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Appendix M Public Health and Safety

5.6 PUBLIC HEALTH

Hydrogen Energy California LLC (HECA LLC) is proposing an Integrated Gasification Combined Cycle (IGCC) polygeneration project (HECA or Project). The Project will gasify a fuel blend of 75 percent coal and 25 percent petroleum coke (petcoke) to produce synthesis gas (syngas). Syngas produced via gasification will be purified to hydrogen-rich fuel, and used to generate a nominal 300 megawatts (MW) of low-carbon baseload electricity in a Combined Cycle Power Block, low-carbon nitrogen-based products in an integrated Manufacturing Complex, and carbon dioxide (CO_2) for use in enhanced oil recovery (EOR). CO_2 from HECA will be transported by pipeline for use in EOR in the adjacent Elk Hills Oil Field (EHOF), which is owned and operated by Occidental of Elk Hills, Inc. (OEHI). The EOR process results in sequestration (storage) of the CO_2.

Terms used throughout this section are defined as follows:

- **Project or HECA.** The HECA IGCC electrical generation facility, low-carbon nitrogen-based products Manufacturing Complex, and associated equipment and processes, including its linear facilities.

- **Project Site or HECA Project Site.** The 453-acre parcel of land on which the HECA IGCC electrical generation facility, low-carbon nitrogen-based products Manufacturing Complex, and associated equipment and processes (excluding off-site portions of linear facilities), will be located.

- **OEHI Project.** The use of CO_2 for EOR at the EHOF and resulting sequestration, including the CO_2 pipeline, EOR processing facility, and associated equipment.

- **OEHI Project Site.** The portion of land within the EHOF on which the OEHI Project will be located and where the CO_2 produced by HECA will be used for EOR and resulting sequestration**.**

- **Controlled Area.** The 653 acres of land adjacent to the Project Site over which HECA will control access and future land uses.

This introduction provides brief descriptions of both the Project and the OEHI Project. Additional HECA Project description details are provided in Section 2.0. Additional OEHI Project description details are provided in Appendix A of this Application for Certification (AFC) Amendment.

HECA Project Linear Facilities

The HECA Project includes the following linear facilities, which extend off the Project Site (see Figure 2-7, Project Location Map):

- **Electrical transmission line.** An approximately 2-mile-long electrical transmission line will interconnect the Project to a future Pacific Gas and Electric Company (PG&E) switching station east of the Project Site.

- **Natural gas supply pipeline.** An approximately 13-mile-long natural gas interconnection will be made with PG&E natural gas pipelines located north of the Project Site.

- **Water supply pipelines and wells.** An approximately 15-mile-long process water supply line and up to five new groundwater wells will be installed by the Buena Vista Water Storage District (BVWSD) to supply brackish groundwater from northwest of the Project Site. An approximately 1-mile-long water supply line from the West Kern Water District (WKWD) east of the Project Site will provide potable water.

- **Coal transportation.** HECA is considering two alternatives for transporting coal to the Project Site:

  — **Alternative 1, rail transportation.** An approximately 5-mile-long new industrial railroad spur that will connect the Project Site to the existing San Joaquin Valley Railroad (SJVRR) Buttonwillow railroad line, north of the Project Site. This railroad spur will also be used to transport some HECA products to market.

  — **Alternative 2, truck transportation.** An approximately 27-mile-long truck transport route via existing roads from an existing coal transloading facility northeast of the Project Site. This alternative was presented in the 2009 Revised AFC.

OEHI Project

OEHI will be installing the CO_2 pipeline from the Project Site to the EHOF, as well as installing the EOR Processing Facility, including any associated wells and pipelines needed in the EHOF for CO_2 EOR and sequestration. The following is a brief description of the OEHI Project, which is described in more detail in Appendix A of this AFC Amendment:

- **CO_2 EOR Processing Facility.** The CO_2 EOR Processing Facility and 13 satellites are expected to occupy approximately 136 acres within the EHOF. The facility will use 720 producing and injection wells: 570 existing wells and 150 new well installations. Approximately 652 miles of new pipeline will also be installed in the EHOF.

CO_2 pipeline. An approximately 3-mile-long CO_2 pipeline will transfer the CO_2 from the HECA Project Site south to the OEHI CO_2 EOR Processing Facility.

The analysis included in this section focuses on the HECA Project as well as the CO_2 pipeline associated with the OEHI Project. The analysis of the CO_2 EOR Processing Facility associated with the OEHI Project is included in Appendix A, Section 4.3, Air Quality and Section 4.7, Hazards and Hazardous Materials, of this AFC Amendment.

For the purposes of the health risk assessment (HRA), impacts were determined outside of both the Project Site and the Controlled Area. HECA will own both the Project Site and the Controlled Area, and will have control over public access and future land use. All temporary construction equipment laydown and parking, including construction parking, offices, and construction laydown areas, will be located on the Project Site and the Controlled Area.

To assess the potential impact of the Project on public health, a human health risk assessment (HRA) was performed, based on the Project's emissions of hazardous air pollutants (HAPs) and toxic air contaminants (TACs). The federal Clean Air Act (CAA) regulates HAPs, airborne pollutants that are known to have adverse human health effects. Unlike criteria pollutants, HAPs do not have adopted ambient air quality standards. HAPs have been regulated at the federal level since the CAA of 1977 under Title 40 of the Code of Federal Regulations (40 CFR), Part 61. Similar to the federal program, the California Clean Air Act regulates TACs, a class of airborne pollutants similar to the federal HAPs. Pollutants addressed under this section are generally referred to as TACs, except where federal designation is required.

To assess the potential impact of the proposed HECA Project on public health, an HRA was performed based on the Project's emissions of TACs. This section describes the methodology and results of the HRA for the Project. The purpose of the HRA is to evaluate potential public exposure and adverse health effects due to TAC emissions associated with Project operations. Impacts associated with the Project's emissions of criteria pollutants (i.e., pollutants for which federal or California ambient air quality standards [AAQS] have been promulgated) are described in Section 5.1, Air Quality. Potential public exposure to accidental releases of hazardous materials on the Project Site during operation is addressed in Section 5.12, Hazardous Materials Handling. To ensure worker safety during operations and construction, safe work practices will be followed (see Section 5.7, Worker Safety). An analysis of the impacts to worker safety from CO_2 venting is provided in Section 5.7, Worker Safety.

5.6.1 Affected Environment

The Project is near an oil-producing area in Kern County, California, as shown in Figure 2-1, Project Vicinity. The Project Site is in western unincorporated Kern County, approximately 7 miles west of the city of Bakersfield, approximately 2 miles northwest of the unincorporated community of Tupman, and approximately 6 miles southeast of the unincorporated community of Buttonwillow. The Project Site is bounded by Adohr Road on the north, Tupman Road to the east, an irrigation canal to the south, and Dairy Road to the west. Primary access to the site is from Adohr Road. Stockdale Highway and Interstate 5 are about 1 mile to the north and 3 miles to the east, respectively.

The western border of the Tule Elk State Natural Reserve is approximately 1,700 feet to the east of the Project Site and Controlled Area.

The California Energy Commission (CEC) defines sensitive receptors as infants and children, the elderly, the chronically ill, and any other members of the general population who are more susceptible to the effects of exposure to environmental contaminants than the population at large. For the purposes of this analysis, sensitive receptors are defined as the locations occupied by groups of individuals that may be more susceptible than the general population to health risks from a chemical exposure. These individuals include infants and children, the elderly, and the chronically ill. Sensitive receptor locations therefore include schools (public and private), day-care facilities, convalescent homes, parks, and hospitals.

Two sensitive receptors exist within 6 miles of the Project (6 miles is the extent of the modeling receptor grid): Elk Hills elementary school, 1.3 miles to the southeast; and the Tule Elk State

Natural Reserve, as described above. Figure 5.6-1, Sensitive and Residential Receptors Located Near the Project Site, shows the location of these sensitive receptors, plus the locations of the nearest residences. A total of 118 residences near the Project Site was included in the modeling. The closest residential neighborhood is in the unincorporated community of Tupman, approximately 2 miles southeast of the Project boundary. There are also additional single-family residences in the immediate Project vicinity, including residences approximately 1,400 feet to the east and 3,300 feet to the southeast of the Project Site. The HRA approach treats all human receptors as sensitive receptors.

After communicating with the local public health department at Kern County, health studies could not be identified concerning the potentially affected population(s) within a 6-mile radius of the Project Site related to respiratory illnesses, cancers, or related diseases (Chung, 2008).

The *Kern County Department of Public Health: Health Status Report – 2003* calculated average cancer mortality rates from 1993 to 2002 in Kern County as 183.0 per 100,000 people, compared to California's average of 185.0/100,000 people (Jinadu, 2003). The leading causes of death have remained consistent, with diseases of the heart and cancer as first and second leading causes of death, accounting for more than 60 percent of all deaths. The report compares the county's performance to the national objectives outlined in the U.S. Department of Health and Human Services' report, "Healthy People 2010: Understanding and Improving Health" (U.S. Department of Health and Human Services, 2000). "Kern County has made appreciable progress towards the 2010 goals in many areas of health. Yet, in other areas, substantial work still needs to be done to improve the health of our residents." In 2001, the Kern County death rate from heart disease was nearly 20 percent higher than the statewide average rate for California.

Coccidioides immites, a fungus that lives in the soils in southwestern United States and northwestern Mexico, is endemic to Kern County. The tiny spores become wind-borne and inhaled into the lungs, where they can cause *Coccidioidomycosis* or "Valley Fever." About 60 percent of the people who breathe in the spores do not get sick at all. For some it may feel like the cold or flu, and for some, pneumonia-like symptoms may occur, requiring medication and bed rest. Approximately 1 out of 200 who do get sick develop the disseminated form (the disease spreads past the lungs to the blood system), which can be fatal. The Health Officer recommends taking the following precautions for construction projects in Kern County:

1. When the top soil of undeveloped land is to be disturbed for construction, the standard precautionary measure of wetting the soil should be aggressively carried out.

2. It is advisable to perform work on non-windy days.

3. Workers doing soil excavation should wear simple dust masks for protection against exposure.

Further information on Valley Fever can be found in the "Valley Fever Task Force Report on the Control of *Coccidioides immites"* produced by the Kern County Department of Public Health (Jinadu, 1995).

The nearest California Air Resources Board (CARB) TAC monitor is in the Bakersfield-5558 California Avenue Monitoring Station, approximately 20 miles east of the Project Site. Although this station is in a suburban neighborhood, the proximity to the Project Site makes it representative of the local air quality. The most recent monitoring data are from year 2007, which are presented in Table 5.6-1, Annual Average Concentrations and Cancer Risks for Year 2007 from the Bakersfield-5558 California Avenue Monitoring Station, along with the estimated excess cancer risk. Summing the risk from all monitored TACs predicts an incremental background cancer risk of 81 in a million. By comparison, the risk of getting cancer for an individual in the United States from all causes is about 1 in 3, or 333,000 in one million.

5.6.2 Environmental Consequences

This section describes the evaluation of potential public health risks due to construction and operation of the Project, as well as the methodology and results of the HRA. A significant impact is defined as a maximum incremental cancer risk greater than 10 in 1 million, a chronic total hazard index (THI) greater than 1.0, or an acute THI greater than 1.0. Also, uncertainties in the HRA are discussed, and other potential health impacts of the Project are described.

5.6.2.1 Public Health Impact Assessment Approach

The potential human health risks posed by the Project's emissions were assessed by following the Office of Environmental Health Hazard Assessment (OEHHA) Air Toxics Hot Spots Program Risk Assessment Guidelines (Cal/EPA/OEHHA, 2003). The OEHHA guidelines were developed to provide risk assessment procedures, as required under the Air Toxics Hot Spots Information and Assessment Act of 1987, Assembly Bill 2588 (Health and Safety Code §§ 44360 *et seq*.). The Hot Spots law established a statewide program to inventory air toxics emissions from individual facilities, as well as guidance for execution of risk assessments and requirements for public notification of potential health risks.

As recommended by the OEHHA guidelines, the CARB Hotspots Analysis and Reporting Program (HARP) was used to perform an OEHHA Tier 1 HRA for the Project. HARP includes two modules: a dispersion module, and a risk module. The HARP dispersion module incorporates the U.S. Environmental Protection Agency (USEPA) ISCST3 air dispersion model. The HARP risk module implements the latest Risk Assessment Guidelines developed by OEHHA. For consistency with the criteria pollutant modeling, the dispersion modeling was conducted with AERMOD software. CARB has created a software package called HARP On-Ramp to convert AERMOD dispersion results into a format that can be read into the HARP risk module. Thus, HARP with AERMOD was used for this HRA.

The HRA was conducted in four steps using the HARP:

1. Hazard identification and emission quantification
2. Exposure assessment
3. Dose-response assessment
4. Risk characterization

First, hazard identification was performed to determine the potential health effects that could be associated with Project emissions. The purpose was to identify whether pollutants emitted during Project operation could be characterized as potential human carcinogens, or associated with other types of adverse health effects. Based on OEHHA guidelines, a list of pollutants with potential cancer and non-cancer health effects associated with the emissions from the Project has been provided in Table 5.6-2, Summary of Operational TACs and Toxicity Values Used to Characterize Health Risks.

Second, an exposure assessment was conducted to estimate the extent of public exposure to Project emissions. Public exposure is quantified based on the predicted maximum short- and long-term ground-level concentrations resulting from Project emissions, the exposure pathway(s), and the duration of exposure to those emissions. Dispersion modeling was performed using the AERMOD model to estimate the highest ground level 1-hour, 8-hour, and annual concentrations near the Project Site and Controlled Area boundary. The AERMOD model was run with unit emission rate (1 gram per second) for each source to calculate the concentration of TACs per unit emission rate from each source, known as "X/Q", for 1-hour and annual averaging times per receptor. AERMOD was run again to obtain the 8-hour concentrations per receptor for substances with 8-hour acute reference exposure levels (RELs). The 1-hour and annual X/Q values were processed in the HARP On-Ramp program for input into the HARP program. The methods used in the dispersion modeling were consistent with the approach described in Section 5.1, Air Quality, and the modeling protocols submitted for the Project to CEC, USEPA, and San Joaquin Valley Air Pollution Control District (SJVAPCD).

Third, a dose-response assessment was performed in HARP that incorporated the maximum 1-hour and annual ground-level concentrations predicted by AERMOD to characterize the relationship between pollutant exposure and the potential incidence of an adverse health effect in the exposed populations. The dose-response relationship is expressed in terms of potency factors for cancer risk and RELs for acute and chronic non-cancer risks. The OEHHA guidelines provide potency factors and RELs for an extensive list of TACs, including those listed in Table 5.6-2. All exposure pathways were included in this analysis, except the beef/dairy and fish ingestion and drinking water consumption pathways, no unenclosed water storage reservoirs or cattle exist near the site. For the calculation of cancer risk, the duration of exposure to Project emissions was assumed to be 24 hours per day for 70 years, at all receptors. The cancer risk was calculated in HARP using the Derived (Adjusted) Method, and the chronic THI was calculated in HARP using the Derived (OEHHA) Method. For the calculation of acute risk, it was assumed that exposure occurs over a 1-hour period. Calculation of chronic risk assumes an exposure over a 1-year period. The risk calculation for the maximally exposed individual worker (MEIW) assumed that the worker would be present at that location for 8 hours per day, 5 days per week, 49 weeks per year, for 40 years (default HARP worker adjustment).

Fourth, risk characterization was performed to integrate the health effects and public exposure information, and provide quantitative estimates of health risks resulting from Project emissions. Risk modeling was performed using HARP to estimate cancer and non-cancer health risks due to Project operational emissions. The HARP model uses OEHHA equations and algorithms to calculate health risks based on input parameters such as emissions, "unit" ground level concentrations, and toxicological data.

AERMOD modeling was conducted to determine the ground-level 8-hour concentrations of acetaldehyde, arsenic, formaldehyde, manganese, and mercury. These concentrations were then divided by the appropriate REL and summed by target organ to determine the total acute health index for TACs with 8-hour RELs.

Health risks were calculated for the areas that have public access; thus, all areas outside the Project Site and Controlled Area were included in the HRA.

Detailed descriptions of the model input parameters and results of the HRA are given in Section 5.6.2.4, Model Input Parameters. All HARP and AERMOD model files are provided electronically with this AFC Amendment.

The HRA was based on the Project with Alternative 1 (rail transportation). The differences that would result from Alternative 2 (truck transportation) are presented in Section 5.6.3, Alternatives.

5.6.2.2 Construction-Phase Emissions and HRA Approach

Of the air pollutants emitted during the construction period, diesel particulate matter (DPM) has the largest potential for human health risk. DPM has been classified by CARB and OEHHA as a TAC and a carcinogen. Section 5.1, Air Quality, presents a detailed analysis of the potential environmental impacts due to criteria pollutant emissions during construction, and a discussion of measures that will be implemented to control or reduce these emissions.

To analyze the potential cancer and chronic health impacts from DPM due to on-site DPM construction emissions, the exposure assessment was evaluated by modeling annual concentrations of particulate matter less than 10 microns in diameter (PM_{10}) from diesel exhaust sources. Because only one pollutant, DPM, was examined, AERMOD was run to estimate the ground-level PM_{10} concentration rather than Chi/Q. The AERMOD analysis conducted for the criteria pollutants was used to determine the ground-level PM_{10} concentration for the grid receptors from diesel exhaust sources. An additional run was conducted for the sensitive, residential, and off-site worker receptors; all other model parameters remained the same. Emissions from the construction activities are described in Section 5.1, Air Quality, and Appendix E-2, Construction Criteria Pollutant and Greenhouse Gas Emissions.

Emissions from the year consisting of construction months 20 through 31 were included in the HRA, because this was the 1-year period with the highest on-site DPM emissions. The cancer risk and chronic health index were estimated based on OEHHA and SJVAPCD guidance. With the exception of the off-site worker, all cancer risk was estimated based on residential cancer risk assumptions. The cancer risk was estimated by determining the inhalation dose from the annual PM_{10} concentration, then multiplying that by the cancer potency factor for an exposure duration factor of 4.1 years, as opposed to a typical lifetime exposure of 70 years, because the exposure to the DPM from construction equipment ends after 4.1 years (49 months). The maximally exposed individual worker (MEIW) cancer risk was analyzed in a manner similar to the residential cancer risk, with the exception that the off-site worker breathing rate of 149 liters per kilogram per day (L/kg-day) was used. The chronic hazard index was calculated by dividing the annual PM_{10} concentration by the chronic reference exposure level of 5.0 micrograms per cubic meter

($\mu g/m^3$). Detailed emission calculations for the PM_{10} from the diesel equipment and vehicles associated with construction are presented in Section 5.1, Air Quality, and Appendix E-2, Construction Criteria Pollutant and Greenhouse Gas Emissions.

To ensure worker safety during construction, safe work practices will be followed (see Section 5.7, Worker Safety and Health). Section 5.1, Air Quality, presents a detailed analysis of the potential environmental impacts due to criteria pollutant emissions during construction, and a discussion of measures that will be implemented to control or reduce these emissions.

Construction Emissions associated with OEHI EOR

The primary emission sources of TACs during construction of the OEHI Project facilities will be DPM from the heavy construction equipment. Different areas within the OEHI Project Site will be disturbed at different times during the 20-year construction phase of the proposed OEHI Project. An analysis of the public health impacts associated with the OEHI Project is included in Appendix A, Section 4.3, Air Quality and Section 4.7, Hazards and Hazardous Materials, of this AFC Amendment. That analysis concludes that the OEHI Project will not result in significant adverse impacts to public health.

5.6.2.3 Operational-Phase Emissions

Stationary Sources

The following operational sources associated with the Project will generate emissions of TACs. These emissions will be generated from the combustion of syngas, natural gas, diesel fuel, and process vent gasses. In addition, emissions will be generated from the operation of the cooling towers, the Manufacturing Complex, and fugitives associated with leaks in the piping and components from each process area.

Power Block	Gasification Block	Ancillary Equipment	Manufacturing Complex
• Combustion Turbine (MHI 501GAC®) • Power Block Cooling Tower	• Coal Dryer • Auxiliary Boiler • Gasification Flare • Sulfur Recovery Unit (SRU) Flare • Rectisol® Flare • Tail Gas Thermal Oxidizer • ASU and Process Cooling Towers • Carbon Dioxide Vent	• 2 Emergency Diesel Generators • Emergency Diesel Firewater Pump	• Nitric Acid Unit • Urea Absorbers • Urea Pastillation • Ammonium Nitrate Unit • Ammonia Synthesis Unit Startup Heater

A summary of the TACs that are expected to be emitted as a result of operations and the corresponding toxicity values used for evaluation are shown in Table 5.6-2.

Table 5.6-3, HECA Total Toxic Air Contaminant Annual Emission Rates, outlines the estimated TAC annual emission rates for each source listed above. These rates were determined based on

the size, capacity, and expected annual operating hours of each piece of equipment. TAC emission estimates were made using the following emission factors and assumptions for each source.

The most significant emission source of the Project will be the combustion turbine generator (CTG) / heat recovery steam generator (HRSG) train. The MHI 501GAC® combustion turbine and steam turbine generator will provide a 405 MW gross output to produce a maximum of 300 MW of reliable, low-carbon baseload electricity. Exhaust gas from the turbine section is ducted through the HRSG to generate high-energy steam, which produces additional electricity in the steam turbine. Some of the exhaust gas is also ducted from the HRSG to the gasification block to dry the feed, and will be discharged at the coal-dryer stack in that process block. Remaining exhaust gas at the HRSG is discharged through the HRSG stack. The combustion system is designed for operation on hydrogen-rich fuel. Natural gas is used during startup and shutdown of the combustion turbine and during periods of unplanned equipment outages (up to 2 weeks per year).

Emission factors for the CTG/HRSG and coal dryer were obtained from the Wabash River Generating Station test data and the National Energy Technology Laboratory, U.S. Department of Energy, *Major Environmental Aspects of Gasification-based Power Generation Technologies, Final Report*, December 2002. These are considered the most representative because of the use of similar technology in operation. Ammonia slip from the SCR is limited to 5 parts per million volume (ppmv) dry at 15 percent O_2. Mercury emissions are based on the mercury content in the feedstock, mercury removal efficiency in the syngas cleanup, and mercury removal efficiency in the coal dryer exhaust. Mercury will be removed downstream of the Sour Shift and Low Temperature Gas Cooling Units, and at the coal dryer using activated carbon.

CTG/HRSG and coal dryer TAC emissions were estimated based on operating conditions firing syngas. Hourly emission rates were calculated based on the maximum hourly heat input required for operation at 100 percent load, which occurred under an ambient temperature of 97°F with duct firing. Annual emissions rates were calculated based on 100 percent load at annual average temperature of 65°F with duct firing. Annual operating hours include operations on syngas with duct firing, startup, shutdown, and backup operation on natural gas. Emissions were conservatively based on all hours of operation applying the syngas emission factors.

Emission factors for TACs from the natural gas external combustion sources, the auxiliary boiler, tail gas thermal oxidizer, gasifier flare, Sulfur Recovery Unit (SRU) flare, Rectisol® flare, and Ammonia Synthesis Startup Heater are from USEPA AP-42 Section 1.4.

Auxiliary boiler hourly emission rates were calculated based on the required standard cubic feet of natural gas required per hour based on boiler design. Ammonia emissions were calculated based on a limit of 5 ppm due to slip from the SCR. Annual emission rates were calculated based on a 25 percent capacity factor.

Tail gas thermal oxidizer hourly emission rates were calculated based on the standard cubic feet of natural gas required per hour based on oxidizer design for a combination of pilot and startup operations. Annual emission rates were calculated based on 8,760 hours per year of operations plus 48 hours per year of startup.

Gasification flare hourly emissions were calculated based on the hourly heat input rate required for pilot flame operation and the heat content of the fuel flared during the peak hour of startup or shutdown activities; contributions of both were accounted for in the hourly rates. Annual emission rates were calculated assuming 8,760 hours per year of pilot operation, and approximately 28 hours per year of flaring events associated with plant startup and shutdown.

SRU flare hourly emissions were calculated based on the hourly heat input rate required for pilot flame operation and the heat content required for assist gas during a startup; contributions of both were accounted for in the hourly rates. Annual emission rates were calculated assuming 8,760 hours per year of pilot operation and approximately 40 hours per year of startup flaring.

Rectisol® flare hourly emissions were calculated based on the hourly heat input rate required for pilot flame operation and the heat content required for assist gas during a startup or shutdown; contributions of both were accounted for in the hourly rates. Annual emission rates were calculated assuming 8,760 hours per year of pilot operation, and approximately 40 hours per year of startup and shutdown flaring.

Ammonia Synthesis Startup Heater hourly emission rates were calculated based on the required standard cubic feet of natural gas required per hour based on heater design. Annual emission rates were calculated based on the usage of 140 hours for startup operation per year.

Cooling tower (Power Block, Air Separation Unit [ASU], and Process Area) TAC emissions were based on engineering calculations using the contaminant concentrations in the raw water, the number of cycles of concentration in the cooling towers, and the assumed drift rate. Arsenic, fluoride, manganese, and selenium concentrations in the raw water were based on analytical test results. Copper concentrations in the raw water were based on one-half of the stated detection limit.

Carbon dioxide (CO_2) vent hourly emissions were calculated based on maximum hourly flow (by mass) of the vent, and the concentration of TACs in the vent stream. The H_2S content in the vent stream is 10 ppm and the carbonyl sulfide (COS) content is 10 ppm. This CO_2 vent is used during startup and emergency upset conditions, which are, by definition, unplanned and difficult to predict. Although the CO_2 centrifugal compressor and other injection equipment have historically been very reliable, as a worst-case scenario, annual emission rates were calculated based on 504 hours of full-rate venting per year.

The only emissions associated with the HP and LP Urea Absorbers are ammonia, which are reduced by the wet scrubber. The ammonia emission rate for each absorber was provided by the Project engineers. The Urea absorbers will operate 8,052 hours per year.

The only TAC emissions associated with the Urea Pastillation Unit are ammonia. The ammonia emission rate was provided by the Project engineers. The Urea Pastillation Unit will operate 8,052 hours per year.

The HECA nitric acid plant will have an ammonia emission limit of 5 ppm due to slip from the SCR. Annual emissions are based on 8,052 hours of operation per year.

The two diesel generator hourly emission rates were calculated based on the horsepower rating of each generator and the USEPA interim Tier 4 emission standard particulate emission rate. Annual emissions were calculated based on 50 hours per year of operation for each of two generators.

Fire-pump engine hourly emission rates were calculated based on the horsepower rating of the engine and the USEPA interim Tier 4 emission standard particulate emission rate. Annual emissions were calculated based on 100 operating hours per year.

Fugitive Emissions

Fugitive emissions of TACs may occur in some areas of the facility due to leaks in the piping and components. Fugitive emissions are associated primarily with the gasification block and the Manufacturing Complex. A leak detection and repair (LDAR) program will be implemented in select process areas to maximize emission reductions. LDAR is the primary established method for controlling fugitive emissions from various pieces of equipment, such as valves and seals.

The Applicant proposes to apply the LDAR program to the following areas in the Gasification Block, Area # 1(methanol), Area # 5 (propylene), Area # 7 (hydrogen sulfide [H_2S]-laden methanol), Area #8 (CO_2-laden methanol), Area # 9 (acid gas), and Area # 10 (ammonia-laden gas), and all portions of the Manufacturing Complex. These areas were selected because they had the largest uncontrolled emissions for methanol, propylene, H_2S and ammonia.

The SJVAPCD released a memo "*Procedures for Quantifying Fugitive VOC Emissions at Petroleum and Synthetic Organic Chemicals Manufacturing Industry (SOCMI) Facilities*" (2005). The memo recommends using emission factors from the California Air Pollution Control Officers Association (CAPCOA) document "*California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities*" (1999), or the emission factors from the U.S. Environmental Protection Agency (USEPA) document "*Protocol for Equipment Leak Emission Estimates*" (1995) for new or modified emission units. In cases where the CAPCOA and USEPA emission factors are different, the SJVAPCD memo says that CAPCOA emissions factors will take precedence over the USEPA emission factors.

According to the USEPA document (USEPA, 1995), the criteria for determining the appropriateness of emission factors are based on the following: (1) process design; (2) process operation parameters; (3) types of equipment used; and (4) types of material handled. Based on these criteria, the Project processes are most similar to a SOCMI plant. Therefore, the SOCMI fugitive emission factors from USEPA are used in the fugitive emission calculations.

Although the fugitive emission factors are typically used for VOC emission, the USEPA document (USEPA, 1995) states that the average emission factors can be used for inorganic compounds (like H_2S and ammonia), in the event that there is no other approach available to estimate the concentration of the inorganic compounds at the equipment leak source. Because this is a new facility, it is not possible to estimate the fugitive concentrations of the inorganic compounds at the equipment leaks; therefore, the average emission factor approach will be used. The SOCMI fugitive emission factors are multiplied by the equipment component count split by service types and the weight percentage of the compounds in the stream.

There were no gasification facilities similar to the HECA Project that have prepared site-specific fugitive emissions factors. Therefore, the average emission factor approach (from USEPA) was used as the best estimate for fugitive emissions. Detailed emission calculations for the fugitives are presented in Appendix M, Public Health and Safety.

Mobile Sources

Trucks and trains delivering feedstock and removing products would travel to the Project Site on a regular basis. On-site truck and train trip emissions were incorporated in the dispersion modeling and HRA.

Emissions associated with the truck movement were calculated using heavy-heavy-duty diesel truck emission factors for all trucks except the Operations and Maintenance trucks, which were calculated with the light-heavy-duty gasoline and diesel factors, from the CARB on-road emissions model EMFAC2007. The anticipated Project start date is 2017. HECA will invest in a fleet of delivery trucks that are model year 2010 or newer; thus, EMFAC2007 emissions factors for vehicles for calendar year 2010 were used in the emission calculations.

The emissions factors for criteria pollutants for line-haul and switch locomotives were obtained from the USEPA document "Technical Highlights: Emission Factors for Locomotives" for Tier 3 engines. On-site feedstock and product train emissions were calculated assuming the majority of the time the line-haul engines will operate in Notch 1 or idling; therefore, emissions were conservatively estimated for Notch 1 horsepower. The percentage of total engine horsepower used at Notch 1 was obtained from the "Port Of Long Beach Air Emissions Inventory for 2007," which was based on data derived from the USEPA. Emissions from the switching engine were based on the EPA Tier 3 emission factors and maximum switching engine horsepower of 260 hp.

Table 5.6-3 presents a summary of the total annual TAC emissions from all sources. Detailed hourly and annual emission calculations for each source are presented in Appendix M, Public Health and Safety.

SJVAPCD Rule 2520 requires adherence to federally mandated operating permits. As such, it is important to designate whether the project is a major source of HAPs or not. Under the federal CAA, §112, a major source is defined as one that emits 10 tons per year or more of any HAP, or 25 tons per year or more of any combination of HAPs. The Project is not a major source of HAPs, as determined by the list of federal HAPs and the Project's total annual HAP emissions presented in Table 5.6-3.

Operations Emissions associated with OEHI EOR

TAC emissions associated with the OEHI Project include emissions from new equipment installed for the purpose of CO_2 EOR, and will include process heaters, tanks, fugitive emissions from equipment at the CO_2 EOR Processing Facility, and DPM emissions from maintenance activities conducted on emergency use only equipment (i.e., diesel engines used for fire pumps). Diesel emergency engine testing is expected to occur 12 hours per year per engine. The emergency use only flares do not include maintenance allowance, because the flares have to be removed from service in order to conduct such maintenance. Mobile source emissions are

limited to on-road vehicle emissions from operational-phase employees transiting between area residences and the OEHI Project Site.

OEHI will implement mitigation in the form of BACT and LDAR, plus ERCs will be provided, as required, to offset criteria pollutant emission increases from permitted sources, ensuring that impacts from emissions are less than significant. An analysis of the public health impacts associated with the OEHI Project is included in Appendix A, Section 4.3, Air Quality and Section 4.7, Hazards and Hazardous Materials, of this AFC Amendment. That analysis concludes that the OEHI Project will not result in significant adverse impacts to public health.

5.6.2.4 Model Input Parameters

The HRA was conducted using the hourly and annual emissions listed for each source identified in Table 5.6-3. Cancer and chronic non-cancer health effects were evaluated using the HARP model with estimated annual average emission rates, and acute non-cancer health effects were analyzed based on maximum hourly emission rates.

Dispersion modeling was performed using the AERMOD model and methods consistent with the approach described in Section 5.1, Air Quality (e.g., building downwash and meteorological input data), and the modeling protocols submitted for review to USEPA, CEC, and SJVAPCD.

The AERMOD model is run with unit emission rates (1 gram per second emissions) for each source described above to calculate the concentration of TACs per unit emission rate from each source. HARP then uses this information—along with the estimated source emission rates for specific TAC compounds (as described above and in Appendix M, Public Health and Safety)—to calculate ground-level concentrations for each chemical species. All sources described in Section 5.6.2.3 are included in the modeling analysis and HRA.

Meteorological data for the years 2006 through 2010 (the same years used in the air quality modeling analysis described in Section 5.1) were used in the HRA. Risk values were modeled for the sensitive and residential receptors identified in Section 5.6.1, and at all grid receptors within 6 miles (10 km) of the site. The same grid receptors used in the air quality modeling were used in the HRA. To be certain that the maximum potential risks resulting from Project emissions would be addressed, all receptors were treated as sensitive receptors.

The stack parameters used for the full-load operations of the CTG/HRSG with duct burning at the average ambient temperature of 65°F were used in the modeling. HECA anticipates that 1 to 2 plant startups/shutdowns will be necessary for maintenance annually. Due to the limited operation in startup mode, only stack parameters for the CTG/HRSG for the on-peak average ambient temperature case were included in the modeling assessment.

Toxicological data, cancer potency factors, and RELs for specific chemicals are built into the CARB's HARP model. The pollutant-specific cancer potency factors and RELs used in the HRA are listed in Table 5.6-2. The HARP model uses the toxicological data in conjunction with the other input data described above to perform health risk estimates based on OEHHA equations and algorithms.

5.6.2.5 Calculation of Health Effects

Adverse health effects are expressed in terms of cancer or non-cancer health risks. Cancer risk is typically reported as "lifetime cancer risk," which is the estimated maximum increase in the risk of developing cancer caused by long-term exposure to a pollutant suspected of being a carcinogen. The calculation of cancer risk conservatively assumes an individual is exposed continuously to the maximum pollutant concentrations 24 hours per day for 70 years. Although such continuous lifetime exposure to maximum TAC levels is highly unlikely, the goal of the approach is to produce a conservative worst-case estimate of potential cancer risk.

Non-cancer risk is typically reported as a THI. The THI is calculated for each target organ as a fraction of the maximum acceptable exposure level or REL for an individual pollutant. The REL is generally the level at (or below) which no adverse health effects are expected. The THIs are calculated for both short-term (acute) and long-term (chronic) exposures to non-carcinogenic substances by adding the ratios of predicted concentrations to RELs for all pollutants.

Both cancer and non-cancer risk estimates produced by the HRA represent incremental risks (i.e., risks due to the modeled sources only) and do not include potential health risks posed by existing background concentrations. The HARP model performs all of the necessary calculations to estimate the potential lifetime cancer risk, and the acute and chronic non-cancer THIs due to the Project's TAC emissions. The acute 8-hour THI is calculated directly from the predicted concentrations of acetaldehyde, arsenic, formaldehyde, manganese, and mercury.

5.6.2.6 Health Effects Significance Criteria

Various state and local agencies provide different significance criteria for cancer and non-cancer health effects. For the Project, the SJVAPCD *Guidelines for Assessing and Mitigating Air Quality Impacts* (January 2002) provide the significance criteria for potential cancer and non-cancer health effects due to Project-related emissions. For carcinogenic health effects, an exposure is considered significant when the predicted increase in lifetime cancer risk exceeds 10 in 1 million (10×10^{-6}). For non-carcinogenic acute and chronic health effects, an exposure that affects each target organ is considered significant when the corresponding THI exceeds a value of 1.0.

5.6.2.7 Health Risk Assessment Results

Construction HRA

Table 5.6-4, Estimated PM_{10} Concentration, Cancer Risk, and Chronic Non-Cancer THI Due to On-Site Construction Equipment DPM Exhaust, presents the peak PM_{10} annual concentration predicted with AERMOD, cancer risk, and chronic hazard index at the point of maximum impact (PMI), the maximally exposed individual resident (MEIR), the MEIW, and the nearest sensitive receptor during construction. The maximum modeled risk at a residence is reported in Table 5.6-4 as the MEIR. As shown in this table, the cancer risk and chronic hazard index from construction-related DPM at all receptor types were predicted to be below the significance thresholds.

The modeling files from this analysis, along with the spreadsheet to estimate the cancer risk and chronic hazard index, are provided electronically with this AFC Amendment.

Operational HRA

Table 5.6-5, Estimated Cancer Risk, Acute and Chronic Non-Cancer THI Due to HECA Operations, presents the results of the HRA at the PMI, MEIR, MEIW, and nearest sensitive receptor.

MEIR for the cancer and chronic and acute non-cancer health risks are presented in Table 5.6-5. As shown in this table, all health risks were predicted to be below the significance thresholds.

The AERMOD modeling files and risk calculation reports from HARP are included in the electronic files with this AFC Amendment. The files include the Chi/Q in micrograms per cubic meter ($\mu g/m^3$) per gram per second from each source at each receptor.

The maximum acute 8-hour THI resulting from worst-case hourly emissions of acetaldehyde, arsenic, formaldehyde, manganese, and mercury are presented in Table 5.6-6, Acute Hazard Index for TACs with 8-Hour RELs Predicted from Peak HECA Emissions, along with the summation of the health indices by target organ to obtain the 8-hour total hazard index per organ.

The estimated cancer risk at all locations is below the significance criterion of 10 in 1 million; thus, the Project emissions are expected to pose a less-than-significant increase in terms of carcinogenic health risk.

The estimated chronic and acute THIs are below the significance criterion of 1.0; thus, the Project emissions of noncarcinogenic TACs would not be expected to pose a significant risk.

5.6.2.8 Uncertainty in the Public Health Impact Assessment

Sources of uncertainty in the results of HRAs include emissions estimates, dispersion modeling, exposure characteristics, and extrapolation of toxicity data in animals to humans. For this reason, assumptions used in HRAs are typically designed to provide sufficient health protection to avoid underestimation of risk to the public. Some sources of uncertainty applicable to this HRA and the procedures and assumptions used to ensure health-protective results are discussed below.

The turbine emission rates were derived from emission factors from a similar project and using vendor data regarding ammonia slip and mercury rates. Both the short- and long-term turbine emissions estimates were developed assuming that the turbine will operate continuously, and at the maximum fuel energy input rate. Under actual operating conditions, the turbine will typically operate fewer hours per year and at lower loads. Consequently, the emissions used for this HRA are likely to be higher than what would be experienced under power plant operation.

Dispersion models approved for regulatory applications contain assumptions that lead to over-prediction of ground-level concentrations. For example, the modeling performed in the HRA assumed a conservation of mass (i.e., all of the pollutants emitted from the sources remained in the atmosphere while being transported downwind). During the transport of pollutants from

sources toward receptors, none of the emitted material was assumed to be removed from the source plumes by means of chemical reactions or losses at the ground surface due to reactions, gravitational settling, or turbulent impaction. In reality, these mechanisms work to reduce the level of pollutants remaining in the atmosphere during plume travel.

The exposure characteristics assessed in the HRA included the assumption that residents will be exposed to turbine emissions continuously at the same location for 24 hours per day, for 70 years. It is extremely unlikely that any resident will actually experience such exposure to the maximum predicted concentrations of TACs over this period. The conservative exposure assumption leads to over-predicted risk estimates in the HRA modeling.

The toxicity data used in the HRA contain uncertainties due to the extrapolation of health effects data from animals to humans. Typically, safety factors are applied when doing the extrapolation. Furthermore, the human population is much more diverse, both genetically and culturally, than bred experimental animals. The intraspecies variability is expected to be much greater among humans than in laboratory animals. With all of the uncertainty in the assumptions used to extrapolate toxicity data, significant measures are taken to ensure that sufficient health protection is built into the available health effects data.

Conservative measures to compensate for all of these uncertainties and ensure that potential health risks are not underestimated are compounded in the final HRA predictions. Therefore, the actual risk numbers are expected to be well below the values presented in this analysis.

5.6.2.9 Criteria Pollutants

The dispersion of the Project's emissions of criteria pollutants (nitrogen dioxide, carbon monoxide, sulfur dioxide, and particulate matter with an aerodynamic diameter of 10 and 2.5 microns or less [PM_{10} and $PM_{2.5}$]) was modeled, and an evaluation of their impacts on air quality is presented in Section 5.1, Air Quality. The federal and state AAQS set limits on the allowable levels of air pollutants in the ambient air necessary to protect public health. The results of the air quality analysis show that the Project will not cause a violation of any state or federal AAQS, and will not significantly contribute to existing violations of federal standards. Therefore, no significant adverse health effects are anticipated to result from the Project's criteria pollutant emissions.

5.6.3 Alternatives

Under Alternative 2, truck transport would be via existing roads from an existing coal transloading facility northeast of the Project Site. The truck route distance is approximately 26.5 miles.

Under this alternative, the on-site railroad spur would not be developed. Therefore, there would be no trains on site for feedstock delivery or product removal. Coal would be transported via trucks on existing roads from an existing coal transloading facility in the town of Wasco, northeast of the Project Site. All product would be transported by truck.

The main difference between Alternative 1 (rail transportation) and Alternative 2 (truck transportation) is that the approximately 5-mile railroad spur that would connect the Project Site to the existing San Joaquin Valley Railroad (SJVRR) Buttonwillow railroad line, north of the Project Site, would not be built; thus, no feedstock or product would be transported to or from the site via train. The coal would still be transported from New Mexico via train, but would be off-loaded at the transloading facility in Wasco, then trucked to the site. All product would be transported off site by truck; therefore, there would be more trucks accessing the site, but no trains. There are no changes to the stationary sources.

The only TAC affected by the change would be DPM. At the Project Site, the increase in emissions from the delivery trucks would be more than offset by the decrease in emissions from the trains. Section 5.1.3, Air Quality Alternatives, presents the transportation-related emissions associated with Alternative 2 (truck transportation), and the difference in emissions from Alternative 2 (truck transportation) to Alternative 1 (rail transportation) by air basin. Emission calculations are provided in Appendix E-12, Operational Transportation Emissions for Alternative 2.

HRA modeling was not conducted for Alternative 2 (truck transportation) because the on-site DPM emissions decrease, and all other TACs remain the same; thus, health risks associated with Alternative 2 (truck transportation) should be lower than predicted for Alternative 1 (rail transportation). Therefore, the TAC emissions from Alternative 2 (truck transportation) would have a less-than-significant health risk impact.

5.6.4 Cumulative Impact Analysis

Under certain circumstances, CEQA requires consideration of a project's cumulative impacts (CEQA Guidelines Section 15130) A "cumulative impact" consists of an impact that is created as a result of the combination of the project under review together with other projects causing related impacts (CEQA Guidelines Section 15355). CEQA requires a discussion of the cumulative impacts of a project when the project's incremental effect is cumulatively considerable (CEQA Guidelines Section 15130[a]). "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 (CEQA Guidelines Section 15065 [a][3]).

When the combined cumulative impact associated with a project's incremental effect and the effects of other projects is not significant, further discussion of the cumulative impact is not necessary (CEQA Guidelines Section 15130[a]). It is also possible that a project's contribution to a significant cumulative impact is less than cumulatively considerable and thus not significant (CEQA Guidelines Section 15130[a]).

The discussion of cumulative impacts should reflect the severity of the impacts and their likelihood of occurrence, but the discussion need not provide as great a level of detail as is provided for the effects attributable to the project under consideration (CEQA Guidelines Section 15130[b]). The discussion should be guided by standards of practicality and reasonableness (CEQA Guidelines Section 15130[b]).

A cumulative impact analysis starts with a list of past, present, and probable future projects within a defined geographical scope with the potential to produce related or cumulative impacts (CEQA Guidelines Section 15130[b]). Factors to consider when determining whether to include a related project include the nature of the environmental resource being examined, the location of the project, and its type (CEQA Guidelines Section 15130[b]). For purposes of this AFC Amendment, Kern County was contacted to obtain a list of related projects, which is contained in Appendix I. Depending on its location and type, not every project on this list is necessarily relevant to the cumulative impact analysis for each environmental topic.

A cumulative HRA is not presented in this AFC Amendment. There are no major sources of HAPs near the Project Site, and none are known to be proposed or under development.

An analysis of the public health impacts associated with the OEHI Project is included in Appendix A, Section 4.3, Air Quality and Section 4.7, Hazards and Hazardous Materials, of this AFC Amendment. That analysis concludes that the OEHI Project will not result in significant adverse cumulative impacts to public health.

5.6.5 Mitigation Measures

The criteria pollutant emissions from the Project will be mitigated by the use of Best Available Control Technology (BACT) and through emissions offsets. These measures are described in Section 5.1, Air Quality. In addition, pollution control technologies employed to control criteria pollutants (for example, the oxidation catalyst in the HRSG and the high-efficiency drift eliminators on the cooling towers) will further reduce emissions of TACs associated with the Project. These measures satisfy the SJVAPCD requirements for toxics (TBACT). Emissions from the cooling system will be limited by the use of high-efficiency drift control eliminators, and a biocide will be used to control bacterial growth and thereby minimize the possibility of Legionella being transmitted from the cooling system.

Strict controls for fugitive dust during construction will mitigate the potential for Valley Fever by reducing the amount of airborne dust particles potentially containing the spores.

The HRA presented in the foregoing subsections shows that the health effects impacts of the Project will be well below the significance thresholds identified in Section 5.6.2.6, Health Effects Significance Criteria. Therefore, no further mitigation of emissions from the Project is required to protect public health.

5.6.6 Laws, Ordinances, Regulations, and Standards

The Project will be constructed and operated in accordance with all laws, ordinances, regulations, and standards (LORS) applicable to protecting public health. This section briefly discusses the identified LORS. Table 5.6-7, Summary of LORS – Public Health, provides a summary of the requirements of the applicable LORS, the agencies that are principally responsible for public health, and the locations in this document where each of these issues is addressed.

5.6.6.1 Federal

The federal CAA of 1970, 42 United States Code 7401 *et seq*., as amended in 1977 and 1990, requires that the public be protected from unhealthful exposure to air pollutants. Based on the results of the risk assessment, health risks due to Project emissions of air toxics will not exceed acceptable levels. Emissions of criteria pollutants will be minimized by applying BACT to the facility. Increases in emissions of criteria pollutants will be fully offset.

This act requires new sources that emit more than 10 tons per year of any specified HAP or more than 25 tons per year of any combination of HAPs to apply Maximum Achievable Control Technology. HECA will not emit more than 10 tons per year of any HAP, or more than 25 tons per year of any combination of HAPs.

Under the federal CAA, on April 16, 2012, USEPA promulgated a new national emission standard for hazardous air pollutants (NESHAP) for both major HAPs and area sources for IGCC electric generating units (EGUs) that limits emissions of mercury, hydrogen chloride, and filterable particulate matter. Emissions of these pollutants from the HECA Project will comply with this standard.

5.6.6.2 State

California Public Resource Code § 25523(a); 20 CCR § 1752.5, 2300-2309, and Division 2 Chapter 5, Article 1, Appendix B, Part (1), requires that protection of environmental quality be ensured and that a quantitative HRA be performed. The HRA discussed in this section satisfies this requirement.

The California Clean Air Act, TAC Program, HSC § 39650, *et seq*. requires quantification of TAC emissions, use of BACT, and preparation of an HRA. The Project will not cause unsafe exposure to TACs based on results of the HRA discussed in this section, and a BACT assessment for the Project has been performed (see Section 5.1, Air Quality).

California Health and Safety Code, Part 6, § 44300 *et seq*. (Air Toxics "Hot Spots") requires inventorying of TACs and HRA, as well as public notification of predicted health risks. The HRA discussed in this section satisfies this requirement.

California Health and Safety Code § 41700 prohibits emissions in quantities that adversely affect public health, other businesses, or property. Section 5.1, Air Quality, and the HRA discussed in this section satisfy this requirement.

California Code of Regulations, Title 22, Section 60306 requires use of a drift eliminator and biocides to minimize the possibility of Legionella being transmitted from the cooling system.

5.6.6.3 Local

SJVAPCD Rule 2550 requires use of TBACT for major HAP sources to achieve maximum available control technology. The Project will not be a major source of HAPs. Therefore, this regulation does not apply, although the Project will apply controls that meet TBACT for the turbine and cooling towers.

SJVAPCD Rule 4102, Section 4.1 requires an HRA to estimate the maximum potential public exposure and health risk for purpose of approving the permit to operate and issuing public notice, if necessary. The HRA discussed in this section satisfies this requirement.

5.6.7 Involved Agencies and Agency Contacts

Agencies likely to be involved in the Project are shown in Table 5.6-8, Involved Agencies and Agency Contacts.

5.6.8 Permits Required and Permit Schedule

The Authority to Construct permitting process that would otherwise apply is superseded in the case of CEC power plant licensing projects by the Determination of Compliance process, which is its functional equivalent. The CEC's final decision on this AFC Amendment will serve as the principal approval required to ensure that the Project's impacts to public health will be within acceptable levels. However, a Permit to Operate will be awarded after SJVAPCD confirmation that the Project has been constructed to operate as described in the permit application(s).

5.6.9 References

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Table 5.6-1
Annual Average Concentrations and Cancer Risks for Year 2007 from the Bakersfield-5558 California Avenue Monitoring Station

TAC	Annual Concentration	Health Risk
Acetaldehyde	1.240	6
Benzene	0.310	29
1,3-Butadiene	0.050	19
Hexavalent Chromium	0.038	6
Formaldehyde	2.610	19
Methylene Chloride	0.100	<1
Perchloroethylene	0.041	2
Total Health Risk		81

Source: ARB Almanac 2009 – Appendix C: Emissions, Air Quality, and Health Risk for Ten Toxic Air Contaminants (http://www.arb.ca.gov/aqd/almanac/almanac09/appc09.htm)

Notes:

1. Concentrations for Hexavalent Chromium are expressed as ng/m^3, Concentrations for all other TACs are expressed as ppb.
2. Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. Total Health Risk represents only those compounds listed in this table and only those with data for the year. There may be other significant compounds for which monitoring and/or health risk information is not available.

TAC = toxic air contaminants

Table 5.6-2
Summary of Operational TACs and Toxicity Values Used to Characterize Health Risks

Compound	CAS #	Acute REL ($\mu g/m^3$)	8-Hour Inhalation REL ($\mu g/m^3$)	Chronic REL ($\mu g/m^3$)	Inhalation Cancer Potency Factor $(mg/kg\text{-}day)^{-1}$
3-Methylchloranthrene	56-49-5	–	–	–	2.2E+01
7,12-Dimethylbenz(a)anthracene	57-97-6	–	–	–	2.5E+01
Acetaldehyde	75-07-0	4.7E+02	3.0E+02	1.4E+02	1.0E-02
Ammonia*	7664-41-7	3.2E+03	–	2.0E+02	–
Arsenic	7440-38-2	2.0E-01	1.5E-02	1.5E-02	1.2E+01
Benz(a)anthracene	56-55-3	–	–	–	3.9E-01
Benzene	71-43-2	1.3E+03	–	6.0E+01	1.0E-01
Benzo(a)pyrene	50-32-8	–	–	–	3.9E+00
Benzo(b)fluoranthene	205-99-2	–	–	–	3.9E-01
Benzo(k)fluoranthene	207-08-9	–	–	–	3.9E-01
Beryllium	7440-41-7	–	–	7.0E-03	8.4E+00
Cadmium	7440-43-9	–	–	2.0E-02	1.5E+01
Carbon Disulfide	75-15-0	6.2E+03	–	8.0E+02	–
Chromium, (hexavalent)	18540-29-9	–	–	2.0E-01	5.1E+02
Chrysene	218-01-9	–	–	–	3.9E-02
Copper*	7440-50-8	1.0E+02	–	–	–
Cyanides	57-12-5	3.4E+02	–	9.0E+00	–
Dibenzo(a,h)anthracene	53-70-3	–	–	–	4.1E+00
Dichlorobenzene	106-46-7	–	–	8.0E+02	4.0E-02
Diesel Particulate Matter*	DPM	–	–	5.0E+00	1.1E+00
Fluoride*	–	2.4E+02	–	1.3E+01	–
Formaldehyde	50-00-0	5.5E+01	9.0E+00	9.0E+00	2.1E-02
Hexane	110-54-3	–	–	7.0E+03	–
Hydrochloric Acid	7647-01-0	2.1E+03	–	9.0E+00	–
Hydrogen Fluoride (Hydrofluoric Acid)	7664-39-3	2.4E+02	–	1.4E+01	–
Hydrogen Sulfide	7783-06-4	4.2E+01	–	1.0E+01	–
Indeno(1,2,3-cd)pyrene	193-39-5	–	–	–	3.9E-01
Lead	7439-92-1	–	–	–	4.2E-02
Manganese	7439-96-5	–	1.7E-01	9.0E-02	–
Mercury	7439-97-6	6.0E-01	6.0E-02	3.0E-02	–

Table 5.6-2
Summary of Operational TACs and Toxicity Values Used to Characterize Health Risks (Continued)

Compound	CAS #	Acute REL ($\mu g/m^3$)	8-Hour Inhalation REL ($\mu g/m^3$)	Chronic REL ($\mu g/m^3$)	Inhalation Cancer Potency Factor $(mg/kg\text{-}day)^{-1}$
Methanol	67-56-1	2.8E+04	–	4.0E+03	
Methyl Bromide (Bromomethane)	74-83-9	3.9E+03	–	5.0E+00	–
Methylene Chloride (Dichloromethane)	75-09-2	1.4E+04	–	4.0E+02	3.5E-03
Naphthalene	91-20-3	–	–	9.0E+00	1.2E-01
Nickel	7440-02-0	6.0E+00	–	5.0E-02	9.1E-01
Nitric Acid*	7697-37-2	8.6E+01	–	–	–
Phenol	108-95-2	5.8E+03	–	2.0E+02	–
Propylene*	115-07-1	–	–	3.0E+03	–
Selenium	7782-49-2	–	–	2.0E+01	–
Sulfuric Acid and Sulfates*	7664-93-9	1.2E+02	–	1.0E+00	–
Toluene	108-88-3	3.7E+04	–	3.0E+02	–
Vanadium*	7440-62-2	3.0E+01	–	–	–

Source: HECA 2012; OEHHA/CARB (2011)
Notes:
CAS # = Chemical Abstracts Service Registry Number
DPM = diesel particulate matter
REL = reference exposure level
$\mu g/m^3$ = micrograms per cubic meter
mg/kg-day = milligrams per kilogram per day
* Denotes pollutants that are not listed as Federal HAPs.

Table 5.6-3
HECA Total Toxic Air Contaminant Annual Emission Rates

Compound	CAS #	Annual Rate (TPY)	CTG/ HRSG Stack (lb/yr)	Coal Dryer Stack (lb/yr)	Cooling Tower (Power Block) (lb/yr)	Cooling Tower (Process Area) (lb/yr)	Cooling Tower (ASU) (lb/yr)	Auxiliary Boiler (lb/yr)	Ammonia Plant Startup Heater (lb/yr)	Emergency Generators (lb/yr)	Fire Water Pump (lb/yr)	Gasification Flare (lb/yr)	SRU Flare (lb/yr)	Rectisol® Flare (lb/yr)	TG Thermal Oxidizer (lb/yr)	CO_2 Vent (lb/yr)	Manufact-uring Complex (lb/yr)	On-site Truck (lb/yr)	On-site Train (lb/yr)	Fugitives (lb/yr)
Acetaldehyde	75-07-0	2.15E-02	3.66E+01	6.46E+00																
Ammonia*	7664-41-7	1.57E+02	1.56E+05	2.75E+04				1.03E+03									1.18E+05			1.14E+04
Antimony	7440-36-0	1.32E-02	2.24E+01	3.95E+00																
Arsenic	7440-38-2	2.88E-02	4.88E+01	8.61E+00	5.33E-02	8.70E-02	2.40E-02	8.89E-02	1.47E-03			1.43E-02	7.75E-04	3.78E-03	2.13E-02					
Benzene	71-43-2	2.94E-02	4.88E+01	8.61E+00				9.33E-01	1.54E-02			1.50E-01	8.14E-03	3.97E-02	2.24E-01					
Beryllium	7440-41-7	3.11E-03	5.28E+00	9.33E-01				5.33E-03	8.80E-05			8.56E-04	4.65E-05	2.27E-04	1.28E-03					
Cadmium	7440-43-9	1.15E-01	1.95E+02	3.44E+01				4.89E-01	8.07E-03			7.85E-02	4.26E-03	2.08E-02	1.17E-01					
Carbon Disulfide	75-15-0	5.50E-01	9.35E+02	1.65E+02																
Carbonyl Sulfide	463-58-1	2.69E+00														5.32E+03				5.94E+01
Chromium	7440-47-3	6.55E-03	1.04E+01	1.83E+00				6.22E-01	1.03E-02			9.99E-02	5.42E-03	2.64E-02	1.49E-01					
Chromium (hexavalent)	18540-29-9	1.83E-03	3.11E+00	5.49E-01																
Cobalt	7440-48-4	3.14E-03	5.28E+00	9.33E-01				3.73E-02	6.16E-04			5.99E-03	3.25E-04	1.59E-03	8.95E-03					
Copper*	7440-50-8	2.93E-04			1.03E-02	1.69E-02	4.66E-03	3.78E-01	6.23E-03			6.06E-02	3.29E-03	1.61E-02	9.06E-02					
Cyanides	57-12-5	6.87E-02	1.16E+02	2.04E+01																1.15E+00
Fluoride*	1101	1.44E-03			9.31E-01	1.52E+00	4.20E-01													
Formaldehyde	50-00-0	2.28E-01	3.46E+02	6.10E+01				3.33E+01	5.50E-01			5.35E+00	2.91E-01	1.42E+00	7.99E+00					
Hexane	110-54-3	5.87E-01						8.00E+02	1.32E+01			1.28E+02	6.97E+00	3.40E+01	1.92E+02					
Hydrochloric Acid	7647-01-0	1.55E-01	2.64E+02	4.66E+01																
Hydrogen Fluoride (hydrofluoric acid)	7664-39-3	5.98E-01	1.02E+03	1.79E+02																
Hydrogen Sulfide	7783-06-4	2.64E+00														3.01E+03				2.28E+03
Lead	7439-92-1	6.70E-03	1.14E+01	2.01E+00																
Manganese	7439-96-5	1.67E-02	2.11E+01	3.73E+00	2.66E+00	4.35E+00	1.20E+00	1.69E-01	2.79E-03			2.71E-02	1.47E-03	7.18E-03	4.05E-02					
Mercury	7439-97-6	7.71E-03	1.03E+01	4.98E+00				1.16E-01	1.91E-03			1.85E-02	1.01E-03	4.91E-03	2.77E-02					
Methanol	67-56-1	7.09E+00																		1.42E+04
Methyl Bromide (Bromomethane)	74-83-9	5.70E-01	9.70E+02	1.71E+02																
Methylene Chloride (Dichloromethane)	75-09-2	2.63E-02	4.47E+01	7.89E+00																
Naphthalene	91-20-3	3.01E-02	5.08E+01	8.97E+00				2.71E-01	4.47E-03			4.35E-02	2.36E-03	1.15E-02	6.50E-02					
Nickel	7440-02-0	5.35E-03	7.93E+00	1.40E+00				9.33E-01	1.54E-02			1.50E-01	8.14E-03	3.97E-02	2.24E-01					
Nitric Acid*	7697-37-2	8.19E-01																		1.64E+03
Phenol	108-95-2	4.40E-01	7.48E+02	1.32E+02																

Table 5.6-3
HECA Total Toxic Air Contaminant Annual Emission Rates (Continued)

Compound	CAS #	Annual Rate (TPY)	CTG/ HRSG Stack (lb/yr)	Coal Dryer Stack (lb/yr)	Cooling Tower (Power Block) (lb/yr)	Cooling Tower (Process Area) (lb/yr)	Cooling Tower (ASU) (lb/yr)	Auxiliary Boiler (lb/yr)	Ammonia Plant Startup Heater (lb/yr)	Emergency Generators (lb/yr)	Fire Water Pump (lb/yr)	Gasification Flare (lb/yr)	SRU Flare (lb/yr)	Rectisol® Flare (lb/yr)	TG Thermal Oxidizer (lb/yr)	CO_2 Vent (lb/yr)	Manufact-uring Complex (lb/yr)	On-site Truck (lb/yr)	On-site Train (lb/yr)	Fugitives (lb/yr)
Propylene*	115-07-1	6.33E+00																		1.27E+04
Selenium	7782-49-2	6.77E-03	1.14E+01	2.01E+00	4.43E-02	7.23E-02	2.00E-02	1.07E-02	1.76E-04			1.71E-03	9.30E-05	4.53E-04	2.56E-03					
Sulfuric Acid and Sulfates*	7664-93-9	1.14E+00	1.93E+03	3.41E+02																
Toluene	108-88-3	1.50E-03	6.71E-01	1.18E-01				1.51E+00	2.49E-02			2.43E-01	1.32E-02	6.42E-02	3.62E-01					
Vanadium*	7440-62-2	7.50E-04						1.02E+00	1.69E-02			1.64E-01	8.91E-03	4.34E-02	2.45E-01					
Diesel Particulate Matter*	DPM	7.72E-02								4.51E+01	1.84E+00							1.48E+01	9.26E+01	
2-Methylnaphthalene	91-57-6	7.83E-06						1.07E-02	1.76E-04			1.71E-03	9.30E-05	4.53E-04	2.56E-03					
3-Methylchloranthrene	56-49-5	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
7,12-Dimethylbenz(a)anthracene	57-97-6	5.22E-06						7.11E-03	1.17E-04			1.14E-03	6.20E-05	3.02E-04	1.71E-03					
Acenaphthene	83-32-9	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Acenaphthylene	208-96-8	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Anthracene	120-12-7	7.83E-07						1.07E-03	1.76E-05			1.71E-04	9.30E-06	4.53E-05	2.56E-04					
Benz(a)anthracene	56-55-3	2.81E-05	4.68E-02	8.25E-03				8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Benzo(a)pyrene	50-32-8	3.91E-07						5.33E-04	8.80E-06			8.56E-05	4.65E-06	2.27E-05	1.28E-04					
Benzo(b)fluoranthene	205-99-2	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Benzo(g,h,i)perylene	191-24-2	3.91E-07						5.33E-04	8.80E-06			8.56E-05	4.65E-06	2.27E-05	1.28E-04					
Benzo(k)fluoranthene	207-08-9	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Chrysene	218-01-9	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Dibenzo(a,h)anthracene	53-70-3	3.91E-07						5.33E-04	8.80E-06			8.56E-05	4.65E-06	2.27E-05	1.28E-04					
Dichlorobenzene	106-46-7	3.91E-04						5.33E-01	8.80E-03			8.56E-02	4.65E-03	2.27E-02	1.28E-01					
Fluoranthene	206-44-0	9.78E-07						1.33E-03	2.20E-05			2.14E-04	1.16E-05	5.67E-05	3.20E-04					
Fluorene	86-73-7	9.13E-07						1.24E-03	2.05E-05			2.00E-04	1.08E-05	5.29E-05	2.98E-04					
Indeno(1,2,3-cd)pyrene	193-39-5	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Phenanathrene	85-01-8	5.54E-06						7.55E-03	1.25E-04			1.21E-03	6.59E-05	3.21E-04	1.81E-03					
Pyrene	129-00-0	1.63E-06						2.22E-03	3.67E-05			3.57E-04	1.94E-05	9.44E-05	5.33E-04					
Total Combined HAPs and TACs (tpy)		**181.47**	**81.44**	**14.37**	**0.00**	**0.00**	**0.00**	**0.93**	**0.01**	**0.02**	**0.00**	**0.07**	**0.00**	**0.02**	**0.10**	**4.17**	**59.17**	**0.01**	**0.05**	**2.11E+01**
Total HAPs* (tpy)		**15.94**	**2.46**	**0.44**	**0.00**	**0.00**	**0.00**	**0.42**	**0.01**	**0.00**	**0.00**	**0.07**	**0.00**	**0.02**	**0.10**	**4.17**	**0.00**	**0.00**	**0.00**	**8.25E+00**

Note:
* Denotes pollutants that are not listed as Federal HAPs. These pollutants are not included in the HAP total provided. As shown, combined annual HAP emissions are less than 25 tons per year. Additionally, individual HAP emissions are below 10 tons per year.
This table presents transportation emissions associated with Alternative 1 (rail transportation).ASU = Air Separation Unit
CAS = Chemical Abstracts Service Registry Number
HAPs = hazardous air pollutant
lb/yr = pounds per year
TACs = toxic air contaminants

Table 5.6-4
Estimated PM_{10} Concentration, Cancer Risk, and Chronic Non-Cancer THI Due to On-site Construction Equipment DPM Exhaust

Location	AERMOD PM_{10} Results ($\mu g/m^3$)	DPM Cancer Risk	DPM Chronic Non-Cancer Total Hazard Index (THI)
Point of maximum impact	0.228	5.5 excess risk in 1 million	0.046
Peak risk at nearest off-site worker (MEIW) (Tule Elk State Reserve Ranger Station)	0.0244	0.16 excess risk in 1 million	0.0049
Peak risk at nearest residence (MEIR) (Residence at Station Rd/Tule Park Rd)	0.0499	1.21 excess risk in 1 million	0.00997
Peak risk at nearest Sensitive Receptor (Elk Hills School, Tupman, CA)	0.0051	0.12 excess risk in 1 million	0.001
Significance threshold	NA	10 in 1 million	1
Below significance?	NA	Yes	Yes

Source: HECA 2012.
Notes:
1. DPM cancer risk is based on 4.1 year exposure to match with the construction duration.

$\mu g/m^3$ = micrograms per cubic meter
DPM = diesel particulate matter
MEIR = maximally exposed individual resident
MEIW = maximally exposed individual worker
NA = not applicable
PM_{10} = particulate matter less than 10 microns in diameter
THI = total hazard index

Table 5.6-5
Estimated Cancer Risk, Acute and Chronic Non-Cancer THI Due to HECA Operations

Location	Cancer Risk	Chronic Non-Cancer Total Hazard Index	Acute Non-Cancer Total Hazard Index
Point of maximum impact	8.97 excess risk in 1 million	0.42	0.88
Coordinates of PMI in UTM NAD83 (m) easting northing	283,967 3,911,925	283,959 3,911,625	282,663 3,912,844
Peak risk at off-site worker MEIW (Tule Elk State Reserve Ranger Station)	1.90 excess risk in 1 million	0.13	0.23
Coordinates of MEIW in UTM NAD83 (m) easting northing	285,106 3,911,707	285,106 3,911,707	285,106 3,911,707
Peak risk at MEIR	4.29 excess risk in 1 million	0.29	0.33
Coordinates of MEIR in UTM NAD83 (m) easting northing	283,989 3,910,951 (Residence along the southeastern side of the property line on Tupman Road)	283,989 3,910,951 (Residence along the southeastern side of the property line on Tupman Road)	284,401 3,912,477 (Residence on Tule Park Road near Station Road)
Peak risk at nearest Sensitive Receptor (Elk Hills School, Tupman, California)	0.96 excess risk in 1 million	0.07	0.11
Coordinates of Sensitive Receptor in UTM NAD83 (m) easting northing	285,878 3,908,605	285,878 3,908,605	285,878 3,908,605
Significance threshold	10 in 1 million	1	1
Below significance?	Yes	Yes	Yes

Source: HECA, 2012.
Notes:
1. MEIW cancer risk is conservatively based on a residential risk calculation; i.e., a 70 year exposure.
This table presents health risks associated with transportation emissions from Alternative 1 (rail transportation).
m = meters
MEIR = maximally exposed individual resident
MEIW = maximally exposed individual worker
PMI = point of maximum impact
THI = total hazard index
UTM = Universal Transverse Mercator

Table 5.6-6
Acute Hazard Index for TACs with 8-hour RELs Predicted from Peak HECA Emissions

TAC	8-hour Inhalation Risk Value µg/m^3	Hazard Index	Hazard Index Target Organs
Acetaldehyde	300	0.000005	Respiratory system
Arsenic	0.015	0.1267	Development; cardiovascular system; nervous system; lung; skin
Formaldehyde	9	0.0320	Respiratory system
Manganese	0.17	0.0097	Nervous system
Mercury	0.06	0.0187	Nervous system
Total Hazard Index – Respiratory system		**0.0320**	**Respiratory system**
Total Hazard Index - Nervous system		**0.1550**	**Nervous system**
Total Hazard Index – Other organs		**0.1267**	**Development; cardiovascular system; lung; skin**

Notes:
RELs = reference exposure levels
TACs = toxic air contaminants
µg/m^3 = micrograms per cubic meter

Table 5.6-7
Summary of LORS – Public Health

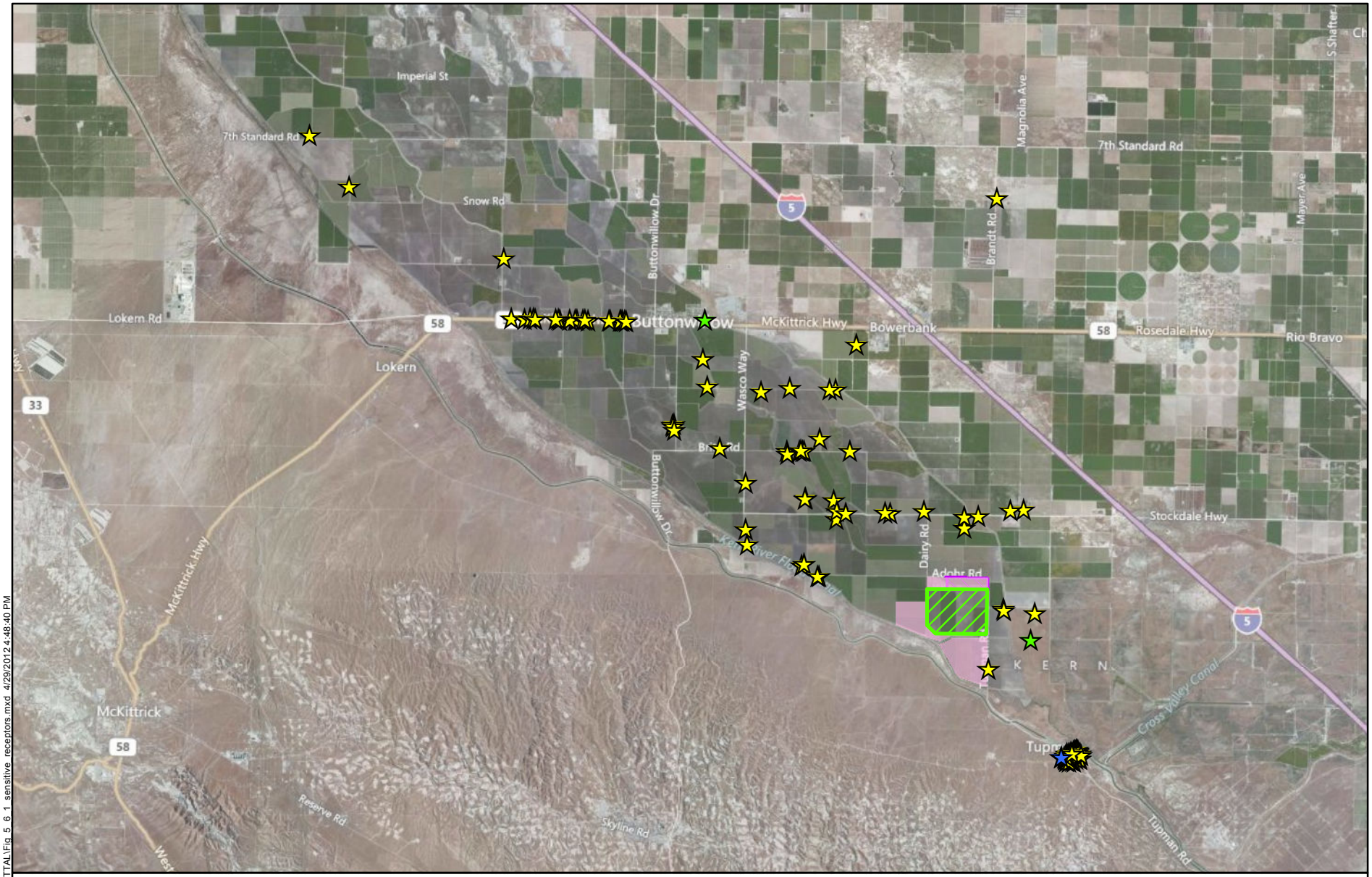
Authority	Administering Agency	Requirement	AFC Amendment Section(s)
Federal			
Clean Air Act (CAA) Section 112	USEPA CARB SJVAPCD	Protect public from unhealthful exposure to air pollutants.	5.6, 5.1
State			
California Public Resource Code § 25523(a); 20 CCR § 1752.5, 2300-2309, and Division 2 Chapter 5, Article 1, Appendix B, Part (1)	CEC	Ensure protection of environmental quality; requires quantitative HRA.	5.6.
California Clean Air Act, TAC Program, H&SC § 39650, et seq.	SJVAPCD with CARB oversight	Requires quantification of TAC emissions, use of BACT, and preparation of an HRA.	5.6, 5.1
H&SC, Part 6, § 44300 et seq. (Air Toxics "Hot Spots")	SJVAPCD with CARB/OEHHA oversight	Requires inventorying of TACs and HRA, as well as public notification of predicted health risks.	5.6.2
H&SC § 41700	SJVAPCD with CARB oversight	Prohibits emissions in quantities that adversely affect public health, other businesses, or property.	5.1
Local			
SJVAPCD Rule 2520, Section 2.1	SJVAPCD	Requires Federally Mandated Operating Permit for major sources of air toxics	The Project will not be a major source of HAPs, thus this regulation does not apply.
SJVAPCD Rule 2550	SJVAPCD	Requires use of TBACT for major HAP sources to achieve MACT.	5.6
SJVAPCD Rule 4102, Section 4.1 and Policy APR 1905	SJVAPCD	Requires sources to not discharge air toxics detrimental to public health and prepare a HRA.	5.6

Notes:

AFC = Application for Certification
BACT = Best Available Control Technology
CARB = California Air Resources Board
CCR = California Code of Regulations
CEC = California Energy Commission
H&SC = Health and Safety Code
HAP = hazardous air pollutant
HRA = Health Risk Assessment
LORS = laws, ordinances, regulations, and standards
MACT = Maximum Available Control Technology
OEHHA = Office of Environmental Health Hazard Assessment
SJVAPCD = San Joaquin Valley Air Pollution Control District
TAC = toxic air contaminant
TBACT = Toxic Best Available Control Technology
USEPA = U.S. Environmental Protection Agency

Table 5.6-8
Involved Agencies and Agency Contacts

Agency	Contact/Title	Telephone
California Energy Commission	Gerry Bemis Air Quality Specialist 1516 Ninth Street Sacramento, CA 95814	(916) 654-4960
	Dr. Alvin Greenberg Public Health Specialist 1516 Ninth Street Sacramento, CA 95814	(415) 479-7560
California Air Resources Board	Mike Tollstrup 1001 I Street Sacramento, CA 95814	(916) 322-6026
San Joaquin Valley Air Pollution Control District	Leland Villalvazo Supervising Air Quality Specialist 1990 E. Gettysburg Avenue Fresno, CA 93726	(559) 230-5881



Project Site
Construction Staging Area
Controlled Area

Dwelling
Park/Reserve
School

N

0 1 2 Miles

SENSITIVE AND RESIDENTIAL RECEPTORS NEAR THE PROJECT SITE

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 5.6-1

Source: Aerial Imagery, (c) 2010 Microsoft Corporation and its data suppliers.

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