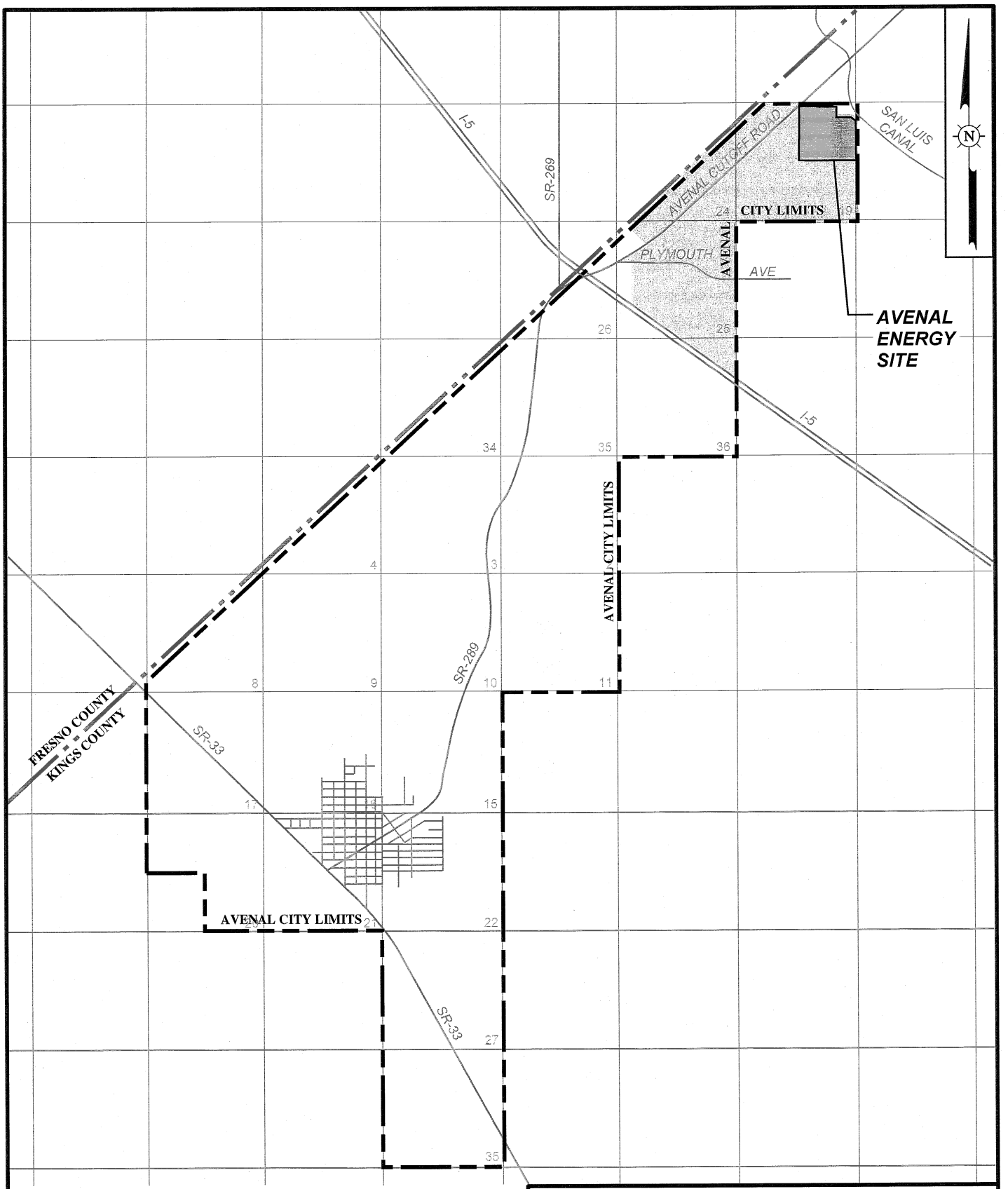
0 60 120 MILES
APPROXIMATE SCALE

REGIONAL LOCATION MAP

FEDERAL ENERGY AVENAL, LLC

AVENAL ENERGY | **FIGURE 2.0-1**

290317-AFC-2.0-2 REV.09/13/01



LEGEND

INDUSTRIAL ZONE (CITY OF AVENAL GENERAL PLAN AND ZONING ORDINANCE)

0 6,000 12,000 FEET

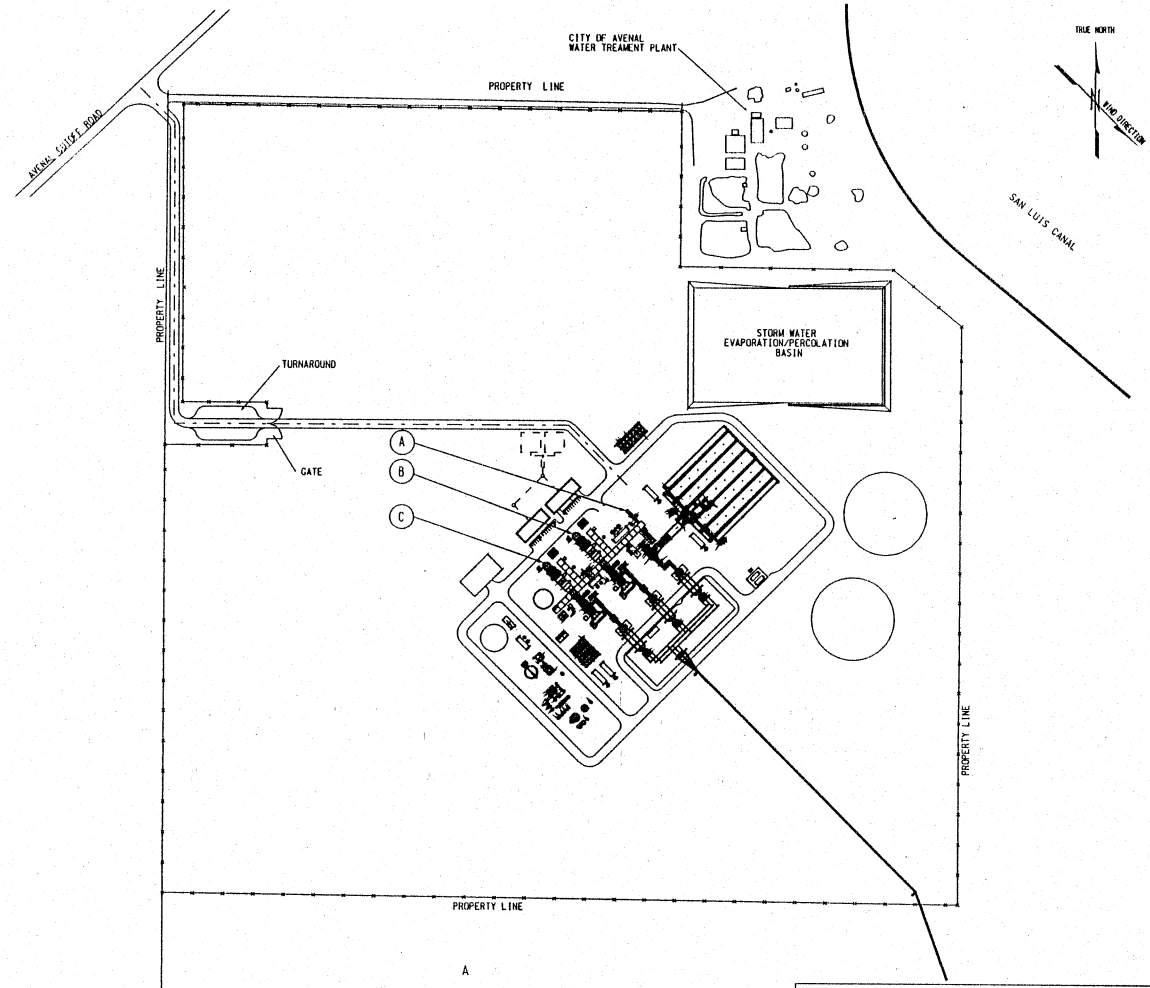
SCALE

REFERENCE: CITY OF AVENAL GENERAL PLAN.

SITE LOCATION

FEDERAL POWER AVENAL, LLC

AVENAL ENERGY | **FIGURE 2.0-2**



Ⓐ	BOILER	N.1,917,806	E.6,248,074
Ⓑ	HRSG STACK 1	N.1,917,734	E.6,247,871
Ⓒ	HRSG STACK 2	N.1,917,635	E.6,247,772

0' 50' 100' 200' 300' 400'
REDUCED PRINT SCALE

REV	DATE	REVISION DESCRIPTION	BY	CHK	APPV	REV	DATE	REVISION DESCRIPTION	BY	CHK	APPV	REFERENCE DWG NUMBER	REFERENCE DRAWINGS
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FLUOR	APP DATE	
CLIENT	APP DATE	

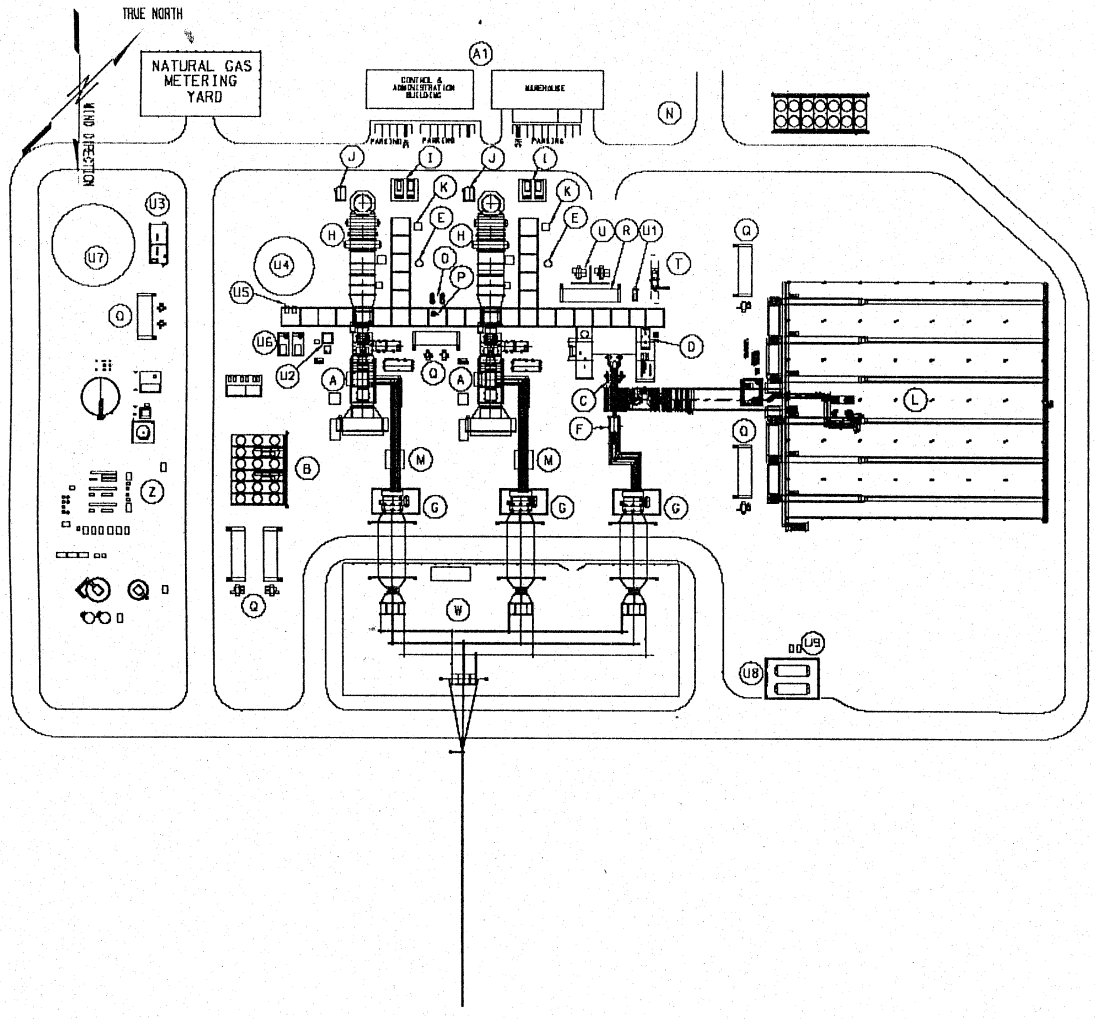
AVENAL, LLC
AVENAL ENERGY PROJECT
AVENAL, CALIFORNIA

FIGURE 2.1-4
SITE PLAN
CONCEPTUAL DESIGN

SCALE	DRAWING NUMBER	REV
1"=400'	A3DV01-1-SP-5-00-1	A

CAD FILE NAME site plan.DGN .DGN

XREF ATTACHED - YES ☐ NO ☐ MANUAL CHANGES MADE - YES ☐ NO ☐ DWG FILE UPDATED - YES ☐ NO ☐ MODEL UPDATED - YES ☐ NO ☐



MAJOR EQUIPMENT LIST

A GAS TURBINE GENERATOR
B INLET AIR CHILLERS
C STEAM TURBINE
D STG LUBE OIL SKID
E HRSG BLOW DOWN DRUM
F STG GENERATOR
G MAIN TRANSFORMERS
H HEAT RECOVERY STEAM GENERATOR
I HP/IP BOILER FEED WATER PUMPS
J CONTINUOUS EMISSIONS MONITORING SYSTEM
K HRSG BLOWDOWN SUMP
L AIR COOLED CONDENSER
M GENERATOR BREAKERS
N CLOSED COOLING WATER AIR COOLER
O CIRCULATING COOLING WATER PUMPS
P CLOSED COOLING WATER EXPANSION TANK
Q POWER DISTRIBUTION CENTER (480 V)
R POWER DISTRIBUTION CENTER (4160 V)
S
T AUXILIARY BOILER
U UNIT AUXILIARY TRANSFORMER
V
W SWITCHYARD
X RAW WATER SOFTENER CLARIFIERS (RWSC)
Y RWSC FILTER PRESS
Z ZERO LIQUID DISCHARGE FACILITY (ZLDF)

A1 SEPTIC TANK & LEACH FIELD (IMMEDIATELY NW)
A2 STORM WATER EVAPORATION/PERCOLATION BASIN

UTILITIES

U1 STANDBY DIESEL GENERATOR
U2 OIL/WATER SEPARATOR
U3 FIREWATER PUMP HOUSE
U4 DEMINERALIZED WATER STORAGE TANK
U5 DEMINERALIZED WATER PUMPS
U6 PLANT/INSTRUMENT AIR COMPRESSORS
U7 RAW WATER/FIREWATER STORAGE TANKS
U8 AMMONIA STORAGE TANKS
U9 AMMONIA TRANSFER PUMPS

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A	1/1/01	ISSUED FOR REVIEW											

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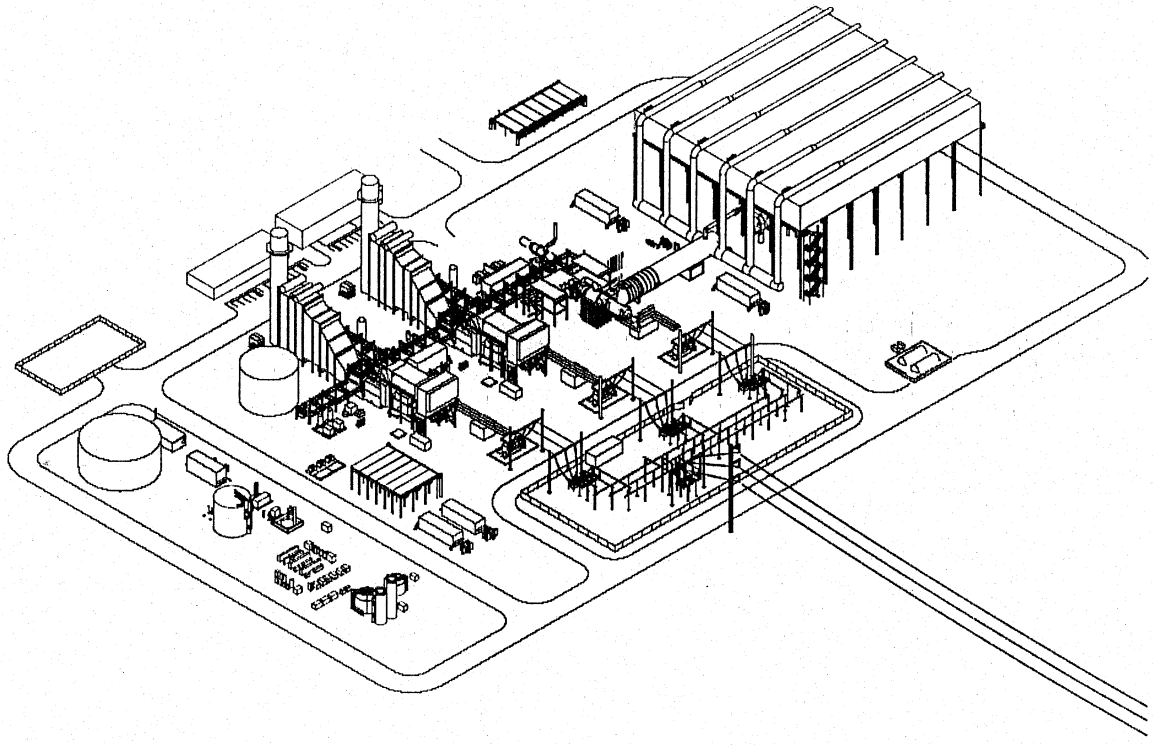
AVENAL, CALIFORNIA

FIGURE 2.3-3
PLOT PLAN
CONCEPTUAL DESIGN

SCALE 1"=125' | DRAWING NUMBER A3DV01-1-PP-5-00-1 | REV A

XREF ATTACHED - YES ☐ NO ☐ MANUAL CHANGES MADE - YES ☐ NO ☐ DWG FILE UPDATED - YES ☐ NO ☐ MODEL UPDATED - YES ☐ NO ☐ CAD FILE NAME .DWN



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A	7/9/01	ISSUED FOR REVIEW											

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LEAD ENGR/SPEC. A. MACKENZIE — APP DATE

FLUOR — APP DATE

CLIENT — APP DATE

AVENAL, LLC
AVENAL ENERGY PROJECT
AVENAL, CALIFORNIA

ISO VIEW
CONCEPTUAL DESIGN

SCALE: NONE

DRAWING NUMBER: A3DV01-1-PP-5-00-2

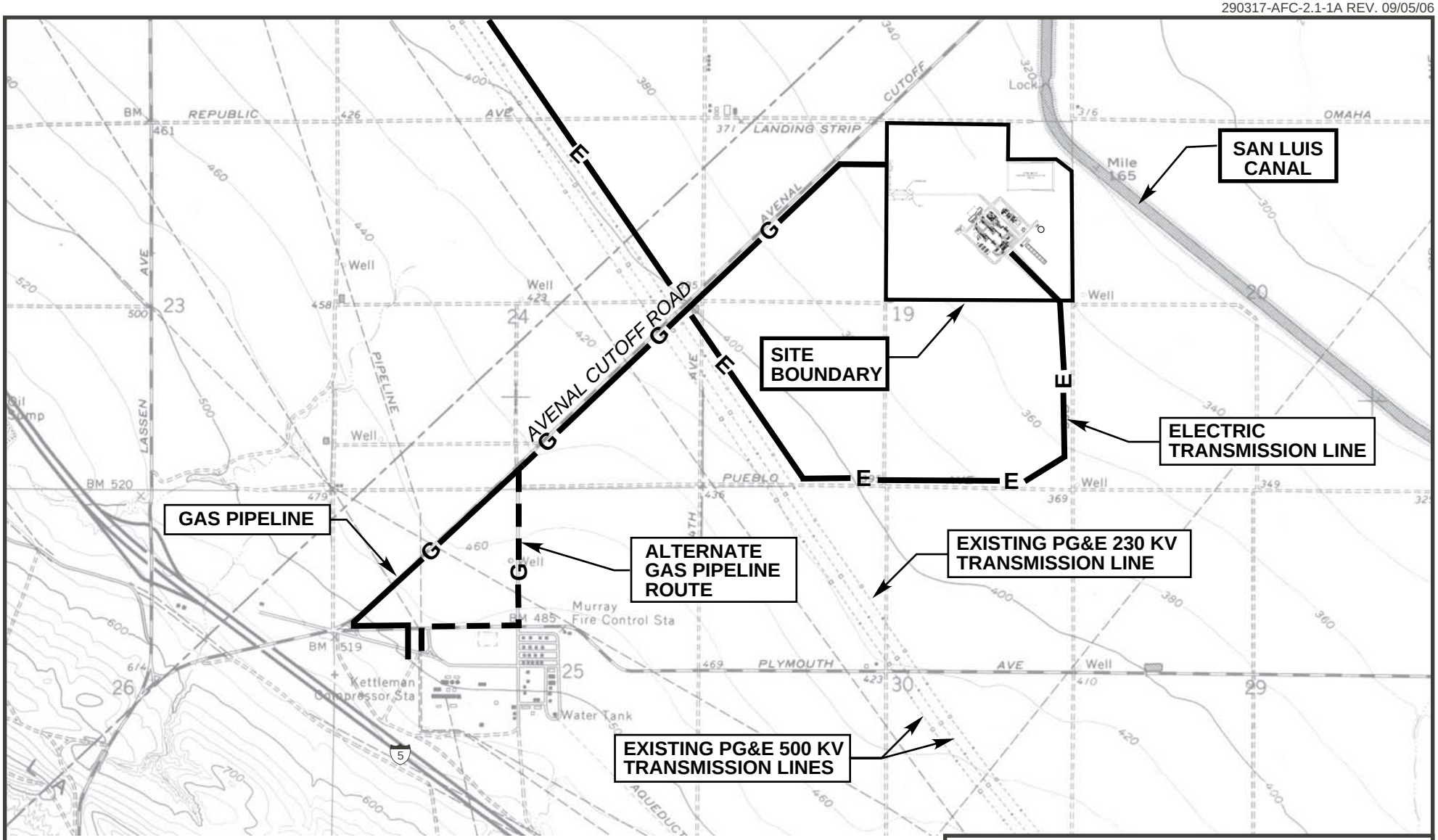
REV: A

CAD FILE NAME

DWG

PLOT DATE

ERDT ATTACHED - YES ☐ NO ☐ MANUAL CHANGES MADE - YES ☐ NO ☐ DWG FILE UPDATED - YES ☐ NO ☐ MODEL UPDATED - YES ☐ NO ☐



REFERENCE:
U.S.G.S 7.5 MINUTE TOPOGRAPHIC SERIES MAP OF LA CIMA, CALIFORNIA, DATED 1978.

0 2,000 4,000 FEET
SCALE

NATURAL GAS AND ELECTRICAL INTERCONNECTION ROUTES

FEDERAL POWER AVENAL LLC

AVENAL ENERGY | FIGURE 2.1-1A

Appendix B

Information on CTDMPLUS Model

The CTDMPLUS and CTSCREEN Models

Complex terrain impacts may need to be modeled with more accuracy than that provided by AERMOD. The use of more refined modeling techniques is specifically addressed in EPA's Appendix W[1] modeling guidance, as follows:

> *Since AERMOD treats dispersion in complex terrain, we have merged sections 4 and 5 of appendix W, as proposed in the April 2000 NPR [Notice of Proposed Rulemaking]. And while AERMOD produces acceptable regulatory design concentrations in complex terrain, it does not replace CTDMPLUS for detailed or receptor-oriented complex terrain analysis, as we have made clear in Guideline section 4.2.2. CTDMPLUS remains available for use in complex terrain. [p. 68225]*
>
> *4.2.2 Refined Analytical Techniques*
> *d. If the modeling application involves a well defined hill or ridge and a detailed dispersion analysis of the spatial pattern of plume impacts is of interest, CTDMPLUS, listed in Appendix A, is available. CTDMPLUS provides greater resolution of concentrations about the contour of the hill feature than does AERMOD through a different plume-terrain interaction algorithm. [p. 68233]*

CTSCREEN is the same basic model as CTDMPLUS, except that meteorological data are handled internally in a simplified manner. As discussed in the CTSCREEN users guide,[2]

> *Since [CTDMPLUS] accounts for the three-dimensional nature of plume and terrain interaction, it requires detailed terrain and meteorological data that are representative of the modeling domain. Although the terrain data may be readily obtained from topographic maps and digitized for use in the CTDMPLUS, the required meteorological data may not be as readily available.*
>
> *Since the meteorological input requirements of the CTDMPLUS can limit its application, the EPA's Complex-Terrain-Modeling, Technology-Transfer Workgroup developed a methodology to use the advanced techniques of CTDMPLUS in situations where on-site meteorological measurements are limited or unavailable. This approach uses CTDMPLUS in a "screening" mode--actual source and terrain characteristics are modeled with an extensive array of predetermined meteorological conditions.*

---

[1] 40 CFR 51 Subpart W, as amended November 9, 2005 at 70 FR 68218, "Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions."

[2] USEPA, EPA-600/8-90-087, "User's Guide to CTDMPLUS: Volume 2. The Screening Mode (CTSCREEN)," October 1990.

This CTDMPLUS screening mode (CTSCREEN) serves several purposes in regulatory applications. When meteorological data are unavailable, CTSCREEN can be used to obtain conservative (safely above those of refined models), yet realistic, impact estimates for particular sources.

Therefore, the use of the CTSCREEN version of CTDMPLUS is consistent with EPA guidance.

Meteorological Data for CTDMPLUS

The discussion in Section 6 of the text focused on meteorological data needed to run AERMOD. As discussed in a later section, an additional model, Complex Terrain Dispersion Model PLUS (CTDMPLUS), may be used in lieu of the model Complex Terrain Screening Model (CTSCREEN) for receptors in the terrain above stack-top height. CTDMPLUS is a USEPA-approved air dispersion model, and is fully supported with user guidance documentation.[3]

CTDMPLUS requires an extensive suite of meteorological data composed of not only wind speed, direction, and temperature, but also horizontal and vertical wind direction standard deviations (sigma theta and sigma phi, respectively), and vertical wind speed standard deviation (sigma w). The AERMOD-compatible meteorological data set provided by the SJVAPCD, derived from measurements taken at Hanford, CA, does not include these non-standard measurements.

It is possible to develop conservative values for the standard deviation parameters sigma theta, sigma phi, and sigma w that are consistent with the available meteorological data, and use them to prepare a meteorological data set that is usable in CTDMPLUS and yields conservative (i.e., high) ground-level concentrations.

If modeling with CTDMPLUS is required, the District will be requested to develop ISCST3-compatible meteorological data sets for the same three years of 2003-2005. The ISCST3 meteorological data set would be used to create the CTDMPLUS-compatible meteorological data set. Because all three of these Gaussian dispersion models—ISCST3, AERMOD, and CTDMPLUS—require upper air data as well as surface data, the upper air data from the Oakland Metropolitan Airport (ID No. 23230) would be used because it is the same station used by the SJVAPCD to develop the AERMOD-compatible meteorological dataset.

The following meteorological parameters are needed for CTDMPLUS and would be taken directly from the AERMET files:

- Observed mixing height, provided as the height of the convective or planetary boundary layer (PBL);

[3] USEPA. Technology Transfer Network, Support Center for Regulatory Atmospheric Modeling, *http://www.epa.gov/scram001/dispersion_prefrec.htm#ctdmplus*

- Calculated mixing height, provided as the height of the mechanical, or surface, boundary layer (SBL);
- Friction velocity (USTAR);
- Monin-Obukhov length (L); and
- Roughness length (Z_O).

The remaining standard deviations (sigma values) are not available from AERMOD and must be obtained from ISCST3-compatible files that would be developed from the Hanford, CA meteorological data. Stability classes determined by MPRM[4] or PCRAMMET[5] from the measured Hanford meteorological data would be used to select the most conservative values from the following ranges recommended in USEPA's Meteorological Monitoring Guidance document:[6]

Stability Category	Sigma Phi (σ_Φ)/ Regulatory Range (degrees)	Sigma Theta (σ_θ)/ Regulatory Range (degrees)
A	11.5	22.5
B	10.0 – 11.5	17.5 – 22.5
C	7.8 – 10.0	12.5 – 17.5
D	5.0 – 7.8	7.5 – 12.5
E	2.4 – 5.0	3.8 – 7.5
F	< 2.4	< 3.8

The most conservative values (that is, the values that produce the highest modeled impacts) for sigma theta and sigma phi within each range would be determined by conducting a sensitivity analysis for all combinations of stack conditions to be modeled using CTDMPLUS and receptor locations for which CTDMPLUS would be used (that is, receptors above stack height). The sensitivity analysis would use the upper and lower values of each range for each stability category. For example, for stability category D, four combinations would be evaluated as follows:

σ_Φ	σ_θ
5.0	7.5
5.0	12.5
7.8	7.5
7.8	12.5

[4] The Meteorological Processor for Regulatory Models
[5] EPA meteorological preprocessor
[6] Tables 6-8a and 6-9a in Meteorological Monitoring Guidance for Regulatory Modeling Applications, EPA-454/R-99-005, US EPA Office of Air and Radiation, Office of Air Quality Planning and Standards, February 2000.

For stability category A, maximum values for σ_Φ and σ_θ of 15.0 and 27.0, respectively, would be evaluated. For stability category F, minimum values for σ_Φ and σ_θ of 1.0 and 2.0, respectively, would be evaluated.

Sigma-w would be estimated by multiplying sigma-phi (after conversion from degrees to radians) by the horizontal wind speed.

Eric Walther

From: Leland Villalvazo [leland.villalvazo@valleyair.org]
Sent: Tuesday, January 22, 2008 2:33 PM
To: Eric Walther
Cc: Derek Fukuda
Subject: Avenal Energy Project AFC - Modeling Protocol
Importance: High
Attachments: Leland Villalvazo.vcf

Eric,

Based on our conversation today the modeling protocol submitted on Aug 15, 2007 is acceptable. The District looks forward to receiving the final HRA modeling results for Avenal Energy.

Thanks,

Leland

Leland Villalvazo
Supervising AQS
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Figure 6.2-2.1
Building Layout for GEP Analysis

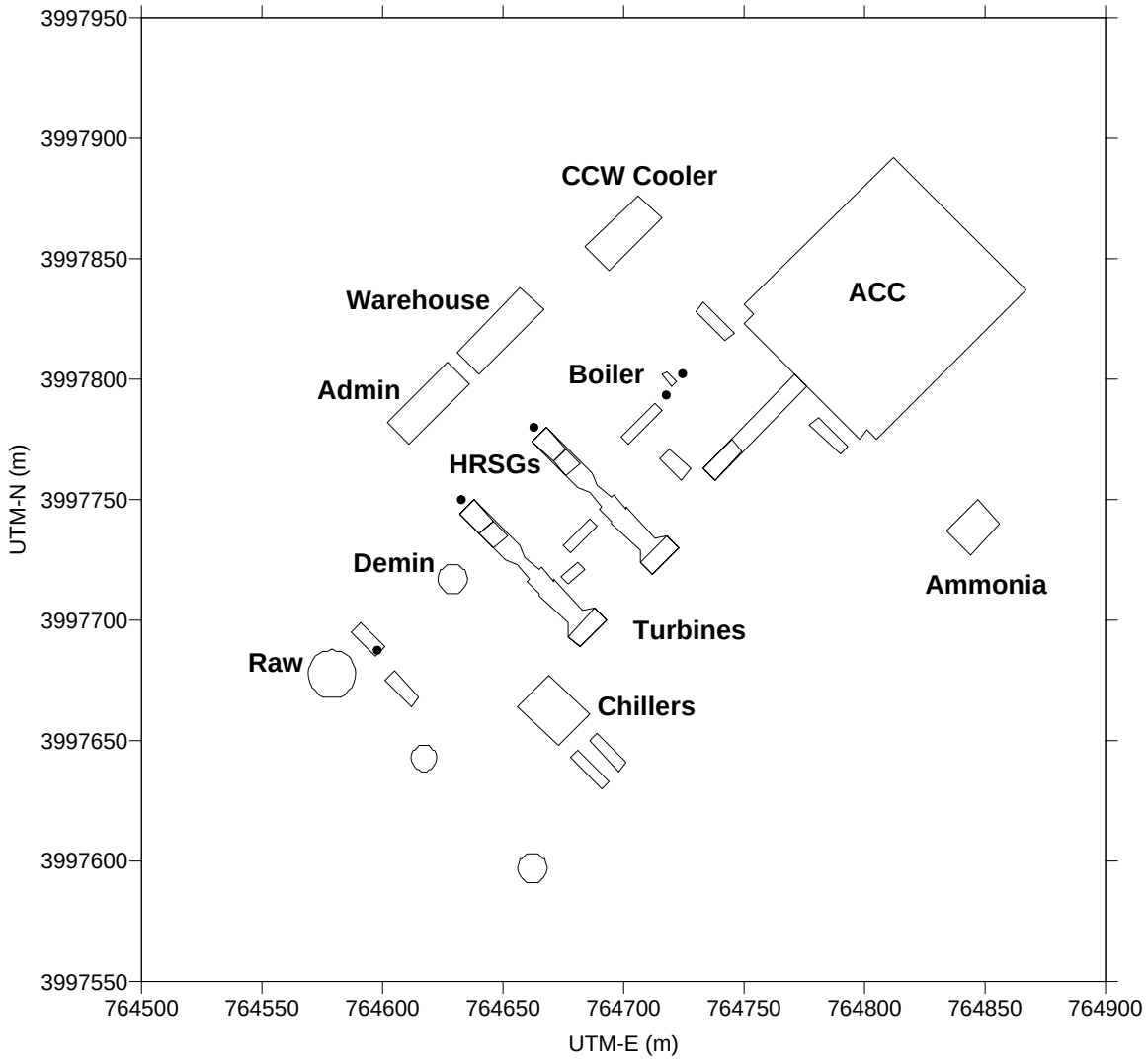

Table 6.2-2.1 Building Dimensions Used in Building Profile Input Program (BPIP)

Building/Structure	Height, feet	Length, feet	Width, feet
HRSGs: Tier 1	26.0	254.3	25.9
HRSGs: Tier 2	70.6	27.5	25.9
HRSGs: Tier 3	80.0	39.7	25.9
CTG Inlet Air Filters	55.0	51.8	20.2
Steam Turbine/Big Tube	20.0	177.3	22.7
Air-Cooled Condensers	139.0	303.6	256.7
Administration Building	15.0	116.6	42.1
Warehouse	24.0	122.3	42.1
Fire Pump Building	12.0	44.5	18.6
Auxiliary Boiler	15.0	19.4	9.7
Inlet Air Chiller	121.0	76.1	60.7
Packaged Distribution Center 1	15.0	58.3	14.6
Packaged Distribution Center 2	15.0	57.5	15.4
Packaged Distribution Center 3	15.0	65.6	15.4
Packaged Distribution Center 4	15.0	49.4	17.0
Packaged Distribution Center 5	15.0	58.3	14.6
Packaged Distribution Center 6	15.0	58.3	14.6
Packaged Distribution Center 7	15.0	51.0	14.6
Packaged Distribution Center 8	15.0	30.0	12.1
Packaged Distribution Center 9	15.0	39.7	19.4
Closed Cooling Water Air Cooler	12.0	101.2	43.7
Ammonia Storage Tanks (2 combined in containment basin)	12.0	58.3	46.2
Demineralized Water Tank	32.0	D= 40.0	
Raw Service/Fire Water Tanks	40.0	D = 65.0	
Waste Tank	24.0	D = 35.0	
Zero Liquids Discharge Facility	45.0	D = 40.0	

Table 6.2-2.2
Screening Modeling Inputs
Data For Each Turbine

No.	Case/Fluor No./SR Name	Amb Temp deg F	Stack height feet	Stack Height meters	Stack Diam feet	Stack Diam meters	Stack flow wacfm	Stack flow m^3/sec	Stack Vel ft/sec	Stack Vel m/sec	Stack Temp deg F	Stack Temp deg K
1	1. Extreme Hot w/ DB	101°F	145	44.20	18.96	5.78	1,044,365	492.95	61.66	18.794	195.300	363.872
2	5. Annual Avg w/ DB	63°F	145	44.20	18.96	5.78	1,025,495	484.04	60.55	18.455	184.900	358.094
3	9. Extreme Cold w/ DB	32°F	145	44.20	18.96	5.78	1,059,836	500.25	62.57	19.073	189.000	360.372
4	2. Extreme Hot Base	101°F	145	44.20	18.96	5.78	1,051,531	496.33	62.08	18.923	207.400	370.594
5	6. Annual Avg Base	63°F	145	44.20	18.96	5.78	1,037,822	489.86	61.27	18.677	198.800	365.817
6	10. Extreme Cold Base	32°F	145	44.20	18.96	5.78	1,071,653	505.83	63.27	19.285	200.900	366.983
7	4. Extreme Hot Low	101°F	145	44.20	18.96	5.78	620,528	292.90	36.64	11.167	180.200	355.483
8	8. Annual Avg Low	63°F	145	44.20	18.96	5.78	644,316	304.12	38.04	11.595	175.800	353.039
9	12. Extreme Cold Low	32°F	145	44.20	18.96	5.78	666,146	314.43	39.33	11.988	177.400	353.928
10	4. Extreme Hot Low, startup	101°F	145	44.20	18.96	5.78	620,528	292.90	36.64	11.167	180.200	355.483
11	8. Annual Avg Low, startup	63°F	145	44.20	18.96	5.78	644,316	304.12	38.04	11.595	175.800	353.039
12	12. Extreme Cold Low, startup	32°F	145	44.20	18.96	5.78	666,146	314.43	39.33	11.988	177.400	353.928
13	4. Extreme Hot Low, commissioning	101°F	145	44.20	18.96	5.78	620,528	292.90	36.64	11.167	180.200	355.483
14	8. Annual Avg Low, commissioning	63°F	145	44.20	18.96	5.78	644,316	304.12	38.04	11.595	175.800	353.039
15	12. Extreme Cold Low, commissioning	32°F	145	44.20	18.96	5.78	666,146	314.43	39.33	11.988	177.400	353.928
16	2. Extreme Hot Base, commissioning	101°F	145	44.20	18.96	5.78	1,051,531	496.33	62.08	18.923	207.400	370.594
17	6. Annual Avg Base, commissioning	63°F	145	44.20	18.96	5.78	1,037,822	489.86	61.27	18.677	198.800	365.817
18	10. Extreme Cold Base, commissioning	32°F	145	44.20	18.96	5.78	1,071,653	505.83	63.27	19.285	200.900	366.983

No.	Case/Fluor No./SR Name	NOx lb/hr	CO lb/hr	PM10 lb/hr	SOx (1) lb/hr	VOC lb/hr	NOx g/sec	CO g/sec	PM10 g/sec	SOx g/sec	VOC g/sec
1	1. Extreme Hot w/ DB	17.13	20.86	11.81	6.65	5.96	2.159	2.628	1.488	0.838	0.751
2	5. Annual Avg w/ DB	16.34	19.90	11.27	6.34	5.68	2.059	2.507	1.420	0.799	0.716
3	9. Extreme Cold w/ DB	16.06	19.56	10.78	6.24	5.59	2.024	2.464	1.359	0.786	0.704
4	2. Extreme Hot Base	13.03	15.86	9.00	5.07	3.17	1.642	1.999	1.134	0.638	0.400
5	6. Annual Avg Base	13.03	15.86	9.00	5.06	3.17	1.642	1.999	1.134	0.638	0.400
6	10. Extreme Cold Base	13.47	16.39	9.00	5.24	3.28	1.697	2.066	1.134	0.660	0.413
7	4. Extreme Hot Low	7.26	8.84	9.00	2.82	1.77	0.915	1.114	1.134	0.356	0.223
8	8. Annual Avg Low	8.01	9.75	9.00	3.12	1.95	1.009	1.228	1.134	0.393	0.246
9	12. Extreme Cold Low	8.51	10.36	9.00	3.31	2.07	1.072	1.305	1.134	0.417	0.261
10	4. Extreme Hot Low, startup	160.00	1000.00	9.00	3.31	16.00	20.160	126.000	1.134	0.417	2.016
11	8. Annual Avg Low, startup	160.00	1000.00	9.00	3.31	16.00	20.160	126.000	1.134	0.417	2.016
12	12. Extreme Cold Low, startup	160.00	1000.00	9.00	3.31	16.00	20.160	126.000	1.134	0.417	2.016
13	4. Extreme Hot Low, commissioning	127.47	1000.00	9.00	3.31	16.00	16.061	126.000	1.134	0.417	2.016
14	8. Annual Avg Low, commissioning	127.47	1000.00	9.00	3.31	16.00	16.061	126.000	1.134	0.417	2.016
15	12. Extreme Cold Low, commissioning	127.47	1000.00	9.00	3.31	16.00	16.061	126.000	1.134	0.417	2.016
16	2. Extreme Hot Base, commissioning	160.00	1000.00	9.00	5.24	16.00	20.160	126.000	1.134	0.660	2.016
17	6. Annual Avg Base, commissioning	160.00	1000.00	9.00	5.24	16.00	20.160	126.000	1.134	0.660	2.016
18	10. Extreme Cold Base, commissioning	160.00	1000.00	9.00	5.24	16.00	20.160	126.000	1.134	0.660	2.016

1) SOx emission rates are at tariff limit of sulfur content in natural gas of 1 gr S/100 dscf.

Table 6.2-2.3
Screening Level Modeling Impacts
(Combined Impacts for Two Gas Turbines)

No.	Case/Fluor No./SR Name	Concentration (µg/m^3)									
		NO_2 1-hr	CO 1-hr	SO_2 1-hr	SO_2 3-hr	CO 8-hr	PM10 24-hr	SO_2 24-hr	NO_2 Annual	PM10 Annual	SO_2 Annual
1	1. Extreme Hot w/ DB	24.362	29.658	9.453	**4.151**	**6.506**	1.963	1.105	0.723	0.499	0.281
2	5. Annual Avg w/ DB	**24.533**	**29.866**	**9.523**	4.089	6.372	2.010	**1.131**	**0.741**	0.511	**0.288**
3	9. Extreme Cold w/ DB	22.948	27.937	8.913	3.934	6.144	1.825	1.056	0.690	0.463	0.268
4	2. Extreme Hot Base	18.141	22.085	7.053	3.068	4.814	1.405	0.791	0.516	0.357	0.201
5	6. Annual Avg Base	18.471	22.487	7.180	3.143	4.926	1.480	0.833	0.544	0.376	0.212
6	10. Extreme Cold Base	18.843	22.940	7.328	3.186	5.006	1.422	0.828	0.540	0.361	0.210
7	4. Extreme Hot Low	16.542	20.138	6.433	2.219	4.282	**2.858**	0.897	0.576	**0.714**	0.224
8	8. Annual Avg Low	18.110	22.047	7.045	2.440	4.638	2.798	0.969	0.624	0.702	0.243
9	12. Extreme Cold Low	18.639	22.691	7.242	2.541	4.752	2.673	0.982	0.633	0.670	0.246
10	4. Extreme Hot Low, startup	364.324	2277.028	7.528	2.596	484.158	2.858	1.050	12.692	0.714	0.262
11	8. Annual Avg Low, startup	361.841	2261.505	7.476	2.589	475.751	2.798	1.028	12.473	0.702	0.258
12	12. Extreme Cold Low, startup	350.497	2190.603	7.242	2.541	458.781	2.673	0.982	11.911	0.670	0.246
13	4. Extreme Hot Low, commissioning	290.255	2277.028	7.528	2.596	484.158	2.858	1.050	10.112	0.714	0.262
14	8. Annual Avg Low, commissioning	288.276	2261.505	7.476	2.589	475.751	2.798	1.028	9.937	0.702	0.258
15	12. Extreme Cold Low, commissioning	279.238	2190.603	7.242	2.541	458.781	2.673	0.982	9.490	0.670	0.246
16	2. Extreme Hot Base, commissioning	222.767	1392.291	7.291	3.172	303.505	1.405	0.818	6.340	0.357	0.208
17	6. Annual Avg Base, commissioning	226.807	1417.545	7.423	3.250	310.522	1.480	0.861	6.682	0.376	0.219
18	10. Extreme Cold Base, commissioning	223.876	1399.224	7.328	3.186	305.350	1.422	0.828	6.410	0.361	0.210

Bolded values indicate the maximum impact full-load case/mode.
Underlined values indicate the maximum impact half-load case/mode.

		Maxima
1-hr	H1	11.28584
	H2	11.91363
	H3	11.33717
	H4	11.04993
	H5	11.25036
	H6	11.10495
	H7	18.07165
	H8	17.94845
	H9	17.38574
	H10	18.07165
	H11	17.94845
	H12	17.38574
	H13	18.07165
	H14	17.94845
	H15	17.38574
	H16	11.04993
	H17	11.25036
	H18	11.10495
3-hr	H1	4.95524
	H2	5.11529
	H3	5.00447
	H4	4.80738
	H5	4.92465
	H6	4.82869
	H7	6.23274
	H8	6.21576
	H9	6.09996
	H10	6.23274
	H11	6.21576
	H12	6.09996
	H13	6.23274
	H14	6.21576
	H15	6.09996
	H16	4.80738
	H17	4.92465
	H18	4.82869
8-hr	H1	2.47566
	H2	2.54169
	H3	2.49319
	H4	2.40877
	H5	2.46446
	H6	2.42341
	H7	3.84252
	H8	3.7758
	H9	3.64112
	H10	3.84252
	H11	3.7758
	H12	3.64112
	H13	3.84252
	H14	3.7758
	H15	3.64112
	H16	2.40877
	H17	2.46446
	H18	2.42341
24-hr	H1	1.31886
	H2	1.41552
	H3	1.3433
	H4	1.23932
	H5	1.3048
	H6	1.25422
	H7	2.52021
	H8	2.4677
	H9	2.35709
	H10	2.52021
	H11	2.4677
	H12	2.35709
	H13	2.52021
	H14	2.4677
	H15	2.35709
	H16	1.23932
	H17	1.3048
	H18	1.25422
annu	H1	0.33506
	H2	0.35986
	H3	0.34106
	H4	0.31447
	H5	0.33147
	H6	0.31797
	H7	0.62958
	H8	0.61869
	H9	0.59083
	H10	0.62958
	H11	0.61869
	H12	0.59083
	H13	0.62958
	H14	0.61869
	H15	0.59083
	H16	0.31447
	H17	0.33147
	H18	0.31797

Table 6.2-2.4
Normal Operation Emission Rates and Stack Parameters for Modeling
Avenal Energy Project

	Stack Diam, m	Stack Height, m	Exh Temp, Deg K	Exhaust Flow, m^3/s	Exhaust Velocity, m/s	Emission Rate, g/s				Stack Diam, ft	Stack Height, ft	Exh Temp, Deg F	Exh Flow Rate, ft3/m	Exhaust Velocity, ft/s	Emission Rate, lbs/hr			
						NOx	SO_2	CO	PM10						NOx	SO_2	CO	PM10
Averaging Period: One hour for NO_2, SO_2, and CO in Normal Operation																		
Turbine 1/HRSG	5.779	44.196	358.09	484.0	18.45	2.059	**0.799**	2.507	n/a	18.96	145.0	184.9	1,025,495	60.55	16.34	**6.344**	19.90	n/a
Turbine 2/HRSG	5.779	44.196	358.09	484.0	18.45	2.059	**0.799**	2.507	n/a	18.96	145.0	184.9	1,025,495	60.55	16.34	**6.344**	19.90	n/a
Auxiliary Boiler	0.813	11.278	476.48	6.33	12.19	5.181E-02	1.328E-02	0.174	n/a	2.67	37.0	398.0	13,404	40	0.41	0.105	1.38	n/a
Emergency Generator Engine	0.203	3.048	698.15	2.31	71.30	0.358	2.296E-03	0.502	n/a	0.67	10.0	797.0	4,899	233.91	2.84	0.018	3.98	n/a
Emerg. Fire Water Pump Engine	0.152	5.486	784.26	0.77	42.22	0.272	3.892E-04	0.036	n/a	0.50	18.0	952.0	1,632	138.53	2.16	0.003	0.28	n/a
Averaging Period: Three hours for SO_2 in Normal Operation																		
Turbine 1/HRSG	5.779	44.196	363.87	492.9	18.79	n/a	**0.838**	n/a	n/a	18.96	145.0	195.3	1,044,365	61.66	n/a	**6.648**	n/a	n/a
Turbine 2/HRSG	5.779	44.196	363.87	492.9	18.79	n/a	**0.838**	n/a	n/a	18.96	145.0	195.3	1,044,365	61.66	n/a	**6.648**	n/a	n/a
Auxiliary Boiler	0.813	11.278	476.48	6.33	12.19	n/a	1.328E-02	n/a	n/a	2.67	37.0	398.0	13,404	40	n/a	0.105	n/a	n/a
Emergency Generator Engine	0.203	3.048	698.15	2.31	71.30	n/a	7.653E-04	n/a	n/a	0.67	10.0	797.0	4,899	233.91	n/a	0.0061	n/a	n/a
Emerg. Fire Water Pump Engine	0.152	5.486	784.26	0.77	42.22	n/a	1.297E-04	n/a	n/a	0.50	18.0	952.0	1,632	138.53	n/a	0.0010	n/a	n/a
Averaging Period: Eight hours for CO in Normal Operation																		
Turbine 1/HRSG	5.779	44.196	363.87	492.9	18.79	n/a	n/a	2.628	n/a	18.96	145.0	195.3	1,044,365	61.66	n/a	n/a	20.86	n/a
Turbine 2/HRSG	5.779	44.196	363.87	492.9	18.79	n/a	n/a	2.628	n/a	18.96	145.0	195.3	1,044,365	61.66	n/a	n/a	20.86	n/a
Auxiliary Boiler	0.813	11.278	476.48	6.33	12.19	n/a	n/a	0.174	n/a	2.67	37.0	398.0	13,404	40	n/a	n/a	1.38	n/a
Emergency Generator Engine	0.203	3.048	698.15	2.31	71.30	n/a	n/a	0.0627	n/a	0.67	10.0	797.0	4,899	233.91	n/a	n/a	0.498	n/a
Emerg. Fire Water Pump Engine	0.152	5.486	784.26	0.77	42.22	n/a	n/a	4.470E-03	n/a	0.50	18.0	952.0	1,632	138.53	n/a	n/a	0.035	n/a
Averaging Period: 24 hours for SO_2 in Normal Operation																		
Turbine 1/HRSG	5.779	44.196	358.09	484.0	18.45	n/a	**0.799**	n/a	n/a	18.96	145.0	184.9	1,025,495	60.55	n/a	**6.344**	n/a	n/a
Turbine 2/HRSG	5.779	44.196	358.09	484.0	18.45	n/a	**0.799**	n/a	n/a	18.96	145.0	184.9	1,025,495	60.55	n/a	**6.344**	n/a	n/a
Auxiliary Boiler	0.813	11.278	476.48	6.33	12.19	n/a	6.642E-03	n/a	n/a	2.67	37.0	398.0	13,404	40	n/a	5.27E-02	n/a	n/a
Emergency Generator Engine	0.203	3.048	698.15	2.31	71.30	n/a	9.566E-05	n/a	n/a	0.67	10.0	797.0	4,899	233.91	n/a	7.59E-04	n/a	n/a
Emerg. Fire Water Pump Engine	0.152	5.486	784.26	0.77	42.22	n/a	1.621E-05	n/a	n/a	0.50	18.0	952.0	1,632	138.53	n/a	1.29E-04	n/a	n/a

Table 6.2-2.4
Normal Operation Emission Rates and Stack Parameters for Modeling
Avenal Energy Project

	Stack Diam, m	Stack Height, m	Exh Temp, Deg K	Exhaust Flow, m^3/s	Exhaust Velocity, m/s	Emission Rate, g/s				Stack Diam, ft	Stack Height, ft	Exh Temp, Deg F	Exh Flow Rate, ft3/m	Exhaust Velocity, ft/s	Emission Rate, lbs/hr			
						NOx	SO_2	CO	PM10						NOx	SO_2	CO	PM10
Averaging Period: 24 hours for PM10 in Normal Operation																		
Turbine 1/HRSG	5.779	44.196	**355.48**	**292.9**	**11.17**	n/a	n/a	n/a	1.134	18.96	145.0	**180.2**	**620,528**	**36.64**	n/a	n/a	n/a	9.00
Turbine 2/HRSG	5.779	44.196	**355.48**	**292.9**	**11.17**	n/a	n/a	n/a	1.134	18.96	145.0	**180.2**	**620,528**	**36.64**	n/a	n/a	n/a	9.00
Auxiliary Boiler	0.813	11.278	476.48	6.33	12.19	n/a	n/a	n/a	1.178E-02	2.67	37.0	398.0	13,404	40	n/a	n/a	n/a	**0.09**
Emergency Generator Engine	0.203	3.048	698.15	2.31	71.30	n/a	n/a	n/a	3.387E-04	0.67	10.0	797.0	4,899	233.91	n/a	n/a	n/a	2.69E-03
Emerg. Fire Water Pump Engine	0.152	5.486	784.26	0.77	42.22	n/a	n/a	n/a	1.967E-04	0.50	18.0	952.0	1,632	138.53	n/a	n/a	n/a	1.56E-03
Averaging Period: Annual NO_2 and SO_2 in Normal Operation																		
Turbine 1/HRSG	5.779	44.196	358.09	484.0	18.45	**2.071**	0.235	n/a	n/a	18.96	145.0	184.9	1,025,495	60.55	**16.43**	1.865	n/a	n/a
Turbine 2/HRSG	5.779	44.196	358.09	484.0	18.45	**2.071**	0.235	n/a	n/a	18.96	145.0	184.9	1,025,495	60.55	**16.43**	1.865	n/a	n/a
Auxiliary Boiler	0.813	11.278	476.48	6.33	12.19	6.476E-03	0.000E+00	n/a	n/a	2.67	37.0	398.0	13,404	40	5.140E-02	0.00E+00	n/a	n/a
Emergency Generator Engine	0.203	3.048	698.15	2.31	71.30	2.045E-03	4.718E-06	n/a	n/a	0.67	10.0	797.0	4,899	233.91	1.623E-02	3.74E-05	n/a	n/a
Emerg. Fire Water Pump Engine	0.152	5.486	784.26	0.77	42.22	1.553E-03	2.221E-06	n/a	n/a	0.50	18.0	952.0	1,632	138.53	1.232E-02	1.76E-05	n/a	n/a
Averaging Period: Annual PM10 in Normal Operation																		
Turbine 1/HRSG	5.779	44.196	355.48	292.9	11.17	n/a	n/a	n/a	1.160	18.96	145.0	**180.2**	**620,528**	**36.64**	n/a	n/a	n/a	9.21
Turbine 2/HRSG	5.779	44.196	355.48	292.9	11.17	n/a	n/a	n/a	1.160	18.96	145.0	**180.2**	**620,528**	**36.64**	n/a	n/a	n/a	9.21
Auxiliary Boiler	0.813	11.278	476.48	6.33	12.19	n/a	n/a	n/a	0.000E+00	2.67	37.0	398.0	13,404	40	n/a	n/a	n/a	0.00E+00
Emergency Generator Engine	0.203	3.048	698.15	2.31	71.30	n/a	n/a	n/a	4.640E-05	0.67	10.0	797.0	4,899	233.91	n/a	n/a	n/a	3.68E-04
Emerg. Fire Water Pump Engine	0.152	5.486	784.26	0.77	42.22	n/a	n/a	n/a	2.694E-05	0.50	18.0	952.0	1,632	138.53	n/a	n/a	n/a	2.14E-04

Table 6.2-2.5

Startup Emission Rates and Stack Parameters for Modeling [1]

Avenal Energy Project

	Stack Diam, m	Stack Height, m	Exh Temp, Deg K	Exhaust Flow, m^3/s	Exhaust Velocity, m/s	Emission Rate, g/s				Stack Diam, ft	Stack Height, ft	Exh Temp, Deg F	Exh Flow Rate, ft3/m	Exhaust Velocity, ft/s	Emission Rate, lbs/hr			
						NOx	SO_2	CO	PM10						NOx	SO_2	CO	PM10
Averaging Period: One hour for NOx, SOx, and CO during Startup at 50% Load																		
Turbine 1/HRSG	5.779	44.196	355.48	292.9	11.17	20.160	0.417	126.000	n/a	18.96	145.0	180.2	620,528	36.64	160	**3.306**	1000	n/a
Turbine 2/HRSG	5.779	44.196	355.48	292.9	11.17	**10.080**	0.417	113.652	n/a	18.96	145.0	180.2	620,528	36.64	**80**	**3.306**	**902**	n/a
Auxiliary Boiler	0.813	11.278	476.48	6.33	12.19	5.181E-02	1.328E-02	0.174	n/a	2.67	37.0	398.0	13,404	40.00	0.41	0.105	1.38	n/a
Emergency Generator Engine	0.203	3.048	698.15	2.31	71.30	0.358	2.296E-03	0.502	n/a	0.67	10.0	797.0	4,899	233.91	2.84	0.018	3.98	n/a
Emerg. Fire Water Pump Engine	0.152	5.486	784.26	0.77	42.22	0.272	3.892E-04	0.036	n/a	0.50	18.0	952.0	1,632	138.53	2.16	0.003	0.28	n/a
Averaging Period: Three hours for SOx in During Startup at 50% Load																		
Turbine 1/HRSG	5.779	44.196	355.48	292.9	11.17	n/a	0.417	n/a	n/a	18.96	145.0	180.2	620,528	36.64	n/a	**3.306**	n/a	n/a
Turbine 2/HRSG	5.779	44.196	355.48	292.9	11.17	n/a	0.417	n/a	n/a	18.96	145.0	180.2	620,528	36.64	n/a	**3.306**	n/a	n/a
Auxiliary Boiler	0.813	11.278	476.48	6.33	12.19	n/a	1.328E-02	n/a	n/a	2.67	37.0	398.0	13,404	40.00	n/a	0.105	n/a	n/a
Emergency Generator Engine	0.203	3.048	698.15	2.31	71.30	n/a	7.653E-04	n/a	n/a	0.67	10.0	797.0	4,899	233.91	n/a	0.0061	n/a	n/a
Emerg. Fire Water Pump Engine	0.152	5.486	784.26	0.77	42.22	n/a	1.297E-04	n/a	n/a	0.50	18.0	952.0	1,632	138.53	n/a	0.0010	n/a	n/a
Averaging Period: Eight hours for CO with a 6-Hour Startup at 50% Load																		
Turbine 1/HRSG	5.779	44.196	355.48	292.9	11.17	n/a	n/a	**87.439**	n/a	18.96	145.0	180.2	620,528	36.64	n/a	n/a	**693.96**	n/a
Turbine 2/HRSG	5.779	44.196	355.48	292.9	11.17	n/a	n/a	**87.111**	n/a	18.96	145.0	180.2	620,528	36.64	n/a	n/a	**691.36**	n/a
Auxiliary Boiler	0.813	11.278	476.48	6.33	12.19	n/a	n/a	0.174	n/a	2.67	37.0	398.0	13,404	40.00	n/a	n/a	1.38	n/a
Emergency Generator Engine	0.203	3.048	698.15	2.31	71.30	n/a	n/a	0.0627	n/a	0.67	10.0	797.0	4,899	233.91	n/a	n/a	0.498	n/a
Emerg. Fire Water Pump Engine	0.152	5.486	784.26	0.77	42.22	n/a	n/a	4.470E-03	n/a	0.50	18.0	952.0	1,632	138.53	n/a	n/a	0.035	n/a
Averaging Period: 24 hours for SO_2 with a 6-Hour Startup at 50% Load																		
Turbine 1/HRSG	5.779	44.196	**355.48**	**292.9**	**11.17**	n/a	**0.583**	n/a	n/a	18.96	145.0	**180.2**	**620,528**	**36.64**	n/a	**4.626**	n/a	n/a
Turbine 2/HRSG	5.779	44.196	**355.48**	**292.9**	**11.17**	n/a	**0.556**	n/a	n/a	18.96	145.0	**180.2**	**620,528**	**36.64**	n/a	**4.415**	n/a	n/a
Auxiliary Boiler	0.813	11.278	476.48	6.33	12.19	n/a	6.642E-03	n/a	n/a	2.67	37.0	398.0	13,404	40.00	n/a	5.27E-02	n/a	n/a
Emergency Generator Engine	0.203	3.048	698.15	2.31	71.30	n/a	9.566E-05	n/a	n/a	0.67	10.0	797.0	4,899	233.91	n/a	7.59E-04	n/a	n/a
Emerg. Fire Water Pump Engine	0.152	5.486	784.26	0.77	42.22	n/a	1.621E-05	n/a	n/a	0.50	18.0	952.0	1,632	138.53	n/a	1.29E-04	n/a	n/a
Averaging Period: 24 hours for PM10 with a 6-Hour Startup at 50% Load																		
Turbine 1/HRSG	5.779	44.196	**355.48**	**292.9**	**11.17**	n/a	n/a	n/a	1.134	18.96	145.0	**180.2**	**620,528**	**36.64**	n/a	n/a	n/a	9.00
Turbine 2/HRSG	5.779	44.196	**355.48**	**292.9**	**11.17**	n/a	n/a	n/a	1.134	18.96	145.0	**180.2**	**620,528**	**36.64**	n/a	n/a	n/a	9.00
Auxiliary Boiler	0.813	11.278	476.48	6.33	12.19	n/a	n/a	n/a	**1.178E-02**	2.67	37.0	398.0	13,404	40.00	n/a	n/a	n/a	**9.35E-02**
Emergency Generator Engine	0.203	3.048	698.15	2.31	71.30	n/a	n/a	n/a	3.387E-04	0.67	10.0	797.0	4,899	233.91	n/a	n/a	n/a	2.69E-03
Emerg. Fire Water Pump Engine	0.152	5.486	784.26	0.77	42.22	n/a	n/a	n/a	1.967E-04	0.50	18.0	952.0	1,632	138.53	n/a	n/a	n/a	1.56E-03

(1) Startup of Turbine 2 lags startup of Turbine 1 by one hour.

Table 6.2-2.6
Fumigation Modeling using SCREEN3
Avenal Energy Project

Dispersion Case	Case No.	Ambient Temperature and Turbine Operating Condition	Emission Rates (g/s per turbine)			
			NOx	CO	PM10	SOx
Rural	Case 1	1. Extreme Hot w/ DB	2.159	2.628	1.489	0.838
	Case 2	5. Annual Avg w/ DB	2.059	2.507	1.421	0.799
	Case 3	9. Extreme Cold w/ DB	2.024	2.464	1.359	0.786
	Case 4	2. Extreme Hot Base	1.642	1.999	1.134	0.638
	Case 5	6. Annual Avg Base	1.642	1.999	1.134	0.638
	Case 6	10. Extreme Cold Base	1.697	2.066	1.134	0.660
	Case 7	4. Extreme Hot Low	0.915	1.114	1.134	0.356
	Case 8	8. Annual Avg Low	1.009	1.228	1.134	0.393
	Case 9	12. Extreme Cold Low	1.072	1.305	1.134	0.417

	Case No.	Unit Impacts	NO_2	CO	PM10	SO_2	Distance to Maxima (m)
		($\mu g/m^3$ per g/s)	($\mu g/m^3$)				
Inversion Breakup (per turbine)	Case 1	1.203	2.5968	3.1614	1.7907	1.0077	16,472
	Case 2	1.27	2.6152	3.1838	1.8040	1.0151	15,827
	Case 3	1.223	2.4756	3.0137	1.6617	0.9615	16,275
	Case 4	1.145	1.8798	2.2885	1.2984	0.7308	17,085
	Case 5	1.192	1.9571	2.3826	1.3517	0.7607	16,590
	Case 6	1.159	1.9666	2.3942	1.3143	0.7648	16,936
	Case 7	1.793	1.6412	1.9980	2.0333	0.6382	12,270
	Case 8	1.787	1.8031	2.1951	2.0265	0.7015	12,297
	Case 9	1.736	1.8611	2.2657	1.9686	0.7231	12,566

	Case No.	Unit Impacts	NO_2	CO	PM10	SO_2	Distance to Maxima (m)
		($\mu g/m^3$ per g/s)	($\mu g/m^3$)				
Flat Terrain (per turbine)	Case 1	1.005	2.1694	2.6410	1.4960	0.8418	1,071
	Case 2	1.046	2.1540	2.6222	1.4858	0.8361	1,168
	Case 3	1.008	2.0404	2.4839	1.3696	0.7925	1,070
	Case 4	0.9957	1.6347	1.9901	1.1291	0.6355	1,073
	Case 5	1.003	1.6468	2.0048	1.1374	0.6401	1,072
	Case 6	0.9977	1.6929	2.0610	1.1314	0.6583	1,073
	Case 7	1.709	1.5643	1.9044	1.9380	0.6083	1,005
	Case 8	1.702	1.7174	2.0907	1.9301	0.6681	1,006
	Case 9	1.634	1.7518	2.1326	1.8530	0.6806	1,019

Appropriate 1-hr unit impacts to use for longer averaging periods

	Case No.	1-hr unit	3-hr unit	8-hr unit	24-hr unit
Inversion Breakup Fumigation (per turbine)	Case 1	1.2030	1.1040	1.0421	1.0174
	Case 2	1.2700	1.1580	1.0880	1.0600
	Case 3	1.2230	1.1155	1.0483	1.0214
	Case 4	1.1450	1.0704	1.0237	1.0050
	Case 5	1.1920	1.0975	1.0384	1.0148
	Case 6	1.1590	1.0784	1.0279	1.0078
	Case 7	1.7930	1.7510	1.7248	1.7143
	Case 8	1.7870	1.7445	1.7179	1.7073
	Case 9	1.7360	1.6850	1.6531	1.6404

1-hr: maximum of flat terrain or inversion breakup
3-hr: 1.5 hrs of fumigation - 1.5 hrs of flat terrain
8-hr: 1.5 hrs of fumigation - 6.5 hrs of flat terrain
24-hr: 1.5 hrs of fumigation - 22.5 hrs of flat terrain

Table 6.2-2.6
Fumigation Modeling using SCREEN3
Avenal Energy Project

Maxima:						
	Case No.	1-hr average Unit Impacts	NO_2	CO	PM10	SO_2
		($\mu g/m^3$ per g/s)	($\mu g/m^3$)			
Inversion Fumigation (per turbine)	Case 1	1.2030	2.5968	3.1614	-	1.0077
	Case 2	1.2700	2.6152	3.1838	-	1.0151
	Case 3	1.2230	2.4756	3.0137	-	0.9615
	Case 4	1.1450	1.8798	2.2885	-	0.7308
	Case 5	1.1920	1.9571	2.3826	-	0.7607
	Case 6	1.1590	1.9666	2.3942	-	0.7648
	Case 7	1.7930	1.6412	1.9980	-	0.6382
	Case 8	1.7870	1.8031	2.1951	-	0.7015
	Case 9	1.7360	1.8611	2.2657	-	0.7231
			NO_2	CO	PM10	SO_2
sum all units - multiply by 2, for two turbines			($\mu g/m^3$)			
Both Turbines	Case 1		5.1937	6.3227	-	2.0153
	Case 2		**5.2305**	**6.3675**	-	**2.0302**
	Case 3		4.9511	6.0275	-	1.9230
	Case 4		3.7596	4.5770	-	1.4616
	Case 5		3.9142	4.7651	-	1.5214
	Case 6		3.9333	4.7883	-	1.5295
	Case 7		3.2824	3.9959	-	1.2764
	Case 8		3.6062	4.3902	-	1.4029
	Case 9		3.7223	4.5315	-	1.4463
Inversion Fumigation (per turbine)	Case No.	3-hr average Unit Impacts	NO_2	CO	PM10	SO_2
		($\mu g/m^3$ per g/s)	($\mu g/m^3$)			
	Case 1	1.1040	-	-	-	0.8323
	Case 2	1.1580	-	-	-	0.8330
	Case 3	1.1155	-	-	-	0.7893
	Case 4	1.0704	-	-	-	0.6148
	Case 5	1.0975	-	-	-	0.6304
	Case 6	1.0784	-	-	-	0.6404
	Case 7	1.7510	-	-	-	0.5609
	Case 8	1.7445	-	-	-	0.6163
	Case 9	1.6850	-	-	-	0.6317
			NO_2	CO	PM10	SO_2
sum all units - multiply by 2, for two turbines			($\mu g/m^3$)			
Both Turbines	Case 1		-	-	-	1.6645
	Case 2		-	-	-	**1.6661**
	Case 3		-	-	-	1.5786
	Case 4		-	-	-	1.2297
	Case 5		-	-	-	1.2607
	Case 6		-	-	-	1.2808
	Case 7		-	-	-	1.1219
	Case 8		-	-	-	1.2326
	Case 9		-	-	-	1.2634

Table 6.2-2.6
Fumigation Modeling using SCREEN3
Avenal Energy Project

	Case No.	8-hr average Unit Impacts	NO_2	CO	PM10	SO_2
		($\mu g/m^3$ per g/s)	($\mu g/m^3$)			
Inversion Fumigation (per trubine)	Case 1	1.0421	-	1.9170	-	-
	Case 2	1.0880	-	1.9093	-	-
	Case 3	1.0483	-	1.8083	-	-
	Case 4	1.0237	-	1.4322	-	-
	Case 5	1.0384	-	1.4529	-	-
	Case 6	1.0279	-	1.4864	-	-
	Case 7	1.7248	-	1.3453	-	-
	Case 8	1.7179	-	1.4772	-	-
	Case 9	1.6531	-	1.5103	-	-
			NO_2	CO	PM10	SO_2
sum all units - multiply by 2, for two turbines			($\mu g/m^3$)			
Both Turbines	Case 1		-	**3.8340**	-	-
	Case 2		-	3.8185	-	-
	Case 3		-	3.6166	-	-
	Case 4		-	2.8644	-	-
	Case 5		-	2.9059	-	-
	Case 6		-	2.9728	-	-
	Case 7		-	2.6907	-	-
	Case 8		-	2.9544	-	-
	Case 9		-	3.0206	-	-
	Case No.	24-hr average Unit Impacts	NO_2	CO	PM10	SO_2
		($\mu g/m^3$ per g/s)	($\mu g/m^3$)			
Inversion Fumigation (per trubine)	Case 1	1.0174	-	-	0.6058	0.3409
	Case 2	1.0600	-	-	0.6023	0.3389
	Case 3	1.0214	-	-	0.5551	0.3212
	Case 4	1.0050	-	-	0.4559	0.2566
	Case 5	1.0148	-	-	0.4603	0.2591
	Case 6	1.0078	-	-	0.4571	0.2660
	Case 7	1.7143	-	-	0.7776	0.2441
	Case 8	1.7073	-	-	0.7744	0.2681
	Case 9	1.6404	-	-	0.7441	0.2733
			NO_2	CO	PM10	SO_2
sum all units - multiply by 2, for two turbines			($\mu g/m^3$)			
Both Turbines	Case 1		-	-	1.2115	**0.6817**
	Case 2		-	-	1.2046	0.6778
	Case 3		-	-	1.1102	0.6424
	Case 4		-	-	0.9118	0.5132
	Case 5		-	-	0.9206	0.5181
	Case 6		-	-	0.9143	0.5320
	Case 7		-	-	**1.5552**	0.4881
	Case 8		-	-	1.5489	0.5361
	Case 9		-	-	1.4881	0.5466

Table 6.2-2.7

Emission Rates and Stack Parameters for Sequential [1] Commissioning of the Two Gas Turbines at 50% and 100% Loads

Equipment	Stack Diam, m	Stack Height m	Temp, deg K	Exhaust Flow, m^3/s	Exhaust Velocity, m/s	Emission Rates, g/s				Stack Diam, ft	Stack Height ft	Exh Temp, Deg F	Exh Flow Rate, ft^3/min	Exhaust Velocity, ft/s	Emission Rates, lb/hr			
						NOx	SOx	CO	PM10						NOx	SOx	CO	PM10
Averaging Period: 1-hour NOx, SOx and CO during Commissioning																		
Gas Turbine 1 (commissioning	5.78	44.20	355.5	292.9	11.17	16.06	4.17E-01	126.0	n/a	18.96	145	180.2	620,528	36.6	127.5	3.31	1000	n/a
Gas Turbine 2 (max. normal)	5.78	44.20	358.1	484.0	18.45	2.06	7.99E-01	2.5	n/a	18.96	145	184.9	1,025,495	60.5	16.3	6.34	19.9	n/a
Auxiliary Boiler	0.813	11.28	476.5	6.33	12.19	5.18E-02	1.33E-02	1.74E-01	n/a	2.67	37.0	398	13,404	40.0	0.411	0.1054	1.38	n/a
Emergency Standby Generator Engine	0.203	3.05	698.2	2.31	71.30	3.58E-01	2.30E-03	5.02E-01	n/a	0.667	10.0	797	4,899	233.9	2.844	1.82E-02	3.98	n/a
Emergency Standby Fire Water Pump Engine	0.152	5.49	784.3	0.770	42.22	2.72E-01	3.89E-04	3.58E-02	n/a	0.500	18.0	952	1,632	138.5	2.159	3.09E-03	0.284	n/a
Averaging Period: 3-hour SO_2 during Commissioning																		
Gas Turbine 1 (commissioning	5.78	44.20	365.8	489.8	18.68	n/a	0.660	n/a	n/a	18.96	145	198.8	1,037,822	61.3	n/a	5.24	n/a	n/a
Gas Turbine 2 (max. normal)	5.78	44.20	363.9	492.9	18.79	n/a	0.838	n/a	n/a	18.96	145	195.3	1,044,365	61.7	n/a	6.65	n/a	n/a
Auxiliary Boiler	0.813	11.28	476.5	6.33	12.19	n/a	1.33E-02	n/a	n/a	2.67	37.0	398	13,404	40.0	n/a	1.05E-01	n/a	n/a
Emergency Standby Generator Engine	0.203	3.05	698.2	2.31	71.30	n/a	7.65E-04	n/a	n/a	0.67	10.0	797	4,899	233.9	n/a	6.07E-03	n/a	n/a
Emergency Standby Fire Water Pump Engine	0.152	5.49	784.3	0.770	42.22	n/a	1.30E-04	n/a	n/a	0.50	18.0	952	1,632	138.5	n/a	1.03E-03	n/a	n/a
Averaging Period: 8-hour CO during Commissioning																		
Gas Turbine 1 (commissioning	5.78	44.20	355.5	292.9	11.17	n/a	n/a	126.0	n/a	18.96	145	180.2	620,528	36.6	n/a	n/a	1000	n/a
Gas Turbine 2 (max. normal)	5.78	44.20	363.9	492.9	18.79	n/a	n/a	2.6	n/a	18.96	145	195.3	1,044,365	61.7	n/a	n/a	20.9	n/a
Auxiliary Boiler	0.813	11.28	476.5	6.33	12.19	n/a	n/a	1.74E-01	n/a	2.67	37.0	398	13,404	40.0	n/a	n/a	1.38	n/a
Emergency Standby Generator Engine	0.203	3.05	698.2	2.31	71.30	n/a	n/a	6.27E-02	n/a	0.667	10.0	797	4,899	233.9	n/a	n/a	0.498	n/a
Emergency Standby Fire Water Pump Engine	0.152	5.49	784.3	0.770	42.22	n/a	n/a	4.47E-03	n/a	0.50	18.0	952	1,632	138.5	n/a	n/a	0.0355	n/a
Averaging Period: 24-hour SO_2 during Commissioning																		
Gas Turbine 1 (commissioning	5.78	44.20	355.5	292.857	11.17	n/a	0.2083	n/a	n/a	18.96	145.0	180.2	620,528	36.6	n/a	1.65	n/a	n/a
Gas Turbine 2 (max. normal)	5.78	44.20	358.1	483.980	18.45	n/a	0.7993	n/a	n/a	18.96	145.0	184.9	1,025,495	60.5	n/a	6.34	n/a	n/a
Auxiliary Boiler	0.813	11.28	476.5	6.33	12.19	n/a	6.64E-03	n/a	n/a	2.67	37.0	398	13,404	40.0	n/a	5.27E-02	n/a	n/a
Emergency Standby Generator Engine	0.203	3.05	698.2	2.31	71.30	n/a	9.57E-05	n/a	n/a	0.67	10.0	797	4,899	233.9	n/a	7.59E-04	n/a	n/a
Emergency Standby Fire Water Pump Engine	0.152	5.49	784.3	0.770	42.22	n/a	1.62E-05	n/a	n/a	0.500	18.0	952	1,632	138.5	n/a	1.29E-04	n/a	n/a
Averaging Period: 24-hour PM-10 during Commissioning																		
Gas Turbine 1 (commissioning	5.78	44.20	355.5	292.9	11.17	n/a	n/a	n/a	1.134	18.96	145	180.2	620,528	36.6	n/a	n/a	n/a	9.00
Gas Turbine 2 (max. normal)	5.78	44.20	355.5	292.9	11.17	n/a	n/a	n/a	1.134	18.96	145	180.2	620,528	36.6	n/a	n/a	n/a	9.00
Auxiliary Boiler	0.813	11.28	476.5	6.33	12.19	n/a	n/a	n/a	1.18E-02	2.67	37.0	398	13,404	40.0	n/a	n/a	n/a	0.093
Emergency Standby Generator Engine	0.203	3.05	698.2	2.31	71.30	n/a	n/a	n/a	3.39E-04	0.67	10.0	797	4,899	233.9	n/a	n/a	n/a	2.69E-03
Emergency Standby Fire Water Pump Engine	0.152	5.49	784.3	0.770	42.22	n/a	n/a	n/a	1.97E-04	0.50	18.0	952	1,632	138.5	n/a	n/a	n/a	0.0016
Averaging Period: Annual NOx and SOx during Commissioning Year																		
Gas Turbine 1 (commissioning	5.78	44.20	355.5	292.9	11.17	2.274	1.98E-01	n/a	n/a	18.96	145	180.2	620,528	36.64	18.05	1.5741	n/a	n/a
Gas Turbine 2 (max. normal)	5.78	44.20	358.1	484.0	18.45	2.274	1.98E-01	n/a	n/a	18.96	145	184.9	1,025,495	36.64	18.05	1.5741	n/a	n/a
Auxiliary Boiler	0.81	11.28	476.5	6.33	12.19	0.0113	4.45E-04	n/a	n/a	2.67	37	398	13,404	40.00	8.97E-02	3.54E-03	n/a	n/a
Emergency Standby Generator Engine	0.203	3.05	698.2	2.31	71.30	2.05E-03	4.72E-06	n/a	n/a	0.667	10.0	797	4,899	233.9	1.62E-02	3.74E-05	n/a	n/a
Emergency Standby Fire Water Pump Engine	0.152	5.49	784.3	0.77	42.22	0	2.22E-06	n/a	n/a	0.50	18.0	952	1,632	138.53	1.23E-02	1.76E-05	n/a	n/a
Averaging Period: Annual PM-10 during Commissioning Year																		
Gas Turbine 1 (commissioning	5.78	44.20	355.5	292.9	11.17	n/a	n/a	n/a	0.907	18.96	145	180.2	620,528	36.6	n/a	n/a	n/a	7.2020
Gas Turbine 2 (max. normal)	5.78	44.20	355.5	292.9	11.17	n/a	n/a	n/a	1.160	18.96	145	180.2	620,528	36.6	n/a	n/a	n/a	9.2075
Auxiliary Boiler	0.813	11.28	476.5	6.33	12.19	n/a	n/a	n/a	2.19E-03	2.67	37.0	398	13,404	40.0	n/a	n/a	n/a	1.74E-02
Emergency Standby Generator Engine	0.203	3.05	698.2	2.31	71.30	n/a	n/a	n/a	4.64E-05	0.67	10.0	797	4,899	233.9	n/a	n/a	n/a	3.68E-04
Emergency Standby Fire Water Pump Engine	0.152	5.49	784.3	0.770	42.22	n/a	n/a	n/a	2.69E-05	0.50	18.0	952	1,632	138.5	n/a	n/a	n/a	2.14E-04

(1) Commissioning of the second gas turbine will commence after completion of commissioning of the first gas turbine. The first turbine will have maximum commissioning emissions while the second turbine will have maximum normal operation emissions.

APPENDIX 6.2-3

CONSTRUCTION PHASE IMPACTS

APPENDIX 6.2-3
CONSTRUCTION PHASE IMPACTS

6.2-3.1 Onsite Construction

Construction of the Project is expected to last approximately 27 months. The onsite construction will be performed in the following five main phases:

- Site preparation;
- Foundation work;
- Installation of major equipment;
- Construction/installation of major structures; and
- Start up and commissioning.

Site preparation includes clearing, grading, excavation of footings and foundations, and backfilling operations. After site preparation is finished, the construction of the foundations and structures is expected to begin. Once the foundations and structures are finished, installation and assembly of the mechanical and electrical equipment are scheduled to commence.

Fugitive dust emissions from the construction of the Project will result from:

- Dust entrained during site preparation and grading/excavation at the construction site;
- Dust entrained during onsite travel on paved and unpaved surfaces;
- Dust entrained during aggregate and soil loading and unloading operations; and
- Wind erosion of areas disturbed during construction activities.

Combustion emissions during construction will result from:

- Exhaust from the Diesel construction equipment used for site preparation, grading, excavation, and construction of onsite structures;
- Exhaust from water trucks used to control construction dust emissions;
- Exhaust from Diesel-powered welding machines, electric generators, air compressors, water pumps, etc.;
- Exhaust from Diesel trucks used to deliver concrete, fuel, and construction supplies to the construction site; and
- Exhaust from automobiles and trucks used by workers to commute to the construction site.

To determine the potential worst-case daily construction impacts, exhaust and dust emission rates have been evaluated for each source of emissions. Maximum daily exhaust and dust emissions are calculated to occur during Month 12 of the construction schedule. Maximum annual emissions are based on the highest rolling 12-month sum of equipment horsepower-hours during the 27-month construction period.

6.2-3.2 Natural Gas/Wastewater Pipelines and Transmission Lines

The installation of a 2.5-mile long natural gas pipeline will generate short-term construction impacts including fugitive dust and construction equipment combustion emissions. For this pipeline route, the excavation, installation of pipe, backfilling, and site cleanup will be performed in approximately 500-foot-long sections over a short duration to minimize fugitive dust and construction equipment combustion emissions.

The installation of a 1.6-mile long water pipeline will also generate short-term construction impacts including fugitive dust and construction equipment combustion emissions.

The proposed project also includes the installation of a 6.4-mile long transmission line interconnect. As with the construction of the natural gas and water pipelines, this construction activity will result in fugitive dust and construction equipment combustion emissions.

6.2-3.3 Available Mitigation Measures

The following mitigation measures are proposed to control exhaust emissions from the Diesel heavy equipment used during construction of the Project:

- Operational measures, such as limiting engine idling time and shutting down equipment when not in use;
- Regular preventive maintenance to prevent emission increases due to engine problems;
- Use of low sulfur and low aromatic fuel meeting California standards for motor vehicle Diesel fuel; and
- Use of low-emitting Diesel engines meeting federal emissions standards for construction equipment if available.

The following mitigation measures are proposed to control fugitive dust emissions during construction of the project:

- Use either water application or chemical dust suppressant application to control dust emissions from unpaved surface travel and unpaved parking areas;
- Use vacuum sweeping and/or water flushing of paved road surface to remove buildup of loose material to control dust emissions from travel on the paved access road (including adjacent public streets impacted by construction activities) and paved parking areas;
- Cover all trucks hauling soil, sand, and other loose materials, or require all trucks to maintain at least two feet of freeboard;
- Limit traffic speeds on unpaved surfaces to 25 mph;
- Install sandbags or other erosion control measures to prevent silt runoff to roadways;
- Re-plant vegetation in disturbed areas as quickly as possible;
- As needed, use gravel pads along with wheel washers or wash tires of all trucks exiting construction site that carry track-out dirt from unpaved surfaces; and
- Mitigate fugitive dust emissions from wind erosion of areas disturbed from construction activities (including storage piles) by application of either water or chemical dust suppressant and/or use of wind breaks.

6.2-3.4 Estimation of Emissions with Mitigation Measures

6.2-3.4.1 Onsite Construction

Tables 6.2-3.1 and 6.2-3.2 show the estimated maximum daily and annual heavy equipment exhaust and fugitive dust emissions with recommended mitigation measures for onsite construction activities. Detailed emission calculations are included as Attachment 6.2-3.1.

6.2-3.4.2 Pipeline/Transmission Line Construction

Table 6.2-3.3 shows the estimated maximum daily heavy equipment exhaust and fugitive dust emissions with recommended mitigation measures for the natural gas pipeline, water pipeline, and transmission line interconnect construction activities. The following is the expected construction period for each pipeline/transmission line route:

- Natural gas pipeline – 4 months
- Water pipeline – 5 months
- Transmission line interconnect – 3 months

Because of the temporary nature of these construction activities, annual emissions are not shown in the following emission summary tables for these three "linear" construction activities. Detailed emission calculations are included as Attachment 6.2-3.1.

Table 6.2-3.1
Maximum Daily Emissions During Onsite Construction
(Month 12; Maximum Emissions), Pounds Per Day

	NO_x	CO	VOC	SO_x	PM_{10}
Onsite					
Construction Equipment	182	230	25	0.37	7.7
Fugitive Dust	--	--	--	--	5.9
Offsite					
Worker Travel, Truck Deliveries	515	2,775	108	2.8	32.4
Total Emissions					
Total	697	3,005	133	3.2	46.0

Table 6.2-3.2
Annual Emissions During Onsite Construction, Tons Per Year

	NO_x	CO	VOC	SO_x	PM_{10}
Onsite					
Construction Equipment	14.1	22.3	2.2	0.034	0.66
Fugitive Dust	--	--	--	--	0.42
Offsite					
Worker Travel, Truck Deliveries	33.8	190.7	7.3	0.19	2.2
Total Emissions					
Total	47.9	213.0	9.5	0.22	3.3

Table 6.2-3.3
Maximum Daily Emissions During Pipeline/Transmission Line Interconnect Construction
Pounds Per Day

	NO_x	CO	VOC	SO_x	PM_{10}
Natural Gas Pipeline					
Onsite					
Construction Equipment	37	29	4.1	0.046	1.7
Fugitive Dust	--	--	--	--	4.2
Offsite					
Truck Deliveries	21.5	4.8	1.2	0.023	1.0
Total Emissions	58.5	33.8	5.3	0.07	6.9
Water Pipeline					
Onsite					
Construction Equipment	43	33	5	0.1	1.9
Fugitive Dust	--	--	--	--	5.4
Offsite					
Truck Deliveries	32	7	1.8	0.04	1.5
Total Emissions	75	40	6.8	0.14	8.8
Transmission Line Interconnect					
Onsite					
Construction Equipment	43	31	4.8	0.1	1.8
Fugitive Dust	--	--	--	--	1.1
Offsite					
Truck Deliveries	54	12	3.0	0.06	2.4
Total Emissions	97	43	7.8	0.16	5.3

6.2-3.5 Analysis of Ambient Impacts from Onsite Construction

Ambient air quality impacts from emissions during construction of the Project were estimated using an air quality dispersion modeling analysis. The modeling analysis considers the construction site location, the surrounding topography, and the sources of emissions during construction, including vehicle and equipment exhaust emissions and fugitive dust.

6.2-3.5.1 Existing Ambient Levels

The existing air quality in the project area is based on the same data used for the modeling analysis performed for the project operating impacts (see Section 6.2.5.1.2). Table 6.2-3.4 shows the maximum concentrations of NO_x, SO_2, CO, and PM_{10} recorded in the project area over the past few years.

TABLE 6.2-3.4
MAXIMUM BACKGROUND CONCENTRATIONS, 2004-2006 (μg/m^3)

Pollutant	Averaging Time	2004	2005	2006
Hanford				
NO_2	1-Hour Annual	129.7 22.6	135.4 22.6	**137.2** [a] **22.6**
Sacramento				
SO_2	1-Hour 3-Hour 24-Hour Annual	21.3 19.2[c] 7.9 2.6	**47.2** **43.2**[c] **7.9** **2.6**	[b] [b] 5.2 2.6
Visalia				
CO	1-Hour 8-Hour	4,111 2,489	**4,222** **2,900**	[b] [b]
Hanford/Corcoran (higher value used)				
PM_{10}	24-Hour Annual	217 43.1	131 41.1	**304** **46.3**
Corcoran				
$PM_{2.5}$	24-Hour Max 98th Percentile 24-Hr 3-Year Avg 98th Percentile 24-Hour Annual Arith. Mean 3-Year Avg AAM [d]	61.0 49.4 52 17.4 **18**	**92.5** **74.5** **55** **17.5** 17	74.2 50.1 **58** 16.9 17

Notes:
[a] Bolded values are maxima.
[b] Insufficient data.
[c] Estimated from 1-hour concentrations by use of USEPA averaging time ratios (i.e., 0.9 for 3 hours)
[d] Annual arithmetic mean.

6.2-3.5.2 Dispersion Model

The Industrial Source Complex Short Term (ISCST3) model was used to estimate ambient impacts from construction activities, as described in the August 14, 2007 Air Dispersion Modeling and Health Risk Assessment Protocol.

The emission sources for the construction site were grouped into two categories: exhaust and construction dust emissions, and fugitive dust emissions. Six meters release height was used for all exhaust and construction dust emissions in this modeling analysis. For fugitive dust emissions, an effective plume height of 0.5 meters was used in the modeling analysis. The fugitive dust emissions were modeled as a single area source that covered the total area of the construction site. The construction impacts modeling analysis used the same receptor locations as used for the project operating impact analysis, but only extending out 0.5 km from the facility boundary to the south. A detailed discussion of the receptor locations is included in Section 6.2.5.1.2.

To determine the construction impacts on short-term ambient standards (24 hours and less), the maximum daily onsite construction emission levels shown in Table 6.2-3.1 were used. For pollutants with annual average ambient standards, the annual onsite emission levels shown in Table 6.2-3.2

were used. Meteorological data for Kettleman City during 1995 was used for the construction emission impacts analysis.

6.2-3.5.2 Modeling Results

Based on the emission rates of NO_x, SO_2, CO, and PM_{10} and the meteorological data, the ISCST3 model calculates hourly and annual ambient impacts for each pollutant. The modeled 1-hour, 3-hour, 8-hour, and 24-hour ambient impacts are based on the maximum daily emission rates of NO_x, SO_2, CO, and PM_{10}. The annual impacts are based on the annual emission rates of these pollutants.

The one-hour and annual average concentrations of NO_2 were computed following EPA guidance. The OLM_ISC model was used for the one-hour average NO_2 impacts. The annual average was calculated using the ambient ratio method (ARM) with the EPA default value of 0.75 for the annual average NO_2/NO_x ratio.

The modeling analysis results are shown in Table 6.2-3.5. Also included in the table are the maximum background levels that have occurred during the past few years and the resulting total ambient impacts. As shown in Table 6.2-3.5, construction impacts alone for all modeled pollutants are expected to be below the most stringent state and national standards. With the exception of 24-hour and annual PM_{10} and $PM_{2.5}$ impacts, construction activities are not expected to cause the violation of any state or federal ambient air quality standard. However, the state and federal 24-hour and annual average PM_{10} and $PM_{2.5}$ standards are exceeded in the absence of the construction emissions for the Project.

Table 6.2-3.5
Modeled Maximum Construction Impacts

Pollutant	Averaging Time	Maximum Construction Impacts (µg/m^3)	Background (µg/m^3)	Total Impact (µg/m^3)	State Standard (µg/m^3)	Federal Standard (µg/m^3)
NO_2[a]	1-Hour	163	137.2	300.2	470/338 [b]	-
	Annual	1.1	22.6	23.7	-	100
SO_2	1-Hour	2.0	47.2	49.2	650	-
	3-Hour	1.0	43.2	44.2	-	1,300
	24-Hour	0.2	7.9	8.1	109	365
	Annual	0.004	2.6	2.6	-	80
CO	1-Hour	1,245	4,111	5,356	23,000	40,000
	8-Hour	178	2,489	2,567	10,000	10,000
PM_{10}	24-Hour	4.7	304	308.7	50	150
	Annual[c]	0.5	46.3	46.5	20	-
$PM_{2.5}$	24-Hour	4.7	58	62.7	-	35
	Annual[c]	0.5	18	18.2	12	15

Notes:
a. OLM_ISC used for 1-hr average impact and ARM applied for annual average, using EPA default ratio of 0.75.
b. Existing and proposed CAAQS.
c. Annual Arithmetic Mean.

The Project construction site impacts are not unusual in comparison to most construction sites; construction sites that use good dust suppression techniques and low-emitting vehicles typically do not cause violations of air quality standards. The input and output modeling files are being provided electronically.

6.2-3.5.3 Health Risk of Diesel Exhaust

The combustion portion of annual PM_{10} emissions from Table 6.2-3.2 above were modeled separately to determine the annual average Diesel PM_{10} exhaust concentration. Combustion Diesel PM_{10} emissions have also been evaluated for the maximum potential cancer risk. During the 27-month construction period, the maximum annual average Diesel PM_{10} level would be 0.067 $\mu g/m^3$. The unit risk factor for DPM is 4.15E-4 per $\mu g/m^3$. Following OEHHA guidance[1] to use a 9-year period (instead of the 70-year lifetime exposure period) to account for the short, temporary duration of project construction, the resulting maximum potential cancer risk would be 3.6 in one million. This is below the 10 in one million level considered to be significant under the SJVAPCD's CEQA guidelines. The small area that would potentially experience a potential cancer risk above one in one million due to construction impacts is roughly the shape of a semicircle extending out from the south project boundary to a maximum distance of approximately 1,030 feet. There are no residences within this area.

6.2-3.5.4 Analysis of Ambient Impacts from Pipeline/Transmission Line Interconnect Construction

Construction of the natural gas and water supply pipelines and the transmission line interconnect activities will be of short duration, will require minimal equipment, and will generally occur along public roads and utility rights-of-way covering a large geographical area. Therefore, the potential ambient air quality impacts associated with these construction projects are expected to be minimal.

[1] OEHHA. *Air Toxics Hot Spots Program Risk Assessment Guidelines: The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments,* August 2003.

ATTACHMENT 6.2-3.1

DETAILED CONSTRUCTION EMISSION CALCULATIONS

Table 6.2-3.1

Avenal Project Construction Staffing Plan

Job Category	Month																											Total Person Months
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	**19**	**20**	21	22	23	24	25	26	27	
																			Maximum months									
Craft																												
Millwrights											10	15	30	45	56	60	60	60	56	56	30	15						493
Pipefitters				25	30	30	30	30	30	45	75	110	152	176	176	176	176	176	176	176	176	150	60	12	12	12	12	2,223
Equipment Operators	5	5	5	12	12	12	12	12	12	24	30	33	33	33	33	33	33	33	33	33	33	28	25	18	10			552
Iron Workers			15	22	22	22	42	42	42	42	42	30	12	12	12	12	12	12	12	12	10							427
Carpenters			30	50	50	50	50	50	50	45	45	45	30	30	30	30	30	30	30	30	30	30	28	23	15	5	5	841
Electricians	5	5	5	12	12	12	12	12	12	5	5	18	50	89	90	90	90	90	90	90	90	90	85	60	6	6	6	1,137
Teamsters	1	1	2	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	2	2	1	88
Boilermakers										15	30	65	65	65	65	65	65	65	65	65	65	35	10	3	3	3	3	752
Surveyors	2	2	3	3	3	3	3	3	3	3	3	3	3															37
Laborers	20	20	25	33	33	33	33	33	33	33	33	33	18	18	18	18	18	18	18	18	18	18	18	18	10	5	5	598
Painters																					5	10	14	14	14	6		63
Insulators																			20	20	33	33	33	33	20	11		203
Cement Masons		3	9	10	10	10	10	9	9	9	9	9																97
Total Craft Manpower Plan	33	36	94	170	175	175	195	195	195	225	286	365	397	472	484	488	488	488	504	504	494	413	277	184	92	50	32	7,511
Total Staff Manpower Plan	9	21	29	33	39	39	41	42	43	44	45	44	45	44	44	46	46	46	46	46	46	46	46	45	43	36	14	1,068
Total Construction Manpower Plan	42	57	123	203	214	214	236	237	238	269	331	409	442	516	528	534	534	534	**550**	**550**	540	459	323	229	135	86	46	8,579
												2573	2973	3432	3837	4168	4488	4808	5122	5435	5737	5927	5919	5739	5432	5002	4520	4694.5

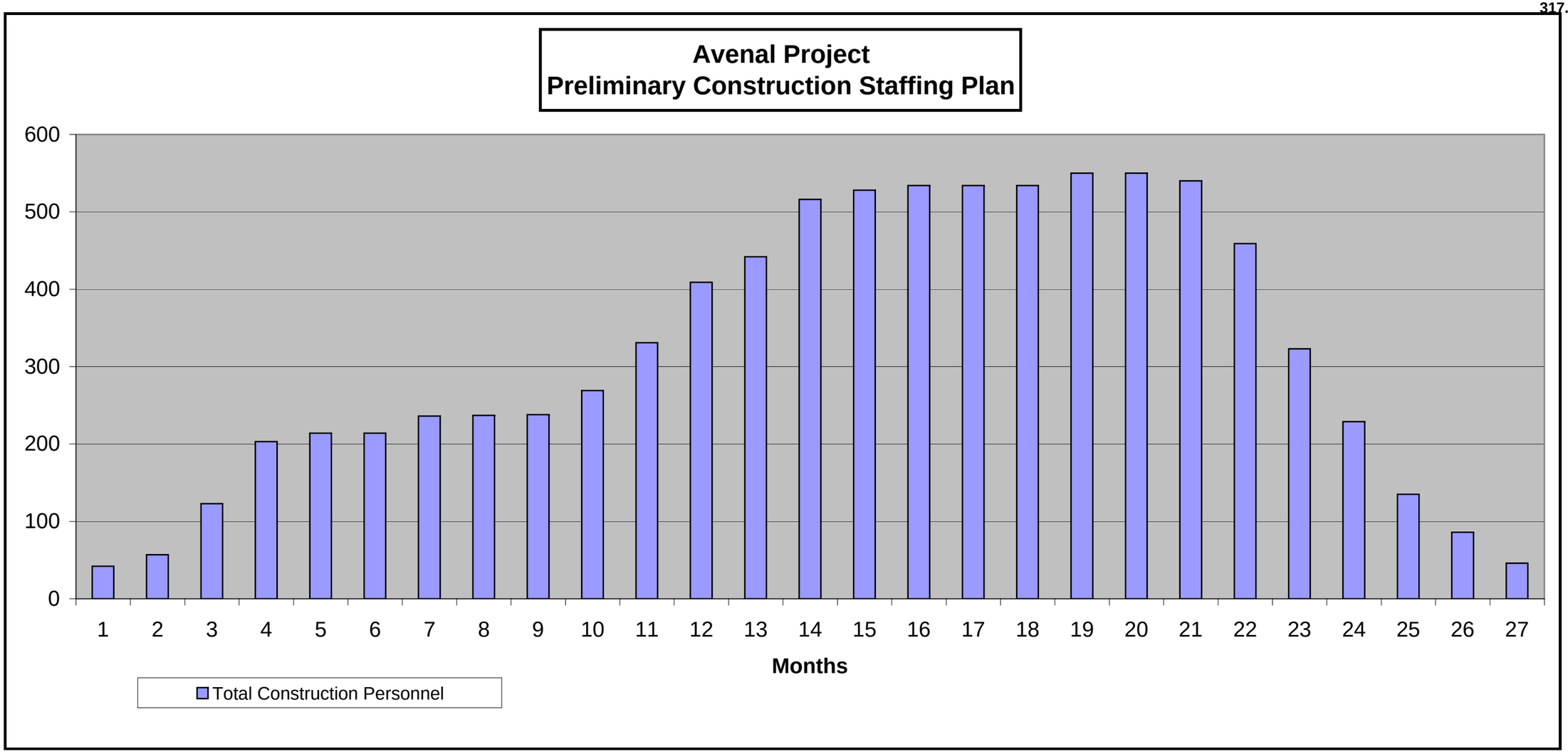
Avenal Project
Preliminary Construction Staffing Plan
600
500
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Months
Total Construction Personnel

TABLE 6.2-3.2: MAJOR CONSTRUCTION EQUIPMENT SUMMARY [1]

Federal Power Avenal LLC

Avenal Energy Project

Construction Equipment	Horse-power	Average run hours per day	Load Factor [2]	Monthly Average Units On Site																											Total Equipment Months
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
Front end loader/backhoe, diesel	100	2	0.48	1	1	2	2	3	3	3	3	2	2	2	1	1	1														27
Dozer tractor crawler, diesel	91	4	0.58	3	3	3	2	2	2	1	1	1	1	1																	20
Trenching machine, diesel	20	4	0.59	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													15
Motor grader, diesel	135	6	0.59	1	2	2	1											1	1												8
Tamper, gasoline	4	2	0.55		3	3	6	6	6	6	2	2	1	1	1	1	1	1	1	1	1	1	1	1							46
Compactor, vibrating plate (gasoline)	8	3	0.55		2	3	4	4	4	4	4	4	1	1	1	1	1	1	1	1	1	1	1	1							41
Roller, vibrating dual drum, diesel	100	2	0.59		2	3	4	4	4	4	4	4																			29
Roller, vibrating dual drum, diesel	22	4	0.59		1	2	2	2	2	1	1	1																			12
Water truck, diesel	150	8	0.59	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						25
Excavator, hydraulic, crawler, diesel	106	5	0.53	3	3	3	2	2	2	1	1	1																			18
Concrete pump truck, diesel	250	1	0.59			1	1	1	1	1	1	1	1	1																	9
Mortar mixer, gasoline	11	1	0.59																												0
Concrete transit mix trucks, diesel	250	4	0.59		1	1	1	3	3	3	3	3	2	1																	21
Paving machine	100	6	0.59	1	1																			1	1						4
Concrete Trowel, 36" blades, gasoline	8	1	0.59		2	2	2	2	2	2	2	2	1	1	1																19
Concrete Trowel, 48" blades, gasoline	8	1	0.59			1	1	1	1	1	1	1	1	1																	9
Concrete Floor Saw, gasoline	5	1	0.78																												0
Dump truck, diesel	235	6	0.59	3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							27
Crane, diesel (35/40 ton)	150	8	0.43		1	1	1	1	2	2	2	2	2	2	2	2	2	1	1	1											25
Crane, diesel (60 ton)	225	8	0.43			2	2	2	2	2	4	4	4	4	4	4	4	4	2	2	2	1	1								50
Crane, diesel (80 ton)	260	7	0.43					1	1	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1						27
Crane, diesel (65 ton)	250	7	0.43																												0
Crane, diesel (100 ton)	270	6	0.43																												0
Crane, 300 Ton, crawler, diesel	450	7	0.43										1	1	1	1	1	1	1	1	1										9
Crane, 360 Ton, crawler, diesel	450	7	0.43											1	1	1	1	1	1	1	1	1									9
Crane, 500 Ton, truck, diesel	685	7	0.43										1	1	2	2	2	2	1	1	1										13
Scissor Lifts (propane)	20	3	0.46																												0
Welder, diesel (400 amp)	26	8	0.19	1	1	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	34
Welder, diesel (250 amp)	23	8	0.19	2	2	8	8	8	8	8	8	8	4	4	4	4	2	2	2	2	2	2	2	2	2	1	1	1	1	1	99
Air compressor, diesel (185 cfm)	50	5	0.43	1	1	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1						29
Air compressor, diesel (375 cfm)	113	5	0.43				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						19
Air compressor, diesel (750 cfm)	250	6	0.43				2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1						34
Generator, diesel (6 kW)	30	4	0.43	3	3	5	4	6	6	6	6	6	4	4	4	4	4	4	4	4	4	4	4	4	2	1	1	1	1	1	100
Forklift, gasoline (3 ton)	61	6	0.59	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				24
Forklift, diesel (4.5 ton)	110	6	0.59	1	1	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1	1	1	1	1	60
Forklift (5 ton), diesel	115	6	0.59					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						18
Fuel/lube truck, diesel	260	4	0.59	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						25
Pickup truck, ½-ton 4WD, gasoline	205	1	0.59	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	3	3	3	3	3	146
Pickup (3/4 ton) gasoline	220	4	0.59																												0
Stakebed truck, gasoline	260	6	0.59	1	1	1	3	3	3	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3						64
Hydraulic boom truck, gasoline	325	6	0.59			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								18
Pump, centrifugal, gasoline	10	1	0.69	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								20
Trash pump, gasoline (150 gpm)	5	1	0.69	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								20
Trash pump, gasoline (600 gpm)	20	1	0.69	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								20
Light tower, diesel (4 kW)	20	1	0.59			2	4	4	4	4	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1						44
Pump, gasoline	18	1	0.69	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								20
Front-end Loader, diesel	170	6	0.59	2	2	2																									6
Semi-tractor, diesel	310	2	0.59			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								18
Tractor, utility, diesel	72	2	0.59	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								20
Aerial work platform, 40 ft.	82	6	0.21					2	4	4	4	4	4	4	4	4	4	4	4	3	3	2	2	2	2						60
Aerial work platform, 60 ft.	82	6	0.21					1	1	2	4	4	4	4	4	4	4	4	4	3	3	2	2	2	2	1	1	1	1		58
Aerial work platform, 80 ft.	70	6	0.21						1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	36
Aerial work platform, 120 ft.	87	5	0.21									1	1	1	1	1	1	1	1	1	1	1	1	1	1						14

1) Equipment estimate is for all equipment including subcontractor machinery on-site.

2) Load Factor is equivalent fraction of time equipment operated at 100 percent capacity during normal working hours (40 hours per week). Conservative default value = 0.75.

3) Assumes average workdays per month = 20

Monthly Average Daily Horsepower-Hours On Site																											Total Equipment Hours
1	2	3	4	5	6	7	8	9	10	11	12 (Max)	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
96	96	192	192	288	288	288	288	192	192	192	96	96	96	0	0	0	0	0	0	0	0	0	0	0	0	0	2592
633.36	633.36	633.36	422.24	422.24	422.24	211.12	211.12	211.12	211.12	211.12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4222.4
47.2	47.2	47.2	47.2	47.2	47.2	47.2	47.2	47.2	47.2	47.2	47.2	47.2	47.2	47.2	0	0	0	0	0	0	0	0	0	0	0	0	708
477.9	955.8	955.8	477.9	0	0	0	0	0	0	0	0	0	0	477.9	477.9	0	0	0	0	0	0	0	0	0	0	0	3823.2
0	13.2	13.2	26.4	26.4	26.4	26.4	8.8	8.8	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	0	0	0	0	0	0	202.4
0	26.4	39.6	52.8	52.8	52.8	52.8	52.8	52.8	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	0	0	0	0	0	0	541.2
0	236	354	472	472	472	472	472	472	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3422
0	51.92	103.84	103.84	103.84	103.84	51.92	51.92	51.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	623.04
1416	1416	1416	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	708	0	0	0	0	0	17700
842.7	842.7	842.7	561.8	561.8	561.8	280.9	280.9	280.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5056.2
0	0	147.5	147.5	147.5	147.5	147.5	147.5	147.5	147.5	147.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1327.5
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	0	0	0
0	590	590	590	1770	1770	1770	1770	1770	1180	590	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12390
354	354	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	354	354	0	0	0	0	0	1416
0	9.44	9.44	9.44	9.44	9.44	9.44	9.44	9.44	4.72	4.72	4.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	89.68
0	0	4.72	4.72	4.72	4.72	4.72	4.72	4.72	4.72	4.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42.48
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	0	0	0
2495.7	2495.7	2495.7	831.9	831.9	831.9	831.9	831.9	831.9	831.9	831.9	831.9	831.9	831.9	831.9	831.9	831.9	831.9	831.9	831.9	831.9	0	0	0	0	0	0	22461.3
0	516	516	516	516	1032	1032	1032	1032	1032	1032	1032	1032	1032	516	516	516	0	0	0	0	0	0	0	0	0	0	12900
0	0	1548	1548	1548	1548	1548	3096	3096	3096	3096	3096	3096	3096	3096	1548	1548	1548	774	774	0	0	0	0	0	0	0	38700
0	0	0	0	782.6	782.6	1565.2	1565.2	1565.2	1565.2	1565.2	1565.2	1565.2	1565.2	1565.2	782.6	782.6	782.6	782.6	782.6	782.6	782.6	0	0	0	0	0	21130.2
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	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	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1354.5	1354.5	1354.5	1354.5	1354.5	1354.5	1354.5	1354.5	1354.5	0	0	0	0	0	0	0	0	0	12190.5
0	0	0	0	0	0	0	0	0	0	1354.5	1354.5	1354.5	1354.5	1354.5	1354.5	1354.5	1354.5	1354.5	0	0	0	0	0	0	0	0	12190.5
0	0	0	0	0	0	0	0	0	2061.9	2061.9	4123.7	4123.7	4123.7	4123.7	2061.85	2061.85	2061.85	0	0	0	0	0	0	0	0	0	26804.05
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	0	0	0
39.52	39.52	79.04	79.04	79.04	79.04	79.04	79.04	79.04	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	1343.68
69.92	69.92	279.68	279.68	279.68	279.68	279.68	279.68	279.68	139.84	139.84	139.84	139.84	69.92	69.92	69.92	69.92	69.92	69.92	69.92	69.92	69.92	34.96	34.96	34.96	34.96	34.96	3461.04
107.5	107.5	215	215	215	215	215	215	215	107.5	107.5	107.5	107.5	107.5	107.5	107.5	107.5	107.5	107.5	107.5	107.5	107.5	0	0	0	0	0	3117.5
0	0	0	242.95	242.95	242.95	242.95	242.95	242.95	242.95	242.95	242.95	242.95	242.95	242.95	242.95	242.95	242.95	242.95	242.95	242.95	242.95	0	0	0	0	0	4616.05
0	0	0	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	645	645	645	645	0	0	0	0	0	21930
154.8	154.8	258	206.4	309.6	309.6	309.6	309.6	309.6	206.4	206.4	206.4	206.4	206.4	206.4	206.4	206.4	206.4	206.4	206.4	206.4	103.2	51.6	51.6	51.6	51.6	51.6	5160
215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	215.94	0	0	0	5182.56
389.4	389.4	778.8	778.8	1168.2	1168.2	1168.2	1168.2	1168.2	1168.2	1168.2	1168.2	1168.2	1168.2	1168.2	1168.2	1168.2	778.8	778.8	778.8	778.8	778.8	389.4	389.4	389.4	389.4	389.4	23364
0	0	0	0	407.1	407.1	407.1	407.1	407.1	407.1	407.1	407.1	407.1	407.1	407.1	407.1	407.1	407.1	407.1	407.1	407.1	407.1	0	0	0	0	0	7327.8
1227.2	1227.2	1227.2	613.6	613.6	613.6	613.6	613.6	613.6	613.6	613.6	613.6	613.6	613.6	613.6	613.6	613.6	613.6	613.6	613.6	613.6	613.6	0	0	0	0	0	15340
604.75	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	362.85	362.85	362.85	362.85	362.85	17658.7
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	0	0	0
920.4	920.4	920.4	2761.2	2761.2	2761.2	3681.6	3681.6	3681.6	3681.6	2761.2	2761.2	2761.2	2761.2	2761.2	2761.2	2761.2	2761.2	2761.2	2761.2	2761.2	2761.2	0	0	0	0	0	58905.6
0	0	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	1150.5	0	0	0	0	0	0	0	20709
6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	0	0	0	0	0	0	0	138
3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	0	0	0	0	0	0	0	69
13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	0	0	0	0	0	0	0	276
0	0	23.6	47.2	47.2	47.2	47.2	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	11.8	11.8	11.8	11.8	0	0	0	0	0	519.2
12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	12.42	0	0	0	0	0	0	0	248.4
1203.6	1203.6	1203.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3610.8
0	0	365.8	365.8	365.8	365.8	365.8	365.8	365.8	365.8	365.8	365.8	365.8	365.8	365.8	365.8	365.8	365.8	365.8	365.8	0	0	0	0	0	0	0	6584.4
84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	0	0	0	0	0	0	0	1699.2
0	0	0	0	206.64	413.28	413.28	413.28	413.28	413.28	413.28	413.28	413.28	413.28	413.28	413.28	309.96	309.96	206.64	206.64	206.64	206.64	0	0	0	0	0	6199.2
0	0	0	0	103.32	103.32	206.64	413.28	413.28	413.28	413.28	413.28	413.28	413.28	413.28	413.28	309.96	309.96	206.64	206.64	206.64	206.64	103.32	103.32	103.32	103.32	0	5992.56
0	0	0	0	0	88.2	88.2	176.4	176.4	176.4	176.4	176.4	176.4	176.4	176.4	176.4	176.4	176.4	176.4	176.4	176.4	88.2	88.2	88.2	88.2	88.2	88.2	3175.2
0	0	0	0	0	0	0	0	91.35	91.35	91.35	91.35	91.35	91.35	91.35	91.35	91.35	91.35	91.35	91.35	91.35	91.35	0	0	0	0	0	1278.9
11,417	13,459	17,474	15,805	18,595	19,406	20,669	22,470	22,466	24,048	23,893	24,905	24,900	24,830	24,696	20,257	19,572	18,667	13,613	12,258	10,201	9,160	1,286	1,286	1,070	1,070	967	**24,905**
228,348	269,185	349,477	316,102	371,909	388,126	413,373	449,406	449,313	480,968	477,850	**498,100**	498,006	496,607	493,925	405,132	391,442	373,334	272,258	245,168	204,011	183,193	25,716	25,716	21,397	21,397	19,331	**498,100**
											4.69E+06	4.96E+06	5.19E+06	5.33E+06	5.42E+06	**5.44E+06**	5.43E+06	5.29E+06	5.08E+06	4.84E+06	4.54E+06	4.09E+06	3.61E+06	3.14E+06	2.66E+06	2.19E+06	**5.44E+06**

Monthly Average Total Daily Horsepower-Hours on Site and Maximum
Total Monthly Horsepower-Hours on Site [3] and Maximum
12-Month Running Total Monthly Horsepower-Hours on Site and Maximum

Construction Equipment	Hourly Fugitive PM10 Emission Rate lbs/hr	Average run hours per day		Monthly Average Units On Site																											Total Equipment Months
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
Front end loader/backhoe, diesel	**0.1750**	**2**		**1**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**														**27**
Dozer tractor crawler, diesel	**0.7528**	**4**		**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**																	**20**
Trenching machine, diesel	**0.0913**	**4**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**													**15**
Motor grader, diesel	**0.5788**	**6**		**1**	**2**	**2**	**1**											**1**	**1**												**8**
Water truck, diesel	**0.0838**	**8**		**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**						**25**
Excavator, hydraulic, crawler, diesel	**0.1750**	**5**		**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**																			**18**
Dump truck, diesel	**0.1038**	**6**		**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**							**27**
Forklift, gasoline (3 ton)	**0.0425**	**6**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**				**24**
Forklift, diesel (4.5 ton)	**0.0425**	**6**		**1**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**60**
Forklift (5 ton), diesel	**0.0425**	**6**						**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**						**18**
Fuel/lube truck, diesel	**0.0150**	**4**		**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**						**25**
Pickup truck, ½-ton 4WD, gasoline	**0.0388**	**1**		**5**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**3**	**3**	**3**	**3**	**3**	**146**
Pickup (3/4 ton) gasoline	0.0388	4																													**0**
Stakebed truck, gasoline	**0.0263**	**6**		**1**	**1**	**1**	**3**	**3**	**3**	**4**	**4**	**4**	**4**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**						**64**
Front-end Loader, diesel	**0.1750**	**6**		**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**												**24**
Bobcat skip loader	0.1750	6																													**0**

Monthly Average Pounds PM10 per Day On Site

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20								
0.35	0.35	0.7	0.7	1.05	1.05	1.05	1.05	0.7	0.7	0.7	0.35	0.35	0.35	0	0	0	0	0	0	0	0	0	0	0	0	0	9.45
9.0336	9.0336	9.0336	6.0224	6.0224	6.0224	3.0112	3.0112	3.0112	3.0112	3.0112	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60.224
0.365	0.365	0.365	0.365	0.365	0.365	0.365	0.365	0.365	0.365	0.365	0.365	0.365	0.365	0.365	0	0	0	0	0	0	0	0	0	0	0	0	5.475
3.4725	6.945	6.945	3.4725	0	0	0	0	0	0	0	0	0	0	3.4725	3.4725	0	0	0	0	0	0	0	0	0	0	0	27.78
1.34	1.34	1.34	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0	0	0	0	0	16.75
2.625	2.625	2.625	1.75	1.75	1.75	0.875	0.875	0.875	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.75
1.8675	1.8675	1.8675	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0.6225	0	0	0	0	0	0	16.8075
0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0	0	0	6.12
0.255	0.255	0.51	0.51	0.765	0.765	0.765	0.765	0.765	0.765	0.765	0.765	0.765	0.765	0.765	0.765	0.765	0.51	0.51	0.51	0.51	0.51	0.255	0.255	0.255	0.255	0.255	15.3
0.000	0.000	0.000	0.000	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.255	0.000	0.000	0.000	0.000	0.000	4.590
0.12	0.12	0.12	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0	0	0	0	0	1.5
0.1938	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.2325	0.11625	0.11625	0.11625	0.11625	0.11625	5.6575
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	0	0	0
0.1575	0.1575	0.1575	0.4725	0.4725	0.4725	0.63	0.63	0.63	0.63	0.4725	0.4725	0.4725	0.4725	0.4725	0.4725	0.4725	0.4725	0.4725	0.4725	0.4725	0.4725	0	0	0	0	0	10.08
2.1	2.1	2.1	1.05	1.05	1.05	1.05	1.05	1.05	2.1	2.1	2.1	2.1	2.1	1.05	1.05	0	0	0	0	0	0	0	0	0	0	0	25.2
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	0	0	0
Total Monthly Average Daily Fugitive PM10 Emission Rate (lbs/day)																											Avg	Max
22.13	25.65	26.25	16.18	13.57	13.57	9.84	9.84	9.49	9.67	9.51	6.15	6.15	6.15	8.22	7.86	3.33	3.08	3.08	3.08	3.08	2.46	0.63	0.63	0.37	0.37	0.37	8.17	26.3

TABLE 6.2-3.3 - NUMBER OF TRUCK DELIVERIES OF EQUIPMENT AND MATERIALS

Avenal Energy Project

	Construction Month																											
Equipment and Material	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**Total**
Major Equipment																												
Heat Recovery Steam Generators (HRSG)							5	25	45	65	70	70	65	45	25	5												420
Combustion Turbine Generator (CTG)									5	15	35	50	50	35	15	10	5											220
Steam Turbine Generator (STG)										10	20	20	20	10	10													90
Mechanical Equipment								7	22	48	48	28	21															174
Electrical Equipment and Material		4	6	6	6	10	20	30	40	40	40	30	30	20	10	5	5											302
Piping, Supports and Valves		2	4	10	10	20	30	50	55	55	55	50	40	20	10	5	5											421
Concrete and Reinforcing Steel		5	4	72	200	215	220	200	150	75	10	10	10	10	2	2	2	2	2	1	1	1						1194
Miscellaneous Steel, Roofing and Siding					10	10	38	75	57	20	10	10																230
Administration/Warehouse Buildings							5	10	10	10	5	5	5															50
Construction Consumables	20	20	30	30	30	35	35	35	30	30	30	40	40	40	40	30	30	20	20	10	10	5	5	5	3	3		626
Office Supplies	5	10	10	5	5	5	5	5	5	5	5	5	5	5	5	2	2	2	2	2	2	1	1	1	1			101
Contractor Mobilization/Demobilization	20	20	10	5																				10	10	15	15	105
Construction Equipment-delivery/pickup	12	5	9	6	4	16	20	20	17	2	2	2	3	3	3	8	8	8	10	10	5	5	10	10	15	15	14	242
TOTAL	57	66	73	134	265	311	378	457	436	375	330	**320**	289	188	120	67	57	32	34	23	18	12	16	26	29	33	29	4175

7.731

Table 6.2-3.4: Mobile Source Emission Factors

	Off-Road/Non-Road Horsepower-Based Emission Factors (g/bhp-hr)				
	NOx	CO	POC/NMHC	SO_2 (1)	PM_{10}
Non-road Equipment 300 < hp, Tier 2 (2)	4.32	2.6	0.48	0.0054	0.15
Non-road Equipment 175≤hp<300 hp, Tier 2 (2)	4.41	2.6	0.49	0.0054	0.15
Non-road Equipment 100≤hp<175 hp, Tier 2 (2)	4.41	3.7	0.49	0.0054	0.22
Non-road Equipment (50≤hp<100 hp, Tier 2) (2)	5.04	3.7	0.56	0.0054	0.30
Non-road Equipment (25≤hp<50 hp, Tier 2) (2)	5.04	4.1	0.56	0.0054	0.45
Small Equipment (11≤hp<25 hp, Tier 2) (2)	5.04	4.9	0.56	0.0054	0.60
Small Equipment (hp<11, Tier 2) (2)	5.04	6.0	0.56	0.0054	0.6
	Fuel-Based Emission Factors (lbs pollutant /1000 gal Diesel fuel @ 0.4 lbs Diesel fuel/hp-hr & 7.1 lb Diesel/gal Diesel)				
	NOx	CO	HC	SO_2	PM
Large Equipment (≥300hp, Tier 2) (2)	169.05	101.74	18.78	0.21	5.87
Small Equipment (50≥hp≥100hp, Tier 2) (2)	197.22	191.74	21.91	0.21	23.48

(1) Based on Diesel fuel consumption factor BSFC = 0.4 lbs/bhp-hr and Diesel fuel sulfur content of 15 ppmw.
(2) ARB and USEPA off-road compression-ignition (Diesel) engine standards.

	On-Road HHD Truck Emission Factors				
Mobile Source Category	NOx	CO	ROC	SO_2	PM10
Truck Hauling (lbs/vmt) (3)	3.25E-02	7.17E-03	1.79E-03	3.53E-05	1.47E-03
Truck Hauling (lbs/1000 gals) (4)	162.60	35.87	8.96	0.18	7.35
Truck Hauling (gm/bhp-hr) (5)	4.15521	0.91662	0.22901	0.00451	0.18789

(3) From EMFAC 2007 version 2.3 (November 1, 2006, for heavy-heavy duty Diesel trucks, fleet average for calendar year 2010, Kings County, and 55 mph.
(4) Heavy-duty trucks mileage (miles per gallon diesel) = 5
Engine, Fuel, and Emissions Engineering, Incorporated, 1996.
(5) Based on lbs/1000 gals emission factor using 0.4 lb Diesel fuel/bhp-hr and 7.1 lb of fuel/gal of fuel.

	On-Road Worker Vehicle and Delivery Truck Emission Factors				
Mobile Source Category	NOx	CO	ROC	SOx	PM10
Worker Travel (lbs/vmt) (6)	3.34E-03	2.56E-02	9.26E-04	2.43E-05	2.36E-04
Medium-Duty Delivery Trucks (lbs/vmt) (7)	1.28E-03	7.92E-03	2.73E-04	1.10E-05	8.60E-05
Medium Duty Delivery Trucks (lbs/1000 gals) (8)	12.83	79.17	2.73	0.11	0.86
Medium Duty Delivery Trucks (gm/bhp-hr) (5)	0.328	2.023	0.070	0.0028	0.022

(6) From EMFAC 2007 version 2.3 (November 1, 2006, for 1/3 light-duty automobiles, 1/3 light-duty trucks (LDT1) and 1/3 light-duty trucks (LDT2), fleet average for calendar year 2010, Kings County, and 55 mph.
(7) From EMFAC 2007 version 2.3 (November 1, 2006, for medium-duty trucks (MDV), fleet average for calendar year 2010, Kings County, and 55 mph.
(8) Medium-duty trucks mileage (miles per gallon Diesel) = 10
?Reference?

Gasoline Equipment Factors - Small Engines (hp < 250)					
	Emission Factors (g/bhp-hr)				
	NOx	CO	TOC	SO2	PM10
Small Equipment(1) (g/bhp-hr)	4.99	199.13	9.79	0.27	0.33
Small Equipment(1) (lbs/bhp-hr)	1.10E-02	4.39E-01	2.16E-02	5.91E-04	7.21E-04
Small Equipment(1) (lb/1000 gal)	195.25	7792.25	383.24	10.49	12.80

Notes:
(1) From AP-42, Table 3.3-1 (Industrial I/C Engines), 10/96.

Table 6.2-3.5 - Fugitive Dust Emission Calculations

(1) Paved Road Travel - Delivery Trucks and Workers - Source: AP-42, Section 13.2.1, 10/97

E = k(sL/2)^0.65*(W/3)^1.5 lb/VMT - PM10

k = particle size constant =	0.016	lb/VMT - PM10
sL = silt loading =	0.015	g/m2 (AP-42, page 13.2.1-5, limited access roads)
W = auto/pickup truck avg. vehicle weight =	2.4	tons (CARB Area Source Manual, 9/97)
W = delivery truck avg. vehicle weight =	27.50	tons (for heavy duty Diesel trucks)
E = auto/pick truck emission factor =	0.0005	lb/VMT - PM10
E = delivery truck emission factor =	0.0185	lb/VMT - PM10

(2) Wind erosion of active construction area - 'Source: "Improvement of Specific Emission Factors (BACM Project No. 1), Final Report", prepared for South Coast AQMD by Midwest Research Institute, March 1996

Level 2 Emission Factor =	0.011	ton/acre-month
Construction Schedule =	5	days/week
=	1.0	lbs/acre-day
=	0.000023	lbs/sf-day

(3) Finish Grading - Source: AP-42, Table 11.9-2, 1/95

E = (0.60)(0.051)(S^2.0) lb/VMT

S = mean vehicle speed =	3.0	mph (estimated)
E = emission factor =	0.2754	lb/VMT

(4) Bulldozer Operation and Scraper Excavation - Source: AP-42, Table 11.9.2, 1/95

E = (0.75)(s^1.5)/(M^1.4) lb/hr

s = silt content =	6.9%	(AP-42, Table 11.9-3, 1/95, overburden)
M = moisture content =	7.9%	(AP-42, Table 11.9-3, 1/95, overburden)
E = emission factor =	0.75	lb/hr

(5) Scraper Travel

W = mean vehicle weight =	73.4	tons empty (651E scraper, Caterpillar Performance Handbook, 10/89)
=	125.4	tons loaded (651E scraper, Caterpillar Performance Handbook, 10/89)
=	99.4	tons mean weight
Daily Scraper Haul Tonnage =	10,972	ton/day (estimated)
Scraper Load =	52.0	ton (651E scraper, Caterpillar Performance Handbook, 10/89)
Daily Scraper Loads =	211	loads/day
Daily Scraper One-Way Hauling Distance =	0.077	miles/load (estimated)
Daily Scraper Travel =	32.56	miles/day

(6) Material Unloading - Source: AP-42, p. 13.2.4-3, 1/95

E = (k)(0.0032)[(U/5)^1.3]/[(M/2)^1.4] lb/ton

k = particle size constant =	0.35	for PM10
U = average wind speed =	2.49	m/sec (based on 5 years of Hanford, CA wind data)
=	5.58	mph
M = moisture content =	7.9%	(AP-42, Table 11.9-3, 1/95, overburden)
E = emission factor =	0.00019	lb/ton

(7) Loader Unpaved Road Travel - Source: AP-42, Section 13.2.2, 1/95

E = (k)[(s/12)^0.8][(W/3)^0.4]/[(M/0.2)^0.3] lb PM10/VMT

k = particle size constant =	2.6	
s = surface silt content =	6.9%	(AP-42, Table 11.9-3, 1/95, overburden)
M = surface moisture content =	7.9%	(AP-42, Table 11.9-3, 1/95, overburden)
W = avg. vehicle weight =	18.50	tons (avg. of loaded and unloaded weights, 966E loader, Caterpillar Performance Handbook, 10/89)
E = emission factor =	0.11	lb PM10/VMT
Soil Density =	1.05	ton/yd3 (Caterpillar Performance Handbook, 10/89)
Loader Bucket Capacity =	4.75	yd3 (966E loader, Caterpillar Performance Handbook, 10/89)
=	4.99	ton/load
Daily Soil Transfer Rate =	2,743	ton/day (estimated)
Daily Loader Trips =	550	loading trips/day
Loading Travel Distance =	203.7	ft/load (estimated)
Daily Loader Travel Distance =	112,030	ft/day
=	21.2	mi/day

(8) Backhoe Trenching - Source: AP-42, Table 11.9-2 (dragline operations), 1/95

E = (0.75)(0.0021)(d^0.7)/(M^0.3) lb/yd3

d = drop height =	3	ft (estimated)		
M = moisture content =	7.9%	(AP-42, Table 11.9-3, 1/95, overburden)		
E = emission factor =	0.0018	lb/yd3		
E = emission factor =	0.7283	lbs/day =	0.09103	lbs/hr
Backhoe Excavating Rate =	49.8	yd3/hr (E70B backhoe, Caterpillar Performance Handbook, 10/89)		
=	398	yd3/day for 1 backhoe @ 8 hr/day		

(9) Excavator Trenching - Source: AP-42, Table 11.9-2 (dragline operations), 1/95

E = (0.75)(0.0021)(d^0.7)/(M^0.3) lb/yd3

d = drop height =	3	ft (estimated)		
M = moisture content =	7.9%	(AP-42, Table 11.9-3, 1/95, overburden)		
E = emission factor =	0.0018	lb/yd3		
E = emission factor =	6.2474	lbs/day =	0.78092	lbs/hr
Excavator Excavating Rate =	427.2	yd3/hr (225D excavator, Caterpillar Performance Handbook, 10/89)		
=	3,418	yd3/day for 1 excavator @ 8 hr/day		

(10) Unpaved Road Travel - Source: AP-42, Section 13.2.2, 9/98.

E = (k)[(s/12)^0.8][(W/3)^0.4]/[(M/0.2)^0.3]

k = particle size constant =	2.6	
s = silt fraction =	8.5%	(AP-42, Table 11.9-3, 1/95, overburden)
M = surface moisture content =	7.9%	(AP-42, Table 11.9-3, 1/95, overburden)
W = water truck avg. veh. weight =	10.0	tons empty (estimated)
=	39.4	tons loaded (estimated with 8,000 gallon water capacity)
=	24.7	tons average
W = fuel truck avg. veh. weight =	8.0	tons empty (estimated)
=	18.2	tons loaded (estimated with 3,000 gallons Diesel fuel capacity)
=	13.1	tons average
W = service truck avg. veh. weight =	5.0	tons (estimated)
W = dump truck avg. veh. weight =	15.0	tons (for heavy duty Diesel trucks)
=	40.0	tons (for heavy duty Diesel trucks)
=	27.5	tons (for heavy duty Diesel trucks)
W = concrete pumper truck avg. veh. wt. =	15.0	tons (for heavy duty Diesel trucks)
=	40.0	tons (for heavy duty Diesel trucks)
=	27.5	tons (for heavy duty Diesel trucks)
W = forklift avg. veh. weight =	8.0	tons empty (estimated)
W = auto/pickup avg. vehicle weight =	2.4	tons (CARB Area Source Manual, 9/97)
W = delivery truck avg. veh. wt. =	27.5	tons (for heavy duty Diesel trucks)
W = scraper avg. veh. wt. =	73.4	tons empty (651E scraper, Caterpillar Performance Handbook, 10/89)
	125.4	tons loaded (651E scraper, Caterpillar Performance Handbook, 10/89)
	99.4	tons mean weight
E = water truck emission factor =	0.15	lb PM10/VMT
E = fuel truck emission factor =	0.12	lb PM10/VMT
E = service truck emission factor =	0.08	lb PM10/VMT
E = dump truck emission factor =	0.16	lb PM10/VMT
E = concrete pumper truck emiss. factor =	0.16	lb PM10/VMT
E = forklift emiss. factor =	0.10	lb PM10/VMT
E = 5th wheel truck emiss. factor =	0.10	lb PM10/VMT
E = auto/pickup emiss. factor =	0.06	lb PM10/VMT
E = delivery truck emiss. factor =	0.16	lb PM10/VMT
E = scraper emiss. factor =	0.27	lb PM10/VMT

(11) Unpaved Road Travel and Active Excavation Area Control - Source: Control of Open Fugitive Dust Sources, U.S EPA, 9/88

C = 100 - (0.8)(p)(d)(t)/(i)

p = potential average hourly daytime evaporation rate =	0.4225	mm/hr (EPA document, Figure 3-2, summer)
d = average hourly daytime traffic rate =	100.0	vehicles/hr (estimated)
t = time between watering applications =	0.25	hr/application (estimated)
i = application intensity =	0.7	L/m2 (typical level in EPA document, page 3-23)
C = average watering control efficiency =	88.4%	

(12) Wind Errosion of Storage Piles - Source: EPA's "Control of Open Fugitive Dust Sources", 9/88, Chapter 4.

Max. Hourly Ave. WS at 10m [1] (m/s)	Fastest [2] Mile @ 10m (m/s)	Threshold Friction Velocity [3] (m/s)	Roughness Height(3) (m)	Threshold Fastest Mile @ 10m (m/s)	TSP Emission Factor [4] (g/m^2)	PM10 Factor [5]	PM10 Emission Factor (g/m^2)	PM10 Emission Factor (lbs/ft^2)
8.90	10.18	0.53	0.0003	13.79	0.000	0.50	0.00E+00	0.00E+00

Notes:
1- maximum hourly average wind speed based on onsite wind data.
2 - calculated based on fastest mile conversion factor.
3 - from Table 4-4 of EPA document (construction site).
4- from equation 4-4 of EPA document.
5 - from equation 4-3 of EPA document.

Table 6.2-3.6 - Daily Fugitive Dust Emissions (Month 12)

Equipment	Number of Units	Daily Process Rate Per Unit	Total Process Rate	Units	PM10 Emission Factor (1) (lbs/unit)	Control Factor (1) (%)	PM10 Emissions (lbs/day)
Front end loader/backhoe, diesel	1	2	2.0	hours	0.091035		0.18
Dozer tractor crawler, diesel	0	4.0	0.0	hours	9.10E-02		0.00
Trenching machine, diesel	1	4.0	4.0	hours	9.10E-02		0.36
Motor grader, diesel	0	18.0	0.0	vmt	2.75E-01		0.00
		2,743.0	0.0	tons	1.89E-04		0.00
Front-end Loader Unpaved Road Travel	1	21.2	21.2	vmt	1.15E-01	88%	0.28
Water Truck Unpaved Road Travel	1	20.0	20.0	vmt	1.52E-01	88%	0.35
Forklift Unpaved Road Travel	5	18.0	90.0	vmt	9.70E-02	88%	1.01
Dump Truck Unpaved Road Travel	1	20.1	20.1	vmt	1.59E-01	88%	0.37
Dump Truck Unloading	1	2,743.0	2,743.0	tons	1.89E-04		0.52
Fuel/Lube Truck Unpaved Road Travel	1	3.1	3.1	vmt	1.18E-01	88%	0.04
Concrete Truck Unpaved Road Travel	0	20.1	0.0	vmt	1.59E-01	88%	0.00
Semi-Tractor Truck Unpaved Road Travel	1	20.1	20.1	vmt	9.70E-02	88%	0.23
Pickup Truck Unpaved Road Travel	6	15.4	92.6	vmt	5.99E-02	88%	0.64
Stakebed Truck Unpaved Road Travel	1	7.7	7.7	vmt	8.03E-02	88%	0.07
Windblown Dust (active construction area)	N/A	474,213.6	474,213.6	sq.ft.	2.33E-05	88%	1.28
Worker Paved Road Travel	409	0.5	201.4	vmt	4.76E-04		0.10
Worker Unpaved Road Travel	409	0.2	63.1	vmt	5.99E-02	88%	0.44
Delivery Truck Paved Road Travel	16	0.5	7.9	vmt	1.85E-02		0.15
Delivery Truck Unpaved Road Travel	16	0.2	2.5	vmt	1.59E-01	88%	0.05
Total =							5.88

Notes:
(1) See notes for fugitive dust emission calculations.

Annual Fugitive Dust Emissions

Activity	Average Daily PM10 Emissions(1) (lbs/day)	Days per Year	Annual PM10 Emissions (tons/yr)
Construction Activities	2.30	260	0.30
Windblown Dust	0.64	365	0.12
Total =			0.42

Notes:
(1) Based on annual average daily emissions that are based on approximately 50% of maximum daily levels.

Table 6.2-3.7
Construction Equipment Daily Exhaust Emissions (Month 12 is maximum)

Equipment	Number of Units	Hrs/Day Per Unit	Engine Size (hp)	Load Factor (3)	Emission Factors (g/bhp-hr) (1) NOx	CO	NMHC (2)	SOx	PM10	Daily Emissions (lbs/day) NOx	CO	NMHC (2)	SOx	PM10
Front end loader/backhoe, diesel	**1**	**2.0**	**100**	**0.48**	**4.41**	**3.70**	**0.49**	**0.0054**	**0.22**	**0.93**	**0.78**	**0.10**	**0.00**	**0.05**
Dozer tractor crawler, diesel	**0**	**4.0**	**91**	**0.58**	**5.04**	**3.70**	**0.56**	**0.0054**	**0.30**	**0**	**0**	**0**	**0**	**0**
Trenching machine, diesel	**1**	**4.0**	**20**	**0.59**	**5.04**	**4.90**	**0.56**	**0.0054**	**0.60**	**0.52**	**0.51**	**0.06**	**0.00**	**0.06**
Motor grader, diesel	**0**	**6.0**	**135**	**0.59**	**4.41**	**3.70**	**0.49**	**0.0054**	**0.22**	**0**	**0**	**0**	**0**	**0**
Tamper, gasoline	**1**	**2.0**	**4**	**0.55**	**5.04**	**6.0**	**0.56**	**0.0054**	**0.6**	**0.05**	**0.06**	**0.01**	**0.00**	**0.01**
Compactor, vibrating plate (gasoline)	**1**	**3.0**	**8**	**0.55**	**4.99**	**199.13**	**9.79**	**0.27**	**0.33**	**0.15**	**5.79**	**0.28**	**0.01**	**0.01**
Roller, vibrating dual drum, diesel	**0**	**2.0**	**100**	**0.59**	**4.41**	**3.70**	**0.49**	**0.0054**	**0.22**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Roller, vibrating dual drum, diesel	**0**	**4.0**	**22**	**0.59**	**5.04**	**4.90**	**0.56**	**0.0054**	**0.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Water truck, diesel	**1**	**8.0**	**150**	**0.59**	**4.41**	**3.70**	**0.49**	**0.0054**	**0.22**	**6.88**	**5.77**	**0.76**	**0.01**	**0.34**
Excavator, hydraulic, crawler, diesel	**0**	**5.0**	**106**	**0.53**	**4.41**	**3.70**	**0.49**	**0.0054**	**0.22**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Concrete pump truck, diesel	**0**	**1.0**	**250**	**0.59**	**4.41**	**2.60**	**0.49**	**0.0054**	**0.15**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Mortar mixer, gasoline	0	1.0	11	0.59	4.99	199.13	9.79	0.27	0.33	0	0	0	0	0
Concrete transit mix trucks, diesel	**0**	**4.0**	**250**	**0.59**	**4.41**	**2.60**	**0.49**	**0.0054**	**0.15**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Paving machine	**0**	**6.0**	**100**	**0.59**	**4.41**	**3.70**	**0.49**	**0.0054**	**0.22**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Concrete Trowel, 36" blades, gasoline	**1**	**1.0**	**8**	**0.59**	**4.99**	**199.13**	**9.79**	**0.27**	**0.33**	**0.05**	**2.07**	**0.10**	**0.00**	**0.00**
Concrete Trowel, 48" blades, gasoline	**0**	**1.0**	**8**	**0.59**	**4.99**	**199.13**	**9.79**	**0.27**	**0.33**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Concrete Floor Saw, gasoline	0	1.0	5	0.78	4.99	199.13	9.79	0.27	0.33	0.00	0.00	0.00	0.00	0.00
Dump truck, diesel	**1**	**6.0**	**235**	**0.59**	**4.41**	**2.60**	**0.49**	**0.0054**	**0.15**	**8.08**	**4.76**	**0.90**	**0.01**	**0.27**
Crane, diesel (35/40 ton)	**2**	**8.0**	**150**	**0.43**	**4.41**	**3.70**	**0.49**	**0.0054**	**0.22**	**10.02**	**8.41**	**1.11**	**0.01**	**0.50**
Crane, diesel (60 ton)	**4**	**8.0**	**225**	**0.43**	**4.41**	**2.60**	**0.49**	**0.0054**	**0.22**	**30.07**	**17.73**	**3.34**	**0.04**	**1.50**
Crane, diesel (80 ton)	**2**	**7.0**	**260**	**0.43**	**4.41**	**2.60**	**0.49**	**0.0054**	**0.15**	**15.20**	**8.96**	**1.69**	**0.02**	**0.52**
Crane, diesel (65 ton)	**0**	7.0	250	0.43	4.41	2.60	0.49	0.0054	0.15	0.00	0.00	0.00	0.00	0.00
Crane, diesel (100 ton)	**0**	6.0	270	0.43	4.41	2.60	0.49	0.0054	0.15	0.00	0.00	0.00	0.00	0.00
Crane, 300 Ton, crawler, diesel	**1**	**7.0**	**450**	**0.43**	**4.32**	**2.60**	**0.48**	**0.0054**	**0.15**	**12.89**	**7.76**	**1.43**	**0.02**	**0.45**
Crane, 360 Ton, crawler, diesel	**1**	**7.0**	**450**	**0.43**	**4.32**	**2.60**	**0.48**	**0.0054**	**0.15**	**12.89**	**7.76**	**1.43**	**0.02**	**0.45**
Crane, 500 Ton, truck, diesel	**2**	**7.0**	**685**	**0.43**	**4.32**	**2.60**	**0.48**	**0.0054**	**0.15**	**39.24**	**23.62**	**4.36**	**0.05**	**1.36**
Scissor Lifts (propane)	**0**	3.0	20	0.46						0.00	0.00	0.00	0.00	0.00
Welder, diesel (400 amp)	**1**	**8.0**	**26**	**0.19**	**5.04**	**4.10**	**0.56**	**0.0054**	**0.45**	**0.44**	**0.36**	**0.05**	**0.00**	**0.04**
Welder, diesel (250 amp)	**4**	**8.0**	**23**	**0.19**	**5.04**	**4.10**	**0.56**	**0.0054**	**0.45**	**1.55**	**1.26**	**0.17**	**0.00**	**0.14**
Air compressor, diesel (185 cfm)	**1**	**5.0**	**50**	**0.43**	**5.04**	**3.70**	**0.56**	**0.0054**	**0.30**	**1.19**	**0.88**	**0.13**	**0.00**	**0.07**
Air compressor, diesel (375 cfm)	**1**	**5.0**	**113**	**0.43**	**4.41**	**3.70**	**0.49**	**0.0054**	**0.22**	**2.36**	**1.98**	**0.26**	**0.00**	**0.12**
Air compressor, diesel (750 cfm)	**2**	**6.0**	**250**	**0.43**	**4.41**	**2.60**	**0.49**	**0.0054**	**0.15**	**12.53**	**7.39**	**1.39**	**0.02**	**0.43**
Generator, diesel (6 kW)	**4**	**4.0**	**30**	**0.43**	**5.04**	**4.10**	**0.56**	**0.0054**	**0.45**	**2.29**	**1.86**	**0.25**	**0.00**	**0.20**
Forklift, gasoline (3 ton)	**1**	**6.0**	**61**	**0.59**	**4.99**	**199.13**	**9.79**	**0.27**	**0.33**	**2.37**	**94.71**	**4.66**	**0.13**	**0.16**
Forklift, diesel (4.5 ton)	**3**	**6.0**	**110**	**0.59**	**4.41**	**3.70**	**0.49**	**0.0054**	**0.22**	**11.35**	**9.52**	**1.26**	**0.01**	**0.57**
Forklift (5 ton), diesel	**1**	**6.0**	**115**	**0.59**	**4.41**	**3.70**	**0.49**	**0.0054**	**0.22**	**3.95**	**3.32**	**0.44**	**0.00**	**0.20**
Fuel/lube truck, diesel	**1**	**4.0**	**260**	**0.59**	**4.41**	**2.60**	**0.49**	**0.0054**	**0.15**	**5.96**	**3.51**	**0.66**	**0.01**	**0.20**
Pickup truck, ½-ton 4WD, gasoline	**6**	**1.0**	**205**	**0.59**	**3.28E-03**	**4.24E-02**	**3.30E-03**	**4.88E-06**	**3.90E-05**	**0.01**	**0.07**	**0.01**	**0.00**	**0.00**
Pickup (3/4 ton) gasoline	**0**	4.0	220	0.59	3.28E-03	4.24E-02	3.30E-03	4.88E-06	3.90E-05	0.00	0.00	0.00	0.00	0.00
Stakebed truck, gasoline	**3**	**6.0**	**260**	**0.59**	**3.28E-03**	**4.24E-02**	**3.30E-03**	**4.88E-06**	**3.90E-05**	**0.02**	**0.26**	**0.02**	**0.00**	**0.00**
Hydraulic boom truck, gasoline	**1**	**6.0**	**325**	**0.59**	**3.28E-03**	**4.24E-02**	**3.30E-03**	**4.88E-06**	**3.90E-05**	**0.01**	**0.11**	**0.01**	**0.00**	**0.00**
Pump, centrifugal, gasoline	**1**	**1.0**	**10**	**0.69**	**4.99**	**199.13**	**9.79**	**0.27**	**0.33**	**0.08**	**3.03**	**0.15**	**0.00**	**0.00**
Trash pump, gasoline (150 gpm)	**1**	**1.0**	**5**	**0.69**	**4.99**	**199.13**	**9.79**	**0.27**	**0.33**	**0.04**	**1.51**	**0.07**	**0.00**	**0.00**
Trash pump, gasoline (600 gpm)	**1**	**1.0**	**20**	**0.69**	**4.99**	**199.13**	**9.79**	**0.27**	**0.33**	**0.15**	**6.05**	**0.30**	**0.01**	**0.01**
Light tower, diesel (4 kW)	**2**	**1.0**	**20**	**0.59**	**5.04**	**4.90**	**0.56**	**0.0054**	**0.60**	**0.26**	**0.25**	**0.03**	**0.00**	**0.03**
Pump, gasoline	**1**	**1.0**	**18**	**0.69**	**4.99**	**199.13**	**9.79**	**0.27**	**0.33**	**0.14**	**5.45**	**0.27**	**0.01**	**0.01**
Front-end Loader, diesel	**0**	**6.0**	**170**	**0.59**	**4.41**	**3.70**	**0.49**	**0.01**	**0.22**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Semi-tractor, diesel	**1**	**2.0**	**310**	**0.59**	**4.32**	**2.60**	**0.48**	**0.01**	**0.15**	**3.48**	**2.09**	**0.39**	**0.00**	**0.12**
Tractor, utility, diesel	**1**	**2.0**	**72**	**0.59**	**5.04**	**3.70**	**0.56**	**0.01**	**0.30**	**0.94**	**0.69**	**0.10**	**0.00**	**0.06**
Aerial work platform, 40 ft.	**4**	**6.0**	**82**	**0.21**	**5.04**	**3.70**	**0.56**	**0.01**	**0.30**	**4.59**	**3.37**	**0.51**	**0.00**	**0.27**
Aerial work platform, 60 ft.	**4**	**6.0**	**82**	**0.21**	**5.04**	**3.70**	**0.56**	**0.01**	**0.30**	**4.59**	**3.37**	**0.51**	**0.00**	**0.27**
Aerial work platform, 80 ft.	**2**	**6.0**	**70**	**0.21**	**5.04**	**3.70**	**0.56**	**0.01**	**0.30**	**1.96**	**1.44**	**0.22**	**0.00**	**0.12**
Aerial work platform, 120 ft.	**1**	**5.0**	**87**	**0.21**	**5.04**	**3.70**	**0.56**	**0.01**	**0.30**	**1.01**	**0.74**	**0.11**	**0.00**	**0.06**
Total										181.54	230.05	25.45	0.37	7.69

Notes:
(1) See notes on combustion emissions.
(2) Non-methane hydrocarbons, considered equivalent to VOCs.
(3) Except for concrete trowels and light tower, load factors are taken from: EPA. Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling, Report EPA420-P-04-005, NR-005c, April 2004.

Construction Equipment Annual Exhaust Emissions

Equipment	Average (2) Number of Units Per Year	Average Operating Hrs/Day Per Unit	Engine Size (hp)	Load Factor	Construction Days per Year (3) (days/yr)	Emission Factors (g/bhp-hr) (1) NOx	CO	NMHC (2)	SOx	PM10	Annual Emissions (tons/yr) NOx	CO	NMHC (2)	SOx	PM10
Front end loader/backhoe, diesel	1.00	2.0	100	0.48	240	4.41	3.70	0.49	0.0054	0.22	1.12E-01	9.40E-02	1.24E-02	1.38E-04	5.59E-03
Dozer tractor crawler, diesel	0.74	4.0	91	0.58	240	5.04	3.70	0.56	0.0054	0.30	2.09E-01	1.53E-01	2.32E-02	2.25E-04	1.24E-02
Trenching machine, diesel	0.56	4.0	20	0.59	240	5.04	4.90	0.56	0.0054	0.60	3.50E-02	3.40E-02	3.88E-03	3.78E-05	4.16E-03
Motor grader, diesel	0.30	6.0	135	0.59	240	4.41	3.70	0.49	0.0054	0.22	1.65E-01	1.39E-01	1.84E-02	2.04E-04	8.24E-03
Tamper, gasoline	1.70	2.0	4	0.55	240	5.04	6.00	0.56	0.0054	0.60	1.00E-02	1.19E-02	1.11E-03	1.08E-05	1.19E-03
Compactor, vibrating plate (gasoline)	1.52	3.0	8	0.55	240	4.99	199.13	9.79	0.2681	0.33	2.65E-02	1.06E+00	5.19E-02	1.42E-03	1.73E-03
Roller, vibrating dual drum, diesel	1.07	2.0	100	0.59	240	4.41	3.70	0.49	0.0054	0.22	1.48E-01	1.24E-01	1.64E-02	1.83E-04	7.38E-03
Roller, vibrating dual drum, diesel	0.44	4.0	22	0.59	240	5.04	4.90	0.56	0.0054	0.60	3.08E-02	2.99E-02	3.42E-03	3.32E-05	3.66E-03
Water truck, diesel	0.93	8.0	150	0.59	240	4.41	3.70	0.49	0.0054	0.22	7.65E-01	6.42E-01	8.50E-02	9.44E-04	3.82E-02
Excavator, hydraulic, crawler, diesel	0.67	5.0	106	0.53	240	4.41	3.70	0.49	0.0054	0.22	2.18E-01	1.83E-01	2.43E-02	2.70E-04	1.09E-02
Concrete pump truck, diesel	0.33	1.0	250	0.59	240	4.41	2.60	0.49	0.0054	0.15	5.74E-02	3.38E-02	6.37E-03	7.08E-05	1.95E-03
Mortar mixer, gasoline	0.00	1.0	11	0.59	240	4.99	199.13	9.79	0.2681	0.33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete transit mix trucks, diesel	0.78	4.0	250	0.59	240	4.41	2.60	0.49	0.0054	0.15	5.35E-01	3.16E-01	5.95E-02	6.61E-04	1.82E-02
Paving machine	0.15	6.0	100	0.59	240	4.41	3.70	0.49	0.0054	0.22	6.12E-02	5.13E-02	6.80E-03	7.55E-05	3.05E-03
Concrete Trowel, 36" blades, gasoline	0.70	1.0	8	0.59	240	4.99	199.13	9.79	0.2681	0.33	4.38E-03	1.75E-01	8.61E-03	2.36E-04	2.87E-04
Concrete Trowel, 48" blades, gasoline	0.33	1.0	8	0.59	240	4.99	199.13	9.79	0.2681	0.33	2.08E-03	8.29E-02	4.08E-03	1.12E-04	1.36E-04
Concrete Floor Saw, gasoline	0.00	1.0	5	0.78	240	4.99	199.13	9.79	0.2681	0.33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump truck, diesel	1.00	6.0	235	0.59	240	4.41	2.60	0.49	0.0054	0.15	9.71E-01	5.72E-01	1.08E-01	1.20E-03	3.30E-02
Crane, diesel (35/40 ton)	0.93	8.0	150	0.43	240	4.41	3.70	0.49	0.0054	0.22	5.57E-01	4.68E-01	6.19E-02	6.88E-04	2.78E-02
Crane, diesel (60 ton)	1.85	8.0	225	0.43	240	4.41	2.60	0.49	0.0054	0.22	1.67E+00	9.86E-01	1.86E-01	2.06E-03	8.34E-02
Crane, diesel (80 ton)	1.00	7.0	260	0.43	240	4.41	2.60	0.49	0.0054	0.15	9.13E-01	5.38E-01	1.01E-01	1.13E-03	3.11E-02
Crane, diesel (65 ton)	0.00	7.0	250	0.43	240	4.41	2.60	0.49	0.0054	0.15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, diesel (100 ton)	0.00	6.0	270	0.43	240	4.41	2.60	0.49	0.0054	0.15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, 300 Ton, crawler, diesel	0.33	7.0	450	0.43	240	4.32	2.60	0.48	0.0054	0.15	5.16E-01	3.11E-01	5.73E-02	6.50E-04	1.79E-02
Crane, 360 Ton, crawler, diesel	0.33	7.0	450	0.43	240	4.32	2.60	0.48	0.0054	0.15	5.16E-01	3.11E-01	5.73E-02	6.50E-04	1.79E-02
Crane, 500 Ton, truck, diesel	0.48	7.0	685	0.43	240	4.32	2.60	0.48	0.0054	0.15	1.13E+00	6.83E-01	1.26E-01	1.43E-03	3.94E-02
Scissor Lifts (propane)	0.00	3.0	20	0.46	240	0.00	0.00	0.00	0.0000	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder, diesel (400 amp)	1.26	8.0	26	0.19	240	5.04	4.10	0.56	0.0054	0.45	6.64E-02	5.40E-02	7.37E-03	7.17E-05	5.92E-03
Welder, diesel (250 amp)	3.67	8.0	23	0.19	240	5.04	4.10	0.56	0.0054	0.45	1.71E-01	1.39E-01	1.90E-02	1.85E-04	1.53E-02
Air compressor, diesel (185 cfm)	1.07	5.0	50	0.43	240	5.04	3.70	0.56	0.0054	0.30	1.54E-01	1.13E-01	1.71E-02	1.66E-04	9.16E-03
Air compressor, diesel (375 cfm)	0.70	5.0	113	0.43	240	4.41	3.70	0.49	0.0054	0.22	1.99E-01	1.67E-01	2.22E-02	2.46E-04	9.95E-03
Air compressor, diesel (750 cfm)	1.26	6.0	250	0.43	240	4.41	2.60	0.49	0.0054	0.15	9.48E-01	5.59E-01	1.05E-01	1.17E-03	3.22E-02
Generator, diesel (6 kW)	3.70	4.0	30	0.43	240	5.04	4.10	0.56	0.0054	0.45	2.55E-01	2.07E-01	2.83E-02	2.75E-04	2.28E-02
Forklift, gasoline (3 ton)	0.89	6.0	61	0.59	240	4.99	199.13	9.79	0.2681	0.33	2.53E-01	1.01E+01	4.97E-01	1.36E-02	1.66E-02
Forklift, diesel (4.5 ton)	2.22	6.0	110	0.59	240	4.41	3.70	0.49	0.0054	0.22	1.01E+00	8.47E-01	1.12E-01	1.25E-03	5.04E-02
Forklift (5 ton), diesel	0.67	6.0	115	0.59	240	4.41	3.70	0.49	0.0054	0.22	3.17E-01	2.66E-01	3.52E-02	3.91E-04	1.58E-02
Fuel/lube truck, diesel	0.93	4.0	260	0.59	240	4.41	2.60	0.49	0.0054	0.15	6.63E-01	3.91E-01	7.37E-02	8.18E-04	2.25E-02
Pickup truck, ½-ton 4WD, gasoline	5.41	1.0	205	0.59	240	0.00	0.04	0.00	0.0000	0.00	5.68E-04	7.33E-03	5.71E-04	8.44E-07	6.75E-06
Pickup (3/4 ton) gasoline	0.00	4.0	220	0.59	240	0.00	0.04	0.00	0.0000	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stakebed truck, gasoline	2.37	6.0	260	0.59	240	0.00	0.04	0.00	0.0000	0.00	1.89E-03	2.44E-02	1.91E-03	2.82E-06	2.25E-05
Hydraulic boom truck, gasoline	0.67	6.0	325	0.59	240	0.00	0.04	0.00	0.0000	0.00	6.66E-04	8.59E-03	6.70E-04	9.90E-07	7.92E-06
Pump, centrifugal, gasoline	0.74	1.0	10	0.69	240	4.99	199.13	9.79	0.2681	0.33	6.75E-03	2.69E-01	1.32E-02	3.62E-04	4.42E-04
Trash pump, gasoline (150 gpm)	0.74	1.0	5	0.69	240	4.99	199.13	9.79	0.2681	0.33	3.37E-03	1.35E-01	6.62E-03	1.81E-04	2.21E-04
Trash pump, gasoline (600 gpm)	0.74	1.0	20	0.69	240	4.99	199.13	9.79	0.2681	0.33	1.35E-02	5.39E-01	2.65E-02	7.25E-04	8.84E-04
Light tower, diesel (4 kW)	1.63	1.0	20	0.59	240	5.04	4.90	0.56	0.0054	0.60	2.56E-02	2.49E-02	2.85E-03	2.77E-05	3.05E-03
Pump, gasoline	0.74	1.0	18	0.69	240	4.99	199.13	9.79	0.2681	0.33	1.21E-02	4.85E-01	2.38E-02	6.52E-04	7.96E-04
Front-end Loader, diesel	0.22	6.0	170	0.59	240	4.41	3.70	0.49	0.0054	0.22	1.56E-01	1.31E-01	1.73E-02	1.93E-04	7.78E-03
Semi-tractor, diesel	0.67	2.0	310	0.59	240	4.32	2.60	0.48	0.0054	0.15	2.79E-01	1.68E-01	3.10E-02	3.51E-04	9.68E-03
Tractor, utility, diesel	0.74	2.0	72	0.59	240	5.04	3.70	0.56	0.0054	0.30	8.39E-02	6.16E-02	9.32E-03	9.06E-05	4.99E-03
Aerial work platform, 40 ft.	2.22	6.0	82	0.21	240	5.04	3.70	0.56	0.0054	0.30	3.06E-01	2.25E-01	3.40E-02	3.31E-04	1.82E-02
Aerial work platform, 60 ft.	2.15	6.0	82	0.21	240	5.04	3.70	0.56	0.0054	0.30	2.96E-01	2.17E-01	3.29E-02	3.20E-04	1.76E-02
Aerial work platform, 80 ft.	1.33	6.0	70	0.21	240	5.04	3.70	0.56	0.0054	0.30	1.57E-01	1.15E-01	1.74E-02	1.69E-04	9.33E-03
Aerial work platform, 120 ft.	0.52	5.0	87	0.21	240	5.04	3.70	0.56	0.0054	0.30	6.32E-02	4.64E-02	7.02E-03	6.82E-05	3.76E-03
Total											14.10	22.30	2.17	0.03	0.65

Notes:
(1) See notes on combustion emissions.
(2) Based on construction period duration of 27 months.
(3) Fluor Power. Personal communication from Alan MacKenzie to Sierra Research, November 2, 2007.

Delivery Truck Daily Emissions (Month 12)												
Average Number of Deliveries per Day (1)	Average Round Trip Haul Distance (miles)	Vehicle Miles Traveled Per Day	Emission Factors (lbs/vmt) (2)					Daily Emissions (lbs/day)				
			NOx	CO	POC	SOx	PM10	NOx	CO	POC	SOx	PM10
16	303.2	4851.2	3.25E-02	7.17E-03	1.79E-03	3.53E-05	1.47E-03	157.76	34.80	8.70	0.171	7.13

Notes:
(1) Based on maximum number of daily truck deliveries during this month.
(2) See notes for combustion emissions.

Delivery Truck Annual Emissions												
Average Number of Deliveries Per Year (1)	Average Round Trip Haul Distance (miles)	Vehicle Miles Traveled Per Year	Emission Factors (lbs/vmt)(2)					Annual Emissions (tons/yr)				
			NOx	CO	POC	SOx	PM10	NOx	CO	POC	SOx	PM10
1,856	303.2	562,604	3.25E-02	7.17E-03	1.79E-03	3.53E-05	1.47E-03	9.15	2.02	0.50	0.0099	0.41

Notes:
(1) Based on annual average number of truck deliveries over the 20-month construction period.
(2) See notes for combustion emissions.

Delivery Truck Idling Emissions				
Maximum Number of Truck Deliveries Per Year	**Maximum Idling Time Per Truck Delivery (hrs)**	**Total Maximum Delivery Truck Idling Time Per Year (hrs/year)**	**DPM Emission Factor (1) (lbs/hr)**	**Maximum Annual PM10 Delivery Truck Emissions (tons/yr)**
1,856	**0.5**	**928**	**0.0282**	**0.0131**

Notes:
(1) Idle emission rate of PM10 for the composite HDD Diesel truck fleet in 2010 from EMFAC2007 for 2010 (g/idle hour) = 12.772

Worker Travel Daily Emissions (Month 12)														
Maximum Month Workers per Day [1]	Average Vehicle Occupancy (person/veh.)	Number of Round Trips Per Day	Average Round Trip Haul Distance (Miles)	Vehicle Miles Traveled Per Day (Miles)	Emission Factors (lbs/vmt) [2]					Daily Emissions (lbs/day)				
					NOx	CO	POC	SOx	PM10	NOx	CO	POC	SOx	PM10
409	1.16	352.6	303.2	106,904	3.34E-03	2.56E-02	9.26E-04	2.43E-05	2.36E-04	357.53	2739.83	98.99	2.59	25.22

Notes:
(1) Expected number of construction workers during this phase of construction.
(2) See notes for combustion emissions.

Worker Travel Annual Emissions															
Annual Average Workers per Day [1]	Average Vehicle Occupancy (person/veh.)	Number of Round Trips Per Day	Average Round Trip Haul Distance (Miles)	Workdays per Year	Vehicle Miles Traveled Per Year	Emission Factors (lbs/vmt) [2]					Annual Emissions (tons/yr)				
						NOx	CO	POC	SOx	PM10	NOx	CO	POC	SOx	PM10
234.7	1.16	202.3	303.2	240	14,724,542	3.34E-03	2.56E-02	9.26E-04	2.43E-05	2.36E-04	24.62	188.69	6.82	0.18	1.74

Notes:
(1) Based on annual average number of workers over the 27-month construction period.
(2) See notes for combustion emissions.

Table 6.2-3.8

Natural Gas Pipeline Construction Heavy Equipment Daily Emissions

Equipment	Equipment Rating (bhp)	Load Factor(1)	Number of Units	Hrs/Day Per Unit	Emission Factors (g/bhp-hr) (1) NOx	CO	VOC	SOx	PM10	Daily Emissions (lbs/day) NOx	CO	VOC	SOx	PM10
Trencher	150	0.38	1	8.0	4.41	3.70	0.49	0.0054	0.22	4.4	3.7	0.5	0.01	0.2
Backhoe	100	0.38	1	8.0	4.41	3.70	0.49	0.0054	0.22	3.0	2.5	0.3	0.00	0.1
Compactor	100	0.59	1	8.0	4.41	3.70	0.49	0.0054	0.22	4.6	3.9	0.5	0.01	0.2
Paving machine	100	0.56	1	8.0	4.41	3.70	0.49	0.0054	0.22	4.4	3.7	0.5	0.01	0.2
Grader	100	0.54	1	8.0	4.41	3.70	0.49	0.0054	0.22	4.2	3.5	0.5	0.01	0.2
Water Truck	150	0.65	1	8.0	4.41	3.70	0.49	0.0054	0.22	7.6	6.4	0.8	0.01	0.4
Fuel/lube truck	175	0.65	1	8.0	4.41	2.60	0.49	0.0054	0.15	8.8	5.2	1.0	0.01	0.3
Total										37.0	28.8	4.1	0.046	1.7

Notes:
(1) See notes for combustion emissions.

Natural Gas Pipeline Construction HHD Material Hauling Truck Daily Emissions

Number of Deliveries Per Day	Average Round Trip Haul Distance (miles)	Vehicle Miles Traveled Per Day	Emission Factors (lbs/vmt) (1) NOx	CO	VOC	SOx	PM10	Daily Emissions (lbs/day) NOx	CO	VOC	SOx	PM10
4	165.6	662.4	3.25E-02	7.17E-03	1.79E-03	3.53E-05	1.47E-03	21.54	4.75	1.19	0.023	0.97

Notes:
(1) See notes for combustion emissions.

Natural Gas Pipeline Construction Daily Fugitive Dust Emissions

Operation	Daily Process Rate Per Unit	Units	PM10 Emission Factor (1) (lbs/unit)	Control Factor (1) (%)	PM10 Emissions (lbs/day)
Windblown Dust	2,000	sq.ft./day	0.000023	88%	0.01
Excavation	667	cu.yd./day	0.0018	0%	1.20
Back filling	700	tons/day	0.0001	0%	0.07
Grader Operation	10	vmt	0.2754	0	2.75
Water truck unpaved surface travel	10	vmt	0.1522	88%	0.18
Delivery truck unpaved surface travel	2	vmt	0.1589	88%	0.04
Total					4.24

Notes:
(1) See notes for fugitive dust emission calculations.

Water Pipeline Construction Heavy Equipment Daily Emissions

Equipment	Equipment Rating (bhp)	Load Factor(1)	Number of Units	Hrs/Day Per Unit	Emission Factors (g/bhp-hr) (1) NOx	CO	VOC	SOx	PM10	Daily Emissions (lbs/day) NOx	CO	VOC	SOx	PM10
Trencher	150	0.38	1	8.0	4.41	3.70	0.49	0.0054	0.22	4.4	3.7	0.5	0.0	0.2
Backhoe	100	0.38	1	8.0	4.41	3.70	0.49	0.0054	0.22	3.0	2.5	0.3	0.0	0.1
Compactor	100	0.59	1	8.0	4.41	3.70	0.49	0.0054	0.22	4.6	3.9	0.5	0.0	0.2
Loader	150	0.38	1	8.0	4.41	3.70	0.49	0.0054	0.22	4.4	3.7	0.5	0.0	0.2
Grader	100	0.54	1	8.0	4.41	3.70	0.49	0.0054	0.22	4.2	3.5	0.5	0.0	0.2
Water Truck	150	0.65	1	8.0	4.41	3.70	0.49	0.0054	0.22	7.6	6.4	0.8	0.0	0.4
Dump Truck	300	0.65	1	8.0	4.32	2.60	0.48	0.0054	0.15	14.9	8.9	1.7	0.0	0.5
Total =										43.1	32.6	4.8	0.1	1.9

Notes:
(1) See notes for combustion emissions.

Water Pipeline Construction HHD Material Hauling Truck Daily Emissions

Number of Deliveries Per Day	Average Round Trip Haul Distance (miles)	Vehicle Miles Traveled Per Day	Emission Factors (lbs/vmt) (1) NOx	CO	VOC	SOx	PM10	Daily Emissions (lbs/day) NOx	CO	VOC	SOx	PM10
6	165.6	993.6	3.25E-02	7.17E-03	1.79E-03	3.53E-05	1.47E-03	32.31	7.13	1.78	0.04	1.46

Notes:
(1) See notes for combustion emissions.

Water Pipeline Construction Daily Fugitive Dust Emissions

Operation	Daily Process Rate Per Unit	Units	PM10 Emission Factor (1) (lbs/unit)	Control Factor (1) (%)	PM10 Emissions (lbs/day)
Windblown Dust	3,000	sq.ft./day	0.000023	66%	0.02
Excavation	1,500	cu.yd./day	0.0018	0%	2.70
Back filling	900	tons/day	0.0001	0%	0.09
Grader Operation	8	vmt	0.2754	0	2.20
Water truck unpaved surface travel	6	vmt	0.1522	66%	0.31
Delivery truck unpaved surface travel	1	vmt	0.15887989	66%	0.06
Total					5.39

Notes:
(1) See notes for fugitive dust emission calculations.

Transmission Line Interconnect Construction Heavy Equipment Daily Emissions

Equipment	Equipment Rating (bhp)	Load Factor(1)	Number of Units	Hrs/Day Per Unit	Emission Factors (g/bhp-hr) (1) NOx	CO	VOC	SOx	PM10	Daily Emissions (lbs/day) NOx	CO	VOC	SOx	PM10
Auger	150	0.75	1	8.0	4.41	3.70	0.49	0.0054	0.22	8.8	7.3	1.0	0.0	0.4
Backhoe	100	0.38	1	8.0	4.41	3.70	0.49	0.0054	0.22	3.0	2.5	0.3	0.0	0.1
Crane	250	0.43	1	8.0	4.41	2.60	0.49	0.0054	0.15	8.4	4.9	0.9	0.0	0.3
Crawler Tractor	300	0.57	1	8.0	4.32	2.60	0.48	0.0054	0.15	13.0	7.8	1.4	0.0	0.5
Water Truck	150	0.65	1	8.0	4.41	3.70	0.49	0.0054	0.22	7.6	6.4	0.8	0.0	0.4
Air Compressor	50	0.48	1	8.0	5.04	3.70	0.56	0.0054	0.30	2.1	1.6	0.2	0.0	0.1
Total										42.8	30.5	4.8	0.1	1.8

Notes:
(1) See notes for combustion emissions.

Transmission Line Interconnect Construction HHD Material Hauling Truck Daily Emissions

Number of Deliveries Per Day	Average Round Trip Haul Distance (miles)	Vehicle Miles Traveled Per Day	Emission Factors (lbs/vmt) (1) NOx	CO	VOC	SOx	PM10	Daily Emissions (lbs/day) NOx	CO	VOC	SOx	PM10
10	165.6	1656	3.25E-02	7.17E-03	1.79E-03	3.53E-05	1.47E-03	53.85	11.88	2.97	0.06	2.44

Notes:
(1) See notes for combustion emissions.

Transmission Line Interconnect Construction Daily Fugitive Dust Emissions

Operation	Daily Process Rate Per Unit	Units	PM10 Emission Factor (1) (lbs/unit)	Control Factor (1) (%)	PM10 Emissions (lbs/day)
Windblown Dust	1,000	sq.ft./day	0.000023	66%	0.01
Excavation	500	cu.yd./day	0.0018	0%	0.90
Back filling	250	tons/day	0.0001	0%	0.03
Water truck unpaved surface travel	2	vmt	0.1522	66%	0.10
Delivery truck unpaved surface travel	2	vmt	0.1589	66%	0.10
Total					1.14

Notes:
(1) See notes for fugitive dust emission calculations.

Table 6.2-3.9: Notes - Fugitive Dust Emission Calculations

(1) Paved road travel emission factors for delivery trucks and worker automobiles are based on AP-42, Section 13.2.1, 10/97.
(2) Wind erosion emission factor for active construction area is based on "Improvement of Specific Emission Factors (BACM Project No. 1), Final Report", prepared for South Coast AQMD by Midwest Research Institute, March 1996.
(3) Finish grading emission factor is based on AP-42, Table 11.9-2, 1/95.
(4) Bulldozer and scraper excavation emission factors are based AP-42, Table 11.9.2, 1/95.
(5) Material unloading emission factors are based on AP-42, p. 13.2.4-3, 1/95.
(6) Loader unpaved road travel emission factor is based on AP-42, Section 13.2.2, 1/95.
(7) Backhoe trenching emission factor is based on AP-42, Table 11.9-2 (dragline operations), 1/95.
(8) Unpaved road travel emission factors for water trucks, fuel trucks, service trucks, dump trucks, scrapers, forklifts, pickup trucks, delivery trucks, 5th wheel tractor trucks, and concrete trucks are based on AP-42, Section 13.2.2, 9/98.
(9) Dust control efficiency for unpaved road travel and active excavation area is based on "Control of Open Fugitive Dust Sources", U.S. EPA, 9/88.

Notes - Combustion Emission Calculations

(1) For Construction Equipment
For heavy Diesel construction equipment, emission factors based on equipment meeting EPA Tier 2 off-road Diesel standards and use of CARB low-sulfur (15 ppmw) fuel.
For different classes of truck, emissions factors are based on EMFAC 2007 Version 2.3 (November 1, 2006) for heavy-heavy duty or medium duty Diesel trucks, Kings County fleet average for calendar year 2010.
For portable equipment, emission factors are based on EPA's AP-42, Table 3.3-1 (Industrial I/C Engines), 10/96.
Gasoline-fueled forklift and stationary equipment emission factors are from SCAQMD off-road table for 2010.
Gasoline-fueled truck emission factors based on EMFAC2007 for Kings County in 2010, starting emissions in grams per trip for one trip per hour.

(2) For Delivery Trucks
From EMFAC 2007 Version 2.3 (November 1, 2006) for Kings County, heavy-heavy duty Diesel trucks, fleet average for calendar year 2010.

(3) For Worker Travel
From EMFAC2007, Version 2.3, November 1, 2006, average of 1/3 light duty automobiles, 1/3 light-duty truck category LDH1 and 1/3 light-duty truck category LDH2, fleet average for calendar year 2010.

Table 6.2-3.10
Assumptions for Construction Air Quality Impact Analysis
Avenal Energy Project

No.	Assumption	Units	Value	Reference
	General			
1	Construction materials are delivered from the following cities in the following proportions: Bakersfield (20%), Fresno (20%), LA (20%), San Francisco (20%) and Sacramento (20%).			
2	Distance from Bakersfield to project site	miles	85	Check traffic analysis
3	Distance from Fresno to project site	miles	65	Check traffic analysis
4	Distance from Los Angeles to project site	miles	185	Check traffic analysis
5	Distance from San Francisco to project site	miles	211	Check traffic analysis
6	Distance from Sacramento to project site	miles	212	Check traffic analysis
7	Average one-way distance from construction supply cities to Avenal	miles	151.6	
8	Average number of workdays per month	days/month	20	Fluor

Table 6.2-3.11

Daily Construction Emissions (Month 12)					
Daily Emissions (lbs/day)					
	NOx	CO	POC	SOx	PM10
Onsite					
Construction Equipment	181.54	230.05	25.45	0.37	7.69
Fugitive Dust					5.88
Subtotal	181.54	230.05	25.45	0.37	13.57
Offsite					
Worker Travel	357.53	2,739.83	98.99	2.59	25.22
Truck Deliveries	157.76	34.80	8.70	0.17	7.13
Subtotal	515.30	2,774.63	107.68	2.76	32.35
Total	696.84	3,004.68	133.13	3.14	45.92

Annual Construction Emissions Annual Emissions (tons/yr)					
	NOx	CO	POC	SOx	PM10
Onsite					
Construction Equipment	14.10	22.30	2.17	0.034	0.66
Fugitive Dust					0.42
Subtotal	14.10	22.30	2.17	0.034	1.07
Offsite					
Worker Travel	24.62	188.69	6.82	0.18	1.74
Truck Deliveries	9.15	2.02	0.50	0.010	0.41
Subtotal	33.77	190.70	7.32	0.19	2.15
Total	47.87	213.01	9.49	0.22	3.22

Table 6.2-3.12: Construction Modeling Inputs

Short-Term Impacts (24 hours and less)					
	Criteria Pollutant				
	NOx	CO	POC	SOx	PM10
Combustion (lbs/day)	181.54	230.05	25.45	0.37	7.69
Combustion (hrs/day)	9.0	9.0	9.0	9.0	9.0
Combustion (lbs/hr)	20.17	25.56	2.83	0.042	0.85
Combustion (g/sec)	2.54	3.22	0.36	0.0052	0.108
Construction Dust (lbs/day)					4.60
Construction Dust (hrs/day)					11
Construction Dust (lbs/hr)					0.42
Construction Dust (g/sec)					0.053
Windblown Dust (lbs/day)					1.28
Windblown Dust (hrs/day)					24
Windblown Dust (lbs/hr)					0.05
Windblown Dust (g/sec)					0.01

Long-Term Impacts (annual)					
	Criteria Pollutant				
	NOx	CO	POC	SOx	PM10
Combustion (tons/yr)	14.10	22.30	2.17	0.03	0.66
Combustion (days/yr)	365	365	365	365	365
Combustion (hrs/day)	24	24	24	24	24
Combustion (lbs/hr)	3.22	5.09	0.49	0.0078	0.15
Combustion (g/sec)	0.41	0.64	0.062	0.0010	0.019
Construction Dust (tons/yr)					0.30
Construction Dust (days/yr)					365
Construction Dust (hrs/day)					24
Construction Dust (lbs/hr)					0.068
Construction Dust (g/sec)					0.0086
Windblown Dust (tons/yr)					0.12
Windblown Dust (days/yr)					365
Windblown Dust (hrs/day)					24
Windblown Dust (lbs/hr)					0.03
Windblown Dust (g/sec)					0.00

APPENDIX 6.2-4

BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS

Appendix 6.2-4

Best Available Control Technology Analysis

Best Available Control Technology (BACT) is defined in San Joaquin Valley Air Pollution Control District (SJVAPCD or District) Regulation II (Permits), Rule 2201 (New and Modified Stationary Source Review) as:

> *3.9 The most stringent emission limitation or control technique of the following:*
>
> > *3.9.1 Achieved in practice for such category and class of source;*
> >
> > *3.9.2 Contained in any State Implementation Plan approved by the Environmental Protection Agency for such category and class of source. A specific limitation or control technique shall not apply if the owner of the proposed emissions unit demonstrates to the satisfaction of the APCO that such a limitation or control technique is not presently achievable; or*
> >
> > *3.9.3 Contained in an applicable federal New Source Performance Standard; or*
> >
> > *3.9.4 Any other emission limitation or control technique, including process and equipment changes of basic or control equipment, found by the APCO to be cost effective and technologically feasible for such class or category of sources or for a specific source.*

Applicable BACT levels are shown in Table 6.2-4.1, along with anticipated potential emissions from each emitting unit and criteria pollutant. SJVAPCD Rule 2201 requires BACT for each unit emitting NOx, VOC, SOx, and PM_{10} (criteria pollutants) in excess of 2.0 pounds per highest day, and CO in excess of 200,000 pounds per year. The calculation of facility emissions is discussed in Section 6.2.5.1.1.

TABLE 6.2-4.1
BEST AVAILABLE CONTROL TECHNOLOGY REQUIREMENTS

POLLUTANT	BACT APPLICABILITY THRESHOLD (LBS/DAY)	MAXIMUM EMISSION LEVEL (LBS/DAY) - BACT REQUIRED?			
		TURBINE	AUXILIARY BOILER	EMERGENCY STANDBY GENERATOR ENGINE	EMERGENCY STANDBY FIRE WATER PUMP ENGINE
VOC	2	407 - **Yes**	1.9 - No	0.63 - No	0.2 - No
NOx	2	2,537 - **Yes**	4.9 - **Yes**	2.8 - **Yes**	2.2 - **Yes**
SO_2	2	319 - **Yes**	1.3 - No	0.02 - No	0.003 - No
PM_{10}	2	567 - **Yes**	2.2 - **Yes**	0.06 - No	0.04 - No
CO	200,000 lbs/year	1,291,000 - **Yes**	1,720 - No	200 - No	14 - No

BACT for the applicable pollutants was determined by reviewing the SJVAPCD BACT Clearinghouse,[1] the South Coast Air Quality Management District (SCAQMD) BACT Guidelines,[2] the Air Resources Board (ARB) BACT Determinations,[3] ARB's power plant siting guidance,[4] and U.S. Environmental Protection Agency (USEPA) Reasonably Available Control Technology (RACT)/BACT/Lowest Achievable Emission Rate (LAER) Clearinghouse (RBLC).[5]

For natural gas-fired combined-cycle gas turbines, available control techniques are well defined and are consistently required, but emission concentration limits vary. Therefore, this analysis will focus on the emission limitations that constitute BACT for each of the proposed emitting units.

BACT for the Combined-Cycle Combustion Gas Turbines

To evaluate BACT for the proposed turbines, the SJVAPCD BACT Clearinghouse was reviewed. BACT Guideline 3.4.2 applies to gas turbines, and is shown in Table 6.2-4.2.

Two relevant determinations by the SCAQMD are shown in Table 6.2-4.3.

[1] SJVAPCD. BACT Clearinghouse, http://www.valleyair.org/busind/pto/bact/bactchidx.htm.
[2] SCAQMD. BACT Guidelines, http://www.aqmd.gov/bact/BACTGuidelines.htm.
[3] ARB. Statewide BACT, http://www.arb.ca.gov/bact/bact.htm.
[4] ARB. *Guidance for Power Plant Siting and Best Available Technology,* September 1999.
[5] USEPA. RBLC, http://cfpub.epa.gov/rblc/htm/bl02.cfm.

TABLE 6.2-4.2
GAS TURBINE BACT DETERMINATIONS FROM SJVAPCD BACT CLEARINGHOUSE

FACILITY/ LOCATION	DATE PERMIT ISSUED	EQUIPMENT RATING	NOx LIMIT/ CONTROL TECHNOLOGY	CO LIMIT/ CONTROL TECHNOLOGY	VOC LIMIT/ CONTROL TECHNOLOGY	PM_{10} / CONTROL TECHNOLOGY	SO_2 LIMIT/ CONTROL TECHNOLOGY
Aera (Midway – Sunset)	6/30/2002	250 MW	2.0 ppmv @ 15% O_2 (1-hr avg), except during startup and shutdown Dry low-NOx combustors, and SCR	6.0 ppmv @ 15% O_2	1.5 ppmv @ 15% O_2	Natural gas fuel, air inlet cooler/ filter, and lube oil vent coalescer.	Fuel gas S limit = 0.75 gr S per 100 dscf

TABLE 6.2-4.3
GAS TURBINE BACT DETERMINATIONS FROM THE SCAQMD

	MAGNOLIA POWER PROJECT BURBANK , CA.	MOUNTAINVIEW POWER CO., LLC SAN BERNARDINO, CA.
Date Permit Issued	1/30/2004	12/18/2001
Equipment/ Rating	GE PG7241FA gas turbines rated at 181 net MW (1,700 MMBtu/hr + 583 MMBtu/hr duct burner), and 147 net MW steam turbine in combined cycle	GE PG7241FA gas turbines rated at 175.7 net MW (1,991 MMBtu/hr + 135 MMBtu/hr duct burner), and 104.6 net MW half of steam turbine in combined cycle
NOx Limit/ Control Technology	2.0 ppmvd @ 15% O_2 (3-hr avg) Dry low-NOx combustors, and SCR operating between 450 and 850°F.	2.5 ppmvd @ 15% O_2 (1-hr avg), and 2.0 ppmvd @ 15% O_2 (12- month avg) Dry low-NOx combustors, and SCR.
CO Limit/ Control Technology	2.0 ppmvd @ 15% O_2 (1-hr avg) Oxidation catalyst	6 ppmvd @ 15% O_2 (1-hr avg) Oxidation catalyst
VOC Limit/ Control Technology	1.5 ppmvd @ 15% O_2 (1-hr avg)	1.4 ppmvd @ 15% O_2
PM_{10} / Control Technology	Natural gas fuel, 0.01 gr/scf and 11 lbs/hr.	Natural gas fuel, 0.01 gr/scf.
SO_2 Limit/ Control Technology	-	-

The ARB's BACT Clearinghouse Database was also reviewed for recent BACT decisions regarding large gas turbine projects in California. Relevant BACT decisions are summarized in Table 6.2-4.4. NOx levels shown in these determinations range from 2.0 to 2.5 ppm, with averaging periods ranging from one to three hours. CO BACT determinations range from 2 to 4 ppm, with various averaging periods. VOC determinations range from 1 to 2 ppm, again with various averaging periods. The ARB's Guidance for Power Plant Siting and Best Available Control Technology was also reviewed. The relevant BACT levels recommended in the ARB power plant guidance document are summarized in Table 6.2-4.5.

TABLE 6.2-4.4
SUMMARY OF BACT DETERMINATIONS (ARB BACT CLEARINGHOUSE)

FACILITY/DISTRICT	PERMIT NO./DATE	EQUIPMENT/ RATING	NOx LIMIT/ CONTROL TECHNOLOGY	CO LIMIT/ CONTROL TECHNOLOGY	VOC/HC LIMIT/ CONTROL TECHNOLOGY
Western Midway Sunset Power Project/ San Joaquin Valley Air Pollution Control District (SJVAPCD)	S-1135-313-0 12/12/2003	GE 7FA or S-W 501F	2 ppm, 1-hr average SCR	4 ppm, 3-hr average Oxidation catalyst	1.4 ppm, 3-hr average Oxidation catalyst
Three Mountain Power, LLC/ Shasta County AQMD	99-PO-01 10/10/2003	GE 7FA or S-W 501F	2.5 ppm, 1-hr average SCR	4 ppm, 3-hr average Oxidation catalyst	2 ppm, 1-hr average Oxidation catalyst
Magnolia Power Project/ SCAQMD	386305 5/27/2003	GE 7FA	2 ppm, 3-hr average SCR	2 ppm, 1-hr average Oxidation catalyst[a]	2 ppm, 1-hr average Oxidation catalyst
Elk Hills Power Project/ SJVAPCD	S-3523-1-0	GE 7FA	2.5 ppm, 1-hr average SCR	4 ppm, 3-hr average Oxidation catalyst	2 ppm, 3-hr average Oxidation catalyst
Sutter Power Project/ Feather River AQMD	97-AFC-2 12/1/2000	S-W 501F	2.5 ppm, 1-hr average SCR	4 ppm, 24-hr average Oxidation catalyst	1 ppm, 24-hr average Oxidation catalyst

Note:
a. District indicates that applicant proposed 2 ppm to lower offset liability.

TABLE 6.2-4.5
ARB BACT GUIDANCE FOR POWER PLANTS

POLLUTANT	BACT
Nitrogen Oxides	2.5 ppmv @ 15% O_2 (1-hour average) 2.0 ppmv @ 15% O_2 (3-hour average)
Sulfur Dioxide	Fuel sulfur limit of 1.0 grains/100 scf
Carbon Monoxide	Nonattainment areas: 6 ppmv @ 15% O_2 (3-hour average) Attainment areas: District discretion
VOC	2 ppmv @ 15% O_2 (3-hour average)
NH_3	5 ppmv @ 15% O_2 (3-hour average)
PM_{10}	Fuel sulfur limit of 1.0 grains/100 scf

Numerous natural gas-fired turbine determinations in the EPA RBLC were reviewed, and several are summarized in Table 6.2-4.6. NOx BACT levels from the RBLC range from 2.0 to 3.0 ppm, with averaging periods ranging from one to 24 hours. CO BACT levels range from 2.0 to 18.0 ppm. VOC levels range from 1.3 to 13 ppm.

TABLE 6.2-4.6
GAS TURBINE BACT DETERMINATIONS (EPA RBLC CLEARINGHOUSE}

FACILITY/LOCATION	DATE PERMIT ISSUED	EQUIPMENT RATING	NOX LIMIT/ CONTROL TECHNOLOGY	CO LIMIT/ CONTROL TECHNOLOGY	VOC LIMIT/ CONTROL TECHNOLOGY
Forsyth Energy Plant Forsyth Co, NC	9/29/2005	1844.3 MMBtu/hr combined cycle turbine w/ duct burner	2.5 ppm, 24-hour average (SCR and DLN)	11.6 ppm, 3-hr average (good combustion practices)	No BACT determination
Sierra Pacific Power Company Tracy Station Storey Co, NV	8/16/2005	306 MW combined-cycle turbine w/ duct burner	2 ppm, 3-hr average (SCR and DLN)	3.5 ppm, 3-hr average (oxidation catalyst)	4 ppm, 3-hr average
North Star Power Co Ramsey Co, MN	8/12/2005	330 MW total, 2 combined-cycle turbines w/ duct burners	No BACT determination	10 ppm w/o duct firing 18 ppm w duct firing (good combustion practices)	2 ppm w/o duct firing 13 ppm w/ duct firing
Wanapa Energy Center Umatilla Co, OR	8/8/2005	GE Frame 7FA gas turbine and duct burner	2 ppm, 3-hr average (SCR and DLN)	2 ppm, 3-hr average (oxidation catalyst)	No BACT determination
Hines Power Block 4 Polk Co, FL	6/8/2005	530 MW combined cycle gas turbine	2.5 ppm (SCR)	8 ppm (good combustion practices)	No BACT determination
Florida Power and Light Turkey Point Power Plant Dade Co, FL	6/8/2005	Four GE 7FA gas turbines with duct firing	2.0 ppm, 24-hr average (DLN and SCR)	8 ppm, 24-hr average (good combustion practices)	1.3 ppm (good combustion practices)
Berrien Energy, LLC Berrien Co, MI	4/13/2005	1584 MMBtu/hr gas turbine with duct firing	2.5 ppm, 24-hr average (SCR and DLN)	2 ppm, 3-hr average (oxidation catalyst)	3.2 lb/hr
Duke Energy Hanging Rock Energy Facility Lawrence Co, OH	12/28/2004	Four GE 7FA gas turbines with duct firing	3.0 ppm, 3-hr average (SCR and DLN)	9 ppm, 24-hr average	20.4 lb/hr
Wellton Mohawk Generating Station Yuma Co, AZ	12/1/2004	GE 7FA gas turbines with duct firing	2.0 ppm, 3-hr average (SCR and DLN)	3.0 ppm, 3-hr average (oxidation catalyst)	2.0 ppm, 3-hr average (oxidation catalyst)

Table 6.2-4.7 summarizes the proposed BACT determination for the project CTGs, which are in line with the determinations discussed above.

TABLE 6.2-4.7
PROPOSED BACT DETERMINATION FOR
AVENAL ENERGY PROJECT COMBINED-CYCLE GAS TURBINES

POLLUTANT	PROPOSED BACT DETERMINATION
Nitrogen Oxides	Dry low-NOx combustor and SCR system, 2.0 ppmc[a], 1-hour average, with excursions under specific conditions
Sulfur Dioxide	Natural gas fuel (sulfur content not to exceed 1.0 grain/100 scf short-term average, 0.36 grains/100 scf long-term average)
Carbon Monoxide	Good combustion practices and oxidation catalyst, 4.0 ppmc, 3-hour average
VOC	Good combustion practices, 1.4 and 2.0 ppmc, 1-hour average, without and with duct firing, respectively
PM_{10}	Natural gas fuel, 9.0 and 11.8 PM_{10} lbs/hr, without and with duct firing, respectively

Note:
a. ppmc: parts per million by volume, corrected to 15% O_2

BACT for the Auxiliary Boiler

To evaluate NOx and PM_{10} BACT for the proposed auxiliary boiler, the SJVAPCD BACT guidelines for natural gas-fired boilers were reviewed. The relevant BACT guideline for this analysis is shown in Table 6.2-4.8.

The auxiliary boiler will meet the BACT limits shown on Table 6.2-4.8 with the use of low-NOx burners, natural gas fuel, and proper combustion.

TABLE 6.2-4.8
SJVAPCD BACT GUIDELINE FOR NATURAL GAS-FIRED BOILERS

POLLUTANT	BACT
NOx	9 ppmv @ 3% O_2 (SJVAPCD BACT Guideline 1.1.2 B)
PM10	Natural gas fuel with LPG backup (SJVAPCD BACT Guideline 1.1.3*)

NOx BACT for the Natural Gas-Fueled Emergency Standby Generator Engine

To evaluate NOx BACT for the proposed natural gas-fired emergency standby generator engine, the relevant SJVAPCD BACT guideline shown in Table 6.2-4.9 was reviewed.

TABLE 6.2-4.9
SJVAPCD BACT GUIDELINE FOR
NATURAL GAS-FIRED EMERGENCY STANDBY GENERATOR ENGINES

POLLUTANT	BACT
NOx	1.0 g/bhp-hr or less (SJVAPCD BACT Guideline 3.1.8*)

The proposed 860 hp Caterpillar Model G3512LE will emit 1.0 g/hp-hr NOx using a catalytic control system.

NOx BACT for the Diesel-Fueled Emergency Standby Fire Water Pump Engine

To evaluate BACT for the proposed emergency standby fire water pump engine, the SJVAPCD BACT guidelines for emergency Diesel internal combustion engines driving fire pumps were reviewed. The relevant BACT determinations for this analysis are shown in Table 6.2-4.10.

The proposed Diesel-fueled emergency standby fire water pump engine will meet the BACT limits shown in Table 6.2-4.10, and will use ultra-low sulfur content (15 ppmw) fuel.

TABLE 6.2-4.9
SJVAPCD BACT GUIDELINES FOR EMERGENCY DIESEL IC ENGINES

POLLUTANT	EMERGENCY DIESEL IC ENGINES	DIESEL ENGINES DRIVING FIRE PUMPS
NOx	6.9 g/bhp-hr or less (SJVAPCD BACT Guideline 3.1.2*)	6.9 g/bhp-hr or less (SJVAPCD BACT Guideline 3.1.4*)

APPENDIX 6.2-5
OFFSET REQUIREMENTS

EPA policies limit the use of ERCs for projects subject to federal requirements. EPA policy requires offsets from non-traditional sources (e.g., motor vehicle buyback programs) to be evaluated under federally enforceable rules and protocols. EPA policy also requires that pre-1990 ERCS must meet the requirements of EPA's 1994 "Response to Request for Guidance on Use of Pre-1990 ERCs and adjusting for RACT at Time of Use." Those requirements are that the ERCs be explicitly included in the District's planning inventory, and that, even though the offsets are included in the planning inventory, they be discounted at the time of use for RACT that applies to the source that is the origin of the offsets.

None of the proposed ERCs come from non-traditional sources. They are all the result of installation of additional controls on, curtailment of, or shutdown of permitted emission units.

Emission Reduction Credits					
	Reduction generating offset	Year	Pollutant	Amount (lbs)	Non-traditional?
C-609-2/ C-400-2	Emission unit shutdown	1991	NOx	8,972	No
N-440-2/ N-229-2	Retrofit of boilers and curtailment of oil	1994	NOx	90,905	No
N-438-2/ N-231-2	Lower NOx limits for boilers	1994	NOx	1,701	No
N-437-2/ N-232-2	Boiler Shutdown	1998	NOx	4,728	No
C-610-1/ C-400-1	Emission unit shutdown	1991	VOC	180	No
N-434-1/ N-232-1	Boiler shutdown	1998	VOC	709	No
N-435-1/ N-233-1	Retrofit of boilers and curtailment of oil	1994	VOC	241	No
S-2083-1/ S-1700-1/ S-1471-1/ (Option from DENA)[a]	Stationary source shutdown	2001	VOC	350,000	No
C-399-1/ C-464-1	Emission unit shutdown	2002	VOC	23,288	No
S-2081-1/ S-1805-1/ S-1752-1 /(Option from DENA)	Stationary source shutdown	2002	VOC	125,689	No
S-2082-1/ S-1797-1/ S-1751-1/ (Option from DENA)	Stationary source shutdown	2002	VOC	125,690	No
S-266-5/ S-1808-5 (Berry Petroleum)	Steam generator shutdown	2002	SOx	281,290	No
S-567-5/ S-1809-5 (Berry Petroleum)	Conversion of heater treater to gas firing only	2002	SOx	21,852	No
S-772-5/S-1810-5 (Berry Petroleum)	Shutdown of gas-fired steam generator	2002	SOx	40	No
S-1811-5 (Berry Petroleum)	Shutdown of steam generator	2002	SOx	21	No
N-256-5/ N-310-5	Burner retrofit and fuel oil usage limitation	2002	SOx	100,000	No
C-608-4/ C-400-4	Emission unit shutdown	1991	PM_{10}	320	No
N-436-4/ N-232-4	Boiler Shutdown	1998	PM_{10}	985	No
N-439-4/ N-229-4	Retrofit of boilers and curtailment of oil	1994	PM_{10}	3,215	No

[a] Duke Energy North America

Emission Reduction Credits Needed and Owned by Applicant						
Pollutant	Cert. No.	Pounds of Offsets Required/ERCs per Quarter				Location
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	
NOx[1]	Offsets Req'd	100,633	100,633	100,633	100,633	n/a
	C-400-2	2,243	2,243	2,243	2,243	12806 Road 26, Madera
	N-229-2	0	1,166	88,317	1,422	12045 S Ingomar Grade, Los Banos
	N-231-2	0	9	1,255	437	12045 S Ingomar Grade, Volta
	N-232-2	0	0	4,728	0	3200 E Eight Mile Rd, Stockton
VOC[1]	Offsets Req'd	18,464	18,464	18,464	18,464	n/a
	C-400-1	45	45	45	45	12806 Road 26, Madera
	N-232-1	0	0	709	0	3200 E Eight Mile Rd, Stockton
	N-233-1	0	0	241	0	12405 S Ingomar Grade, Los Banos
	S-1700-1/ S-1471-1/ S-2083-1 (Option from DENA)	87,500	87,500	87,500	87,500	20807 Stockdale Highway, Bakersfield
	C-399-1/ C-464-1	5,480	6,496	4,696	6,616	5778 W. Barstow Avenue, Fresno
	S-1805-1/ S-1752-1/ S-2081-1 (Option from DENA)	31,431	31,424	31,417	31,417	20807 Stockdale Highway, Bakersfield
	S-1797-1/ S-1751-1/ S-2082-1 (Option from DENA)	31,432	31,424	31,417	31,417	20807 Stockdale Highway, Bakersfield

Emission Reduction Credits Needed and Owned by Applicant						
Pollutant	Cert. No.	Pounds of Offsets Required/ERCs per Quarter				Location
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	
SOx	Offsets Req'd	0	0	0	0	
	S-266-5/ S-1808-5 (Berry Petroleum)	92,179	23,666	69,157	96,288	Heavy Oil Western, Hillside Lease, Section NW34, Township 12N, Range 24W
	S-567-5/ S-1809-5 (Berry Petroleum)	12,862	491	0	8,499	Heavy Oil Western, Hillside Lease, Section NW34, Township 12N, Range 24W
	S-772-5/ S-1810-5 (Berry Petroleum)	6	14	12	8	Fairfield A-1 Lease, Section NE11, Township 31S, Range 22E
	S-1811-5 (Berry Petroleum)	5	7	3	6	Fairfield Lease, Heavy Oil Western, Section NE11, Township 31S, Range 22E
	N-256-5/ N-310-5	25,000	25,000	25,000	25,000	800 W. Church St., Stockton
PM_{10}[2]	Offsets Req'd	49,546	49,546	49,546	49,546	n/a
	C-400-4	80	80	80	80	12806 Road 26, Madera
	N-232-4	0	0	985	0	3200 E Eight Mile Rd, Stockton
	N-229-4	0	0	3,215	0	12045 S Ingomar Grade, Los Banos

Notes: 1. ERCs for NOx and VOC that occurred from April through November (2nd through 4th quarters) may be used to offset increases in NOx and VOC during any period of the year (Rule 2201.4.13.8).

2. ERCs for PM that occurred from October through March (1st and 4th quarters) may be used to offset increases in PM during any period of the year (Rule 2201.4.13.7).

APPENDIX 6.2-6

CUMULATIVE IMPACTS ANALYSIS

APPENDIX 6.2-6

CUMULATIVE IMPACTS ANALYSIS

Potential cumulative air quality impacts that might be expected to occur as a result of the proposed Project and other reasonably foreseeable projects are both regional and localized in nature. These cumulative impacts were evaluated as follows.

Cumulative impacts from the Project could result from emissions of CO, NOx, SOx, VOC and directly emitted PM_{10} and $PM_{2.5}$. To assure that the possible existence of other projects that might have significant cumulative impacts in conjunction with the Project were identified, a search area with a radius of 6 miles[1] was used for the cumulative impacts analysis.

Within this search area, three categories of possible projects with combustion sources were used as criteria for identification:

- Projects that are existing and have been in operation since at least early 2006.
- Projects for which air pollution permits to construct have been issued and that began operation after 2006.
- Projects for which air pollution permits to construct have not been issued, but that are reasonably foreseeable.

Projects that are existing and have been in operation since at least early 2006 are reflected in the 2004-2006 ambient air quality data that have been used to represent background concentrations; consequently, no further analysis of the emissions from this category of facilities was needed. The air quality impact analysis in Section 6.2 added the modeled impacts of the proposed project to the maximum background air quality levels measured during 2004-2006, thus assuring that these existing projects were taken into account.

Identification of projects for which air pollution permits to construct would have been issued but that would not have been operational by the end of 2006 were requested from the SJVAPCD in the July 19, 2007 letter[2] included in this appendix. Projects for which the emissions change was smaller than 5 tons per year were assumed to be *de minimis*, and were not included in the request. In response to the July 19, 2007 request, the District provided on January 24, 2008 the list of projects in Table 6.2-6.1. The annual emissions of these projects are negligible as shown in Table 6.2-6.2, and the VOC emissions are not subject to air dispersion impact analysis. Therefore, no further cumulative air quality impact analysis is required.

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[1] This distance limit was presented in the Air Dispersion Modeling and Health Risk Assessment Protocol transmitted to the SJVAPCD on August 14, 2007, and approved in an email from the District on January 22, 2008. The 6-mile distance originates from the CEC Data Adequacy Worksheet for air quality analysis compliance with siting regulations Appendix B
(g) (8) (I) (iii).

[2] The July 19, 2007 was an update of the previous August 9, 2006 letter requesting the same information from the District.

sierra
research

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July 19, 2007

Arnaud Marjollet
Manager, Permit Services
San Joaquin Valley Air Pollution Control District
1990 E. Gettysburg Avenue
Fresno, CA 93726-0244

Re: Information Request for a Cumulative Air Quality Impact Analysis
Avenal Energy Project

Dear Mr. Marjollet:

Thank you for calling back this morning. Based on our discussion, this letter updates the previous request sent to Dave Warner on August 9, 2006. Sierra Research is conducting the air quality and public health impact analysis for the Avenal Energy Project. Federal Power Avenal, LLC plans to file an updated Application for Certification with the California Energy Commission (CEC) for a combined-cycle gas turbine power plant near Avenal, California. The UTM coordinates of the site are 3997.742 km northing, 764.616 km easting (Zone 10).

As part of the project review, the CEC requires us to update the analysis of the project's potential cumulative impacts. This is defined by the CEC as "a cumulative air quality modeling impacts analysis of the project's typical operating mode in combination with other stationary source emissions sources within a six-mile radius *which have received construction permits but are not yet operating, or are in the permitting process*." [emphasis added] For each criteria pollutant the CEC staff considers facilities having an emission increase of less than five tons per year to be *de minimis*, so such facilities may be excluded.

We would like to get from the District a list of projects that meet these criteria, along with sufficient emissions information and stack parameters so that we can include these sources in our air dispersion modeling.

Thank you very much for your assistance. If you have any questions regarding the information we are requesting, feel free to call.

Sincerely,

Eric Walther

cc: Steve Gilliland, Federal Power Avenal, LLC
Joe Stenger, TRC

Table 6.2-6.1

ATC Within 6 Miles

APPs Received Between 1/1/2006 and 2/1/2008

Region C

Facility ID *276*

Facility Name J.P. OIL COMPANY, INC.

Facility Type OIL AND GAS PRODUCTION

Distance To Location
6481.621

Degrees
216.1121

Received	*Type*	*Status*	*Description*
1/11/2006	ATC	FINAL	installing a separator, a 400 bbl constant level crude oil transfer tank, and a 400 bbl crude oil overflow tank

Facility ID *313*

Facility Name J.P. OIL COMPANY, INC.

Facility Type OIL AND GAS PRODUCTION

Distance To Location
6486.011

Degrees
229.3377

Received	*Type*	*Status*	*Description*
8/3/2006	ATC	FINAL	to add a 15 hp fin fan to reduce fluctuating gas temperatures, and increase maximum production rate from 2.5 MMscf/day to 5.0 MMscf/day

Facility ID *713*

Facility Name KEENAN FARMS INC

Facility Type AGRICULTURAL PRODUCTS PROCESSING, PISTACHIOS

Distance To Location
2385.337

Degrees
239.8623

Received	*Type*	*Status*	*Description*
2/23/2006	ATC	FINAL	add two dryers and 3 silos with two shared portable dryers

Table 6.2-6.1

Facility ID *904*

Facility Name PACIFIC GAS & ELECTRIC CO

Facility Type PUBLIC UTILITY

Distance To Location

3239.127

Degrees

231.2821

Received	*Type*	*Status*	*Description*
9/18/2007	TV REN	PR-INCO	TV renewal appl DROP DEAD DATE: 3/18/09
8/15/2006	ATC	FINAL	correct hp & model # for permit -31

Table 6.2-6.2
New Emission Sources Located within 6 Miles of the Avenal Energy Project

Facility ID	Project #	Facility Name	Implemetation Date	Emission Increases (lb/year)				
				NOx	SOx	PM10	CO	VOC
C-276	C-1060040	J.P. Oil Company, Inc.	August 30, 2006	0	0	0	0	147
C-313	C-1062458	J.P. Oil Company, Inc.	December 11, 2006	0	0	0	0	986
C-713	C-1060578	Keenan Farms Inc.	August 9, 2006	0	0	0	0	0
C-904	C-1062529	Pacific Gas & Electric Co	March 21, 2007	58	2	11	70	21