Throughout this Application, all references to Federal Power, Federal Power Avenal, LLC, and Federal Power Avenal refer to Avenal Power Center, LLC.

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6.16 PUBLIC HEALTH

This section presents the methodology and results of a human health risk assessment performed to assess potential impacts and public exposure associated with airborne emissions from the construction and operation of the Avenal Energy Project (Project). Section 6.16.1 introduces the subject of public health impact analysis for a power plant proposed in a California Energy Commission (CEC) Application for Certification (AFC). Section 6.16.2 describes the laws, ordinances, regulations and standards (LORS) relevant to potential public health impacts of such a project. Section 6.16.3 describes the potentially affected public health environment around the proposed project site. Section 6.16.4 discusses the environmental impacts from construction and operation of the power plant and associated facilities.

This public health section also describes project design features that keep potential impacts below public health-related thresholds of significance (e.g., the sole use of clean-burning natural gas in the gas turbines). This clean fuel, along with other design and operating aspects, will assure that the public health impacts of the Project will be below the level of significance. As discussed in Section 6.15, Hazardous Materials Handling, multiple design features will be implemented in the project to assure that potential public health impacts of a hypothetical accidental release of aqueous ammonia will also be kept below a level of public health-related significance. Section 6.16.5 discusses potential cumulative public health impacts of the combined toxic air contaminant[1] (TAC) emissions from the Project, and other projects, if any, in the process of obtaining Authority to Construct permits or reasonably known by the San Joaquin Valley Air Pollution Control District (SJVAPCD or District) to be entering the permitting process. Section 6.16.6 discusses mitigation measures as may be needed to reduce potentially significant impacts below a level of significance. Section 6.16.7 discusses the agencies involved in public health aspects of permitting and CEQA analysis for the proposed project, along with agency contact information. Section 6.16.8 describes public health-related permits for the Project, and the schedule of obtaining those permits. Finally, Section 6.16.9 contains references cited or consulted in preparing this section.

6.16.1 INTRODUCTION

Air will be the dominant pathway for potential public exposure to non-criteria pollutants released by the Project. Emissions to the air will consist primarily of combustion by-products produced by the combined-cycle gas turbine units. Potential health risks from combustion emissions will

[1] Also called non-criteria pollutants.

occur almost entirely by direct inhalation. To be conservative, additional pathways for dermal absorption, soil ingestion, and mother's milk ingestion were included in the health risk modeling. The health risk assessment methodology was conducted in accordance with guidance established by the California Office of Environmental Health Hazard Assessment (OEHHA),[2] the California Air Resources Board (CARB),[3] and the SJVAPCD.[4]

The Project will use combined-cycle technology to minimize emissions of pollutants per unit of electric energy generated, and use an optimized stack height to reduce ground-level concentrations of the emissions, thus reducing potential effects on public health. It is beyond the scope of this analysis to describe the public health benefits that derive from the generated electric power that is provided to homes, businesses, hospitals, and other societal institutions.
Combustion byproducts with established national and California ambient air quality standards (referred to as "criteria pollutants") are addressed in Section 6.2, Air Quality. Discussion of the potential health risks associated with these criteria pollutants is presented in this section. Human health risks potentially associated with accidental releases of stored hazardous materials at the Avenal Energy Project (aqueous ammonia) are discussed in Section 6.15, Hazardous Materials Handling.

6.16.2 LAWS, ORDINANCES, REGULATIONS AND STANDARDS

An overview of the regulatory process for public health issues is presented in this section. The relevant LORS that affect public health and are applicable to the Project are identified in Table 6.16-1. The compliance of the project with each of the LORS applicable to public health is also presented in this table.

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[2] OEHHA. Air Toxics Hot Spots Program Risk Assessment Guidelines, The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments, April 2005.
[3] CARB. Consolidated Table of OEHHA/ARB-Approved Risk Assessment Health Values, April 25, 2005, http://www.arb.ca.gov/toxics/healthval/healthval.htm.
[4] San Joaquin Valley Unified Air Pollution Control District (SJVAPCD). *Risk Management Policy for Permitting New and Modified Sources.* March 2, 2001, and SJVAPCD. *Guidance for Air Dispersion Modeling, draft Version 1.2,* August 2006.

**TABLE 6.16-1
LAWS, ORDINANCES, REGULATIONS, AND STANDARDS
APPLICABLE TO PUBLIC HEALTH**

LORS	REQUIREMENTS/ APPLICABILITY	ADMINISTERING AGENCY	AFC SECTION EXPLAINING CONFORMANCE
Clean Air Act	Protect public health by limiting emissions and resulting exposure to air pollutants	U.S. Environmental Protection Agency (USEPA) Region 9 ARB SJVAPCD	Emissions of criteria pollutants will be minimized by using efficient combined-cycle turbine technology and natural gas as the only fuel, and applying BACT to the facility, resulting in project ambient levels that would not exceed primary ambient air quality standards established to protect public health. Public health is protected, as demonstrated by the acceptable impacts shown in Section 6.16.4.
Health and Safety Code 25249.5 et seq. (Safe Drinking Water and Toxic Enforcement Act of 1986—Proposition 65)	Inform public at a facility of potential exposure to chemicals known to cause cancer or reproductive toxicity	OEHHA	Based on a health risk assessment that follows ARB/OEHHA and SJVAPCD guidelines, non-criteria pollutant emission rates and resulting doses and carcinogenic risks (see Section 6.16.4) will not exceed thresholds that require Proposition 65 exposure warnings.
40 CFR Part 68 (Risk Management Plan)	Public exposure to acutely hazardous materials	USEPA Region 9 Kings County Department of Public Health, Environmental Health Services	As discussed in Section 6.15, Hazardous Materials Handling, an offsite consequence analysis has been performed to assess potential risks from a spill or rupture of the aqueous ammonia storage tank. A Risk Management Plan (RMP) will be prepared prior to commencement of facility operations.
Health and Safety Code, Article 2, Chapter 6.95, Sections 25531 to 25541; CCR Title 19 (Public Safety), Division 2 (Office of Emergency Services), Chapter 4.5 (California Accidental Release Prevention Program)	Public exposure to regulated substances	Kings County Department of Public Health, Environmental Health Services	As discussed in Section 6.15, Hazardous Materials Handling, an offsite consequence analysis has been performed to assess potential risks from a spill or rupture of the aqueous ammonia storage tank. A RMP will be prepared prior to commencement of facility operations.
Health and Safety Code Sections 44360 to 44366 (Air Toxics "Hot Spots" Information and Assessment Act—AB 2588)	Limit public exposure to toxic air contaminants based on a priority rating system.	SJVAPCD ARB	Non-criteria pollutant concentrations will not exceed acceptable levels, based on the emission inventory for the Project, and maximum potential health impacts in Table 6.16-7.

6.16.3 EXISTING CONDITIONS

Because health risks from operation of the Project will be below public health significance criteria thresholds, no residential, workplace, or sensitive receptors will be impacted. Sensitive receptors are locations where groups of individuals—including infants, children, the elderly and chronically ill—that may be more susceptible than the general population to health risks from air pollution may be found. Schools, day-care facilities, convalescent homes, and hospitals are of particular concern. In accordance with guidance from the CEC[5] a search was conducted for sensitive receptors within 3 miles of the project site.[6] The search revealed none. Sensitive receptors nearest the Project are located in the main part of the City of Avenal, at a distance of more than 6 miles to the southwest (see Figure 6.16-1). Residential receptors exist within 3 miles as shown in Figure 6.16-2, and their coordinates are listed in Table 6.16-2.

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[5] Personal communication from Michael Ringer, CEC staff to Eric Walther, January 29, 1999.
[6] The SJVAPCD requires identification of sensitive receptors from within the closer distance of 2 km. SJVAPCD. *Guidance for Air Dispersion Modeling,* Version 1.2, August 2006.

FIGURE 6.16-1
OFFSITE SENSITIVE RECEPTORS AND PROJECT LOCATION

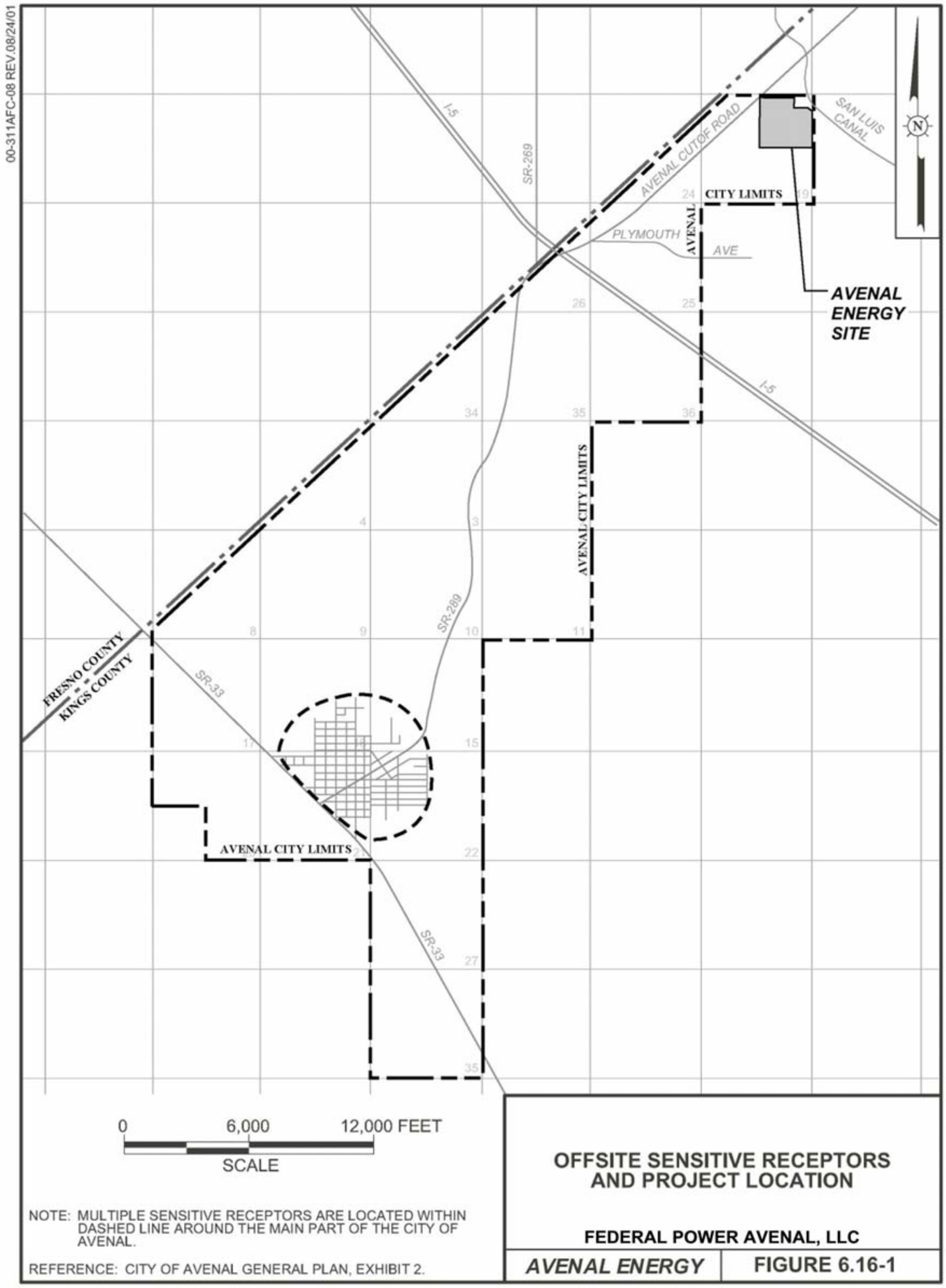

FIGURE 6.16-2
OFFSITE RESIDENTIAL RECEPTORS

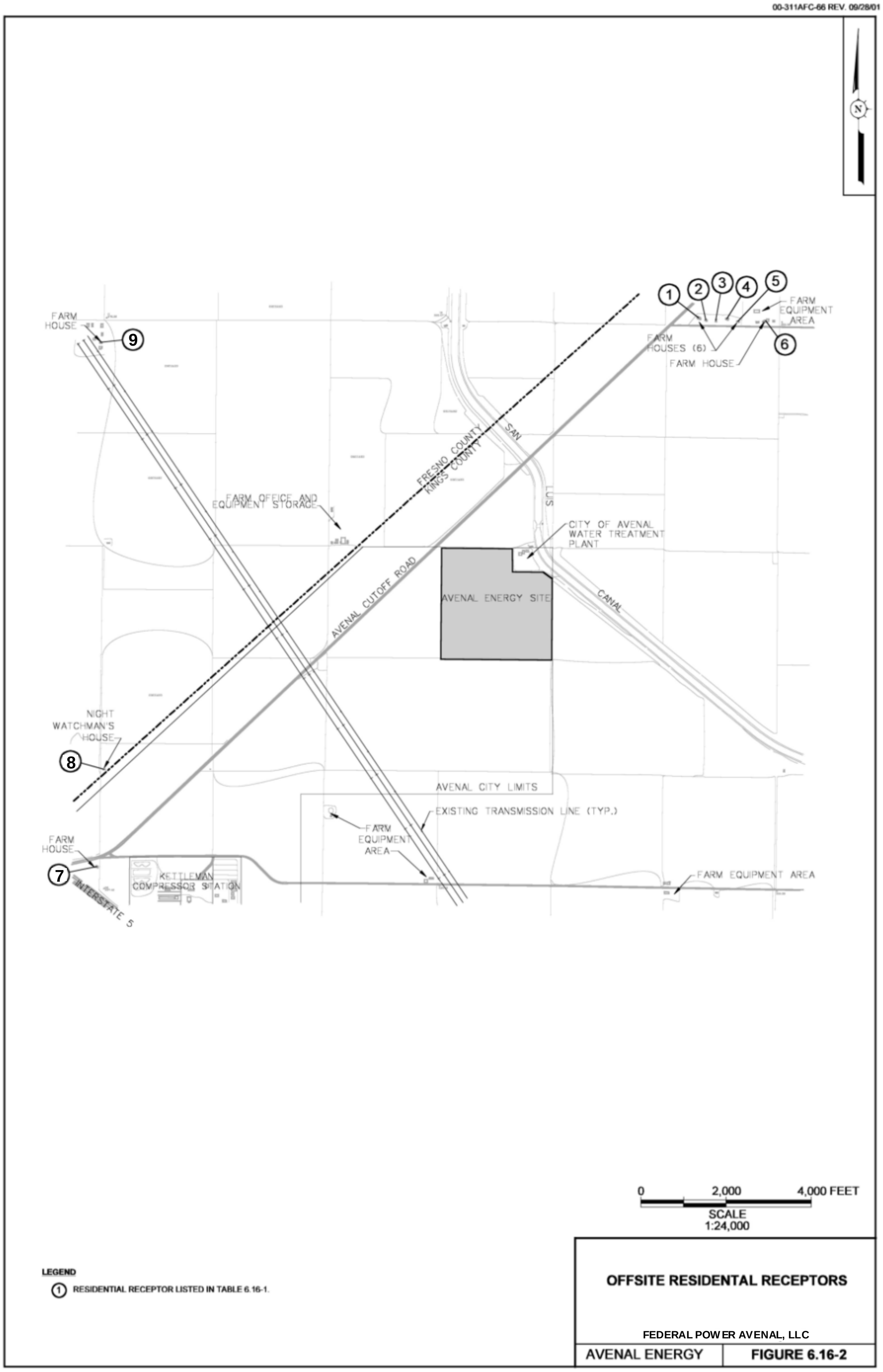

TABLE 6.16-2
OFFSITE RESIDENTIAL AND SENSITIVE RECEPTORS AND THEIR COORDINATES

NO.	RECEPTOR/TYPE	UTM (E)(1)	UTM (N)(2)	DISTANCE FROM CTG STACKS (feet)(3)	REFERENCE FIGURE
1	Residence	765,878	4,000,111	7,700	6.16-2
2	Residence	765,932	4,000,097	7,800	
3	Residence	766,003	4,000,098	7,900	
4	Residence	766,082	4,000,112	8,100	
5	Residence	766,161	4,000,097	8,200	
6	Residence	766,342	4,000,128	8,600	
7	Residence	761,603	3,999,759	11,900	
8	Residence	761,749	3,996,700	10,800	
9	Residence	761,603	3,999,759	11,800	
-	Sensitive	Throughout main part of city		> 6 miles	6.16-1

(1) UTM (E) = Universal Transverse Mercator, east in NAD 83.
(2) UTM (N) = Universal Transverse Mercator, north in NAD 83.
(3) Distance between center of receptor property and a point centered between the two stacks of the combined-cycle combustion gas turbines, rounded to the nearest 100 feet.

Beneficial aspects of the Project regarding protection of public health include the following:

- Use of clean-burning natural gas fuel.
- Low-sulfur content of the natural gas, which reduces sulfate fine particulate generation.
- Advanced combined-cycle combustion gas turbine technology to minimize the amount of fuel and associated combustion emissions needed to produce electricity.
- Selective Catalytic Reduction (SCR) technology to control nitrogen oxide (NO_x) emissions.
- Oxidation catalyst technology to control carbon monoxide (CO) emissions, and to reduce emissions of specific TACs (acrolein, benzene, and formaldehyde).
- Optimized stack height to reduce ground-level concentrations of exhaust pollutants below public health-related significance thresholds.

Air quality and health risk data presented by the ARB in the 2007 Almanac of Emissions and Air Quality for the San Joaquin Valley Air Basin (Basin) show that over the period 1990 through 2005, the average concentrations for the top ten TACs have been substantially reduced, and the associated health risks for the Basin are showing a steady downward trend as well. ARB-estimated emissions inventory values for the top ten TACs for 2006 and ambient levels and associated potential risks for 2005 are presented in Table 6.16-3 for the Basin.

TABLE 6.16-3
TOP TEN TACS EMITTED BY ALL SOURCES IN THE SAN JOAQUIN VALLEY AIR BASIN

TAC	2006 EMISSIONS (TONS/YEAR)	2005 LEVELS AND RISKS	
		CONCENTRATION (PPBV)	POTENTIAL CARCINOGENIC RISK (IN 1 MILLION)
Acetaldehyde	1,761	1.42	7
Benzene	1,789	0.37	35
1,3-Butadiene	503	0.082	31
Carbon tetrachloride	0	0.097 (2003)	26 (2003)
Chromium, hexavalent	0.22	0.076 ng/m^3	11
Para-Dichlorobenzene	147	0.15	10
Formaldehyde	4,396	2.5	19
Methylene chloride	429	0.12	<1
Perchloroethylene	588	0.032	1
Diesel PM	7,695	1.3 μg/m^3 (2000)	390 (2000)

Source: ARB. The California Almanac of Emissions and Air Quality, 2007 Edition, Chapter 5, Tables 5-45 through 5-54, pp. 5-62 through 5-66http://www.arb.ca.gov/aqd/almanac/almanac07/almanac2007all.pdf

μg/m^3 = micrograms per cubic meter
ng/m^3 = nanograms per cubic meter
ppbv = parts per billion by volume

Concerning the current incidence of cancer and respiratory illnesses and diseases within six miles[7] of the project, the Kings County Department of Public offers no relevant information. Essentially the only population within six miles of the Project is limited to the nine residences identified in Table 6.16-2 and Figure 6.16-2.

6.16.4 ENVIRONMENTAL ANALYSIS

This section is organized to discuss the sources and different kinds of air emissions associated with construction and operation of the Project (see Section 6.2, Air Quality), the methodology used in health risk assessment, and the results of the assessment of potential health risks from the project. Other potential public health risks associated with the project are discussed in different sections of the AFC as follows:

[7] Defined in the CEC Data Adequacy Worksheet for public health as a distance of six miles.

- Potential exposure to wastes generated by the project is discussed in Section 6.14, Waste Management.
- Potential exposure to the hypothetical accidental release of aqueous ammonia onsite or during offsite transport is discussed in Section 6.15, Hazardous Materials Handling.
- Potential safety and health impacts relative to the work environment of project employees are discussed in Section 6.17, Worker Health and Safety.
- Potential exposure to transmission line electric and magnetic fields is discussed in Section 6.18, Transmission System Safety and Nuisance.

Project emissions to the air will consist of combustion by-products from operation of the natural gas-fired turbines and auxiliary boiler, and from routine testing and maintenance of the emergency standby natural gas-fired generator engine and Diesel-fueled fire water pump engine. After dispersion to ground-level, inhalation is the main pathway by which air pollutants can potentially cause public health impacts. Other pathways, including ingestion of soil and mother's milk, and dermal absorption, also are evaluated for potential exposure. As discussed below, the resulting health impacts are not significant.

To evaluate potential health impacts, the measures of these impacts are first described in terms of the types of public health impacts and the significance criteria and thresholds for those impacts.

6.16.4.1 Significance Criteria

Significance criteria exist for both cancer risk and non-cancer impacts, and are discussed separately.

6.16.4.1.1 Cancer Risk

Cancer risk is the probability or chance of contracting cancer over a human life span (assumed to be 70 years). Carcinogens (cancer-causing chemicals) are assumed to have no threshold below which there would be no human health impact. In other words, any exposure to a carcinogen is assumed to have some probability of causing cancer; the lower the exposure, the lower the cancer risk (i.e., a linear, no-threshold model). Under state regulations, an incremental cancer risk greater than 10-in-one million due to a project is considered to be a significant impact on public health if the emitting units are determined by the District to be using Toxics Best Available Control Technology (T-BACT).[8] The 10-in-one-million risk level is also used by the Air Toxics "Hot Spots" (AB 2588) program and California's Proposition 65 as the public notification level for air toxic emissions from existing sources.

[8] The threshold would be 1-in-one-million if the emitting units were determined not to be applying T-BACT.

6.16.4.1.2 Non-Cancer Impacts

Non-cancer health effects can be either long-term (chronic) or short-term (acute). In determining potential non-cancer health impacts from air toxics, it is assumed there is a dose of the TAC below which there would be no impact on human health. The air concentration corresponding to this dose is called the Reference Exposure Level (REL). A non-cancer health impact is measured in terms of a health hazard quotient, which is the calculated maximum exposure (concentration) of each TAC divided by its REL. Health hazard quotients for TACs affecting the same target organ are typically summed with the resulting totals expressed as health hazard indices for each organ system. A health hazard index of less than 1.0 is considered to be a less-than-significant health impact.

Chronic toxicity is defined as adverse health effects from prolonged chemical exposure, caused by chemicals accumulating in the body. Because chemical accumulation to toxic levels typically occurs slowly, symptoms of chronic effects usually do not appear until long after exposure commences. The lowest no-effect chronic exposure level for a non-carcinogenic air toxic is the chronic REL. Below this threshold, the body is capable of eliminating or detoxifying the chemical rapidly enough to prevent its accumulation. The chronic health hazard index is calculated as the sum of chronic health hazard quotients, each of which is equal to the annual concentration of the TAC divided by the acute REL.

Acute toxicity is defined as adverse health effects caused by a brief chemical exposure of no more than 24 hours. For most chemicals, the air concentration required to produce acute effects is higher than the level required to produce chronic effects because the duration of exposure is shorter. The maximum one-hour average concentration of each TAC with acute health effects is divided by the TAC's acute REL to obtain the health hazard quotient for health effects caused by relatively high, short-term exposure to air toxics. Although acutely toxic chemicals have identified target organs, acute toxicity is predominantly manifested in the upper respiratory system at threshold exposures. Hence, all acute health hazard quotients for the various target organs are conservatively summed to calculate the acute health hazard index. This method leads to an upper bound assessment. RELs used in the health hazard index calculations were those published in the CARB/OEHHA listings dated April 25, 2005.[9]

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[9] ARB. *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values,* April 25, 2005,

6.16.4.2 Construction Impacts

Construction of the Project is expected to take 27 months. Strict construction practices that incorporate safety and compliance with applicable LORS will be followed. In addition, mitigation measures to reduce air emissions from construction impacts will be implemented as described in Section 6.2.

Temporary air emissions from construction are presented in detail in Appendix 6.2-3, followed by a criteria pollutant air dispersion analysis that demonstrates ambient air quality standards will not be exceeded. The dominant emission with potential health impact is Diesel particulate matter (DPM) from combustion of Diesel fuel in construction equipment (e.g., cranes, dozers, excavators, graders, front-end loaders, backhoes). DPM emissions from construction are summarized in Table 6.16-4.

TABLE 6.16-4
MAXIMUM CONSTRUCTION DPM EMISSIONS

EMITTING ACTIVITY	LBS/DAY	TONS PER YEAR
Construction Equipment	7.7	0.66

The HRA calculations in Appendix Table 6.16-11 demonstrate that the maximum potential cancer risk of DPM emissions during project construction will be less than the significance threshold of 10 in one million, based on adjusting the 70-year lifetime risk for the 25-month duration of construction. If the 70-year lifetime risk is adjusted for a period of 9 years, following OEHHA (2003) guidance, the resulting maximum cancer risk would be 3.6 in one million, still below the 10 in one million significance level. The area of potential impact between 1 and 3.6 in one million extends less than 1,000 feet out from the project south property line, which is unoccupied agricultural land (see Figure 1.5-3A).

Ambient air modeling for PM_{10}, CO, SO_2 and NO_X was performed as described in Section 6.2.5.3 and Appendix 6.2-3. Construction-related emissions are temporary and localized, resulting in no long-term significant impacts to the public.

Small quantities of hazardous waste may be generated during the life of the project. Hazardous waste management plans will be in place so the potential for public exposure is minimal. Refer to Section 6.14, Waste Management, for more information. No acutely hazardous materials will be used or stored on-site during construction (see Section 6.15, Hazardous Materials Handling).

To assure worker safety during construction, safe work practices will be followed (see Section 6.17, Worker Health and Safety).

6.16.4.3 Operations Impacts

Potential human health impacts associated with the Project stem from exposure to air emissions from operation of the natural gas-fired combined-cycle turbines, duct burners, auxiliary boiler, and routine testing of the natural gas-fired emergency standby generator engine and Diesel fuel-fired emergency standby fire water pump engine. The non-criteria pollutants emitted from the project include certain volatile organic compounds and polycyclic aromatic hydrocarbons (PAHs) from the combustion of natural gas, ammonia from the SCR NO_x control systems, and DPM from combustion of Diesel fuel in the emergency standby fire water pump engine. These pollutants are listed in Table 6.16-5, and the detailed emission summaries and calculations are presented in Appendix 6.16.

Emissions of criteria pollutants will not cause violations of the national or California ambient air quality standards as discussed in Section 6.2, Air Quality. The project will include Best Available Control Technology (BACT) as required under SJVAPCD rules.

Air dispersion modeling results (see Section 6.2.5) show that emissions will not result in ambient concentrations of criteria pollutants that exceed ambient air quality standards, with the exception of the state and federal PM_{10} and $PM_{2.5}$ standards. For these pollutants, existing 24-hour average PM_{10} background concentrations and PM_{10} and $PM_{2.5}$ annual background concentrations already exceed state standards, while the project would not add a significant contribution. These standards are intended to protect the general public with a wide margin of safety. Therefore, the project will not have a significant impact on public health from emissions of criteria pollutants.

TABLE 6.16-5
POLLUTANTS EMITTED TO THE AIR FROM THE CECP

Criteria Pollutants	**Non-criteria Pollutants (Continued)**
Carbon monoxide	Formaldehyde
Oxides of nitrogen	Hexane
Particulate matter	Naphthalene
Oxides of sulfur	Propylene
Volatile organic compounds	Propylene oxide
	Toluene
Non-criteria (Toxic) Pollutants	Xylene
Ammonia	Hexane
Acetaldehyde	PAHs
Acrolein	Benzo(α)anthracene
1,3-Butadiene	Benzo(α)pyrene
Benzene	Benzo(β)fluoranthene
Dichlorobenzene	Benzo(k)fluoranthene
Diesel Exhaust Particulate Matter	Chrysene
Ethylbenzene	Dibenz(a,h)anthracene
	Indeno(1,2,3-cd)pyrene

6.16.4.4 Public Health Impact Study Methods

Emissions of non-criteria pollutants from the project were estimated using emission factors approved by the SJVAPCD, ARB, and USEPA. Air dispersion modeling combined the emissions with site-specific terrain and meteorological conditions to estimate short-term and long-term arithmetic mean concentrations in air for use in the health risk assessment. The USEPA-recommended air dispersion model, AERMOD, was used along with five years (2000–2004) of compatible meteorological data assembled and provided by the SJVAPCD. The meteorological data combined surface measurements made at Hanford, CA with upper air data from Oakland International Airport. The health risk assessment has been prepared using the ARB's Hotspots Analysis and Reporting Program (HARP) computer program (Version 1.3), and associated guidance.[10] Because HARP is built on a previous EPA-approved air dispersion model, Industrial Source Complex Short Term, Version 3 (ISCST3), a special method was used

[10] OEHHA. Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments, August 2003; and SDAPCD. Supplemental Guidelines for Submission of Air Toxics "Hot Spots" Program Health Risk Assessments (HRAs), March 2005.

to integrate the air dispersion modeling output from the required air dispersion model, AERMOD, with the risk calculations in the HARP risk module. The following paragraphs describe the procedures used to prepare this health risk assessment.

6.16.4.4.1 Modeling Inputs

The risk assessment module of the HARP model was run using unit ground level impacts to obtain derived cancer risks for each TAC.[11] Cancer risks were obtained for the Derived (OEHHA) Method (for residential and worker exposures), the Derived (Adjusted) Method, Average (Mean) Point Estimate, and High-End Point Estimate options. Only the Derived (OEHHA) Method is used to determine compliance with SJVAPCD requirements. The HARP model output was maximum potential lifetime (70 years for residential and 40 years for worker) cancer risk by pollutant and route for each type of analysis, based on an exposure of 1.0 µg/m3. Individual cancer risks are expressed in units of risk per µg/m3 of exposure.

To calculate the weighted risk for each source, the annual average emission rate in g/s for each pollutant was multiplied by the individual cancer risk for that pollutant in (µg/m3)-1. The resulting weighted cancer risks for each pollutant were then summed for the source (see Appendix 6.16 Tables 6.16-4 and 6.16-5). An identical approach was used to determine the non-cancer acute and chronic health impacts associated with the project (see Appendix 6.16 Tables 6.16-6 through 6.16-9).

6.16.4.4.2 Risk Analysis Method

The screening analysis for the criteria pollutant modeling analysis was performed using the AERMOD model, the 2000 through 2004 Hanford meteorological data, specific receptor grids, and the stack parameters for operating cases at three different ambient temperatures. The results of the screening modeling analysis (see Air Quality Section 6.2.5.1.2) were used to determine the maximum impact operating conditions in modeling the annual and 1-hour averaging periods, which are the averaging periods used in calculating the maximum potential cancer risk and non-cancer chronic health hazard index, and non-cancer acute health hazard index, respectively. The total weighted risk “rate” for each source was used in place of emission rates in the modeling analysis. The weighted risk “rates” used as inputs for the HRA modeling are summarized in Appendix Table 6.16-10. The value calculated by the model was the total health impact at each receptor.

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[11] 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.

The contribution of each toxic compound to total cancer risk and total non-cancer chronic and acute health hazard index for each analysis method was then determined using the individual contribution of each compound to the total weighted risk "rate" (see Appendix Tables 6.16-4 through 6.16-9). Health impacts associated with the estimated concentrations of pollutants in air were characterized in terms of maximum potential lifetime cancer risk (for carcinogenic substances), or non-cancer chronic and acute health hazard indices (for non-carcinogenic substances).

Health impacts were evaluated for a hypothetical maximum exposed individual (MEI) located at the Point of Maximum Impact (PMI). Health impacts associated with emissions from the project are unlikely to be higher at any other location than at the PMI. If there is no significant impact associated with concentrations in air at the PMI location, it is assumed to be unlikely that there would be significant impacts at any other location. The Maximally Exposed Individual Resident (MEIR) is an individual assumed to be located at the MEIR point (i.e., a residential receptor) where the highest concentrations of air pollutants associated with facility emissions are predicted to occur, based on air dispersion modeling.

Health risks potentially associated with concentrations of carcinogenic pollutants in air were calculated as estimated lifetime cancer risks. The inhalation cancer risk associated with the project is calculated by the software from the ground-level concentration and inhalation cancer potency slope as follows:

$$CR_{ij} = CONC_{ij} * ICPF_i * BR$$

where: CR_{ij} = cancer risk from carcinogen i at location j

$CONC_{ij}$ = ground-level concentration (in $\mu g/m^3$) of carcinogen i at location j

$ICPF_i$ = inhalation cancer potency factor for carcinogen i (in kg-day/mg)

BR = breathing rate (in L/kg-day)

The total carcinogenic risk at location j is found by summing the contributions from each carcinogen i. The resulting CR_j can be plotted over all calculated locations.

Evaluation of potential non-cancer health impacts from exposure to short-term and long-term concentrations in air was performed by comparing modeled concentrations in air with the RELs.

An REL is a concentration in air at or below which no adverse health effects are anticipated. RELs are based on the most sensitive adverse effects reported in the medical and toxicological literature. Potential non-cancer effects were evaluated by calculating a ratio of the modeled concentration in air and the REL. This ratio is referred to as a hazard quotient for each compound having non-cancer health effects. The inhalation cancer potency factors and RELs (see Table 6.16-6) used to characterize health risks associated with modeled concentrations in air are imbedded in the risk module of HARP and published in the *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values* (ARB, 4/05).

TABLE 6.16-6
TOXICITY VALUES USED TO CHARACTERIZE HEALTH IMPACTS

TOXIC AIR CONTAMINANT	INHALATION CANCER POTENCY FACTOR $(mg/kg\text{-}d)^{-1}$	CHRONIC REFERENCE EXPOSURE LEVEL $(\mu g/m^3)$	ACUTE REFERENCE EXPOSURE LEVEL $(\mu g/m^3)$
Acetaldehyde	0.010	9.00	—
Acrolein	—	0.06	0.19
Ammonia	—	200	3,200
Benzene	0.10	60	1,300
1,3-Butadiene	0.60	20	—
Diesel PM	1.1	5.0	—
Ethylbenzene	—	2,000	—
Formaldehyde	0.021	3.0	94
Hexane	—	7,000	—
Naphthalene	0.12	9.0	—
PAHs (as BaP for HRA)	3.9	—	—
Propylene	—	3,000	—
Propylene oxide	0.013	30	3.100
Toluene	—	300	37,000
Xylene	—	700	22,000

Source: ARB/OEHHA, latest revision, April 25, 2005.

6.16.4.5 Characterization of Risks from Toxic Air Pollutants

The estimated potential maximum cancer risk associated with concentrations in air estimated for the MIR location is shown in Table 6.16-7. The maximum carcinogenic risk is well below the 10 x 10^{-6} threshold of significance for emitting units determined by the District to be applying T-BACT.

TABLE 6.16-7
SUMMARY OF POTENTIAL HEALTH RISKS

RECEPTOR	CARCINOGENIC RISK[a] (PER MILLION)	CANCER BURDEN	ACUTE HEALTH HAZARD INDEX	CHRONIC HEALTH HAZARD INDEX
Maximum Incremental Cancer Risk (MICR) at PMI	0.46	0	0.19	0.023
MEIR (resident)	0.017		0.082	0.0008
Maximally Exposed Individual Worker [b] (MEIW)	0.030		0.088	0.0014
Significance Level	10	1.0	1.0	1.0

Notes:

[a] Derived (OEHHA) Method used by San Joaquin Valley Air Pollution Control District to determine compliance.

[b] The worker is assumed to be exposed at the work location 8 hours per day, instead of 24, 245 days per year, instead of 365, and for 40 years, instead of 70.

Cancer risks potentially associated with the project also were assessed in terms of cancer burden. Cancer burden is a hypothetical upper-bound estimate of the additional number of cancer cases that could be associated with emissions from the project. Cancer burden is calculated as the maximum product of any potential carcinogenic risk greater than 1 in one million and the number of individuals at that risk level. Because the MICR is less than 1 in one million, the potential cancer burden is zero.

The maximum potential acute non-cancer health hazard index associated with concentrations in air is shown in Table 6.16-7. The acute non-cancer health hazard index for all target organs falls below 1.0, the threshold of significance.

Similarly, the maximum potential chronic non-cancer health hazard index associated with concentrations in air is shown in Table 6.16-7. The chronic non-cancer health hazard index falls below 1.0, the threshold of significance.

No figure is needed to show public health impacts because the indices of carcinogenic risk and chronic and acute health hazards are below significance thresholds at and beyond the Site boundary.

The estimates of cancer and non-cancer impacts associated with chronic or acute exposures fall below thresholds used for regulating emissions of toxic air contaminants to the air. Historically, exposure to any level of a carcinogen has been considered to have a finite risk of inducing cancer. In other words, there is no threshold for carcinogenicity. Because risks at low levels of exposure cannot be quantified directly by either animal or epidemiological studies, mathematical models have estimated such risks by extrapolation from high to low doses. This modeling procedure is designed to provide a highly conservative estimate of cancer risks based on the most sensitive species of laboratory animal for extrapolation to humans (i.e., the assumption being that humans are as sensitive as the most sensitive animal species). Therefore, the true risk is not likely to be higher than risks estimated using inhalation cancer potency factors and is most likely lower, and could even be zero (USEPA, 1986; USEPA, 1996).

The analysis of potential cancer risk described in this section employs methods and assumptions generally applied by regulatory agencies for this purpose. Given the importance of assuring public health, these methods and assumptions are highly conservative.

Conservative methodology and assumptions are as follows:

- The analysis includes representative weather data over a period of five years to assure that the least favorable conditions producing the highest ground-level concentration of power plant emissions are included.
- The Project is assumed to operate at hourly, daily, and annual emission conditions that produce the highest ground-level concentrations.
- The location of the highest ground-level concentration of Project emissions is identified and the analysis then assumes that a sensitive individual resides at this location constantly over the entire 70-year period.

Taken together, these methods and assumptions create a scenario that cannot exist in the real world. For example, if the worst-case weather conditions occur on a winter evening, but the worst-case emission rates occur on a summer afternoon, the analysis nonetheless assumes that these events occur at the same time. The point of using these unrealistic assumptions is to consciously overstate the potential impacts. No one individual will experience exposures as great as those assumed for this analysis. By determining that even this highly overstated exposure will not be significant, the analysis enables a high degree of confidence that the much lower exposures that actual persons will experience will not result in any significant increase in cancer risk. In short, the analysis assures that there will not be any significant public health impacts at any location, under any weather condition, under any operating condition.

A separately transmitted compact disk contains the HRA modeling input and output files.

6.16.4.6 Hazardous Materials

Hazardous materials will be used and stored at the Project site. The hazardous materials stored in significant quantities on-site and descriptions of their uses are presented in Section 6.15. Use of chemicals at the project site will be in accordance with standard practices for storage and management of hazardous materials. Normal use of hazardous materials, therefore, will not pose significant impacts to public health. While mitigation measures will be in place to prevent releases, if an accidental release migrated offsite, potential impacts to the public could result.

The California Accidental Release Program (CalARP) regulations and Code of Federal Regulations (CFR) Title 40 Part 68 under the Clean Air Act establish emergency response planning requirements for acutely hazardous materials. These regulations require preparation of a Risk Management Plan (RMP), which is a comprehensive program to identify hazards and predict the areas that may be affected by a release of a program-listed hazardous material. Materials listed in the RMP and proposed to be used at the facility include aqueous ammonia, as discussed in Section 6.15.

An offsite consequence analysis was performed to assess potential risks to offsite human populations if a spill or rupture of one of the two aqueous ammonia storage tanks were to occur. The results of this analysis, presented in Section 6.15, show that offsite ammonia concentrations do not exceed the CEC's 75 parts per million by volume (ppmv) significance threshold, the Short-Term Public Emergency Limit at the project site boundary; therefore, no significant public health impacts are expected.

6.16.4.7 Operation Odors

A small amount of ammonia used to control NOx emissions can "slip" past the SCR catalyst and be emitted from the exhaust stack, but this amount is less than that required to produce an odor offsite. The expected exhaust gas ammonia concentration, known as ammonia "slip," will be less than 10 ppmv. After mixing with the atmosphere, the concentration at ground level will be far below the detectable odor threshold of 5 ppmv that the Compressed Gas Association has determined to be acceptable, as well as being below the ACGIH[12] TLV[13] and STEL[14] values of 25 and 35 ppm, respectively (adopted 2003). Therefore, potential ammonia emissions would not

[12] American Congress of Government Industrial Hygienists
[13] Threshold Limit Value
[14] Short-Term Exposure Level

create a significant odor. Other combustion contaminants are not present at concentrations that could produce a significant odor.

6.16.4.8 Electromagnetic Field Exposure

The Project will connect to existing offsite transmission line with a 6.4-mile new connecting transmission line. The project will include additional onsite electric power handling transformers and associated equipment, as discussed in more detail in Section 6.18. Based on findings of the National Institute of Environmental Health Sciences (NIEHS, 1999), electromagnetic field exposures from the electric power handling equipment would not result in a significant impact on public health. The NIEHS report to the U.S. Congress found that "the probability that EMF exposure is truly a health hazard is currently small. The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal scientific support that exposure to this agent is causing any degree of harm"(NIEH 1999).

6.16.4.9 Summary of Impacts

Results from the health risk assessment based on emissions modeling indicate that there will be no significant incremental public health impacts from construction or operation of the Project. Results from criteria pollutant modeling for routine operations indicate that potential ambient concentrations of NO_2, CO, SO_2, and PM_{10} will not exceed ambient air quality standards, with the exception of the state and federal PM_{10} and $PM_{2.5}$ standards. For these pollutants, existing 24-hour average PM_{10} background concentrations and PM_{10} and $PM_{2.5}$ annual background concentrations already exceed state standards, while the project will not add a significant contribution. The ambient air quality standards protect public health with a margin of safety for the most sensitive subpopulations (Section 6.2).

6.16.5 CUMULATIVE PUBLIC HEALTH EFFECTS

An analysis of potential cumulative air quality impacts that may result from the proposed project and other reasonably foreseeable projects is required by the CEC. The cumulative air quality impact analysis for criteria pollutants is discussed in AFC Section 6.2.7.1.2. That analysis will be submitted upon receipt of the necessary data from the SJVAPCD. The cumulative impact analysis, if needed for the vicinity of the Avenal Energy Project, would determine if the total set of proposed project and foreseeable other projects will cause a combined air quality impact that exceeds criteria pollutant significance thresholds. In contrast with the approach used to estimate impacts for criteria pollutants, the significance thresholds developed for toxic air contaminants are set sufficiently stringently so as to preclude the potential for any significant cumulative impacts. Thus, a separate cumulative impact analysis for toxic air contaminants is not needed.

6.16.6 MITIGATION MEASURES

No mitigation measures are needed for the Project TAC emissions because the potential air quality and public health impacts are less than significant.

6.16.7 INVOLVED AGENCIES AND AGENCY CONTACTS

Table 6.16-8 provides contact information for agencies involved with public health.

TABLE 6.16-8
AGENCY CONTACTS FOR PUBLIC HEALTH

ISSUE	AGENCY	CONTACT
Public exposure to air pollutants	USEPA Region 9	Gerardo Rios USEPA Region 9 75 Hawthorne Street San Francisco, CA 94105 (916) 972-3974
	ARB	Mike Tollstrup Project Assessment Branch California Air Resources Board 1001 I Street Sacramento, CA 95812 (916) 323-8473
	San Joaquin Valley Air Pollution Control District	Arnaud Marjollet Manager, Permit Services 1990 E. Gettysburg Avenue Fresno, CA 93726-0244 (559) 230-5904
Public exposure to chemicals known to cause cancer or reproductive toxicity	Cal-EPA, Office of Environmental Health and Hazard Assessment (OEHHA)	Cynthia Oshita or Susan Long Office of Environmental Health Hazard Assessment 1001 I Street, Sacramento, CA 95812 (916) 445-6900
Public exposure to accidental releases of hazardous materials	USEPA Region 9	Deborah Jordan USEPA Region 9 75 Hawthorne Street San Francisco, CA 94105 (916) 947-4157
	California Office of Emergency Services	Moustafa Abou-Taleb Governor's Office of Emergency Services 3650 Schriever Avenue Mather, CA 95655 (916) 845-8741
	Kings County Department of Public Health Environmental Health Services	Tim Fillmore Supervising Environmental Health Officer Kings County Department of Public Health Division of Environmental Health Services 330 Campus Drive Hanford, CA 93230 (559) 584-1411

6.16.8 PERMITS REQUIRED AND PERMIT SCHEDULE

Agency-required permits related to public health are listed in Table 6.16-9, and include a Risk Management Plan for hazardous materials, and the SJVAPCD Determination of Compliance

(DOC). Upon approval of the Project by the CEC, the DOC serves as the District Authority to Construct Permit. A Permit to Operate will be issued by the District after construction, and before commencement of operation. These requirements are discussed in detail in Sections 6.2 (Air Quality) and 6.15 (Hazardous Materials Handling).

TABLE 6.16-9
PERMITS AND PERMIT SCHEDULE FOR PUBLIC HEALTH

PERMIT	AGENCY CONTACT	SCHEDULE
Determination of Compliance / Authority to Construct/ Permit to Operate	San Joaquin Valley Air Pollution Control District Arnaud Marjollet Manager, Permit Services 1990 E. Gettysburg Avenue Fresno, CA 93726-0244 (559) 230-5904	District must issue a Preliminary DOC within 180 days after issuing the Application Completeness Determination Letter.
Risk Management Plan (CalARP)	Tim Fillmore Supervising Environmental Health Officer Kings County Department of Public Health Division of Environmental Health Services 330 Campus Drive Hanford, CA 93230 (559) 584-1411	RMP application must be approved before arrival of hazardous materials on site.

6.16.9 REFERENCES

California Air Resources Board (CARB). 2005. Consolidated table of OEHHA/ARB approved risk assessment health values. (http://arbis.arb.ca.gov/toxics/healthval/contable.pdf). August 25.

California Air Resources Board (CARB). HARP Model, Version 1.3, http://www.arb.ca.gov/toxics/harp/harp.htm.

National Institute of Environmental Health Sciences (NIEHS). 1999. Environmental Health Institute report concludes evidence is ‘weak’ that EMFs cause cancer. Press release. National Institute of Environmental Health Sciences, National Institutes of Health.

Office of Environmental Health Hazard Assessment (OEHHA). 2003. Air Toxics Hot Spots Program Risk Assessment Guidelines, The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments, California Environmental Protection Agency. August.