PUBLIC HEALTH AND SAFETY

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SUMMARY OF CONCLUSIONS

U.S. Bureau of Land Management (BLM) and Energy Commission staff (hereafter jointly referred to as staff) have analyzed potential public health and safety risks associated with construction and operation of the Ivanpah Solar Electric Generating System (ISEGS) project and do not expect any adverse cancer or short- or long-term noncancer health effects from project toxic emissions that would be considered to be significant under CEQA or NEPA. Staff's analysis of potential health and safety impacts from the proposed ISEGS uses a highly conservative methodology that accounts for impacts to the most sensitive individuals in a given population, including newborns and infants. According to the results of staff's health risk assessment, emissions from the ISEGS would not contribute significantly to morbidity or mortality in any age or ethnic group residing in the project area. Conditions of Certification referred to herein serve the purpose of both the Energy Commission's Conditions of Certification for purposes of the California Environmental Quality Act (CEQA) and BLM's Mitigation Measures for purposes of the National Environmental Policy Act (NEPA).

INTRODUCTION

The purpose of this Final Staff Assessment/Draft Environmental Impact Statement (FSA/DEIS) is to determine if emissions of toxic air contaminants (TACs) from the proposed ISEGS would have the potential to cause significant adverse public health and safety impacts or to violate standards for public health protection. If potentially significant health and safety impacts are identified, staff will evaluate mitigation measures to reduce such impacts to insignificant levels.

In addition to the analysis contained in this Public Health and Safety Section that focuses on potential effects to the public from emissions of toxic air contaminants, other related aspects to the assessment of ISEGS' potential public health and safety impacts are considered elsewhere in this document as listed and briefly described as follows:

- Air Quality - evaluates the expected air quality impacts from the emissions of criteria air pollutants from both the construction and operation of the ISEGS project; Criteria air pollutants are defined as air contaminants for which the state and/or federal governments have established an ambient air quality standard to protect public health;
- Hazardous Materials Management - evaluates the potential impacts on public and worker health from accidental releases of hazardous materials;
- Socioeconomics and Environmental Justice - evaluates project-induced changes on community services including law enforcement and hospitals;
- Soil and Water Resources – evaluates the potential for ISEGS to cause contamination of soil and water resources, to exacerbate flooding, and to cause adverse effects to water supply in consideration of other existing users and projected needs;

- Traffic and Transportation – evaluates potential effects on roads used during project construction and operation, effects on traffic, and the potential for project-related glare to cause a health or safety hazard;
- Transmission Line Safety and Nuisance – evaluates potential effects associated with proposed transmission lines accounting for both the physical presence of the lines and the physical interactions of their electric and magnetic fields; The potential effects include aviation safety, interference with radio-frequency communication, audible noise, fire hazards, hazardous shocks, nuisance shocks, and electric and magnetic field (EMF) exposure.
- Worker Safety and Fire Protection - assess the worker safety and fire protection measures proposed by the applicant including determining whether the project would have any adverse impacts on fire protection and emergency medical services that are also relied upon by the public;
- Waste Management - evaluates issues associated with wastes generated from the proposed project construction and operation including ensuring that wastes would be managed in an environmentally safe manner;

LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

PUBLIC HEALTH AND SAFETY Table 1
Laws, Ordinances, Regulations, and Standards (LORS)

Applicable Law	Description
Federal	
Clean Air Act section 112 (Title 42, U.S. Code section 7412)	This act requires new sources that emit more than 10 tons per year of any specified Hazardous Air Pollutant (HAP) or more than 25 tons per year of any combination of HAPs to apply Maximum Achievable Control Technology.
State	
California Health and Safety Code section 25249.5 et seq. (Proposition 65)	These sections establish thresholds of exposure to carcinogenic substances above which Prop 65 exposure warnings are required.
California Health and Safety Code section 41700	This section states that "no person shall discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health, or safety of any such persons or the public, or which cause, or have a natural tendency to cause injury or damage to business or property."
California Public Resource Code section 25523(a); Title 20 California Code of Regulations (CCR) section 1752.5, 2300–2309 and Division 2 Chapter 5, Article 1, Appendix B, Part (1); California Clean Air Act, Health and Safety Code section 39650, et seq.	These regulations require a quantitative health risk assessment for new or modified sources, including power plants that emit one or more toxic air contaminants (TACs).
Local	
Mojave Desert Air Quality Management District Regulation XIII Rule 1320	This rule requires a review of new or modified projects that emit toxic air contaminants and the preparation of a health risk assessment. A permit would not be issued if the risk were greater than 10 in 1 million or if the hazard index were greater than 1.0. It also requires the use of best available control of toxics.

SETTING

This section describes the environment in the vicinity of the proposed project site from the public health perspective. Characteristics of the natural environment, such as

meteorology and terrain, affect the project's potential for causing impacts on public health. An emissions plume from a facility may affect elevated areas before lower terrain areas due to a reduced opportunity for atmospheric mixing. Consequently, areas of elevated terrain can often be subjected to increased pollutant impacts. Also, the types of land use near a site influence the surrounding population distribution and density, which, in turn, affect public exposure to project emissions. Additional factors affecting potential public health impacts include existing air quality and environmental site contamination. The area surrounding the project is rural and sparsely populated, primarily dedicated to agricultural uses.

SITE AND VICINITY DESCRIPTION

Land in the vicinity of the proposed project is designated for Class L Limited Use and Class M Moderate Use, which include a variety of industrial uses as well as agricultural and recreational uses (BSE 2007a section 5.6.3.2 and Table 5.6-4). The natural gas pipeline proposed for construction for this project would be approximately 5.3 miles long, running from the Kern River Gas Transmission Company (KRGT) pipeline through Ivanpah 3 and 2 and ending at Ivanpah 1 (BSE 2007a section 2.2.6). The nearest residence is located approximately 5 miles from the site in the community of Primm, Nevada. According to the Application for Certification (AFC), there are no sensitive receptors within 6 miles of the project site (BSE 2007 section 5.9.3). However, staff learned of a house trailer used as a residence that is located near the southeast quadrant of the Interstate 15/Yates Well Road interchange.

The ISEGS would have three exhaust stacks associated with the start-up boilers, one for each plant (Ivanpah 1, 2, and 3). The stack heights would be 39.62 meters (130 feet) (BSE 2007a Table 5.1D-2). The location of elevated terrain (above the stack height) is important in assessing potential exposure, as an emission plume may impact high elevations before impacting lower elevations. The site elevation ranges from 2,880 to 3,030 feet above sea level, and the topography in the immediate vicinity is generally flat. Terrain above stack height includes a volcanic rock structure rising to 3,160 feet above sea level approximately 0.8 miles east of the project site, and at 4 miles from the project site terrain in all directions (except southeast) rises to about 6,000 feet (BSE 2007a section 5.1.3.1).

METEOROLOGY

Meteorological conditions, including wind speed, wind direction, and atmospheric stability, affect the extent to which pollutants are dispersed into ambient air as well as the direction of pollutant transport. This, in turn, affects the level of public exposure to emitted pollutants and associated health risks. When wind speeds are low and the atmosphere is stable, for example, dispersion is reduced, and localized exposure may be increased.

The Ivanpah Basin of the Mojave Desert is characterized by a desert climate. Summers are hot and dry and winters are moderate with an average annual rainfall of 2–5 inches. Winds generally flow west to east across the region (BSE 2007a section 5.1.3.2)

Atmospheric stability is a measure related to turbulence, or the ability of the atmosphere to disperse pollutants due to convective air movement. Mixing heights (the height above

ground level through which the air is well mixed and in which pollutants can be dispersed) are lower during mornings due to temperature inversions and increase during the warmer afternoons. Staff's **Air Quality** section presents more detailed meteorological data.

EXISTING AIR QUALITY

The proposed site is within the jurisdiction of the Mojave Desert Air Quality Management District. By examining average toxic concentration levels from representative air monitoring sites with cancer risk factors specific to each contaminant, lifetime cancer risk can be calculated to provide a background risk level for inhalation of ambient air. For comparison purposes, it should be noted that the overall lifetime cancer risk for the average individual in the United States is about 1 in 3, or 333,000 in 1 million.

There are no monitoring stations in the San Bernardino County; therefore staff was unable to determine background concentrations for the ISEGS site. The applicant noted that air quality data from the South Coast Air Basin (upwind from the project area) between the years 1990 and 2005 show a steady reduction in Toxic Air Contaminant (TAC) emissions (BSE 2007a section 5.9.3).

The use of reformulated gasoline, beginning in the second quarter of 1996, as well as other toxics reduction measures, have led to a decrease of ambient levels of toxics and associated cancer risk during the past few years in all areas of the state and the nation. For example, in the San Francisco Bay Area, cancer risk was 342 in 1 million based on 1992 data, 315 in 1 million based on 1994 data, and 303 in 1 million based on 1995 data. In 2002, the most recent year for which data is available, the average inhalation cancer risk decreased to 162 in 1 million (BAAQMD 2004b, p. 12).

EXISTING PUBLIC HEALTH CONCERNS

When evaluating a new project, staff conducts a detailed study and analysis of existing public health issues in the project vicinity. This analysis is prepared in order to identify the current status of respiratory diseases (including asthma), cancer, and childhood mortality rates in the population located near the proposed project. Assessing existing health concerns in the project area will provide staff with a basis on which to evaluate the significance of any additional health impacts from the proposed ISEGS project and evaluate any proposed mitigation. No existing health issues have been reported within a 6-mile radius of the project.

ASSESSMENT OF IMPACTS AND DISCUSSION OF MITIGATION

METHOD AND THRESHOLD FOR DETERMINING SIGNIFICANCE

The **PUBLIC HEALTH AND SAFETY** section of this FSA/DEIS discusses toxic emissions to which the public could be exposed during project construction, routine operation, and closure/decommissioning. Following the release of toxic contaminants into the air or water, people may come into contact with them through inhalation, dermal contact, or ingestion via contaminated food or water.

Air pollutants for which no ambient air quality standards have been established are called noncriteria pollutants. Unlike criteria pollutants such as ozone, carbon monoxide, sulfur dioxide, or nitrogen dioxide, noncriteria pollutants have no ambient (outdoor) air quality standards that specify levels considered safe for everyone.

Since noncriteria pollutants do not have such standards, a health risk assessment is used to determine if people might be exposed to those types of pollutants at unhealthy levels. The risk assessment consists of the following steps:

- identify the types and amounts of hazardous substances that ISEGS could emit to the environment;
- estimate worst-case concentrations of project emissions in the environment using dispersion modeling;
- estimate amounts of pollutants that people could be exposed to through inhalation, ingestion, and dermal contact; and
- characterize potential health risks by comparing worst-case exposure to safe standards based on known health effects.

Staff relies upon the expertise of the California Environmental Protection Agency (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) to identify contaminants that are known to the state to cause cancer or other noncancer toxicological endpoints and to calculate the toxicity and cancer potency factors of these contaminants. Staff also relies upon the expertise of the California Air Resources Board and the local air districts to conduct ambient air monitoring of toxic air contaminants and the state Department of Public Health to conduct epidemiological investigations into the impacts of pollutants on communities. It is not within the purview or the expertise of the Energy Commission staff to duplicate the expertise and statutory responsibility of these agencies.

Initially, a screening level risk assessment is performed using simplified assumptions that are intentionally biased toward protection of public health. That is, an analysis is designed that overestimates public health impacts from exposure to project emissions. In reality, it is likely that the actual risks from the power plant will be much lower than the risks as estimated by the screening level assessment. The risks for screening purposes are based on examining conditions that would lead to the highest, or worst-case, risks and then using those conditions in the study. Such conditions include:

- using the highest levels of pollutants that could be emitted from the plant;
- assuming weather conditions that would lead to the maximum ambient concentration of pollutants;
- using the type of air quality computer model which predicts the greatest plausible impacts;
- calculating health risks at the location where the pollutant concentrations are estimated to be the highest;
- assuming that an individual’s exposure to cancer-causing agents occurs continuously for 70 years; and

- using health-based standards designed to protect the most sensitive members of the population (i.e., the young, elderly, and those with respiratory illnesses).

A screening level risk assessment will, at a minimum, include the potential health effects from inhaling hazardous substances. Some facilities may also emit certain substances that could present a health hazard from noninhalation pathways of exposure (OEHHA 2003, Tables 5.1, 6.3, 7.1). When these substances are present in facility emissions, the screening level analysis includes the following additional exposure pathways: soil ingestion, dermal exposure, and mother's milk (OEHHA 2003, p. 5-3).

The risk assessment process addresses three categories of health impacts: acute (short-term) health effects, chronic (long-term) noncancer effects, and cancer risk (also long-term). Acute health effects result from short-term (one-hour) exposure to relatively high concentrations of pollutants. Acute effects are temporary in nature and include symptoms such as irritation of the eyes, skin, and respiratory tract.

Chronic health effects are those that arise as a result of long-term exposure to lower concentrations of pollutants. The exposure period is considered to be approximately from 12 percent to 100 percent of a lifetime, or from 8 to 70 years (OEHHA 2003, p. 6-5). Chronic health effects include diseases such as reduced lung function and heart disease.

The analysis for noncancer health effects compares the maximum project contaminant levels to safe levels called *Reference Exposure Levels*, or RELs. These are amounts of toxic substances to which even sensitive people can be exposed and suffer no adverse health effects (OEHHA 2003, p. 6-2). These exposure levels are designed to protect the most sensitive individuals in the population, such as infants, the aged, and people suffering from illness or disease which makes them more sensitive to the effects of toxic substance exposure. The Reference Exposure Levels are based on the most sensitive adverse health effect reported in the medical and toxicological literature and include margins of safety. The margin of safety addresses uncertainties associated with inconclusive scientific and technical information available at the time of standard setting and is meant to provide a reasonable degree of protection against hazards that research has not yet identified. The margin of safety is designed to prevent pollution levels that have been demonstrated to be harmful, as well as to prevent lower pollutant levels that may pose an unacceptable risk of harm, even if the risk is not precisely identified as to nature or degree. Health protection is achieved if the estimated worst-case exposure is below the relevant reference exposure level. In such a case, an adequate margin of safety exists between the predicted exposure and the estimated threshold dose for toxicity.

Exposure to multiple toxic substances may result in health effects that are equal to, less than, or greater than effects resulting from exposure to the individual chemicals. Only a small fraction of the thousands of potential combinations of chemicals have been tested for the health effects of combined exposures. In conformity with the California Air Pollution Control Officers Association (CAPCOA) guidelines, the health risk assessment assumes that the effects of each substance are additive for a given organ system (OEHHA 2003, pp. 1-5, 8-12). Other possible mechanisms due to multiple exposures

include those cases where the actions may be synergistic or antagonistic (where the effects are greater or less than the sum, respectively). For these types of substances, the health risk assessment could underestimate or overestimate the risks.

For carcinogenic substances, the health assessment considers the risk of developing cancer and assumes that continuous exposure to the cancer-causing substance occurs over a 70-year lifetime. The risk that is calculated is not meant to project the actual expected incidence of cancer, but rather a theoretical upper-bound number based on worst-case assumptions.

Cancer risk is expressed in chances per million and is a function of the maximum expected pollutant concentration, the probability that a particular pollutant will cause cancer (called *potency factors* and established by OEHHA), and the length of the exposure period. Cancer risks for each carcinogen are added to yield total cancer risk. The conservative nature of the screening assumptions used means that actual cancer risks due to project emissions are likely to be considerably lower than those estimated.

The screening analysis is performed to assess worst-case risks to public health associated with the proposed project. If the screening analysis predicts no significant risks, then no further analysis is required. However, if risks are above the significance level, then further analysis, using more realistic site-specific assumptions, would be performed to obtain a more accurate assessment of potential public health risks.

Significance Criteria

Energy Commission staff determines the health effects of exposure to toxic emissions based on impacts to the maximum exposed individual. This is a person hypothetically exposed to project emissions at a location where the highest ambient impacts were calculated using worst-case assumptions, as described above.

As described earlier, noncriteria pollutants are evaluated for short-term (acute) and long-term (chronic) noncancer health effects, as well as cancer (long-term) health effects. The significance of project health impacts is determined separately for each of the three categories.

Acute and Chronic Noncancer Health Effects

Staff assesses the significance of noncancer health effects by calculating a *hazard index*. A hazard index is a ratio comparing exposure from facility emissions to the reference (safe) exposure level. A ratio of less than 1.0 signifies that the worst-case exposure is below the safe level. The hazard index for every toxic substance that has the same type of health effect is added to yield a Total Hazard Index. The Total Hazard Index is calculated separately for acute and chronic effects. A Total Hazard Index of less than 1.0 indicates that cumulative worst-case exposures are less than the reference exposure levels. Under these conditions, health protection from the project is likely to be achieved, even for sensitive members of the population. In such a case, staff presumes that there would be no significant noncancer project-related public health impacts. This assumption is consistent with both California and U.S. EPA risk management guidelines.

Cancer Risk

Staff relied upon regulations implementing the provisions of Proposition 65, the Safe Drinking Water and Toxic Enforcement Act of 1986, (Health & Safety Code, §§25249.5 et seq.) for guidance to determine a cancer risk significance level. Title 22, California Code of Regulations section 12703(b) states that "the risk level which represents no significant risk shall be one which is calculated to result in one excess case of cancer in an exposed population of 100,000, assuming lifetime exposure." This level of risk is equivalent to a cancer risk of 10 in 1 million, which is also written as 10×10^{-6}. An important distinction is that the Proposition 65 significance level applies separately to each cancer-causing substance, whereas staff determines significance based on the total risk from all cancer-causing chemicals. Thus, the manner in which the significance level is applied by staff is more conservative (health-protective) than that applied by Proposition 65. The significant risk level of 10 in 1 million is consistent with the level of significance adopted by many air districts. In general, these air districts would not approve a project with a cancer risk exceeding 10 in 1 million. The Mojave Desert Air Quality Management District (MDAQMD) also uses 10 in 1 million as the level of "Significant Health Risk" (MDAQMD 2006). The U.S. EPA has a similar level for acceptable risk.

As noted earlier, the initial risk analysis for a project is typically performed at a screening level, which is designed to overstate actual risks, so that health protection can be ensured. Staff's analysis also addresses potential impacts on all members of the population including the young, the elderly, people with existing medical conditions that may make them more sensitive to the adverse effects of toxic air contaminants, and any minority or low-income populations that are likely to be disproportionately affected by impacts. To accomplish this goal, staff uses the most current acceptable public health exposure levels (both acute and chronic) set to protect the public from the effects of airborne toxics. When a screening analysis shows cancer risks to be above the significance level, refined assumptions would likely result in a lower, more realistic risk estimate. Based on refined assumptions, if risk posed by the facility exceeds the significance level of 10 in 1 million, staff would require appropriate measures to reduce the risk to less than significant. If, after all risk reduction measures had been considered, a refined analysis identifies a cancer risk greater than 10 in 1 million, staff would deem such risk to be significant and would not recommend project approval.

DIRECT/INDIRECT IMPACTS AND MITIGATION

Proposed Project - Construction Impacts and Mitigation

Potential risks to public health during construction may be associated with exposure to toxic substances in contaminated soil disturbed during site preparation, as well as diesel exhaust from heavy equipment operation. Criteria pollutant impacts from the operation of heavy equipment and particulate matter from earth moving are examined in staff's **Air Quality** analysis.

Site disturbances occur during facility construction from excavation, grading, and earth moving. Such activities have the potential to adversely affect public health through various mechanisms, such as the creation of airborne dust, material being carried off site through soil erosion, and uncovering buried hazardous substances. A Phase I

Environmental Site Assessment conducted for this site in 2007 identified no "Recognized Environmental Conditions" per the American Society for Testing and Materials Standards (ASTM) definition. That is, there was no evidence or record of any use, spillage, or disposal of hazardous substances on the site, nor was there any other environmental concern that would require remedial action. In fact, the report concluded that the project site has never been used for commercial or industrial activities (BSE 2007a, Appendix 5.14A). In the event that any unexpected contamination is encountered during construction, proposed **Waste Management** Conditions of Certification **Waste-1** and **Waste-2** (which require a registered professional engineer or geologist to be available during soil excavation and grading to ensure proper handling and disposal of contaminated soil) would ensure that contaminated soil does not affect the public. See the staff assessment section on **Waste Management** for a more detailed analysis of this topic.

The operation of construction equipment will result in air emissions from diesel-fueled engines. Diesel emissions are generated from sources such as trucks, graders, cranes, welding machines, electric generators, air compressors, and water pumps. Although diesel exhaust contains criteria pollutants such as nitrogen oxides, carbon monoxide, and sulfur oxides, it also includes a complex mixture of thousands of gases and fine particles. These particles are primarily composed of aggregates of spherical carbon particles coated with organic and inorganic substances. Diesel exhaust contains over 40 substances that are listed by the U.S. Environmental Protection Agency (U.S. EPA) as hazardous air pollutants and by the California Air Resources Board (ARB) as toxic air contaminants.

Exposure to diesel exhaust may cause both short- and long-term adverse health effects. Short-term effects can include increased coughing, labored breathing, chest tightness, wheezing, and eye and nasal irritation. Long-term effects can include increased coughing, chronic bronchitis, reductions in lung function, and inflammation of the lung. Epidemiological studies also strongly suggest a causal relationship between occupational diesel exhaust exposure and lung cancer.

Based on a number of health effects studies, the Scientific Review Panel on Toxic Air Contaminants recommended a chronic reference exposure level (see discussion of reference exposure levels in Method of Analysis section above) for diesel exhaust particulate matter of 5 micrograms of diesel particulate matter per cubic meter of air ($\mu g/m^3$) and a cancer unit risk factor of $3x10^{-4}$ $(\mu g/m^3)^{-1}$ (SRP 1998, p. 6).[1] The Scientific Review Panel did not recommend a value for an acute Reference Exposure Level since available data in support of a value was deemed insufficient. On August 27, 1998, ARB listed particulate emissions from diesel-fueled engines as a toxic air contaminant and approved the panel's recommendations regarding health effect levels.

Construction of the three power plants of ISEGS is anticipated to take place over a period of 48 months, with each phase taking about 24 months to complete and with 12 months of overlap between the construction of any of the two power plants at one time

(BSE 2007a section 2.2.15). As noted earlier, assessment of chronic (long-term) health effects assumes continuous exposure to toxic substances over a significantly longer time period, typically from 8 to 70 years.

Appendix 5.1F of the AFC (BSE 2007a) presents diesel exhaust emission factors and daily emissions from construction equipment. The applicant estimated worst-case emissions of 267.38 pounds per day of particulate matter 10 (PM10) and 57.56 pounds per day of PM2.5 during construction. Modeling of construction activities including impacts of fugitive dust over a 12-month period (using ISCST3; Industrial Source Complex Short-term, version 3) resulted in a predicted annual average concentration of 0.7 $\mu g/m^3$ of PM10 and 0.2 $\mu g/m^3$ of PM2.5 at any location. Annual background concentrations of PM10 and PM2.5 measured in the vicinity of the ISEGS site are 25.4 $\mu g/m^3$ and 10.6 $\mu g/m^3$ respectively (BSE 2007a Table 5.1F-4). The maximum carcinogenic risk from exposure to diesel emissions during 32 months of construction (not including 15 months of vegetation removal and using average annual emissions estimated for the peak period of construction) was modeled using the ARB/OEHHA Hotspots Analysis and Reporting Program (HARP). The expected cancer risk calculated with the assumptions detailed in section F-5.4 of the AFC would be between 0.3 and 0.5 in 1 million in the immediate vicinity of the project site (BSE 2007a Appendix 5.1F). The applicant has stated that the estimated cancer risk is over-predicted due to the conservative nature of the model used.

The estimated maximum 24-hour emissions of PM10 exceed the federal Prevention of Significant Deterioration (PSD) level of significance. However, the applicant stated that background concentrations already exceed the PSD significance level and that these levels were established for emissions associated with a facility's routine operations and therefore are not appropriate for determining the significance of emissions over a short period of construction.

Mitigation measures are proposed by both the applicant and Energy Commission staff to reduce the maximum calculated PM10 emissions. These include the use of extensive fugitive dust control measures in accordance with **Air Quality** Conditions of Certification **AQ-SC3 and AQ-SC-7**. The fugitive dust control measures are assumed to result in 90 percent reductions of emissions. The applicant has stated that the ISEGS project will incorporate all feasible mitigation measures to reduce PM10 (BSE 2007a section F-4.5.3 of Appendix 5.1F).

In accordance with **Air Quality** Condition of Certification **AQ-SC5** and in order to further mitigate potential impacts from particulate emissions during the operation of diesel-powered construction equipment, Energy Commission staff recommends the use of ultra-low sulfur diesel fuel and Tier 3 California Emission Standards for Off-Road Compression-Ignition Engines. In the event that a Tier 3 engine is not available for any off-road equipment larger than 100 hp, that equipment is to be equipped with a Tier 2 engine, or an engine that is equipped with retrofit controls to reduce exhaust emissions of nitrogen oxides (NOx) and diesel particulate matter (DPM) to no more than Tier 2 emission standard levels. The retrofit controls include installation of an oxidation catalyst and soot filters on diesel equipment. The catalyzed diesel particulate filters are passive, self-regenerating filters that reduce particulate matter, carbon monoxide, and hydrocarbon emissions through catalytic oxidation and filtration. The degree of

particulate matter reduction is comparable for both mitigation measures in the range of approximately 85–92 percent. Such Tier 3 or 2 engines or use of diesel particulate filters on engines that do not meet Tier 3 or 2 emission standards, will reduce diesel emissions during construction and reduce any potential for significant health impacts.

Proposed Project - Operation Impacts and Mitigation

Emissions Sources

The emissions sources at the proposed ISEGS include three partial-load natural gas-fired steam boilers, three emergency diesel fire pumps, and three emergency diesel generators (one per plant). The partial-load steam boilers would be used during startup and periods of cloud cover, would be expected to average about 1 hour per day and not exceed 4 hours per day. On an annual basis, the partial-load steam boilers for each power plant would not exceed a total annual natural gas fuel heat input that is more than 5 percent of the total annual heat input from the sun in accordance with **Air Quality** Condition of Certification **AQ-SC10.** As noted earlier, the first step in a health risk assessment is to identify potentially toxic compounds that may be emitted from the facility. Since the facility uses dry cooling, there are no emissions of metals or volatile organic compounds from cooling tower mist or drift. Also, there is no hazard posed by the potential presence of Legionella bacteria.

Tables 5.9-2, 5.1-B6, and 5.1-B7 of the AFC list noncriteria pollutants that may be emitted from ISEGS boilers as combustion byproducts, along with their anticipated amounts (emission factors). Toxic Air Contaminant emission factors were obtained from the Environmental Protection Agency (EPA) AP-42 database of emission factors. Table 5.9-3 of the AFC lists toxicity values used to characterize cancer and noncancer health impacts from project pollutants. The toxicity values include Reference Exposure Levels, which are used to calculate short-term and long-term noncancer health effects, and cancer unit risks, which are used to calculate the lifetime risk of developing cancer, as published in the OEHHA Guidelines (OEHHA 2003). **PUBLIC HEALTH AND SAFETY Table 2** lists the toxic emissions potentially emitted by the ISEGS and shows how each contributes to the health risk analysis.

PUBLIC HEALTH AND SAFETY Table 2
Types of Health Impacts and Exposure Routes Attributed to Toxic Emissions

Substance	Oral Cancer	Oral Noncancer	Inhalation Cancer	Noncancer (Chronic)	Noncancer (Acute)
Benzene			✔	✔	✔
Diesel Exhaust			✔	✔	
Ethylbenzene				✔	
Formaldehyde			✔	✔	✔
Hexane				✔	
Napthalene		✔	✔	✔	
Polynuclear Aromatic Hydrocarbons (PAHs)	✔	✔	✔	✔	
Toluene				✔	✔

Source: OEHHA 2003, Appendix L and BSE 2007a, Table 5.9-3

Emissions Levels

Once potential emissions are identified, the next step is to quantify them by conducting a “worst case” analysis. Maximum hourly emissions are required to calculate acute (one-hour) noncancer health effects, while estimates of maximum emissions on an annual basis are required to calculate cancer and chronic (long-term) noncancer health effects.

The next step in the health risk assessment process is to estimate the ambient concentrations of toxic substances. This is accomplished by using a screening air dispersion model and assuming conditions that result in maximum impacts. The applicant’s screening analysis was performed using the ARB/OEHHA Hotspots Analysis and Reporting Program (HARP). Ambient concentrations were used in conjunction with Reference Exposure Levels and cancer unit risk factors to estimate health effects that might occur from exposure to facility emissions. Exposure pathways, or ways in which people might come into contact with toxic substances, include inhalation, dermal (through the skin) absorption, soil ingestion, consumption of locally grown plant foods, and mother’s milk.

The above method of assessing health effects is consistent with OEHHA’s Air Toxics Hot Spots Program Risk Assessment Guidelines (OEHHA, 2003) referred to earlier and results in the following health risk estimates.

Impacts

The applicant’s screening health risk assessment for the project including emissions from all sources resulted in a maximum acute Hazard Index (HI) of 0.013 and a maximum chronic HI of 0.00001 (BSE 2007a Table 5.9-4). As **PUBLIC HEALTH AND SAFETY Table 3** shows, both acute and chronic hazard indices are less than 1.0, indicating that no short- or long-term adverse health effects are expected.

PUBLIC HEALTH AND SAFETY Table 3
Operation Hazard/Risk at Point of Maximum Impact: Applicant Assessment

Type of Hazard/Risk	Hazard Index/Risk	Significance Level	Significant?
Acute Noncancer	0.013	1.0	No
Chronic Noncancer	0.00001	1.0	No
Individual Cancer	0.065 in a million	10.0 in a million	No

Source: BSE 2007a Table 5.1E-1
0.065×10^{-6} = 0.065 in 1 million

As shown in **PUBLIC HEALTH AND SAFETY Table 3**, total worst-case individual cancer risk was calculated by the applicant to be 0.065 in 1 million at the location of maximum impact.

Staff conducted an independent analysis of cancer risks and acute and chronic hazards due to emissions from the three solar concentrating thermal power plants which make up the Ivanpah solar project (Ivanpah 1, 2, and 3). Each of the three thermal power plants includes three emitting units: a natural gas-fired boiler, a diesel fuel-fired emergency engine, and a diesel fuel-fired emergency firewater pump engine, for a total of nine emitting sources at the proposed facility.

Staff's quantitative analysis of facility operations included the following:

- emissions from the concurrent operation of all three natural gas boilers, the three emergency diesel generators, and from the three diesel fire pump engines.
- use of a coarse receptor grid of -6000 to 6000 meters east and -6000 to 6000 m north, at 500 meter increments.
- exposure pathways including inhalation, dermal absorption, soil ingestion, and mother's milk.

Atmospheric dispersion modeling was conducted using the ARB/OEHHA Hotspots Analysis and Reporting Program (HARP), Version 1.3. Staff was unable to incorporate the local meteorological data provided by the applicant and used the ARB-approved screening meteorology file that is included with the HARP model. This file includes a full range of meteorological conditions, including all stability classes and wind speeds, and provides a conservative analysis of potential impacts. Local topography and receptor and source elevations were included in this analysis by incorporating demographic files of the local area in the modeling. Site-specific and building-specific input parameters used in the HARP model were obtained from the AFC and modeling files provided by the applicant.

The emission factors used in staff's analysis of cancer risk and hazard were obtained from the AFC and are listed in **PUBLIC HEALTH AND SAFETY Table 4**. Cancer risk

was determined under the Derived(OEHHA) and Derived(Adjusted) risk assessment methods. The following receptor locations were quantitatively evaluated in staff's analysis:

- point of maximum impact (PMI), approximately 500 meters (1,640 feet) south of the southern boundary of Ivanpah 1 (70-year residential scenario)
- location of the nearest residence specified in the AFC, approximately 5.6 miles (9.1 km) northeast of the center of the project (70-year residential scenario)
- location of the nearest residence identified during a site visit by staff (at a mobile home located to the southeast of the intersection of Interstate 15 and Yates Well Road), approximately 3.1 miles (5.0 km) southeast of the center of the project (70-year residential scenario)
- clubhouse at Primm Valley Golf Club, approximately 2.5 miles (4.0 km) east of the center of the project (recreational scenario assuming exposure of 5 hours/day, 2 days/week, 52 weeks/year for 70 years)
- clubhouse at Primm Valley Golf Club (occupational scenario assuming exposure of 8 hours/day, 50 weeks/year for 35 years)

Results of staff's analysis are summarized in **PUBLIC HEALTH AND SAFETY Table 5** and are compared to the results presented in the AFC. Substance-specific risks are presented in **PUBLIC HEALTH AND SAFETY Table 6** for the point of maximum impact and in **PUBLIC HEALTH AND SAFETY Table** 7 for the nearest residence.

PUBLIC HEALTH AND SAFETY Table 4
Emission Factors Used in the Cancer Risk and Hazard Analyses

	Annual Average Emissions lbs/year			Maximum 1-Hour Emissions lbs/hour		
Substance	Boiler	Emergency Generator	Emergency Fire Pump	Boiler	Emergency Generator	Emergency Fire Pump
IVANPAH 1 & 2						
Hexane	4.73E+01			4.05E-01		
PAHs	2.63E-03			2.25E-05		
Toluene	8.96E-02			7.64E-04	9.67E-04	6.17E-05
Naphthalene	1.60E-02			1.37E-04		
Benzene	5.52E-02			4.72E-04	2.20E-03	1.40E-04
Formaldehyde	1.97E+00			1.69E-02	2.78E-03	1.78E-04
Xylene					6.72E-04	4.30E-05
Diesel PM		1.49E+01	2.38E+00			
Acrolein					2.18E-04	1.40E-05
1,3-Butadiene					9.20E-05	5.90E-06
IVANPAH 3						
Hexane	1.89E+02			8.10E-01		
PAHs	1.05E-02			4.50E-05		
Toluene	3.57E-01			1.53E-03	9.67E-04	6.17E-05
Naphthalene	6.41E-02			2.74E-04		
Benzene	2.21E-01			9.44E-04	2.20E-03	1.40E-04
Formaldehyde	7.85E+00			3.37E-02	2.78E-03	1.78E-04
Xylene					6.72E-04	4.30E-05
Diesel PM		1.49E+01	2.38E+00			
Acrolein					2.18E-04	1.40E-05
1,3-Butadiene					9.20E-05	5.90E-06

Source: BSE 2007a, Table 5.1-B6

PUBLIC HEALTH AND SAFETY Table 5
Results of Staff's Analysis and the Applicant's Analysis for Cancer Risk and Chronic Hazard

	Staff's Analysis			Applicant's Analysis		
Risk Methodology	Cancer Risk (per million)	Chronic HI	Acute HI	Cancer Risk (per million)	Chronic HI	Acute HI
PMI Derived(OEHHA)	2.9	0.0014	0.057	0.084	0.00001	0.013
Nearest residence[2] Derived(OEHHA)	0.16	0.000084	0.0025	-	-	-
Second nearest residence[3] Derived(OEHHA)	0.12	0.000066	0.0032	-	-	-
Clubhouse, recreational, Derived(OEHHA)	0.0089	-	-	-	-	-
Clubhouse, occupational	0.017	-	-	-	-	-

HI = Hazard Index
[2] Location of the nearest residence identified during a site visit by staff (at a trailer located to the southeast of the intersection of Interstate 15 and Yates Well Road), 70-year residential scenario.
[3] Location of the nearest residence specified in the AFC, 70-year residential scenario.

Public Health AND SAFETY Table 6
Results of Staff's Analysis: Contribution to Total Cancer Risk by Individual Substances at the Point of Maximum Impact (PMI)

IVANPAH 1

Substance	Boiler	Emerg. Gen.	Fire Pump
PAHs-w/o	5.2E-09		
Naphthalene	3.6E-11		
Benzene	1.0E-10		
Formaldehyde	7.8E-10		
DieselExhPM		2.4E-06	3.1E-07
TOTAL	6.1E-09	2.4E-06	3.1E-07

IVANPAH 2

Substance	Boiler	Emerg. Gen.	Fire Pump
PAHs-w/o	7.7E-10		
Naphthalene	5.3E-12		
Benzene	1.5E-11		
Formaldehyde	1.1E-10		
DieselExhPM		1.1E-07	1.7E-08
TOTAL	9.0E-10	1.1E-07	1.7E-08

IVANPAH 3

Substance	Boiler	Emerg. Gen.	Fire Pump
PAHs-w/o	1.4E-09		
Naphthalene	9.6E-12		
Benzene	2.7E-11		
Formaldehyde	2.1E-10		
DieselExhPM		3.4E-08	5.4E-09
TOTAL	1.6E-09	3.4E-08	5.4E-09

IVANPAH 1, 2 & 3

Substance	TOTAL DUE TO 3 SOURCES AT 3 UNITS
PAHs-w/o	7.3E-09
Naphthalene	5.1E-11
Benzene	1.5E-10
Formaldehyde	1.1E-09
DieselExhPM	2.9E-06
TOTAL	2.9E-06

PUBLIC HEALTH AND SAFETY Table 7
Results of Staff's Analysis: Contribution to Total Cancer Risk by Individual Substances at Nearest Residence

IVANPAH 1

Substance	Boiler	Emerg. Gen.	Fire Pump
PAHs-w/o	6.1E-10		
Naphthalene	4.2E-12		
Benzene	1.2E-11		
Formaldehyde	9.1E-11		
DieselExhPM		9.0E-08	1.4E-08
TOTAL	7.2E-10	9.0E-08	1.4E-08

IVANPAH 2

Substance	Boiler	Emerg. Gen.	Fire Pump
PAHs-w/o	2.7E-10		
Naphthalene	1.8E-12		
Benzene	5.3E-12		
Formaldehyde	4.0E-11		
DieselExhPM		2.9E-08	4.3E-09
TOTAL	3.1E-10	2.9E-08	4.3E-09

IVANPAH 3

Substance	Boiler	Emerg. Gen.	Fire Pump
PAHs-w/o	7.7E-10		
Naphthalene	5.4E-12		
Benzene	1.5E-11		
Formaldehyde	1.2E-10		
DieselExhPM		1.4E-08	2.1E-09
TOTAL	9.1E-10	1.4E-08	2.1E-09

IVANPAH 1, 2 & 3

Substance	TOTAL DUE TO 3 SOURCES AT 3 UNITS
PAHs-w/o	1.7E-09
Naphthalene	1.1E-11
Benzene	3.3E-11
Formaldehyde	2.5E-10
DieselExhPM	1.5E-07
TOTAL	1.6E-07

Proposed Project - Closure and Decommissioning Impacts and Mitigation

Closure of the proposed ISEGS would presumably begin 50 years from the start of commercial operation and would follow a Closure, Revegetation, and Rehabilitation Plan prepared by the applicant and designed to minimize public health and environmental impacts (CH2ML 2009f, Section 3.6 of Attachment DR130-2B). The preparation and implementation of the Closure, Revegetation, and Rehabilitation Plan would be in accordance with **Biological Resources** Condition of Certification **BIO-14**. Staff expects that impacts to public health from the closure and decommissioning process would represent a fraction of the impacts associated with the construction or operation of the proposed ISEGS. Therefore based on staff's analysis for the construction and operation phases of this project, staff concludes that public health-related impacts from closure and decommissioning of the ISEGS would be insignificant.

No Project / No Action Alternative

In the No Project / No Action Alternative, the proposed action would not be undertaken. The BLM land on which the project is proposed would continue to be managed within BLM's framework of a program of multiple use and sustained yield, and the maintenance of environmental quality [43 U.S.C. 1781 (b)] in conformance with applicable statutes, regulations, policy and land use plan.

The results of the No Project / No Action Alternative would be the following:

- The public health impacts of the proposed project would not occur. However, the land on which the project is proposed would become available to other uses that are consistent with BLM's land use plan, including another solar project.
- The benefits of the proposed project in reducing greenhouse gas emissions from gas-fired generation would not occur. Both State and Federal law support the increased use of renewable power generation.

If this project is not approved, renewable projects would likely be developed on other sites in the Mojave Desert or in adjacent states as developers strive to provide renewable power that complies with utility requirements and State/Federal mandates. For example, there are three large solar projects proposed on BLM land in Nevada within a few miles of the Ivanpah site. In addition, as of August 2009 there were 66 applications for solar projects covering 611,692 acres pending with BLM in the California Desert District.

CUMULATIVE IMPACTS AND MITIGATION

A project may result in a significant adverse cumulative impact where its effects are cumulatively considerable. "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects (California Code Regulation, Title 14, section 15130). NEPA states that cumulative effects can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR §1508.7).

There is the potential for substantial future development in the Ivanpah Valley area and throughout the southern California desert region. Analysis of cumulative impacts is based on data provided in the following maps and tables (see Section 4.0, Cumulative Scenario):

- Cumulative Impacts Figure 1, Regional Renewable Applications
- Cumulative Impacts Figure 2, Regional Renewable Applications (Detail)
- Cumulative Impacts Figure 3, Ivanpah Valley Existing and Future/Foreseeable Projects
- Cumulative Impacts Table 1, Regional Renewable Energy Projects
- Cumulative Impacts Table 2, Existing Development in the Ivanpah Valley
- Cumulative Impacts Table 3, Future Foreseeable Projects in the Ivanpah Valley Area.

The analysis in this section first defines the geographic area over which cumulative impacts related to public health could occur. The cumulative impact analysis itself describes the potential for cumulative impacts to occur as a result of implementation of the ISEGS project along with the listed local and regional projects.

Geographic Extent

Cumulative impacts can occur if implementation of the ISEGS project could combine with those of other local or regional projects. Cumulative impacts would occur locally if ISEGS project impacts combined with impacts of projects located within the Ivanpah Valley. Cumulative impacts could also occur as a result of development of some of the many proposed solar and wind development projects that have been or are expected to be under consideration by the BLM and the Energy Commission in the near future. Many of these projects are located within the California Desert Conservation Area, as well as on BLM land in Nevada and Arizona.

For purposes of the cumulative analysis, the emissions from construction or operation of the ISEGS project could potentially combine with emissions from past, present and reasonably foreseeable projects to result in adverse health effects to the public. Cumulative impacts to public health could occur as a result of implementation of the ISEGS project on both a local and regional level. The geographic extent for the analysis of local cumulative impacts associated with the ISEGS project includes the Mojave Desert Air Basin (MDAB) and the Ivanpah Valley Air Basin (IVAB). The shared nature of air resources warrants consideration of emissions occurring outside of the local air basin (MDAB).

Cumulative Impact Analysis

Cumulative impacts of the proposed project and other projects within a 6-mile radius were not evaluated by the applicant. The applicant has requested from the MDAQMD a list of all existing or planned emission sources (with construction permits or in the permitting process) within a 6-mile radius. The information received in response from the MDAQMD indicates that the only existing or planned emission source within six miles of the proposed project is a small existing gasoline dispensing system at the

Primm Valley Gold Club. The permit for this source limits ROG/VOC emissions to 0.45 tons per year. Another emission source (the Union Oil Molycorp facility) is approximately 6 miles from the proposed ISEGS, but the MDAQMD indicated that almost all equipment is located beyond the 6-mile radius (CH2ML 2008a, Attachment DR11-1). The applicant stated that due to the lack of existing or planned projects within a 6-mile radius for which emission data is available, no cumulative impact analysis would be prepared (CH2ML 2008a, Response to Data Requests 11 and 12). Staff has analyzed the public health and safety effects of existing and foreseeable projects listed in the Cumulative Scenario section as follows.

Local Projects

The maximum cancer risk for emissions from ISEGS (calculated by staff) is 2.9 in one million located at an isolated area in the adjacent desert with no buildings or residences nearby. The maximum impact location occurs where pollutant concentrations from ISEGS with all combustion sources operating at the same time would theoretically be the highest. Even at the maximum impact location, and in consideration of the existing natural gas-fired Bighorn Electric Generating Station, a proposed natural gas-fired Ivanpah Energy Center, both near Primm, and the proposed FirstSolar photovoltaic electric generation facility east of ISEGS, staff does not expect any significant change in lifetime risk to any person. The increase does not represent any real contribution to the average lifetime cancer incidence rate due to all causes (environmental as well as life-style and genetic). Modeled facility-related residential risks are lower at more distant locations, and actual risks are expected to be much lower since worst-case estimates are based on conservative assumptions and thus overstate the true magnitude of the risk expected. Therefore, staff does not consider the incremental impact of the additional risk posed by the ISEGS to be either individually or cumulatively significant.

Regional Projects

The nature of public health impacts—acute or long term exposure of people to materials that could result in negative health effects—combined with the vast area over which the future solar and wind development projects would be built in southeastern California, southern Nevada, and western Arizona, as well as the relative isolation of these projects from sensitive receptors, precludes the potential for impacts of these projects to combine with each other to result in significant impacts. Any emission from construction of these projects would be dispersed over these areas and would not be expected to result in acute or chronic health problems to sensitive receptors. Operation of the future solar and wind energy projects would result in negligible emissions, mostly related to worker vehicles and maintenance trucks, therefore, operation of these future projects would not result in negative regional health effects.

Cumulative Impact Conclusion

Public health impacts of the ISEGS project would not combine with impacts of any past, present, or reasonably foreseeable projects to result in cumulatively considerable local or regional impacts. Therefore, no mitigation is recommended to address potential cumulative project impacts.

COMPLIANCE WITH LORS

Staff has considered the minority population as identified in **Socioeconomics Figure 1** in its impact analysis and has found no potential significant adverse impacts for any receptors, including environmental justice populations. In arriving at this conclusion, staff notes that its analysis complies with all directives and guidelines from the Cal/EPA Office of Environmental Health Hazard Assessment and the California Air Resources Board. Staff's assessment is biased toward the protection of public health and takes into account the most sensitive individuals in the population. Using extremely conservative (health-protective) exposure and toxicity assumptions, staff's analysis demonstrates that members of the public potentially exposed to toxic air contaminant emissions of this project—including sensitive receptors such as the elderly, infants, and people with pre-existing medical conditions—will not experience any acute or chronic significant health risk or any significant cancer risk as a result of that exposure. Staff believes that it incorporated every conservative assumption called for by state and federal agencies responsible for establishing methods for analyzing public health impacts. The results of that analysis indicate that there would be no direct or cumulative significant public health and safety impact to any population in the area. Therefore, given the absence of any significant health impacts, there are no disparate health impacts and there are no environmental justice issues associated with **PUBLIC HEALTH AND SAFETY**.

Staff concludes that construction and operation of the ISEGS will be in compliance with all applicable LORS regarding long-term and short-term project impacts in the area of **PUBLIC HEALTH AND SAFETY**.

NOTEWORTHY PUBLIC BENEFITS

It is noteworthy that a solar electric generating facility such as the proposed ISEGS project would emit significantly less TACs to the environment than other energy sources available in California such as natural gas or biomass, thereby reducing the health risks that would otherwise occur with these non-renewable energy sources. At the same time, the proposed ISEGS would provide much needed electrical power to California residences and businesses, and will contribute to electric reliability. Electrical power is not only necessary to maintain a functioning society, but it also benefits many individuals who rely on powered equipment for their health (such as dialysis equipment and temperature control equipment). For example, it is documented that during heat waves in which elevated air-conditioning use causes an electrical blackout, hospitalizations and deaths due to heat stroke are increased.

PUBLIC AND AGENCY COMMENTS ON THE PSA

No comments have been received from the public or from agencies regarding public health.

CONCLUSIONS

Staff has analyzed potential public health risks associated with construction and operation of the ISEGS and does not expect any significant adverse cancer, short-term, or long-term health effects that would be considered to be significant under CEQA or NEPA to any members of the public, including low income and minority populations, from project toxic emissions. Staff also concludes that its analysis of potential health impacts from the proposed ISEGS uses a highly conservative methodology that accounts for impacts to the most sensitive individuals in a given population, including newborns and infants. According to the results of staff's health risk assessment, emissions from the ISEGS would not contribute significantly or cumulatively to morbidity or mortality in any age or ethnic group residing in the project area.

MITIGATION MEASURES/PROPOSED CONDITIONS OF CERTIFICATION

No conditions are proposed.

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