APPENDIX 6.16-1

HEALTH RISK ASSESMENT

Table 6.16-1
Noncriteria Pollutant Emissions from Gas Turbines
Avenal Energy Project

Noncriteria Pollutant	Emission Factor, lb/MMscf (2)	(each turbine) Maximum Hourly Emissions, lb/hr (3)	(each turbine) Annual Emissions, ton/yr (4)	Emission Rates for Modeling (each turbine) One-hour Impacts, g/s	Emission Rates for Modeling (each turbine) Annual Impacts, g/s	Total, 2 turbines tpy
Ammonia	(5)	35.39	117.91	4.46E+00	3.39E+00	235.8
Propylene	7.71E-01	1.79	6.12	2.26E-01	1.76E-01	12.2
Hazardous Air Pollutants						
Acetaldehyde (1)	4.05E-02	9.43E-02	3.22E-01	1.19E-02	9.26E-03	6.44E-01
Acrolein (1,2)	6.49E-03	1.51E-02	--	1.90E-03	--	--
Acrolein	3.69E-03	--	2.93E-02	--	8.43E-04	5.86E-02
Benzene (1,2)	1.22E-02	2.83E-02	--	3.56E-03	--	--
Benzene	3.33E-03	--	2.64E-02	--	7.61E-04	5.29E-02
1,3-Butadiene (1)	4.36E-04	1.01E-03	3.46E-03	1.28E-04	9.95E-05	6.92E-03
Ethylbenzene (1)	3.24E-02	7.54E-02	2.57E-01	9.50E-03	7.41E-03	5.15E-01
Formaldehyde (1,2)	7.19E-01	1.67E+00	--	2.11E-01	--	--
Formaldehyde	3.67E-01	--	2.91E+00	--	8.38E-02	5.83E+00
Hexane	2.59E-01	6.02E-01	2.06E+00	7.59E-02	5.92E-02	4.11E+00
Naphthalene (1)	1.32E-03	3.06E-03	1.05E-02	3.86E-04	3.01E-04	2.09E-02
PAHs: (6)	--	--	--	--	--	--
Anthracene	3.38E-05	7.86E-05	2.68E-04	9.90E-06	7.72E-06	5.37E-04
Benzo(a)anthracene	2.26E-05	5.26E-05	1.79E-04	6.62E-06	5.16E-06	3.59E-04
Benzo(a)pyrene	1.39E-05	3.23E-05	1.10E-04	4.07E-06	3.17E-06	2.21E-04
Benzo(b)fluoranthrene	1.13E-05	2.63E-05	8.97E-05	3.31E-06	2.58E-06	1.79E-04
Benzo(k)fluoranthrene	1.10E-05	2.56E-05	8.73E-05	3.22E-06	2.51E-06	1.75E-04
Chrysene	2.52E-05	5.86E-05	2.00E-04	7.38E-06	5.76E-06	4.00E-04
Dibenz(a,h)anthracene	2.35E-05	5.46E-05	1.87E-04	6.89E-06	5.37E-06	3.73E-04
Indeno(1,2,3-cd)pyrene	2.35E-05	5.46E-05	1.87E-04	6.89E-06	5.37E-06	3.73E-04
Propylene Oxide (1)	2.94E-02	6.83E-02	2.33E-01	8.61E-03	6.71E-03	4.67E-01
Toluene (1)	1.32E-01	3.06E-01	1.05E+00	3.86E-02	3.01E-02	2.09E+00
Xylene (1)	6.49E-02	1.51E-01	5.15E-01	1.90E-02	1.48E-02	1.03E+00
Total HAPs			7.41			14.83

(1) From AP-42 (Table 3.1-3, 4/00 and Table 3.4-1 of the Background Document for Section 3.1). Other emission factors from the CATEF database.

(2) Short-term (1 hour) acrolein, benzene and formaldehyde emission factors are conservatively based on the assumption of no oxidation catalyst to account for early startup hours before the catalyst is fully functional, while long-term (annual) emission factors are reduced to account for oxidation catalyst.

(3) Based on maximum hourly turbine fuel use with duct firing (MMscf/hr) = 2.33

(4) Based on maximum annual turbine fuel use with duct firing (MMscf/yr) = 15,879

(5) Based on 10 ppmv @ 15% O_2 ammonia slip from SCR

(6) Polycyclic aromatic hydrocarbons, excluding naphthalene (treated separately).

Table 6.16-2
Noncriteria Pollutant Emissions from Auxiliary Boiler
Avenal Energy Project

Noncriteria Pollutant	Emission Factor, lb/MMscf (1)	Maximum Hourly Emissions, lb/hr (2)	Annual Emissions, lb/yr (3)	Annual Emissions, ton/yr (3)	Emission Rates for Modeling	
					One-hour Impacts, g/s	Annual Impacts, g/s
Propylene	5.30E-01	1.96E-02	24.4	1.22E-02	2.464E-03	3.510E-04
Hazardous Air Pollutants						
Acetaldehyde	8.9E-03	3.27E-04	0.41	2.04E-04	4.123E-05	5.874E-06
Acrolein	2.70E-03	9.96E-05	0.12	6.22E-05	1.255E-05	1.788E-06
Benzene	4.31E-03	1.59E-04	0.20	9.92E-05	2.003E-05	2.854E-06
Ethylbenzene	6.90E-02	2.55E-03	3.18	1.59E-03	3.207E-04	4.569E-05
Formaldehyde	2.21E-01	8.15E-03	10.2	5.09E-03	1.027E-03	1.463E-04
Hexane	4.6E-03	1.70E-04	0.21	1.06E-04	2.138E-05	3.046E-06
Naphthalene	3.00E-04	1.11E-05	0.01	6.91E-06	1.394E-06	1.987E-07
PAHs (4)	1.00E-04	3.69E-06	0.00	2.30E-06	4.648E-07	6.622E-08
Toluene	2.7E-02	9.78E-04	1.22	6.10E-04	1.232E-04	1.755E-05
Xylene	2.0E-02	7.27E-04	0.91	4.53E-04	9.157E-05	1.305E-05
Total HAPs				8.22E-03		

(1) Acetaldehyde, benzene and formaldehyde from CATEF database. Other factors from Ventura County APCD.
(2) Based on maximum hourly boiler fuel use (MMscf/hr) = 0.037
(3) Based on maximum annual boiler fuel use (MMscf/yr) = 46.04
(4) Polycyclic aromatic hydrocarbons, excluding naphthalene (modeled separately).

Table 6.16-3
Maximum Hourly and Annual Toxic Air Contaminant Emissions for Emergency Standby Generator Internal Reciprocating Engine
Avenal Energy Project

Toxic Air Contaminant	Natural Gas Emission Factor (1)	Maximum			
		Hourly Emissions (2)	Annual Emissions (3)	Hourly Emission Rate	Annual Emission Rate
	lb/MMscf	lbs/hr	tpy	g/sec	g/sec
Propylene	5.38E+00	3.43E-02	8.58E-04	4.32E-03	2.47E-05
Hazardous Air Pollutants					
Acetaldehyde	5.29E-01	3.37E-03	8.43E-05	4.25E-04	2.43E-06
Acrolein	5.90E-02	3.76E-04	9.41E-06	4.74E-05	2.71E-07
Benzene	2.18E-01	1.39E-03	3.48E-05	1.75E-04	1.00E-06
1,3-Butadiene	3.67E-01	2.34E-03	5.85E-05	2.95E-04	1.68E-06
Ethylbenzene	7.11E-02	4.53E-04	1.13E-05	5.71E-05	3.26E-07
Formaldehyde	53.50	3.41E-01	8.53E-03	4.30E-02	2.45E-04
Hexane	1.12E+00	7.17E-03	1.79E-04	9.04E-04	5.16E-06
Naphthalene	2.51E-02	1.60E-04	4.00E-06	2.02E-05	1.15E-07
PAHs (listed individually below)	2.53E-04	1.62E-06	4.04E-08	2.04E-07	1.16E-09
Anthracene	1.19E-04				
Benzo(a)anthracene	5.88E-05				
Benzo(a)pyrene	2.70E-06				
Benzo(b)fluoranthrene	4.09E-05				
Benzo(k)fluoranthrene	7.83E-06				
Chrysene	1.43E-05				
Dibenz(a,h)anthracene	2.70E-06				
Indeno(1,2,3-cd)pyrene	7.17E-06				
Toluene	2.39E-01	1.52E-03	3.81E-05	1.92E-04	1.10E-06
Xylene	6.46E-01	4.12E-03	1.03E-04	5.19E-04	2.96E-06
Total HAPs (tpy) =			9.05E-03		

1) All factors except hexane and formaldehyde are CATEF mean values for natural gas-fired IC engines.
Hexane and formaldehyde are from AP-42 Table 3.2-2 for 4-stroke lean-burn engines.
2) Based on max. ICE firing rate = 0.00638 MMscf/hr natural gas
3) Based on max. ICE firing rate = 0.319 MMscf/yr of natural gas

Table 6.16-4
Calculation of Cancer Risk
Avenal Energy Project

Compound	Annual Average Emissions Per Turbine (g/s)	Derived (OEHHA) Method			Average Point Estimate			High-End Point Estimate			Derived (Adjusted) Method			Worker Exp: Derived (OEHHA) Method		
		Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (2)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (3)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (4)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (5)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (6)
Gas Turbines																
Acetaldehyde	9.26E-03	3.77E-06	3.49E-02	1.33E-02	2.60E-06	2.41E-02	9.19E-03	3.77E-06	3.49E-02	1.33E-02	2.90E-06	2.68E-02	1.03E-02	5.72E-07	5.30E-03	2.02E-03
Benzene	7.61E-04	3.77E-05	2.87E-02	1.09E-02	2.60E-05	1.98E-02	7.55E-03	3.77E-05	2.87E-02	1.09E-02	2.90E-05	2.21E-02	8.42E-03	5.72E-06	4.35E-03	1.66E-03
1,3-Butadiene	9.95E-05	2.26E-04	2.25E-02	8.59E-03	1.56E-04	1.55E-02	5.93E-03	2.26E-04	2.25E-02	8.59E-03	1.74E-04	1.73E-02	6.61E-03	3.43E-05	3.41E-03	1.30E-03
Formaldehyde	8.38E-02	7.91E-06	6.63E-01	2.53E-01	5.46E-06	4.58E-01	1.75E-01	7.91E-06	6.63E-01	2.53E-01	6.08E-06	5.10E-01	1.95E-01	1.20E-06	1.01E-01	3.84E-02
Naphthalene	3.01E-04	4.52E-05	1.36E-02	5.19E-03	3.12E-05	9.39E-03	3.58E-03	4.52E-05	1.36E-02	5.19E-03	3.48E-05	1.05E-02	4.00E-03	6.86E-06	2.06E-03	7.88E-04
PAHs (1)(listed individually below)																
Benzo(a)anthracene	5.16E-06	3.98E-03	2.05E-02	7.84E-03	8.05E-04	4.16E-03	1.59E-03	4.02E-03	2.07E-02	7.92E-03	3.98E-03	2.05E-02	7.84E-03	1.47E-03	7.59E-03	2.90E-03
Benzo(a)pyrene	3.17E-06	3.98E-02	1.26E-01	4.82E-02	8.05E-03	2.56E-02	9.76E-03	4.02E-02	1.28E-01	4.87E-02	3.98E-02	1.26E-01	4.82E-02	1.47E-02	4.67E-02	1.78E-02
Benzo(b)fluoranthrene	2.58E-06	3.98E-03	1.03E-02	3.92E-03	8.05E-04	2.08E-03	7.93E-04	4.02E-03	1.04E-02	3.96E-03	3.98E-03	1.03E-02	3.92E-03	1.47E-03	3.79E-03	1.45E-03
Benzo(k)fluoranthrene	2.51E-06	3.98E-03	1.00E-02	3.82E-03	8.05E-04	2.02E-03	7.72E-04	4.02E-03	1.01E-02	3.86E-03	3.98E-03	1.00E-02	3.82E-03	1.47E-03	3.69E-03	1.41E-03
Chrysene	5.76E-06	3.98E-04	2.29E-03	8.75E-04	8.05E-05	4.63E-04	1.77E-04	4.02E-04	2.31E-03	8.84E-04	3.98E-04	2.29E-03	8.75E-04	1.47E-04	8.46E-04	3.23E-04
Dibenz(a,h)anthracene	5.37E-06	1.43E-02	7.68E-02	2.93E-02	3.47E-03	1.86E-02	7.11E-03	1.48E-02	7.94E-02	3.03E-02	1.43E-02	7.68E-02	2.93E-02	5.17E-03	2.77E-02	1.06E-02
Indeno(1,2,3-cd)pyrene	5.37E-06	3.98E-03	2.14E-02	8.16E-03	8.05E-04	4.32E-03	1.65E-03	4.02E-03	2.16E-02	8.24E-03	3.98E-03	2.14E-02	8.16E-03	1.47E-03	7.89E-03	3.01E-03
Propylene oxide	6.71E-03	4.90E-06	3.29E-02	1.26E-02	3.38E-06	2.27E-02	8.66E-03	4.90E-06	3.29E-02	1.26E-02	3.76E-06	2.52E-02	9.64E-03	7.43E-07	4.99E-03	1.90E-03
			1.06E+00 per $\mu g/m^3$	4.06E-01 in one million (2)		6.06E-01 per $\mu g/m^3$	2.32E-01 in one million (2)		1.07E+00 per $\mu g/m^3$	4.08E-01 in one million (2)		8.79E-01 in one million (2)	3.36E-01 in one million		2.19E-01 per $\mu g/m^3$	8.36E-02 in one million (2)

(1) Maximum unit risk value applied to all PAHs for purposes of this analysis.
(2) Modeled cancer risk.

Compound	Annual Average Emissions (g/s)	Derived (OEHHA) Method			Average Point Estimate			High-End Point Estimate			Derived (Adjusted) Method			Worker Exp: Derived (OEHHA) Method		
		Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (2)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (3)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (4)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (5)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (6)
Auxiliary Boiler																
Propylene	3.51E-04	0	0	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00
Acetaldehyde	5.87E-06	3.77E-06	2.21E-05	1.19E-04	2.60E-06	1.53E-05	8.21E-05	3.77E-06	2.21E-05	1.19E-04	2.90E-06	1.70E-05	9.16E-05	5.72E-07	3.36E-06	1.81E-05
Acrolein	1.79E-06	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00
Benzene	2.85E-06	3.77E-05	1.08E-04	5.79E-04	2.60E-05	7.42E-05	3.99E-04	3.77E-05	1.08E-04	5.79E-04	2.90E-05	8.28E-05	4.45E-04	5.72E-06	1.63E-05	8.78E-05
Ethylbenzene	4.57E-05	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00
Formaldehyde	1.46E-04	7.91E-06	1.16E-03	6.23E-03	5.46E-06	7.99E-04	4.30E-03	7.91E-06	1.16E-03	6.23E-03	6.08E-06	8.90E-04	4.79E-03	1.20E-06	1.76E-04	9.44E-04
Hexane	3.05E-06	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00
Naphthalene	1.99E-07	4.52E-05	8.9796E-06	4.83E-05	3.12E-05	6.20E-06	3.33E-05	4.52E-05	8.98E-06	4.83E-05	3.48E-05	6.91E-06	3.72E-05	6.86E-06	1.36E-06	7.33E-06
Polycyclic Aromatic Hydrocarbons	6.62E-08	3.98E-02	2.64E-03	1.42E-02	8.05E-03	5.33E-04	2.87E-03	4.02E-02	2.66E-03	1.43E-02	3.98E-02	2.64E-03	1.42E-02	1.47E-02	9.73E-04	5.23E-03
Toluene	1.75E-05	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00
Xylene	1.30E-05	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00	0	0	0.00E+00
			3.93E-03 per $\mu g/m^3$	2.12E-02 in one million (2)		1.43E-03 per $\mu g/m^3$	7.68E-03 in one million (2)		3.96E-03 per $\mu g/m^3$	2.13E-02 in one million (2)		3.63E-03 per $\mu g/m^3$	1.95E-02 in one million (2)		1.17E-03 per $\mu g/m^3$	6.29E-03 in one million (2)

Compound	Annual Average Emissions, g/s	Derived (OEHHA) Method			Average Point Estimate			High-End Point Estimate			Derived (Adjusted) Method			Worker Exposure: Derived (OEHHA) Method		
		Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (2)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (3)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (4)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (5)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (6)
Diesel Emergency Fire Water Pump Engine Testing																
Diesel Exhaust Particulate Matter (DPM)	2.69E-05	4.15E-04	1.12E-02 per $\mu g/m^3$	8.02E-02 in one million (2)	2.86E-04	7.70E-03 per $\mu g/m^3$	5.53E-02 in one million (2)	4.15E-04	1.12E-02 per $\mu g/m^3$	8.02E-02 in one million (2)	3.19E-04	8.59E-03 per $\mu g/m^3$	6.16E-02 in one million (2)	6.29E-05	1.69E-03 per $\mu g/m^3$	1.22E-02 in one million (2)

Table 6.16-5
Avenal Energy Project
Calculation of Modeling Inputs and Cancer Risk for the Natural Gas-Fueled Emergency Standby Generator Engine

		Derived (OEHHA) Method			Average Point Estimate			High-End Point Estimate			Derived (Adjusted) Method			Worker Exp: Derived (OEHHA) Method		
Non-Criteria Pollutant	Annual Average Emissions, g/s	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (2)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (3)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk (4)	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk	Unit Risk (per $\mu g/m^3$)	Cancer Risk Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Cancer Risk
Propylene	2.47E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acetaldehyde	2.43E-06	3.77E-06	9.15E-06	6.36E-05	2.60E-06	6.31E-06	4.38E-05	3.77E-06	9.15E-06	2.51E-04	2.90E-06	7.04E-06	4.89E-05	5.72E-07	1.39E-06	9.64E-06
Acrolein	2.71E-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	1.00E-06	3.77E-05	3.77E-05	2.62E-04	2.60E-05	2.60E-05	1.81E-04	3.77E-05	3.77E-05	1.03E-03	2.90E-05	2.90E-05	2.01E-04	5.72E-06	5.72E-06	3.97E-05
1,3-Butadiene	1.68E-06	2.26E-04	3.80E-04	2.64E-03	1.56E-04	2.63E-04	1.82E-03	2.26E-04	3.80E-04	1.04E-02	1.74E-04	2.93E-04	2.03E-03	3.43E-05	5.77E-05	4.01E-04
Ethylbenzene	3.26E-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Formaldehyde	2.45E-04	7.91E-06	1.94E-03	1.35E-02	5.46E-06	1.34E-03	9.31E-03	7.91E-06	1.94E-03	5.33E-02	6.08E-06	1.49E-03	1.04E-02	1.20E-06	2.94E-04	2.05E-03
Hexane	5.16E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Naphthalene	1.15E-07	4.52E-05	5.20E-06	3.62E-05	3.12E-05	3.59E-06	2.50E-05	4.52E-05	5.20E-06	1.43E-04	3.48E-05	4.01E-06	2.78E-05	6.86E-06	7.90E-07	5.49E-06
PAHs (listed individually below) (1)	1.16E-09	8.09E-03	9.40E-06	6.53E-05	8.05E-03	9.36E-06	6.50E-05	4.02E-02	4.67E-05	1.28E-03	3.98E-02	4.63E-05	3.21E-04	1.47E-02	1.71E-05	1.19E-04
Benzo(a)anthracene		*8.09E-04*			*8.05E-04*			*4.02E-03*						*1.47E-03*		
Benzo(a)pyrene		*8.09E-03*			*8.05E-03*			*4.02E-02*						*1.47E-02*		
Benzo(b)fluoranthrene		*8.09E-04*			*8.05E-04*			*4.02E-03*						*1.47E-03*		
Benzo(k)fluoranthrene		*8.09E-04*			*8.05E-04*			*4.02E-03*						*1.47E-03*		
Chrysene		*8.09E-05*			*8.05E-05*			*4.02E-04*						*1.47E-04*		
Dibenz(a,h)anthracene		*3.41E-03*			*3.47E-03*			*1.48E-02*						*5.17E-03*		
Indeno(1,2,3-cd)pyrene		*8.09E-04*			*8.05E-04*			*4.02E-03*						*1.47E-03*		
Toluene	1.10E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Xylene	2.96E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2.38E-03	1.66E-02		1.65E-03	1.15E-02		2.42E-03	6.64E-02		1.87E-03	1.30E-02		3.77E-04	2.62E-03
			per $\mu g/m^3$	in one million		per $\mu g/m^3$	in one million		per $\mu g/m^3$	in one million		per $\mu g/m^3$	in one million		per $\mu g/m^3$	in one million

1) Maximum unit risk value applied to all PAHs for purposes of this analysis.

Table 6.16-6
Calculation of Gas Turbine HHIs
Avenal Energy Project

Compound	Max Hourly Emissions Per Turbine (g/s)	HARP Acute HI (per μg/m^3)	Acute HHI Model Input (g/s per μg/m^3)	Modeled Contribution to Acute HHI	Annual Average Emissions Per Turbine (g/s)	HARP Chronic HI (per μg/m^3)	Chronic HHI Model Input (g/s per μg/m^3)	Modeled Contribution to Chronic HHI
Ammonia	4.4587	3.13E-04	1.40E-03	1.66E-02	3.39E+00	5.00E-03	1.70E-02	6.46E-03
Propylene	0.2259	--	--	--	1.76E-01	3.33E-04	5.86E-05	2.23E-05
Acetaldehyde	1.188E-02	--	--	--	9.26E-03	1.11E-01	1.03E-03	3.91E-04
Acrolein	1.900E-03	5.26E+00	1.00E-02	1.19E-01	8.43E-04	1.67E+01	1.41E-02	5.36E-03
Benzene	3.563E-03	7.69E-04	2.74E-06	3.26E-05	7.61E-04	1.67E-02	1.27E-05	4.84E-06
1,3-Butadiene	1.277E-04	--	--	--	9.95E-05	5.00E-02	4.98E-06	1.89E-06
Ethylbenzene	9.501E-03	--	--	--	7.41E-03	5.00E-04	3.70E-06	1.41E-06
Formaldehyde	2.108E-01	1.06E-02	2.23E-03	2.66E-02	8.38E-02	3.33E-01	2.79E-02	1.06E-02
Hexane	7.589E-02	--	--	--	5.92E-02	1.43E-04	8.46E-06	3.22E-06
Naphthalene	3.860E-04	--	--	--	3.01E-04	1.11E-01	3.34E-05	1.27E-05
PAHs (listed individually below)	4.829E-05	--	--	--	3.76E-05	--	--	--
Benzo(a)anthracene								
Benzo(a)pyrene								
Benzo(b)fluoranthrene								
Benzo(k)fluoranthrene								
Chrysene								
Dibenz(a,h)anthracene								
Indeno(1,2,3-cd)pyrene								
Propylene oxide	8.611E-03	3.23E-04	2.78E-06	3.30E-05	6.71E-03	3.33E-02	2.23E-04	8.51E-05
Toluene	3.860E-02	2.70E-05	1.04E-06	1.24E-05	3.01E-02	3.33E-03	1.00E-04	3.81E-05
Xylene	1.900E-02	4.55E-05	8.65E-07	1.03E-05	1.48E-02	1.43E-03	2.12E-05	8.06E-06
		Total =	1.36E-02	1.62E-01 (1)		Total =	6.04E-02	2.30E-02 (2)

Table 6.16-7
Calculation of HHI Modeling Inputs for Gas Turbines During Commissioning Hours without Oxidation Catalyst
Avenal Energy Project

Compound	Max Hourly Emissions Per Turbine g/s	HARP Acute HI (per $\mu g/m^3$)	Acute HHI Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Acute HHI
Ammonia	4.4587	3.13E-04	1.40E-03	1.66E-02
Acrolein	1.90E-03	5.26E+00	1.00E-02	1.19E-01
Benzene	3.56E-03	7.69E-04	2.74E-06	3.26E-05
Formaldehyde	2.11E-01	1.06E-02	2.23E-03	2.66E-02
Propylene oxide	8.61E-03	3.23E-04	2.78E-06	3.30E-05
Toluene	3.86E-02	2.70E-05	1.04E-06	1.24E-05
Xylene	1.90E-02	4.55E-05	8.65E-07	1.03E-05
		Total =	1.36E-02	1.62E-01 (1)

1) Modeled non-cancer acute HHI from both CTG.

Table 6.16-8
Avenal Energy Project
Calculation of Risk Assessment Modeling Inputs and Results for Auxiliary Boiler and Fire Pump Engine

Non-Criteria Pollutant	Max Hourly Emissions. g/s	HARP Acute HI (per $\mu g/m^3$)	Acute HHI Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Acute HHI	Annual Average Emissions, g/s	HARP Chronic HI (per $\mu g/m^3$)	Chronic HHI Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Chronic HHI
Auxiliary Boiler								
Propylene	2.46E-03	--	--	--	3.51E-04	3.33E-04	1.17E-07	6.33E-07
Acetaldehyde	4.12E-05	--	--		5.87E-06	1.11E-01	6.52E-07	3.53E-06
Acrolein	1.26E-05	5.26E+00	6.60E-05	5.96E-03	1.79E-06	1.67E+01	2.99E-05	1.62E-04
Benzene	2.00E-05	7.69E-04	1.54E-08	1.39E-06	2.85E-06	1.67E-02	4.77E-08	2.58E-07
Ethylbenzene	3.21E-04	--	--		4.57E-05	5.00E-04	2.28E-08	1.24E-07
Formaldehyde	1.03E-03	1.06E-02	1.09E-05	9.84E-04	1.46E-04	3.33E-01	4.87E-05	2.64E-04
Hexane	2.14E-05	--	--	--	3.05E-06	1.43E-04	4.36E-10	2.36E-09
Naphthalene	1.39E-06	--	--	--	1.99E-07	1.11E-01	2.21E-08	1.19E-07
Polycyclic Aromatic Hydrocarbons	4.65E-07	--	--	--	6.62E-08	--	--	--
Toluene	1.23E-04	2.70E-05	3.33E-09	3.00E-07	1.75E-05	3.33E-03	5.84E-08	3.16E-07
Xylene	9.16E-05	4.55E-05	4.17E-09	3.76E-07	1.30E-05	1.43E-03	1.87E-08	1.01E-07
		Total =	7.69E-05	6.95E-03 (1)		Total =	7.94E-05	4.30E-04 (2)
Emergency Standby Fire Water Pump Engine								
Particulate Emissions from Diesel-Fueled Engines	4.72E-03	n/a	n/a	n/a	2.69E-05	0.2	5.39E-06	4.00E-05
						Total =	5.39E-06	4.00E-05 (3)

1) Modeled non-cancer acute HHI from the auxiliary boiler.
2) Modeled non-cancer chronic HHI from the auxiliary boiler.
3) Modeled non-cancer chronic HHI from the emergency standby fire water pump engine.

Table 6.16-9
Avenal Energy Project
Calculation of Risk Assessment Modeling Inputs and Results for the Natural Gas-Fueled Emergency Standby Generator Engine

Toxic Air Contaminant	Max Hourly Emissions. g/s	HARP Acute HI (per $\mu g/m^3$)	Acute HHI Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Acute HHI	Annual Average Emissions, g/s	HARP Chronic HI (per $\mu g/m^3$)	Chronic HHI Model Input (g/s per $\mu g/m^3$)	Modeled Contribution to Chronic HHI
Emergency Standby Generator Engine								
Propylene	4.32E-03	--	--	--	2.47E-05	3.33E-04	8.22E-09	5.69E-08
Acetaldehyde	4.25E-04	--	--		2.43E-06	1.11E-01	2.69E-07	1.87E-06
Acrolein	4.74E-05	5.26E+00	2.49E-04	6.42E-02	2.71E-07	1.67E+01	4.52E-06	3.13E-05
Benzene	1.75E-04	7.69E-04	1.35E-07	3.47E-05	1.00E-06	1.67E-02	1.67E-08	1.16E-07
1,3-Butadiene	2.95E-04	--	--	--	1.68E-06	5.00E-02	8.42E-08	5.83E-07
Ethylbenzene	5.71E-05	--	--		3.26E-07	5.00E-04	1.63E-10	1.13E-09
Formaldehyde	4.30E-02	1.06E-02	4.56E-04	1.17E-01	2.45E-04	3.33E-01	8.17E-05	5.66E-04
Hexane	9.04E-04	--	--	--	5.16E-06	1.43E-04	7.38E-10	5.11E-09
Naphthalene	2.02E-05	--	--	--	1.15E-07	1.11E-01	1.28E-08	8.85E-08
Polycyclic Aromatic Hydrocarbons	2.04E-07	--	--	--	1.16E-09	--	--	--
Toluene	1.92E-04	2.70E-05	5.19E-09	1.33E-06	1.10E-06	3.33E-03	3.65E-09	2.53E-08
Xylene	5.19E-04	4.55E-05	2.36E-08	6.08E-06	2.96E-06	1.43E-03	4.24E-09	2.93E-08
		Total =	7.05E-04	1.82E-01 (1)		Total =	8.66E-05	6.00E-04 (2)

1) Modeled non-cancer acute HHI from the emergency standby generator engine.
2) Modeled non-cancer chronic HHI from the emergency standby generator engine.

Table 6.16-10
Summary of Modeling Inputs
Avenal Energy Project

Emitting Unit	Derived (OEHHA) Method Cancer Risk Model Input (Res)	Average Point Estimate Cancer Risk Model Input (Res)	High-end Point Estimate Cancer Risk Model Input (Res)	Derived (Adjusted) Method Cancer Risk Model Input (Res)	Derived (OEHHA) Method Cancer Risk Model Input (Worker)	Acute HHI Model Input	Chronic HHI Model Input
Turbine acute HHI wo ox cat	--	--	--	--	--	1.363E-02	--
Each Turbine	1.063E+00	6.063E-01	1.068E+00	8.791E-01	2.189E-01	1.363E-02	6.044E-02
Auxiliary Boiler	3.932E-03	1.428E-03	3.958E-03	3.632E-03	1.170E-03	7.693E-05	7.942E-05
Emergency Standby Generator Engine	2.383E-03	1.648E-03	6.642E-02	1.871E-03	3.772E-04	7.053E-04	8.663E-05
Emergency Standby Fire Water Pump Engine	1.118E-02	7.705E-03	1.118E-02	8.594E-03	1.695E-03	--	5.388E-06

All modeling input values are in units of g/s per $\mu g/m^3$

Table 6.16-11
Calculation of Construction Cancer Risk
Avenal Energy Project

	HRA Method:	Derived (OEHHA) Method		Average Point Estimate		High-End Point Estimate		Derived (Adjusted) Method		Worker Exposure: Derived (OEHHA) Method	
Toxic Air Contaminant	Maximum Annual Average Concentration (µg/m3)	Unit Risk (per µg/m^3)	Cancer Risk (in one million)	Unit Risk (per µg/m^3)	Cancer Risk (in one million)	Unit Risk (per µg/m^3)	Cancer Risk (in one million)	Unit Risk (per µg/m^3)	Cancer Risk (in one million)	Unit Risk (per µg/m^3)	Cancer Risk (in one million)
Construction Equipment Diesel Engine Exhaust											
Diesel Exhaust Particulate Matter (DPM)	0.067	4.15E-04	3.6 (1)	2.86E-04	2.5 (1)	4.15E-04	3.6 (1)	3.19E-04	2.7 (1)	6.29E-05	0.94 (1)
			0.9 (2)		0.6 (2)		0.9 (2)		0.7 (2)		0.2 (2)

1) The 70-year cancer risk is reduced by the ratio 9/70 to recognize the smaller impact of the temporary 27-month construction period, following guidance in OEHHA (2003).

2) The 70-year cancer risk is reduced by the ratio (27/12)/70 to recognize the smaller impact of the temporary 27-month construction period.