URS

California Energy Commission
DOCKETED
08-AFC-8A
TN 70895
MAY 20 2013

May 17, 2013

CALIFORNIA ENERGY COMMISSION – DOCKET UNIT
Attn: Docket No. 08-AFC-08A
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512

Re: HECA Updated Emissions and Modeling Report

Enclosed is the Updated Emissions and Modeling Report prepared by URS Corporation for the HECA Project. The enclosed report is intended to consolidate Project refinement information provided since the Authority to Construct Permit Application and Supplemental Information for the Prevention of Significant Deterioration Permit Application submitted to SJVAPCD and the Amended Application for Certification submitted to CEC in May 2012 in one place for ease of use. It is being provided at this time to accompany the Applicant's comments on the SJVAPCD Preliminary Determination of Compliance.

The vast majority of this information has been previously presented in various Data Requests (from both the CEC and interveners) and agency communications, and is in the public forum. None of the information contained within represents substantive Project changes.

Modeling files burned to DVD are also being sent to the CEC.

Sincerely,

URS Corporation

Dale Shileikis
Project Manager
URS Corporation

Enclosure:
Updated Emissions and Modeling Report
Modeling Files DVD

cc: Marisa Mascaro, HECA

URS Corporation
One Montgomery Street, Suite 900
San Francisco, CA 94104
Tel: 415.896.5858
Fax: 415.882.9261

HYDROGEN ENERGY CALIFORNIA
KERN COUNTY, CALIFORNIA

UPDATED EMISSIONS AND MODELING REPORT

Prepared for:
San Joaquin Valley Air Pollution Control District

Prepared on behalf of:
Hydrogen Energy California LLC

Prepared by:

URS Corporation
Post Montgomery Center
One Montgomery Street, Suite 900
San Francisco, CA 94104-4538

URS Project Number 28068052

May 2013

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Acronyms

AAQS	Ambient Air Quality Standards
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AFC	Application for Certification
AGR	acid gas removal
AQRV	Air quality related values
ASU	air separation unit
ATC	Authority to construct
BACT	Best available control technology
BPIP-Prime	Building Parameter Input Program – Prime
CAAQS	California Ambient Air Quality Standards
$CaCO_3$	calcium carbonate
CARB	California Air Resources Board
CAS	Chemical Abstract Service
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CTG	combustion turbine generator
DPM	Diesel particulate matter
EOR	enhanced oil recovery
EPS	Emission Performance Standard
ERC	emissions reduction credits
°F	degrees Fahrenheit
FLAG	Federal Land Managers' Air Quality Related Values Workgroup
GCD	General Conformity Determination
GEP	Good Engineering Practices
GHG	Greenhouse gas
gr/dscf	grain per dry standard cubic foot
H_2	hydrogen
H_2S	Hydrogen sulfide
HAP	hazardous air pollutant
HARP	Hotspots analysis and reporting program
HECA	Hydrogen Energy California (or Applicant)
HHV	higher heating value
HP	high pressure
HRA	Health risk assessment
HRSG	heat recovery steam generator
ID	Identification

lb/MWh	pound per megawatt-hour
lbs/hr	pounds per hour
LDAR	Leak detection and repair
LP	low pressure
LTCG	low-temperature cooling gas
MEIR	Maximally exposed individual resident
MEIW	Maximally exposed individual worker
$\mu g/m^3$	micrograms per cubic meter
MHI	Mitsubishi Heavy Industries
MMBtu	million British thermal units
MMBtu/hr	million British thermal units per hour
MW	megawatt
MWh	megawatts per hour
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NH_3	Ammonia
NO_2	Nitrogen dioxide
NO_X	Nitrogen oxides
NSR	New source review
O_3	ozone
OEHI	Occidental of Elk Hills, Incorporated
petcoke	Petroleum and coke
PM	Particulate matter
PM_{10}	particulate matter less than 10 μm in diameter
$PM_{2.5}$	particulate matter less than 2.5 μm in diameter
ppm	parts per million
ppmv	parts per million by volume
PSA	Pressure Swing Adsorption
PSD	Prevention of significant deterioration
PVMRM	Plume Volume Molar Ratio Method
Q/d	sum of the annualized daily emissions of PM_{10}, NO_2, SO_2, and H_2SO_4 divided by the distance to the nearest Class I Area
REL	Reference Exposure Level
SB	Senate Bill
SCR	Selective catalytic reduction
SF_6	Sulfur hexafluoride
SIL	Significant impact level
SJVAB	San Joaquin Valley Air Basin
SJVAPCD	San Joaquin Valley Air Pollution Control District
SMC	Significant Monitoring Concentrations
SO_2	Sulfur dioxide
SO_X	sulfur oxide

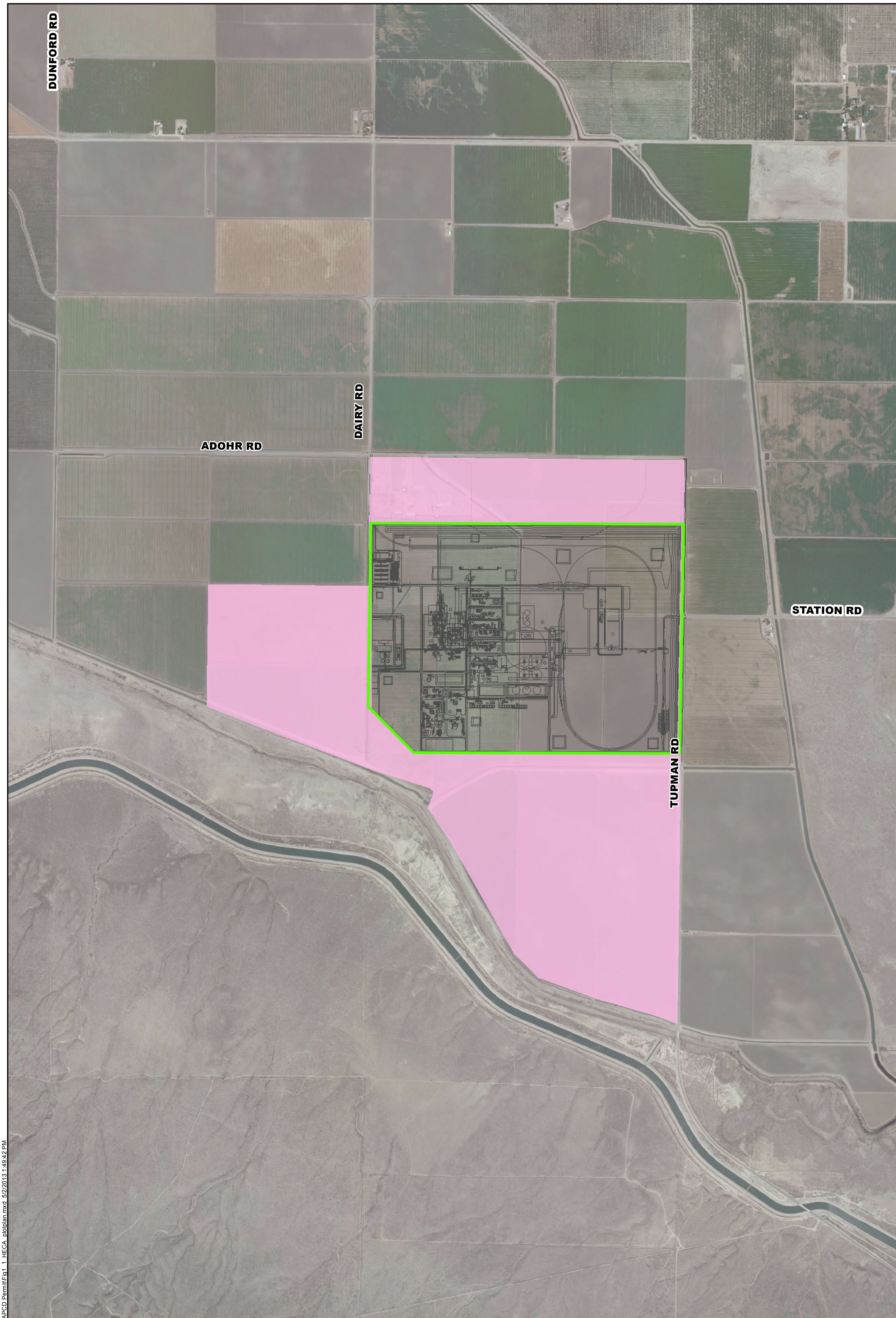
SRU	sulfur recovery unit
STG	steam turbine generator
syngas	Synthesis gas
TAC	toxic air contaminants
TGTO	Tail Gas Thermal Oxidizer
TGU	tail gas unit
THI	total hazard index
tonnes	metric tons
tonnes/yr	metric tons per year
tpy	tons per year
UAN	urea ammonium nitrate
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VOCs	volatile organic compounds

During the process of developing the San Joaquin Valley Air Pollution Control District (SJVAPCD) air permit, and in response to Data Requests from the California Energy Commission (CEC), emissions from some sources have been updated as a result of Project engineering performed subsequent to the submittal of the permit application. This report outlines these Project updates since the submittal of the Authority to Construct (ATC) Permit Application and Supplemental Information for the Prevention of Significant Deterioration (PSD) Permit Application (ATC/PSD Application) in May 2012; and the Amended Application for Certification (Amended AFC) submitted to CEC in May 2012.

These refinements modify some emissions rates, stack parameters, and stack and building locations, but do not fundamentally alter the nature of the Project. This report describes the Project refinements, and analyzes potential air quality impacts. The emissions of criteria pollutants, toxic air contaminants (TAC), and greenhouse gases (GHG) changed as a result of Project refinements; all of these changes are shown in the updated emission spreadsheets included as appendices to this report. However, the American Meteorological Society/ Environmental Protection Agency Regulatory Model (AERMOD) and California Air Resources Board Hotspots Analysis and Reporting Program (HARP) modeling results demonstrate that the Project impacts remain less than significant, and these refinements do not change the conclusions of the criteria pollutant or GHG Best Available Control Technology (BACT) determinations.

This report outlines Project refinements and associated updated analyses. It supplements the information provided in the ATC/PSD Application, and compiles, in one place, all changes since the ATC/PSD Application, for ease of use and inclusion in the Final Determination of Compliance. This document follows generally the same outline as the ATC/PSD Application, without repeating information that has not changed. Many of the tables, figures, and appendices presented in the ATC/PSD Application have been updated; they are called out as "Revised" in this document, and replace those presented in the ATC/PSD Application. All source descriptions, emission calculation techniques, and modeling techniques described in the ATC/ PSD Application remain valid, and thus are not repeated in this report. Where needed for clarification, descriptions of Project refinements and emission calculations are included.

General project refinements are discussed in Section 2. Changes that have affected emissions estimates or modeling parameters are summarized in Section 3. Updated dispersion modeling is detailed in Section 4, and the Health Risk Assessment is discussed in Section 5. The revised Additional Impacts Analysis is summarized in Section 6. Section 7 summarizes the extensive Project mitigation.



Project Site

Controlled Area

N

0 750 1,500 FEET

PROJECT SITE PLAN AND VICINITY

May 2013
28068052

Hydrogen Energy California (HECA)
Kern County, California

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REVISED FIGURE 1-1

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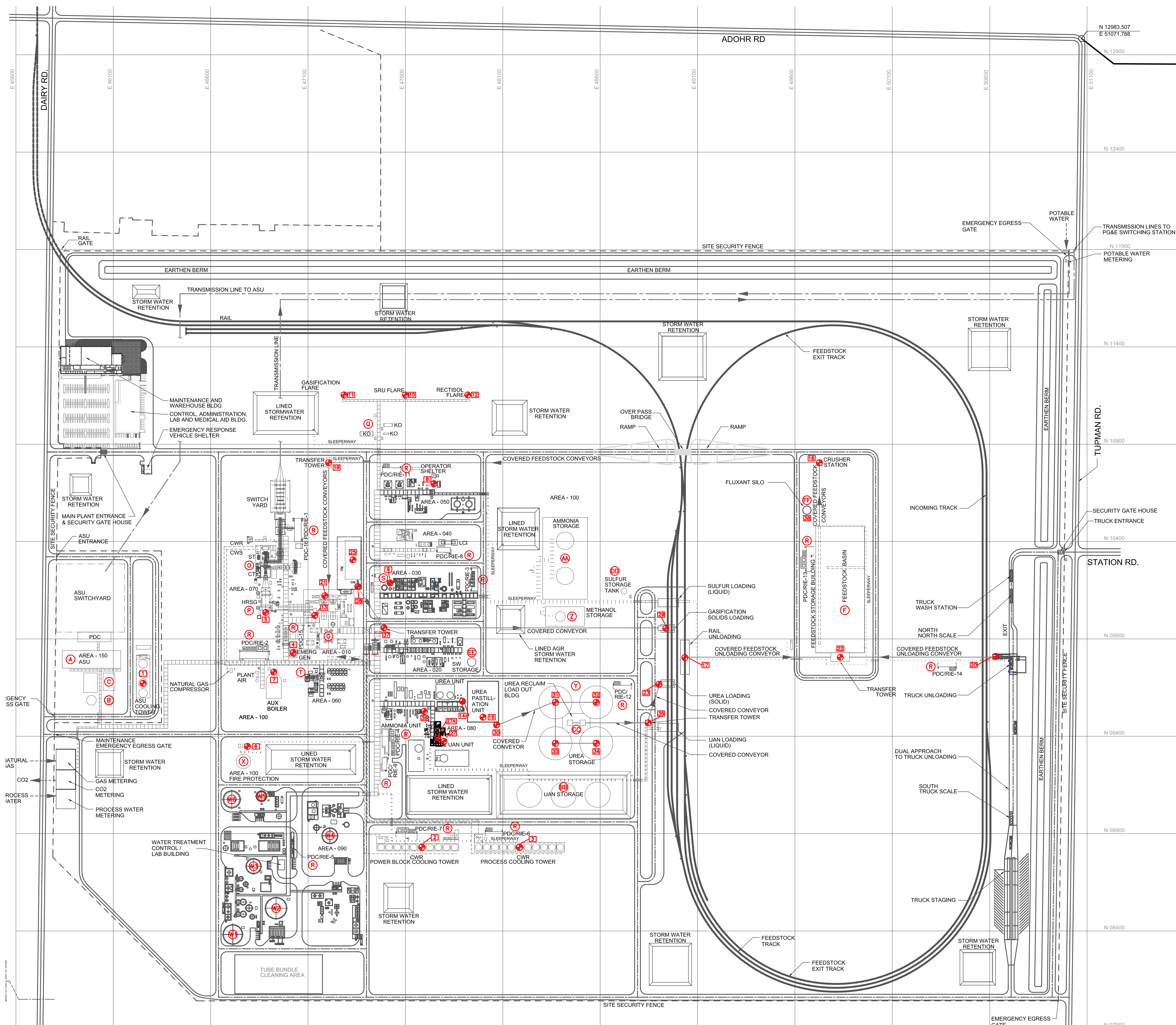
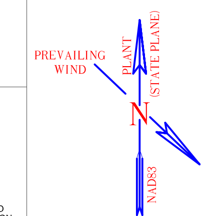
Source: Aerial Photo, Digital Globe, 2008.



DWA #20001: (CALCULATED)	NORTHING	EASTING
STATE PLANE COORD.	2312983.507	6151071.788
NAD83 ZONE V (U.S. FEET)		
LATITUDE: 35°20'25.11201"	LONGITUDE: 119°22'36.22853"	
LATITUDE: 35.340308891°	LONGITUDE: 119.376730147°	



PLANT COORDINATE AND DATUM NOTES

1. PLANT COORDINATES IN FEET EQUATE TO E. 61XXXXX AND N. 23YYYYY OF CALIFORNIA STATE PLANE COORDINATE SYSTEM (NAD 83 ZONE V.)
2. PLANT ELEVATION 100.00' EQUATES TO 288.50' ABOVE MSL (NAVD88.)
3. ACCURACY/TOLERANCE OF EMISSION POINT(S) COORDINATES ARE WITHIN A 50 FOOT RADIUS OF SOURCE POINT NOTED.
4. LOCATION OF EMISSION POINTS IS SUBJECT TO COMPLETION OF DETAILED DESIGN BY LICENSORS AND EQUIPMENT SUPPLIERS.
5. EMISSION POINT IS SHOWN FOR INFORMATION ONLY. ZERO EMISSIONS ARE EXPECTED DURING STEADY STATE OPERATION.

EMISSIONS SOURCES

ID	SOURCE	STATE PLANE COOR. (ROUNDED) EAST	NORTH	APPX. ELEVATIONS FROM GRADE (FT)
1	ASU COOLING TOWER	46253'-0"	9672'-0"	55'
2	POWER BLOCK COOLING TOWER	47684'-7"	8830'-0"	65'
3	PROCESS COOLING TOWER	48185'-6"	8830'-0"	65'
4	EMERGENCY ENGINES (GENERATORS)	47023'-6"	9828'-4"	20'
5	HRSG STACK	46882'-6"	10036'-0"	213'
6	EMERGENCY ENGINE (FIRE WATER PUMP)	46789'-0"	9348'-0"	20'
7	AUXILIARY BOILER (NOTE 5)	46924'-0"	9730'-0"	80'
8	TAIL GAS THERMAL OXIDIZER	47746'-4"	10697'-0"	165'
9	CO2 VENT (NOTE 5)	47521'-6"	10187'-4"	355'
10	SRU FLARE	47599'-8"	11153'-2"	250'
11	GASIFICATION FLARE	47284'-8"	11153'-2"	250'
12	RECTISOL FLARE	47919'-9"	11153'-2"	250'
13	FEEDSTOCK DRYER	47134'-10"	10021'-2"	305'
14	UREA PLANT ABSORBER	47893'-0"	9580'-0"	170'
16	UREA PASTILLATION VENT	47998'-6"	9498'-2"	50'
17	FEEDSTOCK RAIL UNLOADING VENT	49035'-0"	9804'-0"	30'
18	FEEDSTOCK CRUSHER VENT	49726'-0"	10805'-0"	100'
19	FEEDSTOCK TRANSFER TOWER 2	47206'-0"	10805'-0"	100'
20	FEEDSTOCK TRUCK UNLOADING VENT	50631'-0"	9810'-0"	60'
21	GASIFIER FEED BUILDING VENT	47186'-0"	10122-0"	230'
22	FEEDSTOCK TRANSFER TOWER 1	49833'-0"	9806'-0"	100'
23	UREA LOADING VENT	48902'-0"	9667'-0"	110'
25	GASIFICATION SOLIDS PAD	47330'-6"	10306'-4"	N/A
27	NITRIC ACID ABSORBER VENT	47797'-0"	9373'-0"	120'
27A	AMMONIUM NITRATE SCRUBBER VENT	47767'-0"	9392'-0"	55'
28	GASIFICATION SOLIDS BUCKET ELEVATOR	47355'-6"	10169'-2"	30'
29	GASIFICATION SOLIDS LOADING VENT	48936'-10"	9954'-9"	110'
30	UREA BUCKET ELEVATOR	48068'-5"	9458'-8"	50'
31	UREA TRANSFER TOWER 1	48370'-0"	9574'-0"	100'
32	UREA TRANSFER TOWER 2	48580'-0"	9574'-0"	100'
33	UREA TRANSFER TOWER 3	48370'-0"	9364'-0"	100'
34	UREA TRANSFER TOWER 4	48580'-0"	9364'-0"	100'
35	UREA TRANSFER TOWER 5	48846'-3"	9469'-0"	100'
36	AMMONIA UNIT STARTUP HEATER	47697'-0"	9527'-7"	80'
37	GASIFICATION SOLIDS TRANSFER TOWER	47490'-0"	9957'-0"	75'
38	FLUXANT SILO VENT	49661'-8"	10561'-4"	90'

MAJOR STRUCTURES/ EQUIPMENT AND TANKS

ID	DESCRIPTION	APPX. ELEVATIONS FROM GRADE (FT)	
A	ASU MAIN AIR COMPRESSOR ENCLOSURE	40	
B	LIQUID OXYGEN STORAGE (LOX) TANK	90	
C	AIR SEPARATION COLUMN CAN	200	
F	FEEDSTOCK BARN	160	
G	GASIFICATION STRUCTURE	260	
O	COMBUSTION TURBINE GENERATOR STRUCTURE	50	
P	HEAT RECOVERY STEAM GENERATOR STRUCTURE	90	
Q	FLARE K.O. DRUMS (QTY 3)	40	
R	POWER DISTRIBUTION CENTERS	25	
S	AGR METHANOL WASH COLUMN	330	
T	PSA OFFGAS COMPRESSOR	35	
W1	RAW WATER TANK	95'DIA X 70'H	TANKS SET AT GRADE ELEVATION
W2	TREATED WATER TANK	105'DIA X 65'H	
W3	FILTERED WATER TANK	75'DIA X 55'H	
W4	WASTE WATER ZLD FEED TANK	80'DIA X 50'H	
W5	UTILITY WATER TANK	50'DIA X 55'H	
W6	DEMINERALIZED WATER STORAGE TANK	80'DIA X 65'H	
X	FIREWATER STORAGE TANK	74'DIA X 50'H	
Y	UREA STORAGE (4 DOMES)	170'DIA X 85'H	
Z	METHANOL STORAGE TANK	46'DIA X 55'H	
AA	AMMONIA STORAGE (2 TANKS)	90'DIA X 70'H	
BB	UAN STORAGE (3 TANKS)	130'DIA X 65'H	
CC	UREA RECLAIM LOADOUT BUILDING	30	
DD	SULFUR STORAGE TANK	30'DIA X 28'H	
EE	SOUR WATER STORAGE TANK	45'DIA X 50'H	
FF	FLUXANT SILO	30'DIA X 80'H	

0 100' 200' 400' 600' 800' 1000'

HECA PLOT PLAN WITH EMISSION SOURCE LOCATIONS

May 2013
28068052

Hydrogen Energy California (HECA)
Kern County, California

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REVISED FIGURE 1-2

Source:
Fluor; HECA-SCS, 2012 AFC Update; Preliminary Emissions Sources Plot Plan;
Drawing No: A4UV-000-50-SK-0002, Rev. G (4/16/13)

5/02/13 vsa..HECA-SCS 2012\GRAPHICS 2013\SJVAPCD_ATC App\Fig1-2_REVISED_plotplan_emissions_RevG.ai

This section provides a description of the more significant changes to the proposed Hydrogen Energy California (HECA) Project. Data on the pollutant emissions resulting from the operation of the units are presented in Section 3.

2.1 HECA PROJECT REFINEMENTS

The project refinements described below do not fundamentally alter the nature of the Project; they are the result of further detailed project design.

The gross power output of the Combined Cycle Power Block is now expected to be up to 431 megawatts (MW) of gross power generation. The additional gross output is the result of optimization and improvement in heat recovery, and there is no additional fuel input or emissions. The gross power output may range from 405 to 431 MW, with the net power output ranging from 267 to 300 MW. Engineers are designing to optimize to the higher end of these ranges, but for some emission factor calculations it is more conservative to use the low-end value (e.g., for the Mercury and Air Toxics Standards).

The coordinates of the fence around the Controlled Area were moved slightly in toward the center of the Project Site to ensure adequate roadway easement. The fences along Station, Adohr, and Dairy roads were affected. Boundaries of the Project Site and Controlled Area are shown on Revised Figure 1-1, Project Site Plan and Vicinity.

The locations of some sources have been adjusted, including the heat recovery steam generator (HRSG), feedstock dryer, cooling towers, flares, carbon dioxide (CO_2) vent, Manufacturing Complex sources, material handling sources, emergency engines, and fugitive sources. Revised Figure 1-2, HECA Plot Plan with Emission Source Locations, shows the layout of Project process areas, equipment, and emission sources within the proposed site.

Many of the sources have different source identifications (IDs) (but the same or similar names) on the plot plan. These source IDs are for the purposes of the Project Emission Sources Plot Plan, and are not intended to match the permit unit numbers in the Preliminary Determination of Compliance. Several buildings and tanks were moved or have revised dimensions. A few sources have different stack heights and stack parameters.

Emissions of criteria pollutants, TAC and GHG were updated. Total stationary source project emissions of nitrogen oxides (NO_X) and carbon monoxide (CO) decreased, sulfur dioxide (SO_2) increased, and volatile organic compounds (VOCs), particulate matter 10 microns in diameter or less (PM_{10}) and particulate matter 2.5 microns in diameter or less ($PM_{2.5}$) remained approximately the same.

Mitsubishi Heavy Industries (MHI) completed pilot plant testing on the Project-specific feedstock (coal and petroleum coke [petcoke]), and determined that a fluxant should be added to the feedstock blend in order to increase the calcium content. Calcium lowers the ash fusion temperature and promotes a more stable and reliable flow of molten gasification solids along the walls of the gasifier, and down through the water bath and lock hopper valves into the gasification solids removal system. This helps the process achieve the vitreous, “glass like,” gasification solids that HECA expects to be able to recycle as a substitute for other raw materials. The fluxant is limestone (calcium carbonate), the same basic material that is used to soften water in the water treatment plant. HECA may be able to recycle the spent water treatment lime for use as a fluxant, which would reduce fluxant deliveries by truck. The fluxant addition is expected to be about 1 percent of total feed rate, but could be up to 3 percent. Thus, it was conservatively assumed that the amount of fluxant required will be 3 percent of total feed without the benefit of recycling water softening solids. Additional trucks will be needed to deliver the fluxant and remove the additional gasification solids.

The applicant has decided not to sell ammonia; thus, there will not be an ammonia loading area or offsite transportation of ammonia. In response to the modifications, total Project-related daily and annual transportation estimates of trucks and trains have been updated, and the emissions from the travel of these associated vehicles have decreased from the information presented in the Amended AFC.

The following explanation and clarification of the Sulfur Recovery Unit's (SRU) innovative and environmentally beneficial process design is provided to avoid potential confusion with the more commonly used industrial SRU process flow schemes. The HECA SRU uses the same Claus conversion technology found in most refineries. HECA's tail gas hydrogenation section is also included in those refineries using a SCOT-type Tail Gas Unit (TGU). However, HECA's TGU process has important differences. Unlike a refinery, which uses an amine solvent to absorb and recycle the hydrogen sulfide (H_2S) in the hydrogenated tail gas, the remaining tail gas and residual trace H_2S is oxidized and released to the atmosphere as SO_2. HECA is able to compress and recycle the hydrogenated tail gas (H_2S) back to the synthesis gas (syngas) treatment section for further sulfur removal and CO_2 capture. This eliminates atmospheric sulfur emissions from the SRU-TGU during normal operations. Many of the emission points and sulfur plant conditions typically found in a refinery application do not apply in HECA's design.

This section discusses specific changes to sources in the proposed Project. These changes include revisions to emissions or modeling parameters, and this information has been compiled to provide, in one place, all project refinements since the ATC/PSD Application. All emission calculation techniques and stack parameters remained the same as presented in the ATC/PSD Application, unless specifically noted. Operational criteria pollutant emission calculations for all sources are presented in Appendix A, Revised Operational Criteria Pollutant Emissions, of this document. The Project refinements do not affect the commissioning emissions; thus, these emissions are not discussed in this document.

Emissions of criteria pollutants, TACs, and GHGs were estimated for each affected source. These emissions will be used to show that the Project will not cause an exceedance of PSD Significant Impact Level (SIL), increments, California or Federal Ambient Air Quality Standards (AAQS), or significant health risk measures.

3.1 PERMIT UNITS AND DESCRIPTIONS

This section summarizes the specifications of all equipment that will emit air pollutants at HECA, and the controls applied to limit emissions. The permit numbers match those presented in the Preliminary Determination of Compliance, and the descriptions were updated to match the Project revisions.

Permit Unit #	Permit Unit Description
S-7616-17-0	RAIL UNLOADING AND TRANSFER SYSTEM FOR THE HANDLING OF COAL, INCLUDING: ENCLOSED RAIL UNLOADING BUILDING SERVED BY BAGHOUSE DUST COLLECTOR AND DUST SUPPRESSION SPRAY SYSTEM, WITH RAILCAR UNLOADING STATION, RAIL UNLOADING BIN(S), BELT FEEDER(S), RAIL UNLOADING CONVEYOR(S) ENCLOSED IN UNLOADING TUNNEL (SERVED BY A DUST COLLECTOR) THAT TRANSFERS MATERIAL TO TOWER #1 SERVING FEEDSTOCK STORAGE (S-7616-19)
S-7616-18-0	TRUCK UNLOADING AND TRANSFER SYSTEM FOR THE HANDLING OF PETROLEUM COKE (PETCOKE) AND/OR COAL, INCLUDING: ENCLOSED TRUCK UNLOADING BUILDING SERVED BY BAGHOUSE DUST COLLECTOR AND DUST SUPPRESSION SPRAY SYSTEM, WITH TRUCK UNLOADING STATION(S), TRUCK UNLOADING BIN(S), BELT FEEDER(S), TRUCK UNLOADING CONVEYOR(S) ENCLOSED IN AN UNLOADING TUNNEL (SERVED BY A DUST COLLECTOR) THAT TRANSFERS MATERIAL TO TOWER #1 SERVING FEEDSTOCK STORAGE (S-7616-19)
S-7616-19-0	FEEDSTOCK STORAGE, BLENDING, AND RECLAIM SYSTEM INCLUDING: TRANSFER TOWER #1 (THAT TRANSFERS FEEDSTOCK FROM RAIL AND TRUCK UNLOADING AND TRANSFER SYSTEMS, S-7616-17 AND -18) SERVED BY A DUST COLLECTOR WITH COAL CRUSHER, REJECTS CONVEYOR(S); FEEDSTOCK STORAGE BUILDING (BARN) WITH A SEPARATE COAL AND PETCOKE STORAGE AREAS, STORAGE CONVEYOR(S), DISCHARGE CHUTE(S), AND RECLAIM CONVEYOR(S); AND TRANSFER TOWER #2 (THAT TRANSFERS MATERIAL TO THE FEEDSTOCK DRYING AND GRINDING/ CRUSHING OPERATION, S-7616-20) SERVED BY TWO DUST COLLECTORS (ONE OPERATING AND ONE SPARE), TWO ENCLOSED TRANSFER CONVEYORS, FLUXANT SILO AND UNLOADING VENT SERVED BY A DUST COLLECTOR
S-7616-20-0	FEEDSTOCK DRYING AND GRINDING/CRUSHING OPERATION INCLUDING: CRUSHER BUILDING SERVED BY BAGHOUSE DUST COLLECTOR, WITH SURGE BIN(S), BELT FEEDER(S), BYPASS SCREEN(S), TWO FEEDSTOCK CRUSHERS; TWO ENCLOSED PLANT FEED CONVEYORS SERVED BY BAGHOUSE DUST COLLECTOR; MILLING AND DRYING BUILDING WITH FEEDSTOCK DRYER [WITH DRYING GAS FROM TREATED EXHAUST GAS FROM HEAT RECOVERY STEAM GENERATOR LISTED ON S-7616-26] SERVED BY BAGHOUSE DUST COLLECTOR, WITH REVERSING CONVEYOR(S), DIVERTER GATE(S), AND TWO MILLING AND DRYING SILOS

Permit Unit #	Permit Unit Description
S-7616-21-0	GASIFICATION SYSTEM INCLUDING: ONE MHI OXYGEN-BLOWN GASIFIER; SYNGAS SCRUBBING SYSTEM; SOUR SHIFT/LOW TEMPERATURE GAS COOLING (LTGC) SYSTEM; SOUR WATER TREATMENT SYSTEM, MERCURY REMOVAL SYSTEM, RECTISOL® ACID GAS REMOVAL (AGR) UNIT, AND METHANOL STORAGE TANK
S-7616-22-0	GASIFICATION SOLIDS MATERIAL HANDLING AND STORAGE SYSTEM INCLUDING: GASIFICATION SOLIDS UNLOADING BUNKER (STORAGE COVER WITH ROOFING AND PARTIAL SIDING) WITH DEWATERING TANK(S), STORAGE PILE(S), RECLAIM HOPPER AND GRIZZLY, BUCKET ELEVATOR FEED CONVEYOR SERVED BY DUST COLLECTOR, ENCLOSED TRANSFER CONVEYOR (TO GASIFICATION SOLIDS TRANSFER TOWER), GASIFICATION SOLIDS TRANSFER TOWER SERVED BY DUST COLLECTOR, WITH ENCLOSED LOAD-OUT FEED CONVEYOR (TO GASIFICATION SOLIDS LOAD-OUT BUILDING); AND ENCLOSED GASIFICATION SOLIDS LOAD-OUT BUILDING SERVED BY BAGHOUSE DUST COLLECTOR, WITH GASIFICATION SOLIDS LOAD-OUT SYSTEM WITH ONE TRUCK AND ONE RAIL LOAD-OUT STATION
S-7616-23-0	SULFUR RECOVERY AND TAIL GAS COMPRESSION SYSTEM CONSISTING OF SULFUR RECOVERY UNIT (SRU), A TAIL GAS UNIT (TGU) WITH A NATURAL GAS-FIRED TAIL GAS THERMAL OXIDIZER RATED UP TO 96 MMBTU/HR (OR EQUIVALENT), AND MISCELLANEOUS TANKS, COMPRESSORS, PUMPS, CONDENSERS, HEAT EXCHANGERS, PIPING
S-7616-24-0	CO_2 RECOVERY (CAPTURE, COMPRESSION, AND TRANSPORTATION) AND VENT SYSTEM FOR EMERGENCY RELEASES OF A STREAM OF PRIMARILY CO_2 FROM THE ACID GAS REMOVAL UNIT
S-7616-25-0	230 MMBTU/HR NATURAL GAS-FIRED AUXILIARY BOILER EQUIPPED WITH LOW-NO_X BURNER WITH FLUE GAS RECIRCULATION AND SELECTIVE CATALYTIC REDUCTION (SCR) SYSTEM (OR EQUIVALENT)
S-7616-26-0	431 MW NOMINAL (GROSS) COMBINED-CYCLE POWER GENERATING SYSTEM CONSISTING OF HYDROGEN-RICH SYNGAS FUEL AND/OR BACK UP NATURAL GAS-FIRED MHI M501 GAC G-CLASS, AIR-COOLED ADVANCED COMBUSTION TURBINE GENERATOR (CTG), WITH A HEAT RECOVERY STEAM GENERATOR (HRSG), AND A CONDENSING STEAM TURBINE-GENERATOR (STG) OPERATING IN COMBINED CYCLE MODE, AND FEEDSTOCK DRYER (WITH DRYING GAS FROM TREATED EXHAUST GAS FROM HEAT RECOVERY STEAM GENERATOR)
S-7616-27-0	MULTI-CELL MECHANICAL-DRAFT COOLING TOWER WITH HIGH-EFFICIENCY DRIFT ELIMINATORS, SERVING GASIFICATION BLOCK AND PROCESS UNITS
S-7616-28-0	MULTI-CELL MECHANICAL-DRAFT COOLING TOWER WITH HIGH-EFFICIENCY DRIFT ELIMINATORS, SERVING AIR SEPARATION UNIT
S-7616-29-0	MULTI-CELL MECHANICAL-DRAFT COOLING TOWER WITH HIGH-EFFICIENCY DRIFT ELIMINATORS, SERVING POWER BLOCK
S-7616-30-0	4,000 MMBTU/HR ELEVATED FLARE WITH 0.5 MMBTU/HR NATURAL GAS-FIRED PILOT, PRIMARILY SERVING GASIFICATION BLOCK (OR EQUIVALENT)
S-7616-31-0	2,100 MMBTU/HR ELEVATED FLARE WITH 0.3 MMBTU/HR NATURAL GAS FIRED PILOT, PRIMARILY SERVING SULFUR RECOVERY UNIT (OR EQUIVALENT)
S-7616-32-0	5,500 MMBTU/HR ELEVATED FLARE WITH 0.3 MMBTU/HR NATURAL GAS-FIRED PILOT, PRIMARILY SERVING RECTISOL® UNIT (OR EQUIVALENT)
S-7616-33-0	AMMONIA SYNTHESIS UNIT CONSISTING OF: ONE 56.0 MMBTU/HR NATURAL GAS-FIRED AMMONIA STARTUP HEATER EQUIPPED WITH FOUR LOW-NOX BURNERS, EACH RATED AT 14.0 MMBTU/HR (OR EQUIVALENT); AMMONIA SYNTHESIS CONVERTER; SEPARATORS; ELECTRIC SYNGAS COMPRESSOR; ELECTRIC AMMONIA REFRIGERATION COMPRESSOR; AMMONIA ACCUMULATOR; AMMONIA REFRIGERATION SYSTEM; COLD LIQUID AMMONIA STORAGE SYSTEM; AMMONIA RECOVERY UNIT
S-7616-34-0	UREA UNIT WITH UREA PASTILLATION SYSTEM: UREA UNIT WITH HIGH-PRESSURE AND LOW-PRESSURE ABSORBERS VENTED TO THE UREA ABSORBER VENT; PASTILLATION UNIT WITH A DROP FORMER, MOVING BELT, OSCILLATING SCRAPER, AND BUCKET ELEVATOR SERVED BY A DUST COLLECTOR

Permit Unit #	Permit Unit Description
S-7616-35-0	NITRIC ACID UNIT FOR THE PRODUCTION OF NITRIC ACID FROM AMMONIA OXIDATION, NITRIC OXIDE OXIDATION, AND ABSORPTION SERVED BY: SELECTIVE CATALYTIC REDUCTION (SCR) TO CONTROL NO_X, AND TERTIARY CATALYTIC DECOMPOSITION TO CONTROL N_2O
S-7616-36-0	AMMONIUM NITRATE UNIT THAT PRODUCES AMMONIUM NITRATE, CONSISTING OF: NEUTRALIZER WITH INTEGRAL SCRUBBER TO CONTROL AMMONIA; PROCESS CONDENSATE TANK WITH VENT SCRUBBER TO CONTROL PARTICULATE MATTER EMISSIONS; AMMONIUM NITRATE COOLER, AND PROCESS PUMP(S)
S-7616-37-0	UREA STORAGE AND HANDLING OPERATION CONSISTING OF FOUR 20,000-TON STORAGE CAPACITY ENCLOSED UREA STORAGE DOMES EACH WITH ONE UREA TRANSFER TOWER, WITH EACH TRANSFER TOWER SERVED BY ONE DUST COLLECTOR; ENCLOSED UREA RECLAIM BUILDING WITH RECLAIM HOPPERS AND GRIZZLIES; ENCLOSED, TUBULAR RECLAIM CONVEYOR (THAT TRANSFERS MATERIAL TO UREA TRANSFER TOWER #5); UREA TRANSFER TOWER #5 SERVED BY DUST COLLECTOR; ENCLOSED, TUBULAR LOAD-OUT FEED CONVEYOR (THAT TRANSFERS MATERIAL TO LOAD-OUT BUILDING); UREA LOADOUT BUILDING SERVED BY BAGHOUSE DUST COLLECTOR, RAIL/TRUCK LOAD-OUT CONVEYOR, ONE TRUCK AND ONE TRAIN LOAD-OUT WEIGH SYSTEM, AND ONE TRUCK AND ONE TRAIN LOADING SPOUT AND VENT SYSTEM
S-7616-38-0	2,922 BHP CUMMINS MODEL QSK60-G6 INTERIM TIER 4 (OR THE HIGHEST TIER RATING APPLICABLE AT THE TIME OF PURCHASE, WHICHEVER TIER IS HIGHER) CERTIFIED DIESEL-FIRED EMERGENCY STANDBY IC ENGINE POWERING A 2,000 KW CUMMINS MODEL DQKC ELECTRIC GENERATOR, #1 (OR EQUIVALENT)
S-7616-39-0	2,922 BHP CUMMINS MODEL QSK60-G6 INTERIM TIER 4 (OR THE HIGHEST TIER RATING APPLICABLE AT THE TIME OF PURCHASE, WHICHEVER TIER IS HIGHER) CERTIFIED DIESEL-FIRED EMERGENCY STANDBY IC ENGINE POWERING A 2,000 KW CUMMINS MODEL DQKC ELECTRIC GENERATOR, #2 (OR EQUIVALENT)
S-7616-40-0	556 BHP CUMMINS MODEL CFP-15E-F40 INTERIM TIER 4 (OR THE HIGHEST TIER RATING APPLICABLE AT THE TIME OF PURCHASE, WHICHEVER TIER IS HIGHER) CERTIFIED DIESEL-FIRED EMERGENCY STANDBY IC ENGINE POWERING A FIREWATER PUMP (OR EQUIVALENT)

3.2 STATIONARY SOURCES

3.2.1 CTG/HRSG and Feedstock Dryer (S-7616-26-0)

The only updates to these sources were the decrease in start-up duration, thus decreasing emissions (described in the next section); the decrease in mercury emissions due to more detailed emission control specifications (see Section 5.1.1); and the increase in HRSG stack diameter to 24 feet. The HRSG flow rate did not change; therefore, the exit velocity decreased for all scenarios analyzed.

The maximum short-term operational emissions, excluding start-up and shut-down emissions, from the CTG/HRSG and feedstock dryer when combusting syngas, and from the CTG/HRSG when operating on natural gas, are presented in Table 3-3. These emissions have not changed from those presented in the ATC/PSD Application. The annual emissions of criteria pollutants for the CTG/HRSG and feedstock dryer are presented in Revised Table 3-4, and have been calculated based on the expected operating schedule of 8,000 hours of operations, two start-ups and shut-downs per year, and 2 weeks of natural-gas operations in addition to the start-up and shut-down events. Emissions and calculation details for all operating cases are presented in Appendix A, Revised Operational Criteria Pollutant Emissions.

Table 3-3
Maximum Short-Term Emissions From CTG/HRSG And Feedstock Dryer Stack During On-Peak Operations

Pollutant	CTG/ HRSG Emissions lb/hr	Feedstock Dryer Emissions lb/hr	Basis	CTG/HRSG Emissions Basis (ppmv)	CTG/ HRSG Emissions lb/hr	CTG/HRSG Emissions Basis (ppmv)
	Hydrogen-Rich Fuel				Natural Gas	
NO_X	25.0	4.4	Case 1 (ON Peak, 97°F Ambient)	2.5	34.1	4
CO	18.3	3.2	Case 1 (ON Peak, 97°F Ambient)	3	26.0	5
VOC	3.5	0.6	Case 1 (ON Peak, 97°F Ambient)	1	5.9	2
$PM_{10}/PM_{2.5}$	12.9	1.4	Case 3 (ON Peak, 39°F Ambient)	15 lb/hr	15.0	15 lb/hr
SO_2	4.1	0.9	Case 2 (OFF Peak, 97°F Ambient)	2 ppmv total sulfur in syngas, 10 ppmv sulfur in PSA Off-gas	4.7	12.65 ppm sulfur in natural gas
NH_3	18.5	3.2	Case 1 (ON Peak, 97°F Ambient)	5 ppmv ammonia slip	15.8	5 ppmv ammonia slip

Source: HECA, 2012.
Notes:
Emissions include duct burner operations with syngas and PSA off-gas.
Feedstock dryer PM emissions controlled to 0.001 gr/dscf by baghouse

CO = carbon monoxide
CTG/HRSG = Combustion turbine generator/heat recovery steam generator
°F = degrees Fahrenheit
gr/dscf = grain per dry standard cubic feet
lb/hr = pound per hour
NH_3 = ammonia
NO_X = nitrogen oxides
PM_{10} = particulate matter less than 10 microns
$PM_{2.5}$ = particulate matter less than 2.5 microns
ppmv = parts per million by volume
PSA = Pressure Swing Adsorption
SO_2 = sulfur dioxide
VOCs = volatile organic compounds

Revised Table 3-4
CTG/HRSG and Feedstock Dryer Maximum Annual Operation Emissions

Pollutant	CTG/HRSG, tons/year				Feedstock Dryer, tons/year		
	Start-Up/ Shut-Down	Operations	Natural Gas Operations	Total	Start-Up/ Shut-Down	Operations	Total
NO_X	1.15	99.6	5.73	106.5	0.09	16.9	17.0
CO	11.8	72.8	4.36	89.0	0.36	12.4	12.7
VOC	0.26	13.9	1.00	15.1	0.01	2.4	2.4
$PM_{10}/PM_{2.5}$	0.19	51.3	2.52	54.0	0.01	5.6	5.6
SO_2	0.032	16.3	0.80	17.1	0.00	2.8	2.8
NH_3	0.07	73.6	2.65	76.4	0.01	12.5	12.5

Source: HECA, 2013.
Notes:

CO = carbon monoxide
CTG/HRSG = Combustion turbine generator/heat recovery steam generator
NH_3 = ammonia
NO_X = nitrogen oxides
PM_{10} = particulate matter less than 10 microns
$PM_{2.5}$ = particulate matter less than 2.5 microns
SO_2 = sulfur dioxide
VOC = volatile organic compounds

3.2.1.1 CTG/HRSG and Feedstock Dryer Start-Up and Shut-Down Emissions

Because start-up and shut-down events typically have higher emission rates than normal operating conditions, they are incorporated into the short- and long-term emissions estimates for the CTG/HRSG for modeling purposes. The CTG will initially be started up using natural-gas fuel, and then shifted to syngas as the syngas becomes available. Conversely, during a shut-down, the CTG will be operated on syngas until production decreases, and then operated on natural gas.

Start-up hours were reduced from 50 hours to 2 hours for the CTG/HRSG and feedstock dryer during operation at 40 percent load on syngas, which is Step 3 of the start-up process. After further design development by MHI—the combustion turbine manufacturer—the total start-up time for the HRSG will be less than 5 hours. MHI has confirmed that the turbine does not need to hold at 40 percent load burning syngas for 50 hours, and this duration can be shortened to 2 hours. The shut-down time will remain at 9 hours or less. HECA will operate the catalytic emission controls in the HRSG during these start-up/shut-down periods within the constraint of the minimum catalyst temperature for ammonia injection to avoid selective catalytic reduction (SCR) fouling.

The oxidation catalyst will start functioning automatically as soon as it reaches its operating temperature range. The only action to be taken in order to begin catalytic operation is to start the ammonia injection for the SCR. The ammonia injection must wait until the SCR reactor exceeds the maximum temperature for ammonium sulfate precipitation to avoid fouling the catalyst. The time it takes for the catalysts to reach their respective temperatures will be determined when the HRSG supplier has been selected; and the emissions calculations will be adjusted if appropriate. The estimates used are conservative based on current information.

This substantial reduction in start-up duration translates into a reduction in emissions of criteria pollutants, TACs, and GHGs. The expected emissions and durations of start-up and shut-down events summarized in Revised Table 3-5 reflect the emissions from both natural gas and syngas combustion.

3.2.2 Process, Air Separation Unit (ASU), and Power Block Cooling Towers (S-7616-27, 28, and 29)

The emission rates for each cooling tower did not change, although the locations of all three cooling towers moved slightly. The ASU cooling tower (Unit 28) is now oriented north-south, and all stack parameters remained the same. The fan height increased to 65 feet for the Power Block and Process cooling towers. The number of cells for the Power Block cooling tower (Unit 29) decreased to 10, and the diameter of the cells decreased to 25 feet. The number of cells for the Process cooling tower (Unit 27) decreased to 11, and the diameter of the cells decreased to 29 feet. The stack exhaust flow rate changed for the Power Block and Process cooling towers.

3.2.3 Auxiliary Boiler (S-7616-25)

The burner capacity proposed by the supplier is 230 million British thermal units per hour (MMBtu/hr) higher heating value (HHV); however, HECA intends to keep the maximum allowable heat release at 213 MMBtu/hr HHV, and will accept a permit condition to this effect. Thus, emissions do not increase. Compliance will be monitored with a natural-gas fuel flow meter.

Revised Table 3-5
CTG/HRSG and Feedstock Dryer Stack Emissions During Start-Up and Shut-Down

Step	Duration (hours)	Units	SO_2	NO_X	CO	PM_{10}/ $PM_{2.5}$	VOC
CTG/HRSG Start-Up							
1. CTG ignition and synchronization, 20 percent load on natural gas	0.5	lb/hr	2.1	67.1	2270	15.0	65
		lb	1.0	33.6	1135	7.5	32.4
2. HRSG/STG warm-up, ramp CTG to 40 percent load on natural gas	2	lb/hr	2.4	107.2	1044	13.1	13
		lb	4.8	214	2088	26.3	26.8
3. CTG fuel change-over, 40 percent load on syngas, start-up PSA/ ammonia/urea units	2	lb/hr	2.4	66.6	81.0	13.1	4.6
		lb	4.8	133.2	162.1	26.3	9.3
		Tons/Start-Up	**0.01**	**0.19**	**1.69**	**0.03**	**0.03**
Feedstock Dryer Start-Up							
Step	**Duration (hours)**	**Units**	**SO_2**	**NO_X**	**CO**	**PM_{10}/ $PM_{2.5}$**	**VOC**
2. HRSG/STG warm-up, ramp CTG to 40 percent load on natural gas	2	lb/hr	0.3	15.1	147.4	0.9	1.9
		lb	0.7	30.3	294.7	1.9	3.8
3. CTG fuel change-over, 40 percent load on syngas	2	lb/hr	0.3	9.4	11.5	0.9	0.7
		lb	0.7	18.8	22.9	1.9	1.3
		Tons/Start-Up	**0.00**	**0.02**	**0.16**	**0.00**	**0.00**
CTG/HRSG Shut-Down							
Step	**Duration (hours)**	**Units**	**SO_2**	**NO_X**	**CO**	**PM_{10}/ $PM_{2.5}$**	**VOC**
1. PSA, ammonia, and urea unit shut-down; gasifier to 60 percent; CTG to 40 percent load on syngas	4	lb/hr	2.4	66.6	81.0	13	4.6
		lb	9.6	266	324	52.6	18.5
2. CTG fuel change-over, 40 percent load on natural gas, gasifier depressurization	3	lb/hr	2.7	122	1191	15.0	15.3
		lb	8.2	367	3574	45.0	45.9
3. Minimum plant load, 20 percent load on natural gas	2	lb/hr	2.1	67.1	2270	15.0	64.8
		lb	4.2	134	4539	30.0	129.7
		Tons/Shut-Down	**0.01**	**0.38**	**4.22**	**0.06**	**0.10**

Revised Table 3-5
CTG/HRSG and Feedstock Dryer Stack Emissions During Start-Up and Shut-Down (Continued)

Feedstock Dryer Shut-Down							
Step	**Duration (hours)**	**Units**	**SO_2**	**NO_X**	**CO**	**PM_{10}/ $PM_{2.5}$**	**VOC**
1. PSA, ammonia, and urea plant shut-down; gasifier to 60 percent; CTG to 40 percent load on syngas	4	lb/hr	0.3	9.4	11.5	0.9	0.7
		lb	1.4	37.6	45.8	3.8	2.6
		Tons/Shut-Down	**0.00**	**0.02**	**0.02**	**0.00**	**0.00**

Source: HECA, 2013.

Notes:

Basis: Start-up/shut-down procedures provided by MHI.

Feedstock drying starts at Step 2, above.

PM_{10}/$PM_{2.5}$ emission rate based on 0.001 gr/dscf
gr/dscf = dry standard cubic foot
CTG/HRSG = Combustion turbine generator/heat recovery steam generator
NH_3 = ammonia
PSA = Pressure Swing Adsorption
NO_X = nitrogen oxides
CO = carbon monoxide
VOC = volatile organic compounds
PM_{10} = particulate matter less than 10 microns
$PM_{2.5}$ = particulate matter less than 2.5 microns
SO_2 = sulfur dioxide

3.2.4 Gasification, SRU, and Rectisol® Flares (S-7616-30, 31, 32)

SJVAPCD determined that BACT for emissions of NO_X from the natural gas pilot for all three flares is 0.068 lb/MMBtu. This resulted in a very minor reduction of NO_X emissions.

For the Gasification Flare (Unit 30), PM_{10}, SO_2, and VOC emission factors during start-up were changed from negligible to the syngas emission factors from the turbine. This was done to account for the very small (negligible), but not zero, emissions of PM_{10}, SO_2, and VOCs.

The maximum rating of each flare is higher than the capacity needed for flaring during planned events such as start-up and shut-down. Although this additional capacity is not planned to be intentionally used, it may be needed in the event of an upset or emergency. The maximum rating of the gasification flare is 4,000 MMBtu/hr, the sulfur recovery unit flare is 2,100 MMBtu/hr, and the Rectisol® flare is 5,500 MMBtu/hr. Although these capacities are greater than the capacity needed for planned flaring, HECA intends to keep the maximum allowable heat release of each flare as described in the ATC/PSD application for planned flaring, and will accept permit conditions to this effect.

A summary of emissions from each flare is presented in Revised Table 3-6. Detailed emission calculations are included in Appendix A, Revised Operational Criteria Pollutant Emissions.

3.2.5 Sulfur Recovery Unit and Tail Gas Thermal Oxidizer (TGTO) (S-7616-23-0)

Two maintenance activities associated with the TGTO have been identified. In the first activity, the TGTO will be used to dispose of sulfur-bearing gases during intermittent post-shut-down SRU passivation. In this operation, natural gas is fired in the SRU burners with a small amount of excess air to oxidize and remove residual sulfur from the SRU equipment. This step is necessary for safety reasons prior to opening the process equipment for major maintenance such as catalyst change-out. This operation is expected to occur about once every 3 years for 24 hours. Emissions during this time will be 75 pounds per hour of SO_2, plus 80 MMBtu/hr of natural gas combustion in the SRU, on top of the normal 13 MMBtu/hr TGTO assist natural gas combustion rate.

In the second activity, the TGTO will be used to safely oxidize and dispose of H_2S, SO_2, and sulfur vapor from the "presulfiding" of tail gas hydrogenation catalyst. Presulfiding, which activates new catalyst oxide loaded in the reactor prior to normal operation, consists of adding and recirculating steam-heated hydrogen and nitrogen through the hydrogenation catalyst. The hydrogen reacts with a layer of elemental sulfur on the fresh catalyst material to form sulfides, which converts the catalyst from its shipped oxide to its active, sulfide state. A purge is withdrawn from the recirculating stream to remove the added mass. The purge stream contains H_2S, SO_2, and other sulfur products and is directed to the TGTO for safe disposal. This operation is expected to occur less than once per year, for 24 hours per event. SO_2 emissions will be 125 pounds per hour, and the process does not need any additional natural gas combustion in the SRU beyond the normal 13 MMBtu/hr TGTO assist natural gas combustion rate.

Revised Table 3-6
Total Combined Annual Criteria Pollutant Emissions[1]

Pollutant / Equipment	NO_X	CO	VOC	SO_2	PM_{10}	$PM_{2.5}$
	tons/yr					
CTG/HRSG	106.5	89.0	15.1	17.1	54.0	54.0
Feedstock Dryer	17.0	12.7	2.4	2.8	5.6	5.6
Auxiliary Boiler	1.4	8.6	0.9	0.5	1.2	1.2
Tail Gas Thermal Oxidizer	13.7	11.4	0.3	10.7	0.5	0.5
CO_2 Vent	N/A	125.1	3.8	N/A	N/A	N/A
Gasification Flare	2.5	18.5	0.05	0.08	0.24	0.24
Rectisol® Flare	0.7	0.8	0.01	0.3	0.03	0.03
SRU Flare	0.1	0.2	0.003	0.4	0.006	0.006
Cooling Towers[2]	N/A	N/A	N/A	N/A	25.5	15.3
Emergency Generators[3]	0.2	0.8	0.1	0.001	0.02	0.02
Fire Water Pump	0.09	0.2	0.01	0.0003	0.001	0.001
Nitric Acid Unit	16.8	N/A	N/A	N/A	N/A	N/A
Urea Pastillation Unit	N/A	N/A	N/A	N/A	0.2	0.2
Ammonium Nitrate Unit	N/A	N/A	N/A	N/A	0.8	0.8
Ammonia Start-Up Heater	0.04	0.15	0.02	0.01	0.02	0.02
Material Handling[4]	N/A	N/A	N/A	N/A	2.4	2.3
Fugitives	0.005	4.8	12.2	0.1	0.1	0.03
Total Annual	**159.0**	**272.1**	**35.0**	**31.9**	**90.4**	**80.1**

Source: HECA 2013

Notes:

1 Total annual emissions represent the maximum annual emissions during operations plus start-up and shut-down emissions.
2 Includes contributions from all three cooling towers.
3 Includes contributions from both emergency generators.
4 Material handling emissions are shown as the contribution of all dust collection points.

HRSG = Heat Recovery Steam Generator
CTG = combustion turbine generator
CO = carbon monoxide
N/A = not applicable
NO_X = nitrogen oxides
PM_{10} = particulate matter less than 10 microns in diameter
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

The thermal oxidizer will be equipped with a natural-gas–fired burner rated up to 16 MMBtu/hr HHV. The SRU reactor furnace, which burns natural gas for system warm-up and post-shut-down plant maintenance, has an 80 MMBtu/hr waste gas burner. The thermal oxidizer natural gas assist burner rating increased from 13 to 16 MMBtu/hr due to new information provided by the supplier; however, HECA intends to keep the maximum allowable heat release at 13 MMBtu/hr and will accept a permit condition to this effect; thus, normal operational emissions do not increase. Compliance will be monitored with a natural gas fuel flow meter.

A summary of the TGTO emissions is presented in Revised Table 3-6. Detailed emission calculations are included in Appendix A, Revised Operational Criteria Pollutant Emissions.

3.2.6 Carbon Dioxide Vent (S-7616-24-0)

Emissions of methanol from the CO_2 vent were updated in response to Sierra Club Data Request 109, submitted to the CEC on December 21, 2012. Methanol, a VOC and TAC, is used by the Rectisol® process to capture and remove CO_2 from syngas to produce clean, hydrogen-rich gas. Captured CO_2 is compressed and transported offsite for enhanced oil recovery and sequestration, and provisions are included for venting CO_2 for short periods of time in the event of unplanned equipment outages. A small amount of methanol remains in the CO_2 vent gas, and a wash system is in place to further reduce the potential for methanol emissions when venting occurs. The Rectisol® process licensor, Linde, anticipates that the typical methanol content in the vented CO_2 stream will be 18 to 20 parts per million (ppm). The annual emission estimate is based on the typical methanol content of 20 ppm and the expected annual quantity of CO_2 that would be vented, which will range from 70 to 100 percent of vent flow capacity. Emissions of methanol in the vented CO_2 gas are presented in Appendix A, Revised Operational Criteria Pollutant Emissions.

HECA proposes a methanol emission limit from the CO_2 vent gas of 2.4 tons/year. HECA will manage annual CO_2 venting to meet the proposed emission limits for this source. HECA will measure the actual methanol concentration in the vent stream for each venting occurrence, along with flow rate. Based on the actual average annual methanol concentration and annual emission quantity to date, HECA will reduce the venting rate and/or duration as necessary to comply with annual emission limits. The CO_2 vent will be a highly instrumented and closely monitored system because venting affects the low GHG basis associated with all products produced.

Front End Engineering Design phase work identified that some benzene, a VOC, and TAC could be produced in the gasification reduction reaction. A benzene removal section has been included in the Rectisol® unit to remove and return the benzene back into the gasification oxidation zone for destruction. A small amount of residual benzene may partition into the CO_2 stream, where it would be sequestered. HECA has updated the emissions from the CO_2 vent to include the residual benzene. Due to the addition of the benzene removal section to the Rectisol® unit, the height of the methanol wash column has increased to 330 feet, and the CO_2 vent height has been increased to 355 feet.

With the introduction of fluxant, the CO_2 flow for enhanced oil recovery (EOR), which is occasionally vented, goes up incrementally. The fluxant and feedstock enter the gasifier together, where the limestone (calcium carbonate [$CaCO_3$]) splits into two components: calcium oxide and CO_2. The calcium oxide becomes part of the gasification solids. The CO_2 becomes part of the syngas stream and is captured in the Rectisol® Unit. The operating characteristics of the Rectisol® unit are such that the CO_2 concentration in the clean syngas remains constant even with the incremental increase in CO_2 flow rate in the incoming syngas. All of the additional CO_2 (an increase of less than 1 percent) is separated from the clean syngas in the Rectisol® unit and flows with the main CO_2 streams used for urea manufacture, EOR, or is occasionally vented. Due to the constant concentration of CO_2 in the outlet of the Rectisol® unit, the flow of carbon in the syngas to the Power Block and Manufacturing Complex remains constant.

The fluxant addition is expected to be about 1 percent of total feed rate, but could be up to 3 percent. To estimate the maximum increase in the CO_2 flow rate available for EOR or infrequent venting, the maximum fluxant addition to feedstock would be 14,448 pounds per hour, based on 3 percent. The fluxant is 95 percent $CaCO_3$ and 5 percent ash/moisture. This equates to an increase in CO_2 in the EOR stream of 6,035 pounds per hour (= 14,448 lb/hr * 44 lb/lb-mole/100 lb/lb-mole * 0.95).

Although the addition of fluxant should not change the TAC and criteria pollutant emissions, emissions of these pollutants are calculated based on a small percentage of the vented stream, and with the increase in vented CO_2, conservatively, these emissions were estimated to increase.

GHG, TAC, CO, and VOC emissions increase due to these changes. A summary of the CO_2 vent criteria pollutant emissions is presented in Revised Table 3-6. Detailed emission calculations are included in Appendix A, Revised Operational Criteria Pollutant Emissions.

3.2.7 Gasification System (S-7616-21-0)

There is no direct stack or vent associated with this permit unit. Fugitive emissions of VOC, CO, ammonia (NH_3), H_2S, and trace hazardous air pollutants (HAPs) and GHGs due to leaks in the piping and components from the Gasification Block are associated with this unit. Fugitive emissions for the Gasification Block were updated to reflect the refined Project design. Fugitive streams 22 – Lower Benzene Concentration, and 23 – Higher Benzene Concentration, resulting from benzene in the syngas cleanup (discussed further in Section 3.2.6), were added to this permit unit. These modifications resulted in minor changes in emissions of criteria pollutants, TACs, and GHGs.

The methanol storage tank for the Rectisol® Unit solvent has been added to this permit unit. This tank has always been part of the Project, but it was unintentionally not addressed in the ATC/ PSD Application. This tank will be used to supply makeup solvent to the Rectisol® Unit, and to provide adequate storage capacity for the entire solvent inventory when unit maintenance is required. The size is based on the capacity needed to hold the entire solvent inventory from the unit. The tank has a 600,000-gallon capacity and a fixed roof, is 55 feet tall above grade (with 48-foot-high sides), and is 46 feet in diameter. Uncontrolled emissions were calculated using the U.S. Environmental Protection Agency (USEPA) TANKS model. The tank vent will have a scrubber with 99.98 percent control efficiency. Resulting annual VOC emissions from the tank are 3.9 pounds per year.

For the purpose of calculating building downwash, the height of the gasification structure was revised to 260 feet. The structure remains 305 feet tall, but the top portion has an open structure that wind can pass through; therefore, downwash was estimated from the lower more solid portion of the structure.

3.2.8 Ammonia Synthesis Unit (S-7616-33-0)

The ammonia synthesis start-up heater will be equipped with four low-NO_X burners, each rated at 14 MMBtu/hr, for a total rating of 56 MMBtu/hr; this is a change from 55 MMBtu/hr due to new information provided by the vendor. This causes a very minor increase in emissions. Emissions and calculations are included in Appendix A, Revised Operational Criteria Pollutant Emissions. This heater is for start-up only, and will not be used more than a few days per year.

Two new CO_2 streams associated with the Manufacturing Complex (streams 18a – CO_2 Product and Purification Compressors, and 18b – Urea CO_2 Compressor) were added to this permit unit. These streams more appropriately account for the composition of the streams passing through the compressors previously associated with stream 18 – High CO_2 concentration stream.

Fugitive emissions for the Manufacturing Complex were updated to reflect the refined Project design. The emissions presented in Appendix B, Revised Toxic Air Contaminant Emissions, reflect the most recent Project design. This resulted in minor changes in emissions of criteria pollutants, TACs, and GHGs. Criteria pollutant fugitive emissions and ammonia synthesis start-up heater emissions are summarized in Revised Table 3-6.

3.2.9 Urea Unit (S-7616-34-0)

The high pressure (HP) and low pressure (LP) absorbers now vent to the same stack, referred to as the urea absorber stack. All stack parameters were modified to represent the single source vent. There is no change in emissions; the emissions represent the sum of the previous HP and LP emissions. Only ammonia is emitted from this source.

There were no changes to the Urea Pastillation vent.

3.2.10 Nitric Acid Unit (S-7616-35-0)

NH_3 and nitrous oxide (N_2O) emissions increased due to new information provided by the vendor, as described in Sections 5.1.1 and 3.4, respectively. These emissions were described in the response to the Notice of Incomplete Application provided to SJVAPCD on August 1, 2012, and below. NO_X emissions did not change.

Stack parameters were modified, including a reduction in stack height to 120 feet, an increased temperature, decreased flow, and decreased exit velocity.

3.2.11 Ammonium Nitrate Unit (S-7616-36-0)

The annual operating hours were increased slightly to 8,052 hours per year to match the operating hours of all other sources in the Manufacturing Complex. The stack height was raised to 55 feet.

3.2.12 Material Handling (S-7616-17, 18, 19, 20, 22, 37)

One tank vent filter has been added to control emissions from the new fluxant unloading and storage silo associated with Unit 19, the feedstock storage, blending, and reclaim system. PM emissions from this source will be minor at 0.01 ton per year.

Particulate matter emissions are associated with the material handling of the feedstock, fluxant, urea, and gasification solids. The design of these material handling systems has been modified, and the associated emissions have been calculated as presented in Appendix A, Revised Operational Criteria Pollutant Emissions. All PM emissions from these sources are assumed to be $PM_{2.5}$ or smaller.

Updated process flow diagrams show the material handling system. Only the feedstock crusher vent and feedstock transfer tower 2 switched locations; now the crusher station is closer to the feedstock barn (Figures 3-1 through 3-4). Although these do not show the fluxant handling system, there will be a baghouse that services the fluxant unloading and storage silo. The fluxant will be blended with the feedstock when it leaves the northern side of the feedstock barn.

The fugitive dust calculation for material handling on the gasification solids pad has been divided into two parts to account for the difference in material moisture content for placement (stacking) versus removal (reclaim), and the corresponding emission factors for both PM_{10} and $PM_{2.5}$ have been applied to estimate emissions.

A summary of the material handling emissions is presented in Revised Table 3-6. Detailed emission calculations are included in Appendix A, Revised Operational Criteria Pollutant Emissions.

3.2.13 Emergency Generator Engines and Firewater Pump Engine (S-7616-38, 39, 40)

There were no changes to the emergency engines.

3.2.14 HECA Facility-Wide Criteria Pollutant Emissions

The total annual emissions of criteria pollutants from all stationary emission sources of the Project addressed in the previous subsections are shown in Revised Table 3-6.

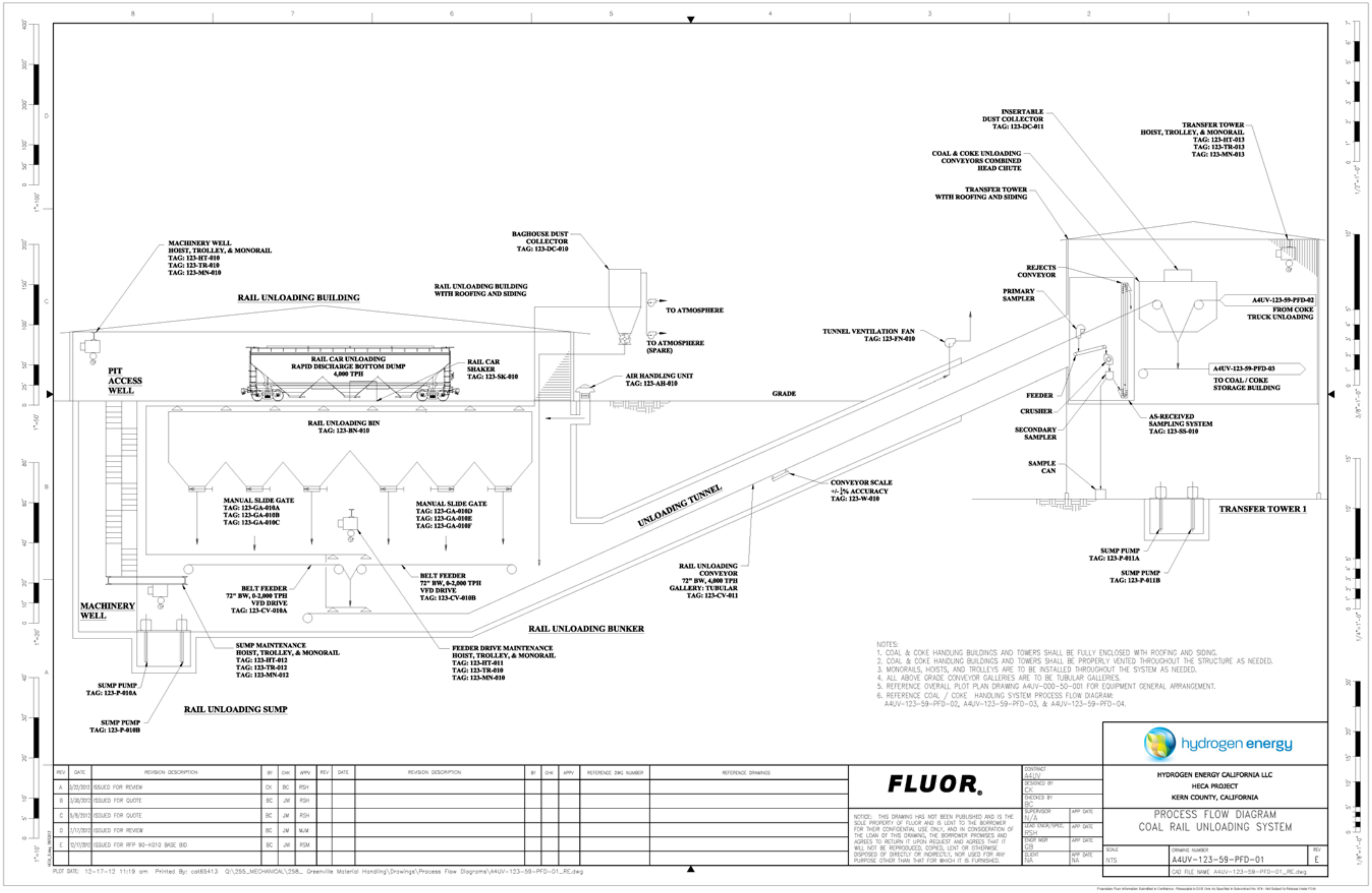
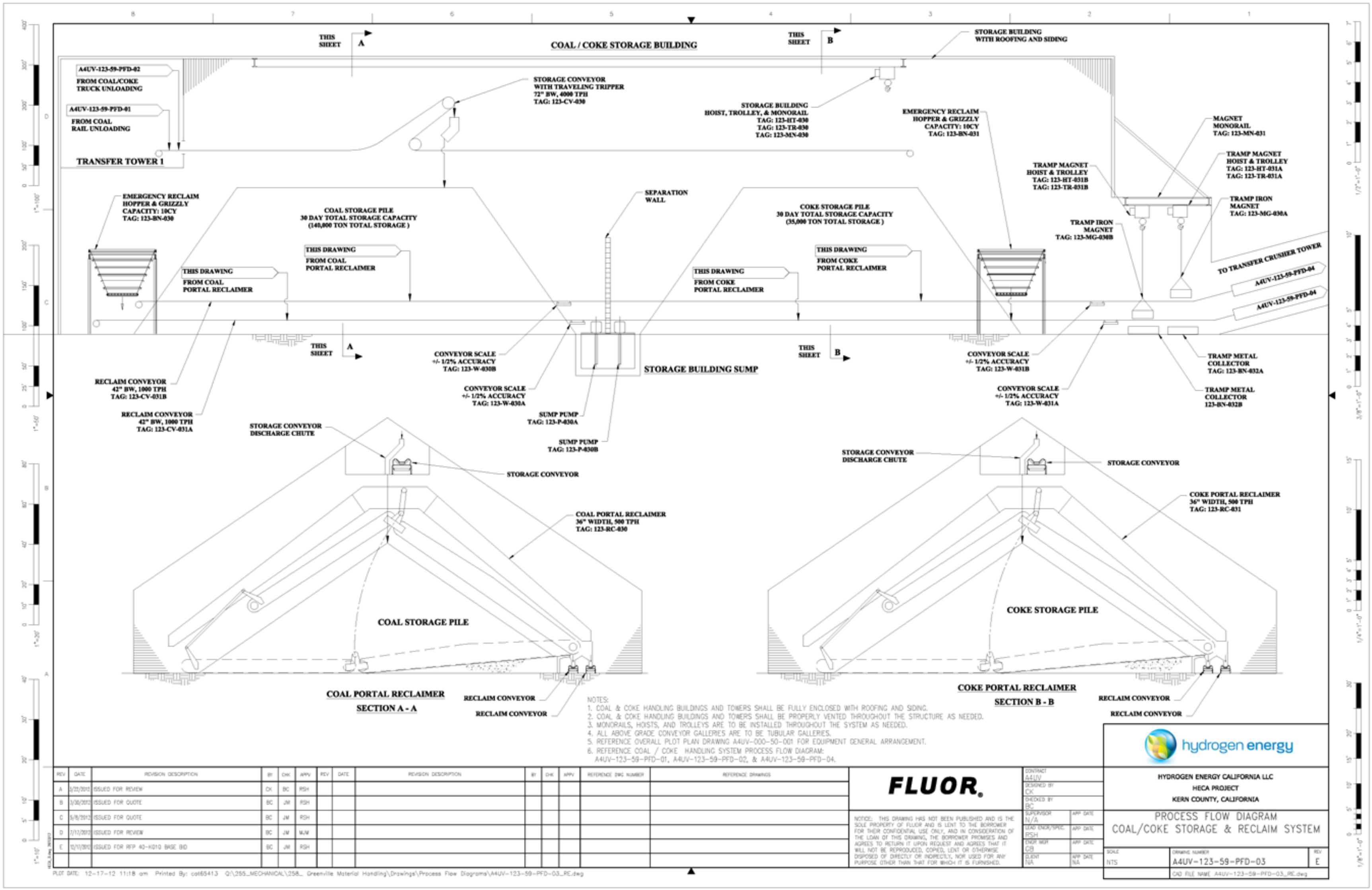


Figure 3-1 Process Flow Diagram Coal Rail Unloading System



Proprietary Fluor Information Submitted in Confidence - Releasable to DOE Only As Specified in Subcontract No. 674 - Not Subject to Release Under FOIA

Figure 3-2 Process Flow Diagram Coal/Coke Storage and Reclaim System

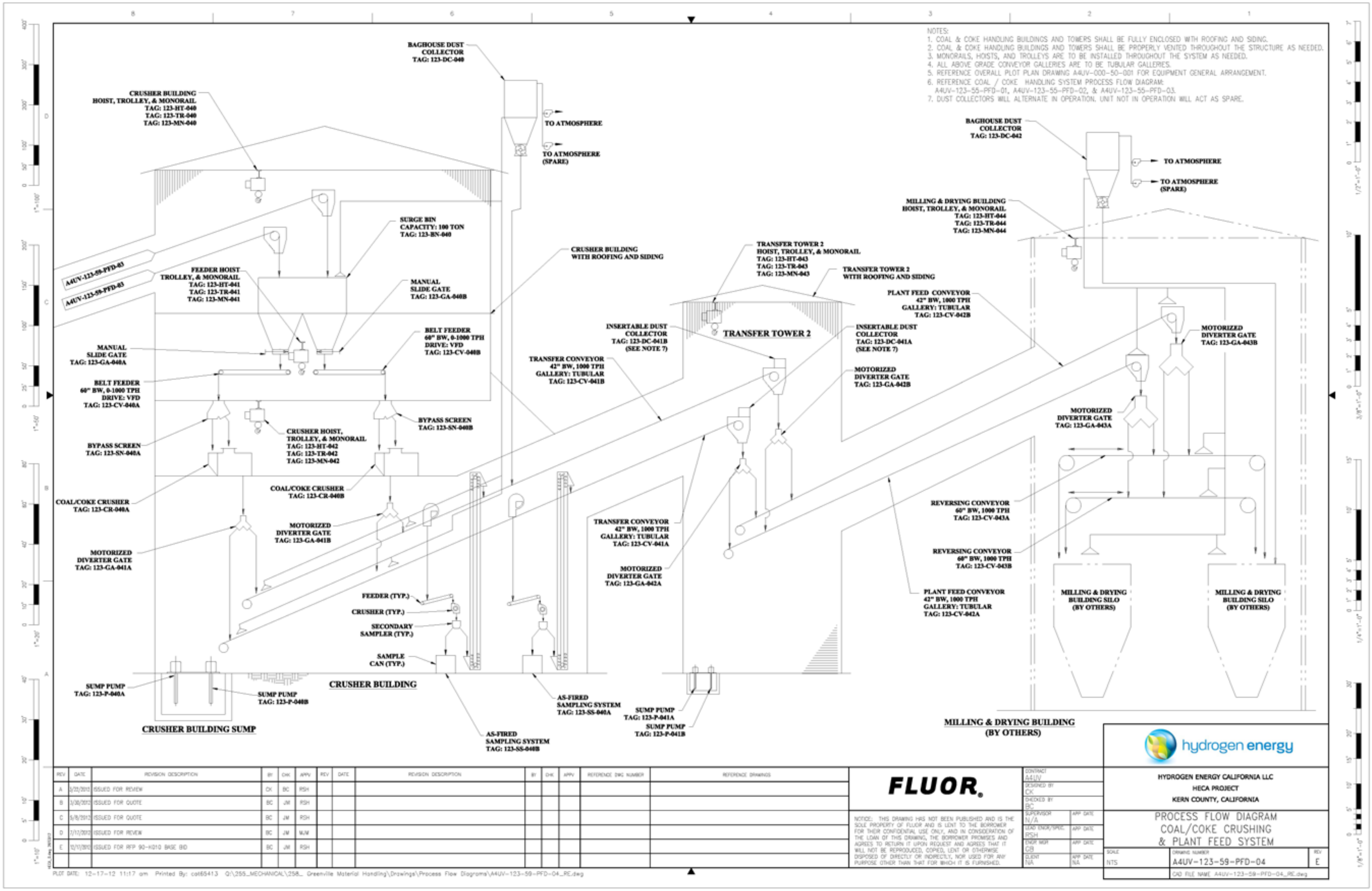


Figure 3-3 Process Flow Diagram Coal/Coke Crushing and Plant Feed System

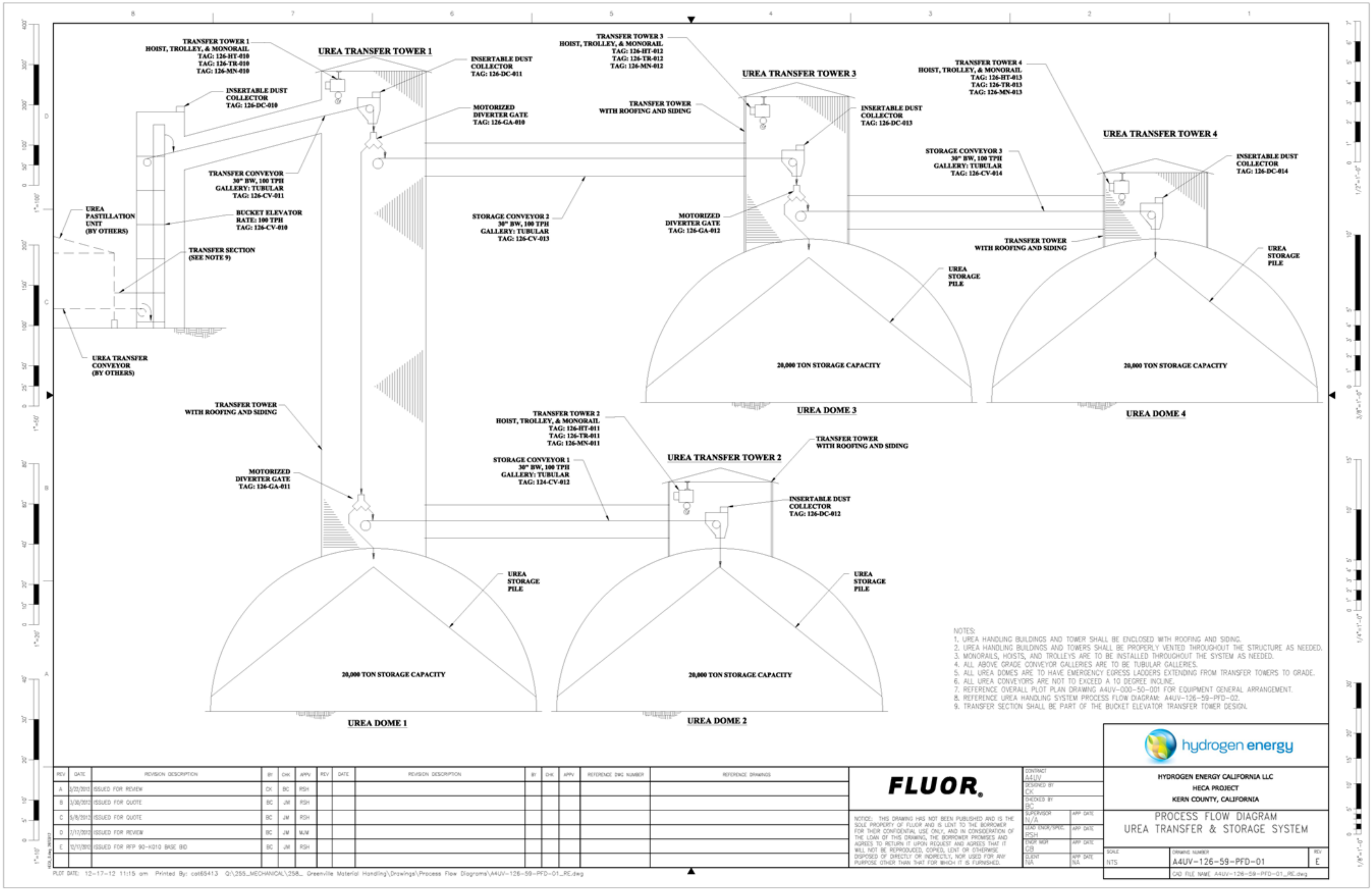


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Figure 3-4 Process Flow Diagram Urea Transfer and Storage System

3.3 MOBILE SOURCES

As in the ATC/PSD application, onsite truck and train trip emissions were incorporated in the dispersion modeling for California Environmental Quality Act (CEQA) purposes. Mobile sources were not included in the PSD SIL or National Ambient Air Quality Standards (NAAQS) analyses. Transportation emissions are considered indirect project emissions and are included in the federal conformity analysis.

Changes to the transportation emissions for both Alternative 1 (Rail Transportation) and Alternative 2 (Truck Transportation) were presented in the September 2012 and April 2013 General Conformity Evaluation reports, and also in response to data requests. These changes affected the criteria pollutant, GHG, and diesel particulate matter emissions for Alternatives 1 and 2.

In addition to the normal operational transportation emissions, Appendices C and D for Alternatives 1 and 2, respectively, present the overlap of construction emissions and operational transportation emissions, which is expected to occur in 2017.

The maximum expected numbers of truck and train trips for the averaging period corresponding to the AAQS are summarized in Revised Table 3-11. These are the basis for the modeling analysis that was conducted for Alternative 1.

Revised Table 3-11
Onsite Maximum Trucks and Trains by Averaging Period

Period	Petcoke Trucks	Fluxant and Product Trucks	Miscellaneous Trucks	Coal Trains	Product Trains
1 hour	7	9	7	1	1
3 hours	20	27	7	1	1
8 hours	54	71	7	2	1
24 hours	68	89	7	2	1
Annual	15,200	21,620	2,330	119	165

Source: HECA, 2013.

Notes:

- This represents the transportation needs for Alternative 1.
- The facility will also maintain 20 vehicles (10 gasoline and 10 diesel trucks) for onsite operations and maintenance.
- The maximum daily number of trains will be two, consisting of either two coal trains or two coal train and one product train.
- The maximum daily number of trucks includes the normal expected daily trucks plus 45 additional trucks to account for fluctuations in feedstock or product trucks, thus these additional trucks were spread evenly in the truck categories for modeling purposes.

3.3.1 Trains

The number of trains needed to move feedstock and product was updated to match Project refinements. There will be a slight increase in the number of trains coming to the site annually; there will not be any ammonia trains, because the applicant has decided not to sell ammonia. For

Alternative 1, the daily number of trains will be at most two trains: either one product and one coal train, or two coal trains. For onsite modeling, this is a decrease from three trains per day. Each unit coal train consists of 111 rail cars; and each product train consists of 60 rail cars. The travel routes and distances for trucks and trains in each affected air basin were refined and revised.

At the recommendation of the CEC, emission factors used in the train calculations came from the USEPA's Technical Highlights: Emission Factors for Locomotives, April 2009(a) (http://www.epa.gov/nonroad/locomotv/420f09025.pdf). The train emissions were calculated using USEPA Tier 3 emission factors, locomotive conversion factors, and locomotive load factors. Emissions calculation techniques were based on the techniques used in "The Port of Long Beach – 2007 Air Emissions Inventory." These incorporated the average train travel speed of 40 miles per hour, the average line haul locomotive load factor of 28 percent, and the ratio of required horsepower (empty train/full train) of 0.76. These changes were presented in response to CEC Data Request A18 on August 22, 2012. The result is a decrease in criteria pollutants and diesel particulate matter for both short-term and annual emissions, even though the number of trains increased per year. GHG emissions associated with trains increased, due to increase in number of trains per year.

Fugitive coal dust emissions from coal trains were calculated and presented in response to CEC Workshop Data Request A34 on December 20, 2012. It was determined that the rail cars would not be covered, but a surfactant with a control efficiency of at least 85 percent will be applied to all cars to limit fugitive coal dust.

The approach for quantifying coal dust fugitives used AP-42, Compilation of Air Pollutant Emission Factors, Section 13.2.5, Industrial Wind Erosion (USEPA, 2012). Each uncovered coal car can be visualized as a coal pile, and the wind speed equal to the speed of the train. The method presented in Section 13.2.5 estimates fugitive emissions based on the fastest wind speed in each period of disturbance (adding to or removing from the pile), assuming that all available fines will be emitted during that time. In this case, there is only one period of disturbance, the loading of the coal in the cars, and the coal is not disturbed again until it is removed at the Project Site. The emissions will primarily occur in the beginning of the trip, when the train starts up and achieves maximum speed. The AP-42 Industrial Wind Erosion equation is applied to each individual car.

Emissions were calculated based on a train speed of 40 miles per hour, the average exposed area of coal in each car, the expected number of coal cars travelling to the Project Site per year, and roughness parameters (roughness height, z_o, and threshold friction velocity, ut*) appropriate for coal (from AP-42). After applying the 85 percent control efficiency for application of chemical surfactants, the total fugitive coal dust from all rail cars along the entire route is 3.85 tons per year of emissions of PM_{10}, and 0.58 ton per year of emissions of $PM_{2.5}$. It has been assumed that all emitted PM will be lost during the first 100 miles of the trip; therefore, all PM emissions have been assigned to transportation emissions in New Mexico.

3.3.2 Trucks

The number of trucks needed to move feedstock and product was updated to match Project refinements. There will be an increase in the number of trucks coming to the site daily and annually for both alternatives. Some notable changes on the number of trucks are as follows:

- Fluxant delivery trucks were added.
- There is an increase in gasification solids trucks to accommodate the additional solids associated with the addition of fluxant.
- The number of urea trucks was increased to correct a previous under estimation.
- Small increase in liquid sulfur, urea ammonium nitrate (UAN), equipment, and miscellaneous trucks.
- The Project owner has decided not to sell ammonia; thus, there will not be any ammonia trucks. In the modeling, the idling ammonia truck point source was removed.

A more realistic maximum daily truck scenario was developed for both alternatives and used in the modeling. The maximum number of trucks per day in Alternative 1 is 164; and in Alternative 2 the maximum is 536 trucks per day—this breakdown is described further in Appendix A, Revised Operational Criteria Pollutant Emissions. Criteria pollutant emissions from onsite trucks decreased in the modeling for short term (due to a lower number of maximum trucks per day, although on average there will be more trucks per day), and increased for the annual time period.

The onsite Project-related mobile emissions for Alternatives 1 and 2 are summarized in Revised Table 3-12. A summary of the fugitive dust emissions from the onsite delivery trucks, and vehicles is presented in Revised Table 3-6. Onsite transportation emissions and calculations are included in Appendix A, Revised Operational Criteria Pollutant Emissions. Offsite transportation emissions and calculations are presented in Appendix C, Revised Operational Transportation Emissions for Alternative 1; and Appendix D, Revised Operational Transportation Emissions for Alternative 2.

3.4 GREENHOUSE GAS EMISSIONS

The GHG emissions presented in this section reflect the design refinements outlined in the previous sections. Total project GHG emissions increased nominally as a result of these refinements. As noted in Section 3.2.6, with the introduction of fluxant, the CO_2 flow for EOR goes up incrementally; thus, the flow from the CO_2 vent also increases. Also noted in Section 3.2.6, the flow of carbon in the syngas to the Power Block and Manufacturing Complex remains constant; thus, GHG emissions from the CTG/HRSG and Feedstock Dryer did not change due to the addition of fluxant.

Revised Table 3-12
Operational Transportation Emissions Related to the Project

Emission Source	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOCs
	Annual Emission Rates (tons/year)					
Alternative 1						
Onsite train	0.87	2.45	0.04	0.04	0.06	0.12
Onsite truck	0.63	0.98	0.15	0.05	0.01	0.16
Total Emission (ton/ year)	**1.51**	**3.43**	**0.19**	**0.09**	**0.07**	**0.28**
Alternative 2						
Onsite train	—	—	—	—	—	—
Onsite truck	1.52	2.98	0.30	0.10	0.01	0.45
Total Emission (ton/ year)	**1.52**	**2.98**	**0.30**	**0.10**	**0.01**	**0.45**

Source: HECA, 2013.

Notes:

Onsite worker travel and associated emissions are negligible.

CO = carbon monoxide
NO_X = nitrogen oxides
PM_{10} = particulate matter less than 10 microns
$PM_{2.5}$ = particulate matter less than 2.5 microns
SO_2 = sulfur dioxide
VOCs = volatile organic compounds

The nitric acid unit licensor has stated that the emissions of N_2O vary with the age of the oxidation catalyst. The N_2O emission rate reflects the variation of N_2O inlet concentration to the N_2O abator catalyst (or tertiary decomposition catalyst). This variation is caused by the gradual degradation of the oxidation catalyst in the nitric acid unit used to convert the ammonia to NO_2, which is then reacted with water to produce nitric acid. With a new oxidation catalyst, the controlled N_2O emissions will be 6.6 pounds per hour (lb/hr); the N_2O emissions can increase to 15.9 lb/hr by the end of the oxidation catalyst life. The emission rate presented in the permit application was the lower end of the emission profile corresponding to fresh, start-of-run catalyst conditions, and therefore would not fully account for the total N_2O emissions from the nitric acid unit. The average N_2O emission rate from the nitric acid unit is 11.25 lb/hr, or 41 tonnes per year (tonnes/yr), which equates to 12,659 tonnes/yr of CO_2 equivalent (CO_2e). Based on the average emission rate for N_2O, the emission factor would be 0.54 lb N_2O per ton of nitric acid produced.

Total annual Project GHG emissions were estimated for the three operating scenarios, as described below:

- **Early Operations** are expected to last approximately 2 years, during which time hydrogen-rich fuel availability will be approximately 65 to 75 percent. During this period, all sources are expected to be operated at maximum operating conditions, including two plant start-ups and shut-downs. The CO_2 vent is included, with maximum permitted venting emissions of up to 504 hours at full capacity.

- **Mature Operations** are expected to occur after the first 2 years of commercial operation, when the hydrogen-rich fuel availability will be approximately 85 percent. At this stage, significantly less venting is expected to occur; therefore, CO_2 vent emissions are estimated based on approximately 10 days of venting at 50 percent capacity (or 120 hours of venting at 100 percent capacity). All other sources are operated at maximum operating conditions, including two plant start-ups and shut-downs.

- **Steady State Operations** occur in the same time frame as mature operations; that is, after the 2 years of early operation. In this scenario, emissions are estimated based on maximum operating conditions, excluding start-ups, shut-downs, and CO_2 venting. Emissions from operation of the CTG/HRSG on syngas are included; no natural gas use is included.

Revised Table 3-14 presents the annual CO_2e emissions from all stationary sources at HECA in metric tons (tonnes) during the early operations phase. This operational phase represents the maximum total Project annual CO_2e emissions. Detailed emission calculations can be found in Appendix E, Revised Operational Greenhouse Gas Emissions.

Revised Table 3-14
Maximum Annual CO_2e Emissions - Early Operations

Source	Permitted CO_2e Emissions (tonne/yr)
CTG/HRSG H_2-rich fuel and PSA off-gas	267,117
CTG/HRSG natural gas	44,772
CO_2 Vent	175,493
SF_6 circuit breakers	86
Flares	8,257
Thermal oxidizer	6,048
Emergency generators and fire pump	181
Auxiliary boiler	24,782
Ammonia synthesis plant start-up heater	417
Urea absorber vents	116
Nitric acid unit	12,659
Fugitives	42
Total CO_2e Annual Emissions	**539,971**

Source: HECA, 2013.

Notes:

Maximum permitted emissions include periods of start-up and shut-down.

CO_2e = carbon dioxide equivalent
CO_2 = carbon dioxide
CTG/HRSG = combustion turbine generator/heat recovery steam generator
H_2 = hydrogen
SF_6 = sulfur hexafluoride

For comparison to the California Senate Bill (SB) 1368 Greenhouse Gases Emission Performance Standard (EPS) for CO_2 of 1,100 lb per megawatt hour (lb/MWh), CO_2 emissions and electricity production were calculated following CEC's "Regulations Establishing and Implementing a Greenhouse Gases Emission Performance Standard for Local Publicly Owned Electric Utilities" (CEC, 2012). SB 1368 is a standard that regulates the emissions of CO_2 on a lb/MWh basis of power produced and sold to publicly owned electric utilities. This standard does not regulate the power or CO_2 emissions from the Manufacturing Complex.

More detailed information regarding how the CO_2 emissions and power use is portioned between power production, syngas production, and the Manufacturing Complex was used to revise the SB 1368 EPS calculations. The methodology and assumptions for allocating CO_2 emissions between the production of power and the Manufacturing Complex are outlined below.

This allocation is required because the common portion of the plant produces syngas, and only a portion of the syngas is used to produce power; the remainder is used in the production of fertilizer. CO_2 emissions and power attributable to the production of fertilizer are excluded from the calculation of the EPS. The power output calculations are approximated for On-Peak and Off-Peak operation, from which the daily average is estimated based on 16 hours and 8 hours of operation per day, respectively.

The plant is divided into three sections. The common section produces clean syngas. The clean syngas flows to the remaining sections: the Manufacturing Complex section and the power section. The CO_2 emissions from the production of the syngas are allocated between the fertilizer production and power production according to the respective portion of clean syngas used. The allocation is performed on a lower heating value basis.

Gross power generation has been attributed to the power block, except for the portion of power generated that is attributable to the steam used by or produced by the Manufacturing Complex. Steam integration with the Manufacturing Complex increases the output of the steam turbine above that which would be achieved without steam integration. The power attributable to steam integration with the Manufacturing Complex is noted and subtracted from the gross generator output to give the portion attributable to the power block.

The auxiliary loads are also segregated into the three sections noted above. The common auxiliary loads are further allocated to power or manufacturing according to the portion of clean syngas used by the power block or fertilizer units.

Net power output is the gross generation allocation to power, less the auxiliary loads attributable to power. The Manufacturing Complex power consumption is the gross generation allocation to fertilizer, less the auxiliary loads attributable to fertilizer. The daily average net output of syngas-fired power production was multiplied by 8,000 hours of operation per year to obtain the megawatt-hours of power produced per year. Natural-gas–fired power generation was calculated at 336 hours per year (2 weeks) times 300 MW net output. The total net power output is the sum of power generated from operation on syngas, plus power generated from operation on natural gas. Conservatively, the net output does not include the power output during start-up or shut-down operations.

The CO_2 emissions are split according to the respective portion of clean syngas used. The CO_2 emitted when burning natural gas in the turbine to produce power is allocated only to the power block. The CO_2 emitted from the urea unit vent or when burning natural gas in the ammonia start-up heater is allocated only to the Manufacturing Complex. The remaining CO_2 emissions are considered common, and split between the power section and Manufacturing Complex.

Emissions and power output were estimated for the three scenarios: early operations, mature operations, and steady-state operations. Revised Table 3-15 compares the CO_2 emissions of the Project with the SB 1368 emission standard for the three scenarios. CO_2 emissions from the electricity production at HECA are approximately 150 lb/MWh during steady-state operations on hydrogen-rich fuel. The maximum CO_2 emissions during early operations, including emissions from natural-gas operation, start-up, shut-down, and CO_2 venting, would be approximately 300 lb/MWh. Detailed emission calculations can be found in Appendix E, Revised Operational Greenhouse Gas Emissions.

Revised Table 3-15
Annual CO_2 Emissions for SB 1368 Emission Performance Standard

Operating Parameter	Early Operations (Maximum Permitted)[1]	Mature Operations[2]	Steady-State Syngas Operations[3]
Total CO_2 Annual Emissions Attributable to Power Production (ton/year)	386,494	290,865	188,228
Net Power Output (MWh)	2,565,374	2,565,374	2,464,574
CO_2 EPS (lb/MWh)	301	227	153

Source: HECA, 2013.

Notes:

[1] Early operations emissions include two periods of start-up and shut-down, natural gas use in the CTG, and 504 hours of CO_2 venting.

[2] Mature operations emissions include two periods of start-up and shut-down, natural gas use in the CTG and 120 hours of CO_2 venting.

[3] During steady-state operation, the CTG and duct burners will fire only hydrogen-rich fuel and PSA off-gas; no start-ups and shut-downs, no natural gas backup use, and no CO_2 venting.

CO_2 = carbon dioxide
EPS = Emission Performance Standard
MWh = megawatt hours
lb/MWh = pounds per megawatt hours
SB = Senate Bill

HECA will capture 90 percent of the carbon in the raw syngas. This captured CO_2 will be sequestered or occasionally vented during periods when the compression and transportation system is unavailable. The removal of carbon, and its subsequent sequestration in EOR and use in urea production, ensures that the generation of electric power and fertilizer starts from a very low carbon syngas, ultimately lowering the GHGs associated with the generation of these products.

The extent to which carbon capture reduces CO_2e emissions from the facility is illustrated in Figure 3-5. This figure represents the early operations or maximum permitted emissions. As shown, a substantial majority of CO_2 generated from the gasification process during normal plant operations will be captured

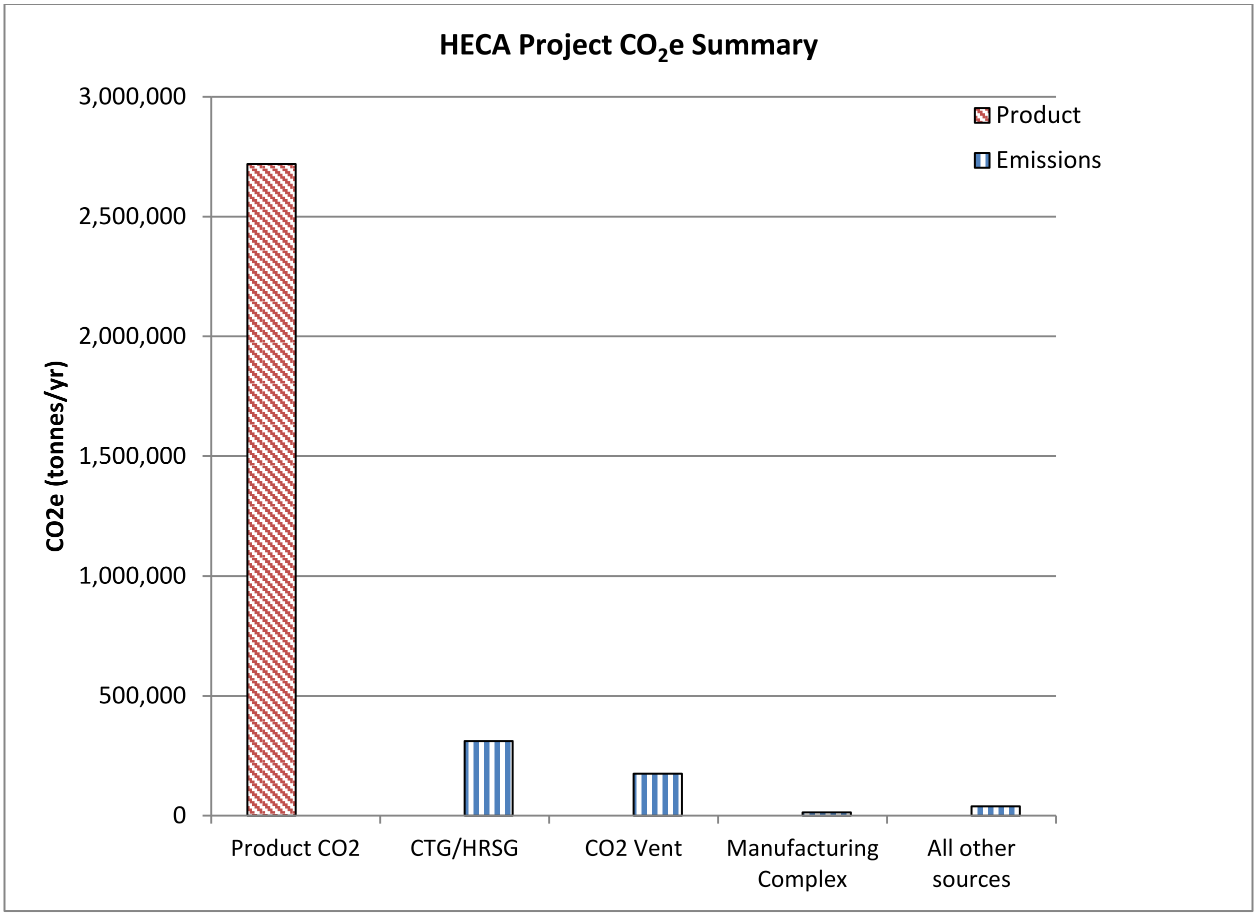


Figure 3-5 HECA CO_2e Emissions and Product Summary

and sequestered. This product will be transported to Occidental of Elk Hills, Incorporated (OEHI), and used for EOR, resulting in sequestration of the CO_2; used in urea production, and thus not emitted; or periodically vented during periods when the compression and transportation system is unavailable, or during a gasification block start-up or shut-down. The amount of CO_2 sequestered is calculated based on the maximum CO_2 production rate of 767,435 lb/hr times the amount of time CO_2 is sent to OEHI. During the early operations scenario, there will be up to 8,314 hours of syngas production, minus 504 hours of venting; therefore, approximately 2.7 million tonnes per year of CO_2 will be sequestered.

Transportation-related GHG emissions are presented in Revised Table 3-16, and calculation details are included in Appendix E, Revised Operational Greenhouse Gas Emissions.

Revised Table 3-16
Greenhouse Gas Emissions Associated with Mobile Sources During Project Operations

Source	Annual CO_2e Emissions (tonne/yr)
Onsite trucks	422
Onsite trains	297
Offsite Workers Commuting	824
Offsite Trucks	12,372
Offsite Trains	50,075
Total CO_2e Annual Emissions	**63,990**

Source: HECA, 2013.

Notes:

Onsite worker travel and associated emissions are negligible.

Emissions represent Alternative 1 transportation requirements.

CO_2e = carbon dioxide equivalent

To assess the potential impact of the Project on ambient air quality, updated dispersion modeling was performed based on the Project's revised emissions of criteria pollutants. The methodology, model input, and receptors presented in the ATC/PSD Application remain the same. Some emission rates, stack parameters, and source locations have changed, and those are discussed below. The purpose of the dispersion modeling is to evaluate Project compliance with state and federal AAQS.

4.1 DISPERSION MODELING METHODOLOGY

4.1.1 Model and Model Option Selections

Updated impacts from Project operations were evaluated using the most recent version of AERMOD: Version 12345. All model option selections used the same methodology as outlined in Section 4 of the May 2012 ATC/PSD Application. All other input data, such as the meteorological, ozone, and nitrogen dioxide (NO_2) data sets, remained the same.

4.1.2 Building Wake and Good Engineering Practice

All stacks in the HECA Project are still less than or equal to the Good Engineering Practices (GEP) default height of 65 meters, with the exception of the feedstock dryer, three flares, and the CO_2 vent. The height of the CO_2 vent has increased to 355 feet, because it needs to be taller than the methanol wash. The flare and feedstock dryer stack heights remain the same as presented in the ATC/PSD Application. Therefore, the heights of these stacks are as follows:

- Feedstock Dryer: 92.9 meters
- SRU Flare, Gasification Flare, Rectisol® Flare: 76.2 meters
- CO_2 Vent: 108.2 meters.

Building Parameter Input Program (BPIP)-Prime was run to determine the GEP height for each stack. The output of this model shows that the GEP for the three flares is 65 meters, for the feedstock dryer is 198 meters, and for the CO_2 vent, 198 meters. BPIP files will be provided with this report.

GEP is calculated based on the following equation:

$$Hg = H + 1.5 * L$$

where: Hg = GEP stack height (in meters)
H = height of the nearby structure (in meters)
L = lesser dimension of the height or projected width of the nearby structure (in meters)

The largest downwash structure near the feedstock dryer and the CO_2 vent remains the gasifier building, which has an updated height for downwash purposes of 79.2 meters high, and measures 28 meters in length by 84.4 meters in width. Therefore, L = 79.2 meters, H = 79.2 meters, and Hg = 198 meters.

The gasifier building is located at a distance within five times L (396 meters) from the CO_2 vent and the feedstock dryer; therefore, GEP for these stacks is calculated based on the gasifier building dimensions. The heights of the feedstock dryer and CO_2 vent are thus well below the GEP height of 198 meters.

The flares are upwind of the gasification building along its shorter axis; thus, L = 28 meters and Hg = 121 meters. The flares are not within five times L (140 meters) of the gasification structure or any other structure that is large enough to create downwash for the flares in BPIP-Prime. It is important to note that the flares will be built at 76.2 meters in height for safety from a Project engineering perspective. However, a 65-meter stack height, or GEP, was used to calculate specific effective stack heights for each flare modeling scenario based on the flare's heat release rate during that modeling scenario. The effective stack height is the height of the stack plus the height above the stack where the flare flame ends and a plume can begin. The effective stack parameters were calculated using the SCREEN3 technique, and were input into the AERMOD model (USEPA, 1995b). Therefore, the lower, 65-meter stack height was used in the calculation of the effective stack heights for the flares, rather than the actual stack height. Appendix A, Revised Operational Criteria Pollutant Emissions, presents the effective stack parameters for the flares.

4.1.3 Receptor Locations

The Project Controlled Area boundary was moved slightly to ensure adequate roadway easements; thus, the boundary along Station, Adohr, and Dairy roads was affected. Receptors were placed along the new property line using the same methodology as given in the ATC/PSD Application. The property line extends around the perimeter of the Project Site and Controlled Area (see Revised Figure 1-1).

4.1.4 Sensitivity Modeling

Because the start-up time for the CTG/HRSG is now shorter and some sources have updated emission rates, a few maximum impact scenarios for the short-term averaging time pollutants are different from the scenarios described in the ATC/PSD Application. Sensitivity modeling was completed for the CO 8-hour standard, and it was determined that the maximum CO 8-hour impact would occur during a CTG/HRSG shut-down. Maximum PM 24-hour impacts also now occur during a CTG/HRSG and feedstock dryer shut-down.

Lastly, SO_2 maximum short-term impacts now occur during a tail-gas thermal oxidizer hydrogenation catalyst presulfiding event. All other emissions scenarios for modeling remained the same.

Further details on worst-case modeling scenarios for these pollutants, and averaging times, are described in Section 4.1.5.

4.1.5 Modeling Scenarios

4.1.5.1 Operations Emission Scenarios for Modeling

A few modeling scenarios that give maximum estimated impacts have changed since the CTG/ HRSG start-up time was shortened, and emission rates for some sources have changed. The following describes the changes made for pollutants and averaging times that differ from the ATC/PSD Application.

CO 8-hour

The maximum CO 8-hour impact scenario occurs during a plant shut-down when the CTG/ HRSG and feedstock dryer are shutting down, and a number of other sources are operating during this shut-down period. For 3 hours, the CTG/HRSG and feedstock dryer shut down, and operate at 40 percent load on syngas; then the CTG runs for 3 hours at 40 percent load on natural gas; lastly, the CTG runs for 2 hours at 20 percent load on natural gas. The TGTO operates in normal mode for the entire 8-hour duration. The Rectisol® and SRU flares are in pilot mode, and shifted syngas is flared in the gasification flare for 4 hours, then goes to pilot mode. The CO_2 vent has maximum process venting for the entire period. The auxiliary boiler, ammonia start-up heater, and emergency equipment are not operating during a CTG/HRSG shut-down period. CO fugitives from the gasification, shift, AGR, SRU, sour water, CO_2 compression, and Pressure Swing Adsorption unit areas are also included. Mobile sources are not included in model runs to predict impacts for comparison to the NAAQS, but are included in the simulations to evaluate compliance with the California Ambient Air Quality Standards (CAAQS).

PM_{10} and $PM_{2.5}$ 24-hour

This modeling scenario was selected to conservatively assess high emissions and impacts, and could not occur in actual plant operation. The maximum PM_{10} and $PM_{2.5}$ 24-hour impacts occur when the CTG/HRSG and feedstock dryer are operating in shut-down mode. Stack parameters for these sources used flow rates based on normal off-peak mode. All other sources were modeled in the same manner as in the ATC/PSD Application. The TGTO and all flares were included with maximum emissions during start-up. All three cooling towers (ASU, Power Block, and Process) were included with maximum 24-hour PM_{10} and $PM_{2.5}$ emission rates. The auxiliary boiler was not operating during this time, because it is not expected to operate while the CTG is operating. Both emergency generators are tested for 1 hour of the 24-hour period, and the emergency diesel firewater pump is tested for 2 hours during the 24-hour period. The emergency equipment maximum daily emissions were spread evenly across all hours in the day. The ammonia start-up heater was operating in start-up mode. All sources associated with the manufacturing plant with PM emissions were assumed to be operating, including the ammonium nitrate unit, and the urea pastillation stack; all material-handling sources were operating as well, which include all feedstock, urea, and gasification solids storage and handling systems. Emission source release points for material handling may be found in Appendix A, Revised Operational Criteria Pollutant Emissions. Mobile sources are not included for comparison to the NAAQS, although the maximum daily number of onsite mobile sources is included for comparison to the CAAQS.

SO_2 1-hour, 3-hour, 24-hour

All sources were modeled in the same manner as presented in the ATC/PSD Application, with the exception of the TGTO. The TGTO has the highest SO_2 impacts during a 24-hour hydrogenation catalyst presulfiding event. For the CAAQS, the TGTO modeling used the highest SO_2 emissions occurring during this event for short-term SO_2 averaging times. For the SO_2 1-hour NAAQS, annualized emissions for the tail gas thermal oxidizer, which includes all emission events for this source that occur over the year, are higher than this source's normal process vent disposal SO_2 emission rate. Therefore, the TGTO annualized emission rate was used in the SO_2 1-hour NAAQS analysis.

As presented in the ATC/PSD Application, the maximum SO_2 short-term impacts occur when the CTG/HRSG is operating at 80 percent load on natural gas, which is the highest SO_2 emission rate for the CTG/HRSG, conservatively mixed with the lowest exhaust flow rate (Case 2 – off-peak ambient temperature 97 degrees Fahrenheit [°F]) that occurs during CTG/HRSG operations in off-peak power mode. The feedstock dryer has the highest short-term SO_2 emissions during off-peak power, combined with the lowest exhaust flow rate. Although these two sources will not operate in their worst-case mode at the same time, SO_2 short-term modeling was completed as described above to minimize the need for several sensitivity runs. The ammonia start-up heater and all three flares are operating with maximum short-term start-up emission rates. Both emergency generators and the emergency diesel firewater pump are conservatively testing for all averaging times. The two emergency generators are both testing for 1 hour of the 24-hour period, while the emergency diesel firewater pump is testing for 2 hours during the 24-hour period. The maximum daily emissions of the emergency equipment were spread evenly across all hours in the day. Mobile sources are not included for comparison to the NAAQS, while the maximum number of mobile sources is included for comparison to the CAAQS.

4.2 COMPLIANCE WITH AMBIENT AIR QUALITY STANDARDS

4.2.1 Operational Impacts

4.2.1.1 SIL Modeling

HECA is a major PSD source for CO, NO_2, and PM_{10}. These pollutants are in attainment in the Project area, and annual HECA Project emissions are greater than the PSD Significant Emission Rates for these pollutants. SIL modeling was performed using the same methodology as in the ATC/PSD Application. Revised Table 4-2 summarizes updated maximum impacts due to HECA emissions compared with the applicable SILs.

PM_{10} 24-hour, PM_{10} annual, CO 1-hour, CO 8-hour, and NO_2 annual modeled impacts due to Project operations are less than the SILs.

NO_2 1-hour impacts were predicted to be greater than the SIL; therefore, a cumulative NO_2 1-hour NAAQS modeling analysis was conducted using the same methodology as in the ATC/PSD Application. The updated NO_2 modeling uses updated HECA emissions, stack parameters, and plant layout.

Significant Monitoring Concentrations (SMCs) are applicable to PSD pollutants only, and are compared to the same modeled pollutant concentrations from the Project as were compared to the SILs. SMCs are higher than SILs. HECA estimated impacts are lower than all applicable SMCs, therefore, monitoring is not required. No SMC exists for NO_2 1-hour.

Revised Table 4-2
Project Operations Modeling Impacts Compared with Significant Impact Levels and Monitoring Concentrations

Pollutant	Averaging Period	Modeled Impact ($\mu g/m^3$)	Class II Significant Impact Level (SIL) ($\mu g/m^3$)	Significant Monitoring Concentration (SMC) ($\mu g/m^3$)
Operational Impacts				
CO	1 hour	1,850	2,000	N/A
	8 hour	387	500	575
NO_2	1 hour[2]	22	7.55	NA
	Annual	0.6	1	14
PM_{10}	24 hour	3.9	5	10
	Annual	0.6	1	N/A

Source: HECA, 2013.
Notes:
1 Model predicted concentrations are the maximum impact from HECA stationary sources.
2 The NO_2 1-hour concentration is the maximum first high concentration averaged over 5 years. The NO_2 1-hour SIL is interim, and was established in June 29, 2010.
CO = carbon monoxide
$\mu g/m^3$ = micrograms per cubic meter
N/A = not applicable
NO_2 = nitrogen dioxide
PM_{10} = particulate matter 10 microns in diameter or less
SIL = Significant Impact Level
SMC = Significant Monitoring Concentration

4.2.1.2 PSD Increment Consumption

Federal PSD regulations require that proposed major sources such as HECA, as well as other sources constructed since a specified "baseline date," not contribute to air pollution in excess of PSD increments in criteria pollutant attainment areas. There are no PSD increments for CO 1-hour and 8-hour, and NO_2 1-hour.

The Project's maximum modeled air impacts for PM_{10} 24-hour and annual, and NO_2 annual are below the applicable SILs. Because the HECA NO_X and PM_{10} impacts will be less than the SILs, increment consumption will be insignificant, and no preconstruction monitoring or additional impact analyses are required.

4.2.1.3 PSD Regional NO_2 Analysis

Because NO_2 impacts from HECA exceeded the 1-hour SIL, a cumulative impact assessment was completed to determine whether the Project would cause or contribute to any modeled violations of the NAAQS. HECA sources were combined with nearby sources and modeled in AERMOD with Plume Volume Molar Ratio Method (PVMRM), and hourly NO_2 ambient background concentrations were added to the hourly model predictions. Revised Table 4-3 presents the highest of the modeled 5-year average of the 98th percentile of the maximum 1-hour daily concentrations (design value) at any receptor, which complies with the 1-hour NO_2

Revised Table 4-3
AERMOD Modeling Results for Project Operations

Pollutant	Averaging Period	Modeled Impact ($\mu g/m^3$)	Background[1] ($\mu g/m^3$)	Monitoring Station Description[1, 2]	Total Predicted Concentration ($\mu g/m^3$)	CAAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
Operational Impacts							
CO	1 hour[3]	1,854	4,581	a	6,435	23,000	40,000
	8 hour[3]	392	2,485	a	2,877	10,000	10,000
NO_2[8]	1 hour CAAQS[3]	187	140	b	327	339	—
	1 hour NAAQS[4]	119	5	5	119	—	188
	Annual CAAQS[6]	1.6	26	b	28	57	—
	Annual NAAQS[7]	0.6	26	b	27	—	100
PM_{10}	24 hour[3]	4.0	264	c	—	50	150
	Annual[6]	0.6	54	c	—	20	—
$PM_{2.5}$	24 hour[9]	2.3	196	c	—	—	35
	Annual[6]	0.5	22	c	—	12	15
SO_2	1 hour CAAQS[3]	532	42	d	574	655	—
	1 hour NAAQS[10]	32	42	d	74	—	196
	3 hour[3]	260	26	d	286	—	1,300
	24 hour[3]	43	13	d	56	105	*revoked*
H_2S	1 hour[11]	29.3	N/A	N/A	29.3	42	—

Source: HECA, 2013.

Notes:

1 Background concentrations are maximum concentrations from the last 3 years of available USEPA AirData and/or California Air Resources Board data. See note 2.

2 Monitoring station/background concentration as described below:
- a Bakersfield—Golden State Highway Monitoring Station, Maximum Concentration, 2007–2009
- b Shafter–Walker Street Monitoring Station, Maximum Concentration, 2009–2011
- c Bakersfield—California Avenue Monitoring Station, Maximum Concentration, 2008–2010
- d Fresno—First Street Monitoring Station, Maximum Concentrations, 2007–2009 for 3-hour SO_2; 2009–2011 for 1-hour and 24-hour SO_2

3 Maximum modeled short term concentration, includes HECA mobile sources and stationary sources

4 Regional NO_2 analysis modeling results. Modeled impact is the maximum 5-year average of 98th percentile of 1-hour daily maximum concentration. Modeled impact includes contributions from HECA, nearby sources and background concentrations. Excludes HECA mobile sources. Includes HECA stationary sources modeled at maximum normal operating emissions or annualized maximum intermittent operating emissions, whichever resulted in higher 1-hour emission rates. For further modeling details see ATC/PSD Application Section 4.1.9.1 and ATC/PSD Application Appendix I, NO_2 1-Hour Regional Analysis, plus USEPA Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 NAAQS, March 2011.

5 Hourly NO_2 background monitoring concentrations from the Shafter–Walker Street station were included in AERMOD analysis for the same years of meteorological data applied (2006–2010), data provided by SJVAPCD.

6 Maximum annual modeled concentration from any of the 5 years modeled, 2006–2010. Includes HECA mobile sources and stationary sources.

7 Maximum annual modeled concentration from any of the 5 years modeled: 2006–2010. Excludes mobile sources, includes HECA stationary sources

8 NO_2 modeling applied the PVMRM ozone limiting method with hourly ozone data from the Shafter–Walker Street monitoring station.

9 Maximum 5-year average first high daily concentration at any receptor. Excludes HECA mobile sources, includes HECA stationary sources.

10 Modeled impact is the maximum 5-year average of 99th percentile 1-hour daily concentrations. Modeled impact includes HECA stationary sources, excludes mobile sources. Includes HECA stationary sources modeled at maximum normal operating emissions or annualized maximum intermittent operating emissions, whichever resulted in higher 1-hour emission rates.

11 Maximum modeled 1-hour concentration. Includes all HECA H_2S sources.

CO = carbon monoxide
NO_2 = nitrogen dioxide
PM_{10} = particulate matter less than 10 microns in diameter
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
SO_2 = sulfur dioxide
H_2S = hydrogen sulfide
NAAQS = National Ambient Air Quality Standards
CAAQS = California Ambient Air Quality Standards
$\mu g/m^3$ = micrograms per cubic meter
N/A = not available

NAAQS. This analysis demonstrates that HECA would not cause or contribute to any modeled violations, because the total design value predicted from the HECA sources, the nearby regional sources, and background measured concentrations of NO_2 are less than the NAAQS.

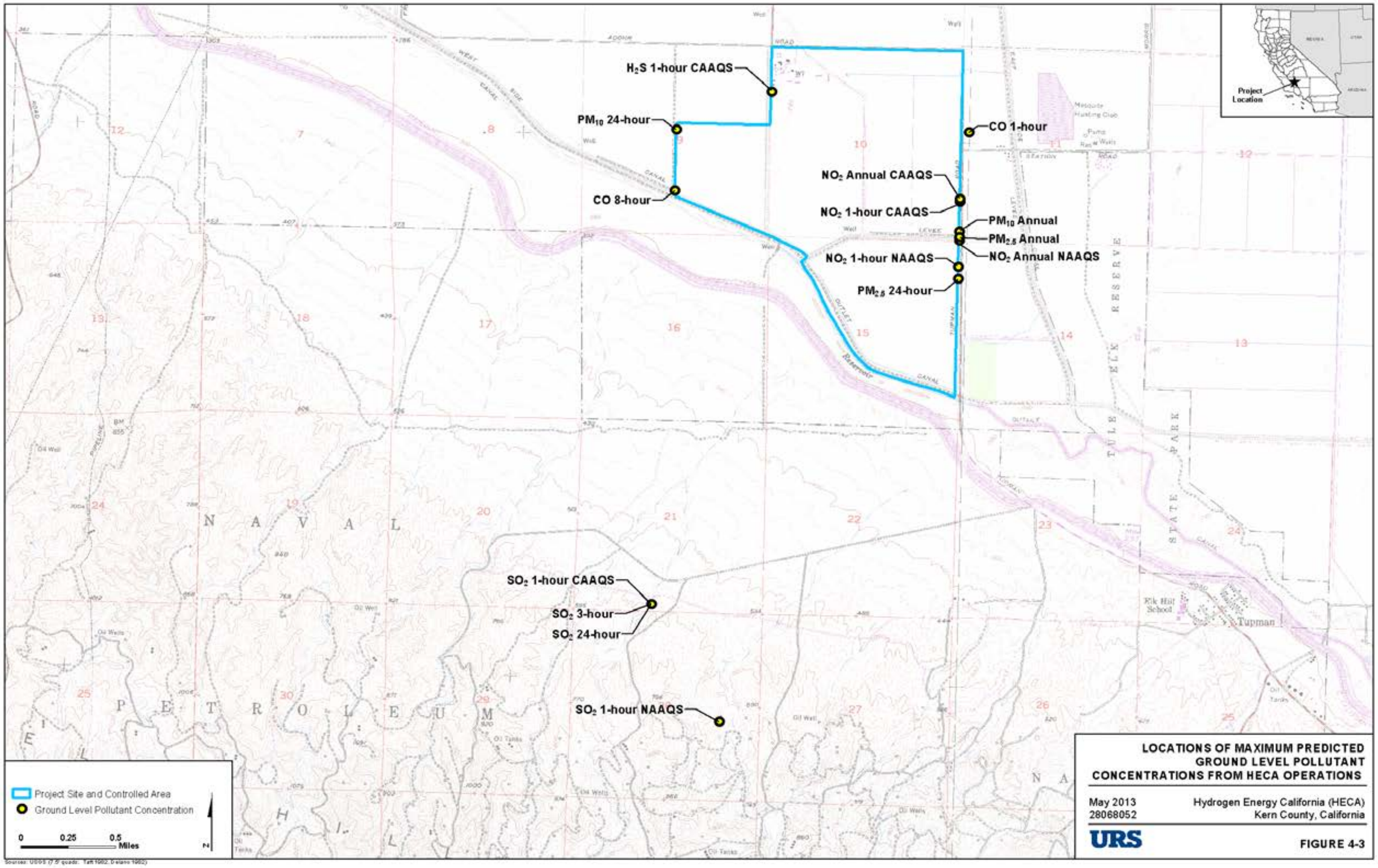
4.2.1.4 NAAQS/CAAQS Modeling

Revised Table 4-3 summarizes the updated maximum predicted criteria pollutant concentrations due to Project emissions. This table continues to show that the modeled impacts due to the Project emissions, in combination with conservative background concentrations, will not cause a violation of any CAAQS or NAAQS, and will not significantly contribute to the existing violations of the federal and state PM_{10} and $PM_{2.5}$ standards. In addition, as described in Section 7, all of the Project's operational emissions of PM_{10}, NO_X, VOCs, and sulfur oxides (SO_X) will be offset to ensure a net air quality benefit. $PM_{2.5}$ emissions will be mitigated by the PM_{10} emissions reduction credits (ERCs), because $PM_{2.5}$ is a subset of PM_{10}. All of the ERCs used to offset PM_{10} were from combustion sources; thus, the majority of the emission reductions are both PM_{10} and $PM_{2.5}$. Therefore, because all of the PM emissions will be offset, impacts of PM_{10} and $PM_{2.5}$ would be less than significant.

Revised Figure 4-3, Locations of Maximum Predicted Ground Level Pollutant Concentrations from HECA Operations, shows updated locations of the maximum predicted operational impacts for all pollutants and averaging times. All peak annual impacts occur on the eastern boundary of the property line, along with the peak CO 1-hour impact, the NO_2 1-hour CAAQS and NAAQS impacts, and the $PM_{2.5}$ 24-hour impact. The peak PM_{10} 24-hour, CO 8-hour, and H_2S 1-hour impacts all occur on the western boundary of the property line. All maximum SO_2 short term impacts occur in the hills to the southwest of the Project Site, approximately 3.5 kilometers from the southern boundary of the property line.

4.2.1.5 SJVAPCD $PM_{2.5}$ Analysis

The updated $PM_{2.5}$ modeling continued to follow the methodology outlined in the draft modeling guidance from SJVAPCD. For the $PM_{2.5}$ SIL modeling, only permitted stationary sources were included in the modeling analyses. Revised Table 4-4 shows that the primary $PM_{2.5}$ modeled concentrations exceed both the 24-hour and annual SILs; therefore, per SJVAPCD draft guidance, primary and secondary $PM_{2.5}$ emissions should be offset. HECA will fully offset all primary $PM_{2.5}$ and secondary $PM_{2.5}$ (oxides of nitrogen, and oxides of sulfur) emissions. HECA will use SO_X ERCs to offset PM_{10} emissions on an interpollutant basis at a ratio of 1:1, and incorporating a distance ratio of 1.5:1, as previously approved by SJVAPCD. Because the SO_X ERCs are from combustion sources, and the majority of combustion emissions contain particles smaller than 2.5 microns, they will also effectively offset the Project's $PM_{2.5}$ emissions. We believe that this satisfies the offsetting provisions in the draft modeling guidance. Therefore, HECA demonstrates it will not cause or contribute significantly to a $PM_{2.5}$ violation.



Revised Figure 4-3 Locations of Maximum Predicted Ground Level Pollutant Concentrations

Revised Table 4-4
AERMOD Modeling Results for $PM_{2.5}$ from HECA Operations

Pollutant	Averaging Period	Modeled Impact (µg/m³)	Class II Significant Impact Level (SIL) (µg/m³)
$PM_{2.5}$	24 hour[1]	2.3	1.2
	Annual[2]	0.5	0.3

Source: HECA, 2013.

Notes:

[1] Maximum 5-year average first high daily concentration at any receptor. Excludes HECA mobile sources, includes HECA stationary sources.

[2] Maximum annual modeled concentration from any of the 5 years modeled, 2006–2010. Excludes HECA mobile sources, includes HECA stationary sources.

µg/m³ = micrograms per cubic meter
$PM_{2.5}$ = particulate matter 2.5 microns in diameter or less

4.2.1.6 Fumigation

The updated predicted peak concentrations from inversion breakup fumigation from Project emissions, including background, are predicted to be below the applicable 1-hour CAAQS and NAAQS, and are presented in Revised Table 4-5. Therefore, fumigation modeling complies with all applicable 1-hour ambient air quality standards. See revised Appendix F, Revised Fumigation Modeling, for further details.

Revised Table 4-5
SCREEN3 Fumigation Modeling Results for Project Operations

Pollutant	Averaging Period	Maximum Modeled Impact (µg/m³)	Background[1] (µg/m³)	Monitoring Station Description[1,2]	Total Predicted Concentration (µg/m³)	CAAQS (µg/m³)	NAAQS (µg/m³)
Fumigation Impacts							
CO	1 hour	282	4,581	[a]	4,863	23,000	40,000
NO_2	1 hour	43	140	[b]	183	339	N/A
SO_2	1 hour	104	42	[c]	146	655	N/A

Source: HECA, 2013.

Notes:

[1] Background concentrations are maximum concentrations from the last 3 years of available USEPA AirData and/or California Air Resources Board data.

[2] Monitoring station/background concentration as described below:
- [a] Bakersfield—Golden State Highway Monitoring Station, Maximum Concentration, 2007–2009
- [b] Shafter–Walker Street Monitoring Station, Maximum Concentration 2009–2011
- [c] Fresno—First Street Monitoring Station, Maximum Concentration, 2009–2011 for 1 hour SO_2

CAAQS = California Ambient Air Quality Standards
CO = Carbon Monoxide
µg/m³ = micrograms per cubic meter
N/A = not applicable
NAAQS = National Ambient Air Quality Standards
NO_2 = nitrogen dioxide
SO_2 = sulfur dioxide

4.2.2 Odor Impacts

Modeling was conducted to determine the concentration of H_2S off site. This modeling showed that the concentration predicted was less than the CAAQS (see Revised Table 4-3), which is equivalent to the odor detection threshold; thus, H_2S odors will not be detectable beyond the property line.

Ammonia emissions from stationary and fugitive sources within the proposed HECA facility were included in the Health Risk Assessment (HRA) modeling for the Project, which is presented in Section 5, Health Risk Assessment. The Office of Environmental Health Hazard Assessment acute reference exposure level for ammonia is lower than the odor detection threshold for ammonia. Therefore, since the total acute health index was predicted to be less than significant, the ammonia concentration will be below the odor detection level and ammonia odors are not expected to be detectable beyond the property line.

To assess the potential impact of the Project on public health, an updated HRA was performed based on the Project's revised emissions of HAPs and TACs. The methodology, model input, and sensitive receptors presented in the ATC/PSD Application remain the same. Some emission rates, stack parameters, and source locations have changed, and those are discussed below. The purpose of the HRA is to evaluate potential public exposure and adverse health effects due to TAC emissions associated with Project operations. For the purposes of the HRA, impacts were determined outside of both the Project Site and the Controlled Area (see Revised Figure 1-1, Project Site Plan and Vicinity). HECA will own both the Project Site and the Controlled Area, and will have control over public access and future land use.

5.1 OPERATIONAL-PHASE AIR TOXICS EMISSIONS

5.1.1 Stationary Sources

As outlined in Section 3, Project refinements affected the emissions of TACs. Those refinements are outlined below. All emission calculation techniques and stack parameters remained the same as presented in the ATC/PSD Application, unless specifically noted.

The CTG/HRSG and feedstock dryer start-up duration was decreased, thus decreasing emissions. The HRSG stack diameter was increased to 24 feet, but because the flow rate did not change, the exit velocity decreased for the scenario analyzed.

Mercury emissions decreased due to more detailed emission control specifications. Mercury emission calculations were updated to reflect a worst-case feedstock scenario of 100 percent coal, although the Project is expected to operate on a 75 percent coal and 25 percent petcoke feedstock on an annual basis. These calculations also incorporate a 75 percent mercury removal in the feedstock dryer and 99 percent control efficiency from the adsorber; these improved control efficiencies were identified by the vendors and presented in response to Sierra Club Data Requests 144 and 145 on February 15, 2013. The mercury content of the El Segundo coal may be as high as 0.13 part per million by weight (dry basis). Using this information, the updated mercury emission calculation is provided below.

Mercury Emission Calculation – 100 Percent El Segundo Coal Feed

Gasifier coal feed (dry basis) = 5023 tons/day (based on El Segundo coal)
Coal mercury concentration (dry basis) = 0.13 part per million by weight
Mercury in gasifier feed = 0.05442 lb/hr

Uncontrolled mercury in feedstock dryer exhaust (pro-rated MHI estimate) = 0.0028 lb/hr
Feedstock dryer mercury removal = 75 percent
Feedstock dryer mercury emission = 0.00069 lb/hr

Inlet mercury to syngas adsorber bed = 0.05442 – 0.00069 = 0.0537 lb/hr
Adsorber removal = 99 percent
Estimated HRSG flue gas mercury = 0.000537 lb/hr

About 85 percent of the HRSG flue gas mercury will be emitted through the HRSG stack and the remainder through the feedstock dryer stack. It is assumed that the mercury in HRSG flue gas sent to the dryer will be reduced by the dryer mercury removal system, therefore:

Feedstock dryer mercury emission = 0.00069 lb/hr + (0.000537 lb/hr * 0.15 * 0.25)

HRSG mercury emission = 0.000537 lb/hr * 0.85

Summary

Feedstock dryer emission = 0.000710 lb/hr

HRSG emission = 0.000457

Total plant = 0.001167 lb/hr

Total mercury/gross power = 0.001167 lb/hr/405 MW × 1,000 MW/gigawatt = 0.00288 lb/gigawatt hour

Mercury emission calculations are presented in Appendix B, Revised Toxic Air Contaminant Emissions.

Two new events associated with the SRU and thermal oxidizer have been identified: Passivation, and Presulfiding. Further details are provided in Section 3.2.5. This increased TAC emissions from the thermal oxidizer by increasing the hours of operation of the natural gas burner in the SRU during the passivation activities.

The Ammonia Synthesis Start-up Heater will be equipped with four Low-NO_X burners, each rated at 14 MMBtu/hr, for a total rating of 56 MMBtu/hr. This is a change from 55 MMBtu/hr due to new information provided by the vendor, and causes a very minor increase in emissions. This change was provided via email to Homero Ramirez, SJVAPCD on January 9, 2013.

Cooling tower (Power Block, ASU, and Process Area) TAC emissions did not change, although the locations of all three cooling towers moved slightly. The ASU cooling tower (Unit 28) is now oriented north-south, and all stack parameters remained the same. The fan height increased to 65 feet for the Power Block and Process cooling towers. The number of cells for the Power Block cooling tower (Unit 29) decreased to 10, and the diameter of the cells decreased to 25 feet. The number of cells for the Process cooling tower (Unit 27) decreased to 11, and the diameter of the cells decreased to 29 feet. The stack exhaust flow rate changed for the Power Block and Process cooling towers.

CO_2 vent emissions were revised to include trace amounts of methanol and benzene. The total venting rate increased as a result of the fluxant addition to the feedstock; therefore, all TAC emissions increased slightly. The CO_2 vent stack height was raised to 355 feet. A detailed discussion of these changes is presented in Section 3.2.6.

There are no changes in ammonia emissions associated with the Urea Absorber; however, the HP and LP absorber vents were combined into one stack. All stack parameters were modified to represent the combined vent, and emissions from the two vents were combined for the current single vent.

The HECA nitric acid plant ammonia (NH_3) emissions increased due to new information provided by the vendor. These emissions are described in the response to the Notice of Incomplete Application provided to SJVAPCD on August 1, 2012. To adequately control the NO_2 emissions from the nitric acid unit, sufficient ammonia must be injected into the SCR system; thus, it is expected that the ammonia emission rate may be as high as 10 ppm, or 1.0 lb/hr. This equates to annual ammonia emissions from the nitric acid unit of 4 tons per year. Additionally, the stack height was reduced to 120 feet, and all stack parameters were modified: temperature increased, flow decreased, and exit velocity decreased.

There were no TAC emissions or stack parameter changes from the auxiliary boiler, gasifier flare, SRU flare, Rectisol® flare and emergency generators, and fire pump.

Revised Table 5-2, HECA Total Toxic Air Contaminant Annual Emission Rates, outlines the revised estimated TAC annual emission rates for each source listed above.

5.1.2 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 minimize these emissions. LDAR is the primary established method for controlling fugitive emissions from equipment, such as valves and seals. In addition, the refined design identified that all light liquid pumps and all compressors will have dual mechanical seals and barrier fluid maintained at a higher pressure than the pump fluid or compressed gas. These seals ensure no fugitive emission leakage.

Two new fugitive streams associated with the Manufacturing Complex (streams 18a – CO_2 Product and Purification Compressors; and 18b – Urea CO_2 Compressor) were added to permit unit S-7616-33-0, Ammonia Synthesis Unit. These streams more appropriately account for the composition of the streams passing through the compressors previously associated with stream 18 – High CO_2 concentration stream.

Fugitive streams 22 – Lower Benzene Concentration; and 23 – Higher Benzene Concentration, resulting from benzene in the syngas cleanup (discussed further in Section 3.2.6), were added to permit unit S-7616-21-0, the Gasification System. These modifications resulted in minor changes in emissions of TACs.

A methanol storage tank has been added to permit unit S-7616-21-0, as described in Section 3.2.7, and tank emissions have been included with the fugitives from this source. Detailed emission calculations for the fugitives are presented in Appendix B, Revised Toxic Air Contaminant Emissions.

5.1.3 Mobile Sources

For CEQA purposes, onsite mobile source diesel particulate matter (DPM) emissions were incorporated in the HRA. Trucks and trains delivering feedstock and removing products would travel to and from the Project Site on a regular basis. Changes to emissions estimates from mobile sources are discussed in Section 3.3.

5.1.4 Total Project Toxic Air Contaminant Emissions

Revised Table 5-2 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 B, Revised Toxic Air Contaminant Emissions.

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 Clean Air Act, §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 Revised Table 5-2.

5.2 ESTIMATED LIFETIME CANCER RISK AND CHRONIC AND ACUTE TOTAL HAZARD INDICES

The HRA was conducted using the hourly and annual emissions listed for each source identified in Revised Table 5-2. The same methodology as outlined in the ATC/PSD Application was used to conduct the updated HRA.

Revised Table 5-3, Estimated Cancer Risk, Acute and Chronic Non-Cancer total hazard index (THI) due to HECA Operations, presents the results of the HRA at the point of maximum impact, maximally exposed individual resident (MEIR), maximally exposed individual worker (MEIW), and nearest sensitive receptor.

MEIR for the cancer and chronic and acute non-cancer health risks are presented in Revised Table 5-3. 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 report. The files include calculated X/Q values in $\mu g/m^3$ 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 Revised Table 5-4, Acute Hazard Index for TACs with 8-Hour Reference Exposure Levels (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 (THI) per organ.

Revised Table 5-2
HECA Total Toxic Air Contaminant Annual Emission Rates

Compound	CAS #	Annual Rate (TPY)	CTG/ HRSG (lb/yr)	Feedstock 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 Start-up 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)	Manu-facturing Complex (lb/yr)	Onsite Truck (lb/yr)	Onsite Train (lb/yr)	Fugitives (lb/yr)
Acetaldehyde	75-07-0	2.13E-02	3.62E+01	6.38E+00																
Ammonia*	7664-41-7	1.54E+02	1.53E+05	2.50E+04				1.03E+03									1.22E+05			7.61E+03
Antimony	7440-36-0	1.30E-02	2.21E+01	3.90E+00																
Arsenic	7440-38-2	2.85E-02	4.82E+01	8.51E+00	5.33E-02	8.70E-02	2.40E-02	8.89E-02	1.49E-03			1.43E-02	7.75E-04	3.78E-03	2.17E-02					
Benzene	71-43-2	1.47E+00	4.82E+01	8.51E+00				9.33E-01	1.57E-02			1.50E-01	8.14E-03	3.97E-02	2.28E-01	2.79E+03				9.69E+01
Beryllium	7440-41-7	3.08E-03	5.22E+00	9.22E-01				5.33E-03	8.96E-05			8.56E-04	4.65E-05	2.27E-04	1.30E-03					
Cadmium	7440-43-9	1.14E-01	1.93E+02	3.40E+01				4.89E-01	8.21E-03			7.85E-02	4.26E-03	2.08E-02	1.19E-01					
Carbon Disulfide	75-15-0	5.44E-01	9.24E+02	1.63E+02																
Carbonyl Sulfide	463-58-1	2.79E+00														5.37E+03				2.09E+02
Chromium	7440-47-3	6.49E-03	1.02E+01	1.81E+00				6.22E-01	1.05E-02			9.99E-02	5.42E-03	2.64E-02	1.52E-01					
Chromium (hexavalent)	18540-29-9	1.81E-03	3.07E+00	5.43E-01																
Cobalt	7440-48-4	3.10E-03	5.22E+00	9.22E-01				3.73E-02	6.27E-04			5.99E-03	3.25E-04	1.59E-03	9.11E-03					
Copper*	7440-50-8	2.94E-04			1.03E-02	1.69E-02	4.66E-03	3.78E-01	6.35E-03			6.06E-02	3.29E-03	1.61E-02	9.22E-02					
Cyanides	57-12-5	6.91E-02	1.15E+02	2.02E+01																3.35E+00
Fluoride*	1101	1.44E-03			9.31E-01	1.52E+00	4.20E-01													
Formaldehyde	50-00-0	2.25E-01	3.42E+02	6.03E+01				3.33E+01	5.60E-01			5.35E+00	2.91E-01	1.42E+00	8.13E+00					
Hexane	110-54-3	5.89E-01						8.00E+02	1.34E+01			1.28E+02	6.97E+00	3.40E+01	1.95E+02					
Hydrochloric Acid	7647-01-0	1.62E-01	2.61E+02	4.61E+01																1.75E+01
Hydrogen Fluoride (hydrofluoric acid)	7664-39-3	5.91E-01	1.00E+03	1.77E+02																
Hydrogen Sulfide	7783-06-4	2.44E+00														3.04E+03				1.83E+03
Lead	7439-92-1	6.62E-03	1.13E+01	1.99E+00																
Manganese	7439-96-5	1.65E-02	2.09E+01	3.69E+00	2.66E+00	4.35E+00	1.20E+00	1.69E-01	2.84E-03			2.71E-02	1.47E-03	7.18E-03	4.12E-02					
Mercury	7439-97-6	4.88E-03	3.82E+00	5.77E+00				1.16E-01	1.94E-03			1.85E-02	1.01E-03	4.91E-03	2.82E-02					
Methanol	67-56-1	9.73E+00														4.87E+03				1.46E+04
Methyl Bromide (Bromomethane)	74-83-9	5.64E-01	9.59E+02	1.69E+02																
Methylene Chloride (Dichloromethane)	75-09-2	2.60E-02	4.42E+01	7.80E+00																
Naphthalene	91-20-3	2.98E-02	5.02E+01	8.87E+00				2.71E-01	4.55E-03			4.35E-02	2.36E-03	1.15E-02	6.61E-02					
Nickel	7440-02-0	5.30E-03	7.84E+00	1.38E+00				9.33E-01	1.57E-02			1.50E-01	8.14E-03	3.97E-02	2.28E-01					
Nitric Acid*	7697-37-2	3.04E-01																		6.09E+02
Phenol	108-95-2	4.35E-01	7.40E+02	1.31E+02																
Propylene*	115-07-1	4.75E+00																		9.49E+03
Selenium	7782-49-2	6.70E-03	1.13E+01	1.99E+00	4.43E-02	7.23E-02	2.00E-02	1.07E-02	1.79E-04			1.71E-03	9.30E-05	4.53E-04	2.60E-03					
Sulfuric Acid and Sulfates*	7664-93-9	1.12E+00	1.91E+03	3.37E+02																
Toluene	108-88-3	1.50E-03	6.63E-01	1.17E-01				1.51E+00	2.54E-02			2.43E-01	1.32E-02	6.42E-02	3.69E-01					

Revised Table 5-2
HECA Total Toxic Air Contaminant Annual Emission Rates (Continued)

Compound	CAS #	Annual Rate (TPY)	CTG/ HRSG (lb/yr)	Feedstock 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 Start-up 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)	Manu-facturing Complex (lb/yr)	Onsite Truck (lb/yr)	Onsite Train (lb/yr)	Fugitives (lb/yr)
Vanadium*	7440-62-2	7.52E-04						1.02E+00	1.72E-02			1.64E-01	8.91E-03	4.34E-02	2.49E-01					
Diesel Particulate Matter*	DPM	7.14E-02								4.51E+01	1.84E+00							2.01E+01	7.56E+01	
2-Methylnaphthalene	91-57-6	7.85E-06						1.07E-02	1.79E-04			1.71E-03	9.30E-05	4.53E-04	2.60E-03					
3-Methylchloranthrene	56-49-5	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
7,12-Dimethylbenz(a)anthracene	57-97-6	5.23E-06						7.11E-03	1.19E-04			1.14E-03	6.20E-05	3.02E-04	1.73E-03					
Acenaphthene	83-32-9	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Acenaphthylene	208-96-8	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Anthracene	120-12-7	7.85E-07						1.07E-03	1.79E-05			1.71E-04	9.30E-06	4.53E-05	2.60E-04					
Benz(a)anthracene	56-55-3	2.78E-05	4.62E-02	8.16E-03				8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Benzo(a)pyrene	50-32-8	3.93E-07						5.33E-04	8.96E-06			8.56E-05	4.65E-06	2.27E-05	1.30E-04					
Benzo(b)fluoranthene	205-99-2	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Benzo(g,h,i)perylene	191-24-2	3.93E-07						5.33E-04	8.96E-06			8.56E-05	4.65E-06	2.27E-05	1.30E-04					
Benzo(k)fluoranthene	207-08-9	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Chrysene	218-01-9	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Dibenzo(a,h)anthracene	53-70-3	3.93E-07						5.33E-04	8.96E-06			8.56E-05	4.65E-06	2.27E-05	1.30E-04					
Dichlorobenzene	106-46-7	3.93E-04						5.33E-01	8.96E-03			8.56E-02	4.65E-03	2.27E-02	1.30E-01					
Fluoranthene	206-44-0	9.81E-07						1.33E-03	2.24E-05			2.14E-04	1.16E-05	5.67E-05	3.25E-04					
Fluorine	86-73-7	9.16E-07						1.24E-03	2.09E-05			2.00E-04	1.08E-05	5.29E-05	3.04E-04					
Indeno(1,2,3-cd)pyrene	193-39-5	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Phenanathrene	85-01-8	5.56E-06						7.55E-03	1.27E-04			1.21E-03	6.59E-05	3.21E-04	1.84E-03					
Pyrene	129-00-0	1.64E-06						2.22E-03	3.73E-05			3.57E-04	1.94E-05	9.44E-05	5.42E-04					
Total Combined HAPs and TACs (tpy)		**180.38**	**79.76**	**13.11**	**0.00**	**0.00**	**0.00**	**0.93**	**0.01**	**0.02**	**0.00**	**0.07**	**0.00**	**0.02**	**0.10**	**8.03**	**61.04**	**0.01**	**0.04**	**1.72E+01**
Total HAPs* (tpy)		**19.90**	**2.43**	**0.43**	**0.00**	**0.00**	**0.00**	**0.42**	**0.01**	**0.00**	**0.00**	**0.07**	**0.00**	**0.02**	**0.10**	**8.03**	**0.00**	**0.00**	**0.00**	**8.38E+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.

ASU = Air Separation Unit
CAS = Chemical Abstracts Service Registry Number
HAPs = hazardous air pollutant
lb/yr = pounds per year
TACs = toxic air contaminants

Revised Table 5-3
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	8.85 excess risk in 1 million	0.36	0.72
Coordinates of PMI in UTM NAD83 (m) easting northing	283,951 3,911,962	283,944 3,911,662	282,397 3,913,018
Peak risk at offsite worker MEIW (Tule Elk State Reserve Ranger Station)	1.75 excess risk in 1 million	0.11	0.21
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	3.56 excess risk in 1 million	0.22	0.30
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)	0.82 excess risk in 1 million	0.06	0.10
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, 2013.

Notes:

1 MEIW cancer risk is conservatively based on a residential risk calculation; i.e., a 70-year exposure.

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

Revised Table 5-4
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	0.000004	Respiratory system
Arsenic	0.015	0.1173	Development; cardiovascular system; nervous system; lung; skin
Formaldehyde	9	0.0309	Respiratory system
Manganese	0.17	0.0092	Nervous system
Mercury	0.06	0.0178	Nervous system
THI – Respiratory system		**0.0309**	**Respiratory system**
THI –Nervous system		**0.1444**	**Nervous system**
THI – Other organs		**0.1173**	**Development; cardiovascular system; lung; skin**

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

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.

5.3 MITIGATION MEASURES

The criteria pollutant emissions from the Project will be mitigated by the use of BACT and through emissions offsets. 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 also reduce emissions of TACs associated with the Project. These measures satisfy the SJVAPCD requirements for toxics. 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.

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

6.1 CLASS I AREA SIL ANALYSIS

Class I SIL modeling was revised using the modeling scenarios as described above in Section 4.1.5 for the NO_2 annual, $PM_{2.5}$ 24-hour and annual, and PM_{10} 24-hour and annual Class I SILs.

The Class I SILs are presented in Revised Table 6-1. Modeling for the Class I $PM_{2.5}$ SILs was completed, because the San Rafael Wilderness Area is in Santa Barbara County, which is an unclassified/attainment area for $PM_{2.5}$. Class I SILs for NO_2 1-hour, and CO 1-hour, and 8-hour do not exist. Impacts due to HECA operations without mobile sources were modeled, using the same modeling scenarios as described in Section 4.1.9.2. The AERMOD model was applied for the Class I SIL modeling analyses, which used a receptor grid extending out 50 kilometers from the Project site, the same receptor grid used in the NO_2 1-hour NAAQS regional analysis. The AERMOD model has been evaluated for estimating impacts out to 50 kilometers, and it is believed that this is the maximum extent of the model's reliability; therefore, receptors did not extend beyond 50 kilometer into the San Rafael Wilderness Area. However, this modeling approach, with receptors out to 50 kilometers, gave an understanding of whether the model predicted Class I SILs would be contained inside the 50-kilometer grid. Isopleth figures were prepared for each pollutant and averaging time to show the extent of the areas with Project Impacts above the SILs.

Revised Table 6-1
Class I Significant Impact Levels

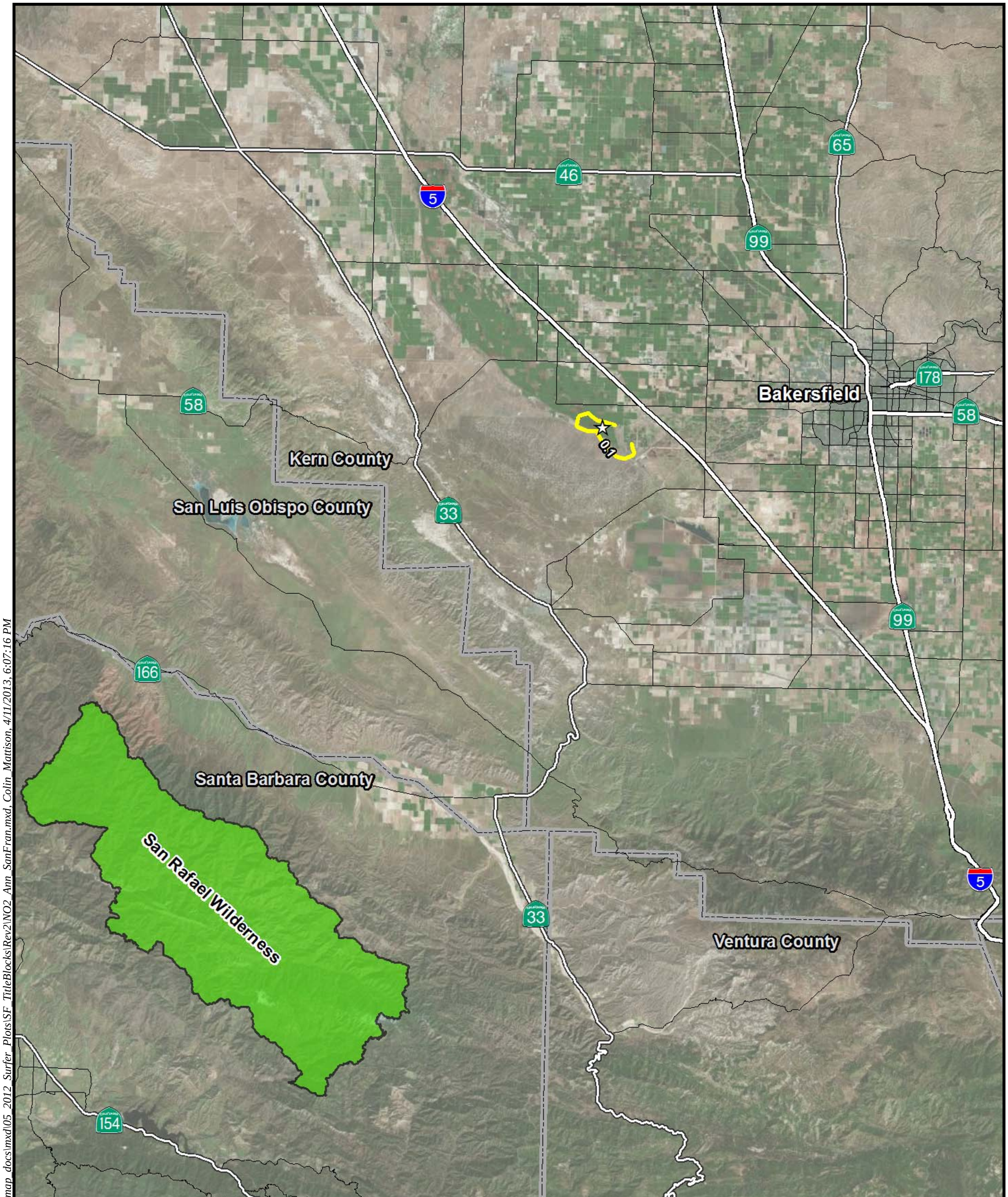
Pollutant	Averaging Period	Class I Significant Impact Level (SIL) [1] ($\mu g/m^3$)
NO_2	Annual	0.1
PM_{10}	24 hour	0.32
	Annual	0.2
$PM_{2.5}$	24 hour	0.07
	Annual	0.06

Notes:

[1] The SIL concentrations in this table were compared to highest modeled concentrations from HECA stationary sources for NO_2, PM_{10} and $PM_{2.5}$ annual, and PM_{10} 24-hour. For $PM_{2.5}$ 24-hour the model was run to predict the multiyear average of the highest 24-hour concentration at each receptor.

NO_2 = nitrogen dioxide
PM_{10} = particulate matter less than 10 microns in diameter
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
$\mu g/m^3$ = micrograms per cubic meter
SIL = Significant Impact Level

Revised Figures 6-1 through 6-5 provide a visualization of the model predicted concentration isopleths for each pollutant and averaging time. The model predicted that the NO_2, PM_{10}, and $PM_{2.5}$ annual concentrations still fall below the Class I SILs within 2 to 3 kilometers, as shown on Revised Figures 6-1 through 6-3. For the PM_{10} and $PM_{2.5}$ 24-hour averaging times, the model predicted that the concentrations still fall below the Class I SIL out 20 to 30 kilometers southwest of HECA, in the direction toward San Rafael Wilderness Area, as shown on Revised Figures 6-4 and 6-5. Therefore, updated modeled concentrations due to HECA operations in the vicinity of San Rafael Wilderness continue to stay below the Class I significance levels.



☆ Project Site

Class I SIL NO_2 Annual 0.1 µg/m^3

County Boundary

San Rafael Wilderness Area

N

0 5 10 Kilometers

SOURCES:
Contours (URS, 2012), San Rafael Wilderness (USFS, 2009)
County Boundary, Streets (ESRI, 2007), Aerial (Bing Maps, 2012)

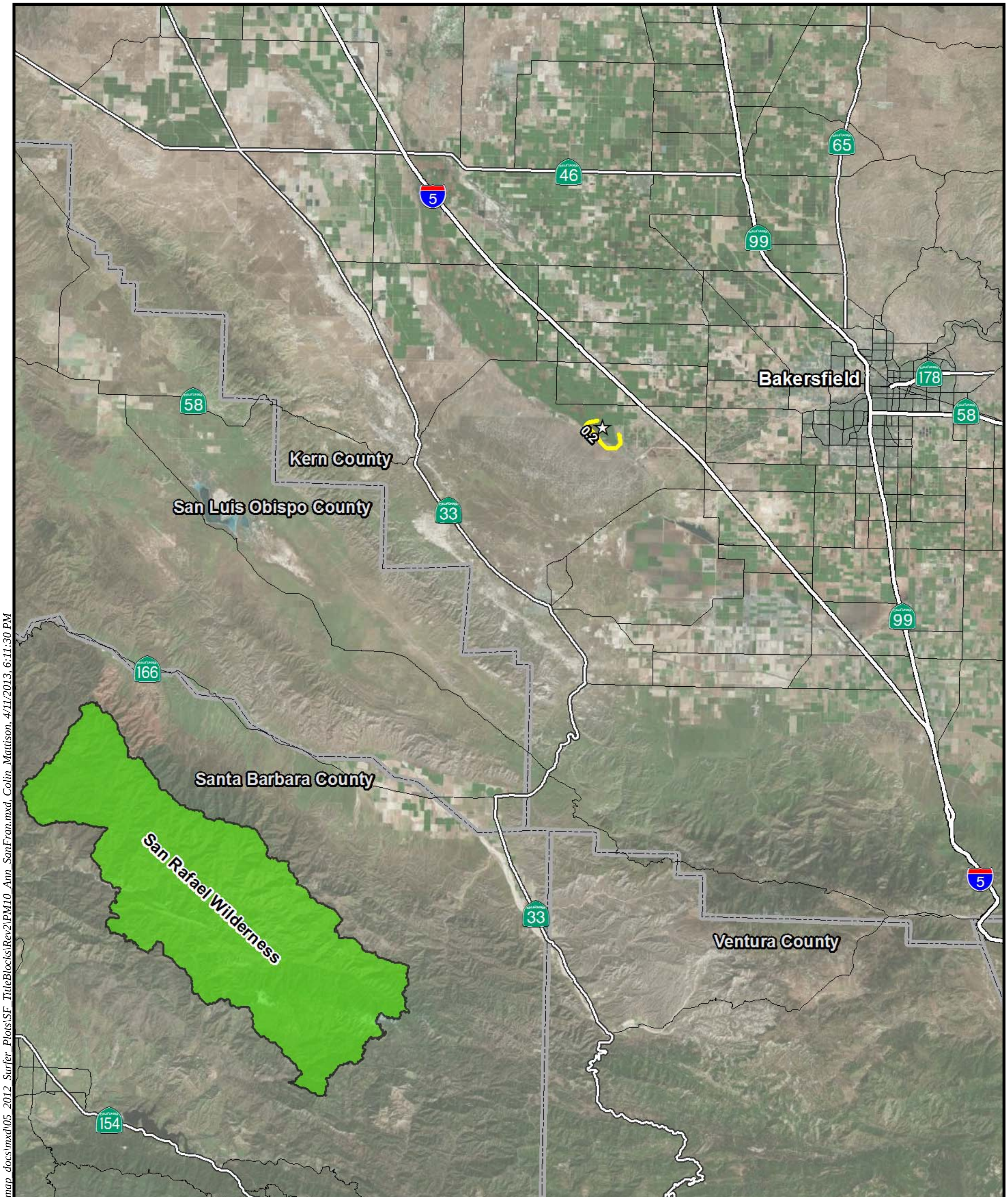
EXTENT OF NO_2 ANNUAL CLASS I SIL FROM HECA OPERATIONS

April 2013 Hydrogen Energy California (HECA)
28068052 Kern County, California

URS

FIGURE 6-1

Path: G:\gis\projects\1577\28068052\map_docs\mxd\05_2012_Surfer_Plots\SF_TitleBlocks\Rev2\NO2_Ann_SanFran.mxd, Colin_Mattison, 4/11/2013, 6:07:16 PM



☆ Project Site

Class I SIL PM_{10} Annual 0.20 µg/m^3

County Boundary

San Rafael Wilderness Area

N

0 5 10 Kilometers

SOURCES:
Contours (URS, 2012), San Rafael Wilderness (USFS, 2009)
County Boundary, Streets (ESRI, 2007), Aerial (Bing Maps, 2012)

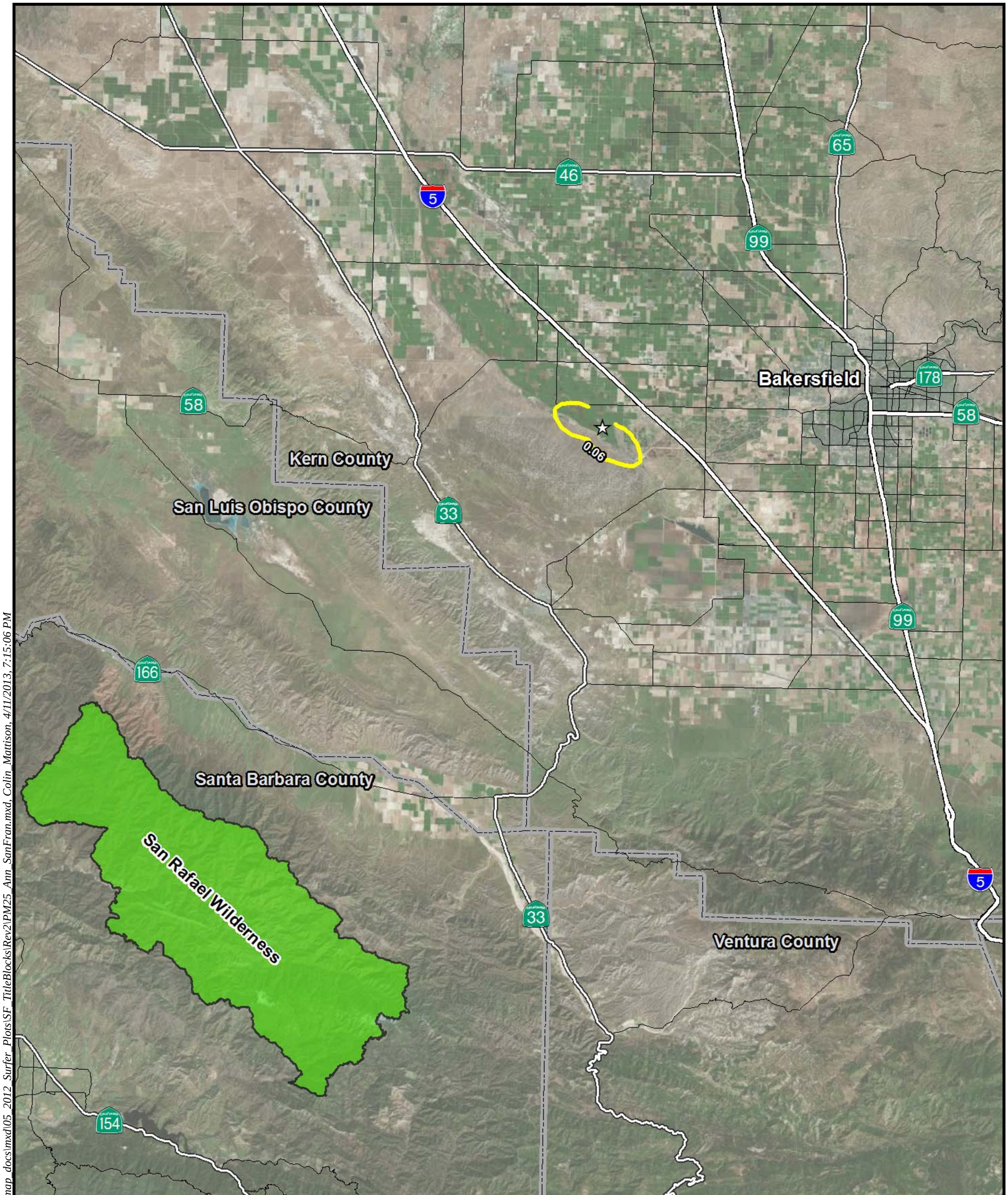
EXTENT OF PM_{10} ANNUAL CLASS I SIL FROM HECA OPERATIONS

April 2013 Hydrogen Energy California (HECA)
28068052 Kern County, California

URS

FIGURE 6-2

Path: G:\gis\projects\1577\28068052\map_docs\mxd\05_2012_Surfer_Plots\SF_TitleBlocks\Rev2\PM10_Ann_SanFran.mxd, Colin_Mattison, 4/11/2013, 6:11:30 PM



Path: G:\gis\projects\1577\28068052\map_docs\mxd\05_2012_Surfer_Plots\SF_TitleBlocks\Rev2\PM25_Ann_SanFran.mxd, Colin_Mattison, 4/11/2013, 7:15:06 PM

☆ Project Site

Class I SIL $PM_{2.5}$ Annual 0.06 µg/m^3

County Boundary

San Rafael Wilderness Area

SOURCES:
Contours (URS, 2012), San Rafael Wilderness (USFS, 2009)
County Boundary, Streets (ESRI, 2007), Aerial (Bing Maps, 2012)

N

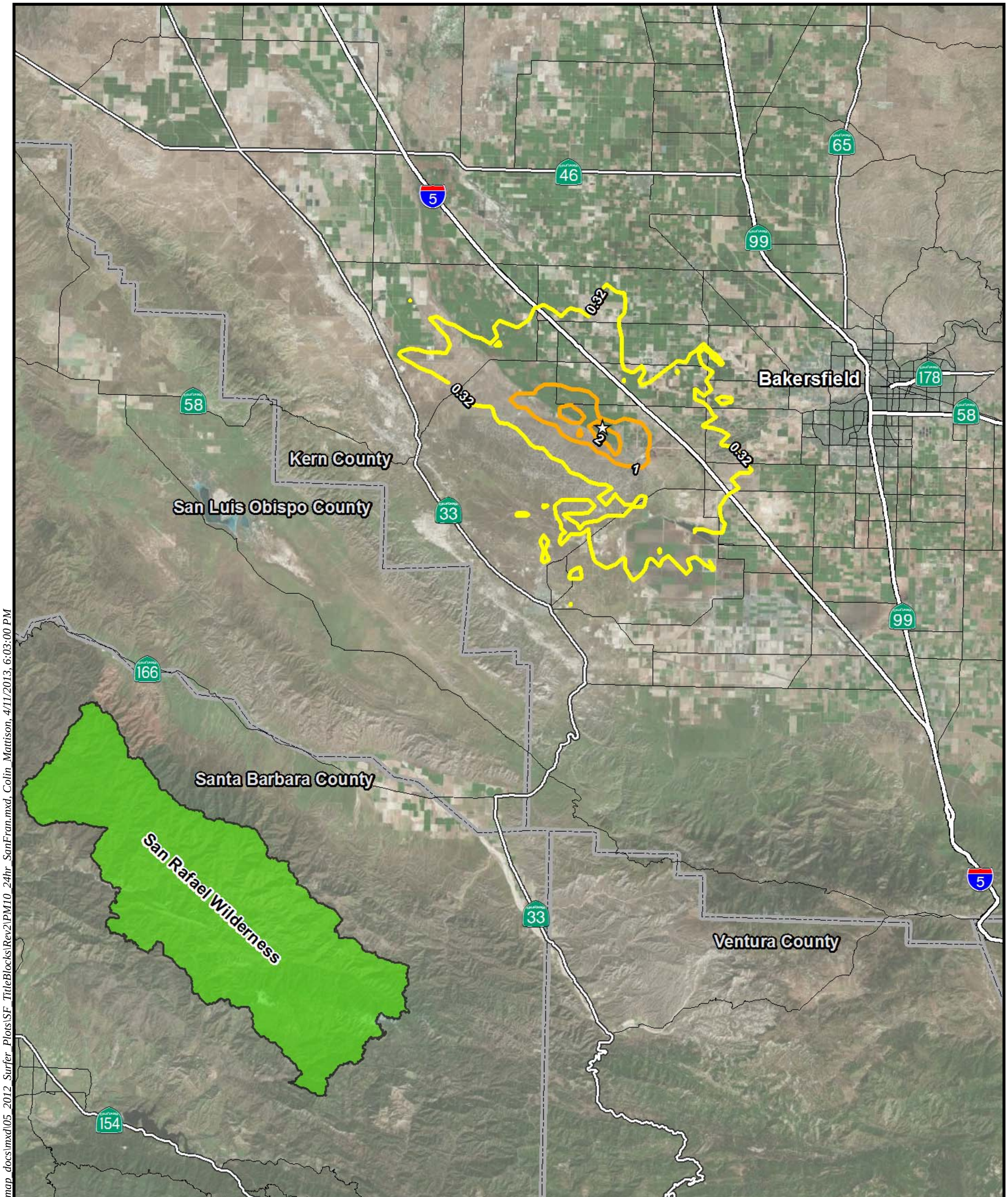
0 5 10 Kilometers

EXTENT OF $PM_{2.5}$ ANNUAL CLASS I SIL FROM HECA OPERATIONS

April 2013 — Hydrogen Energy California (HECA)
28068052 — Kern County, California

URS

FIGURE 6-3



☆ Project Site

Class I SIL PM_{10} 24-hour 0.32 µg/m^3

PM_{10} 24-hour Concentration Isopleths (µg/m^3)

County Boundary

San Rafael Wilderness Area

SOURCES:
Contours (URS, 2012), San Rafael Wilderness (USFS, 2009),
County Boundary, Streets (ESRI, 2007), Aerial (Bing Maps, 2012)

N

0 5 10 Kilometers

EXTENT OF PM_{10} 24-HOUR CLASS I SIL FROM HECA OPERATIONS

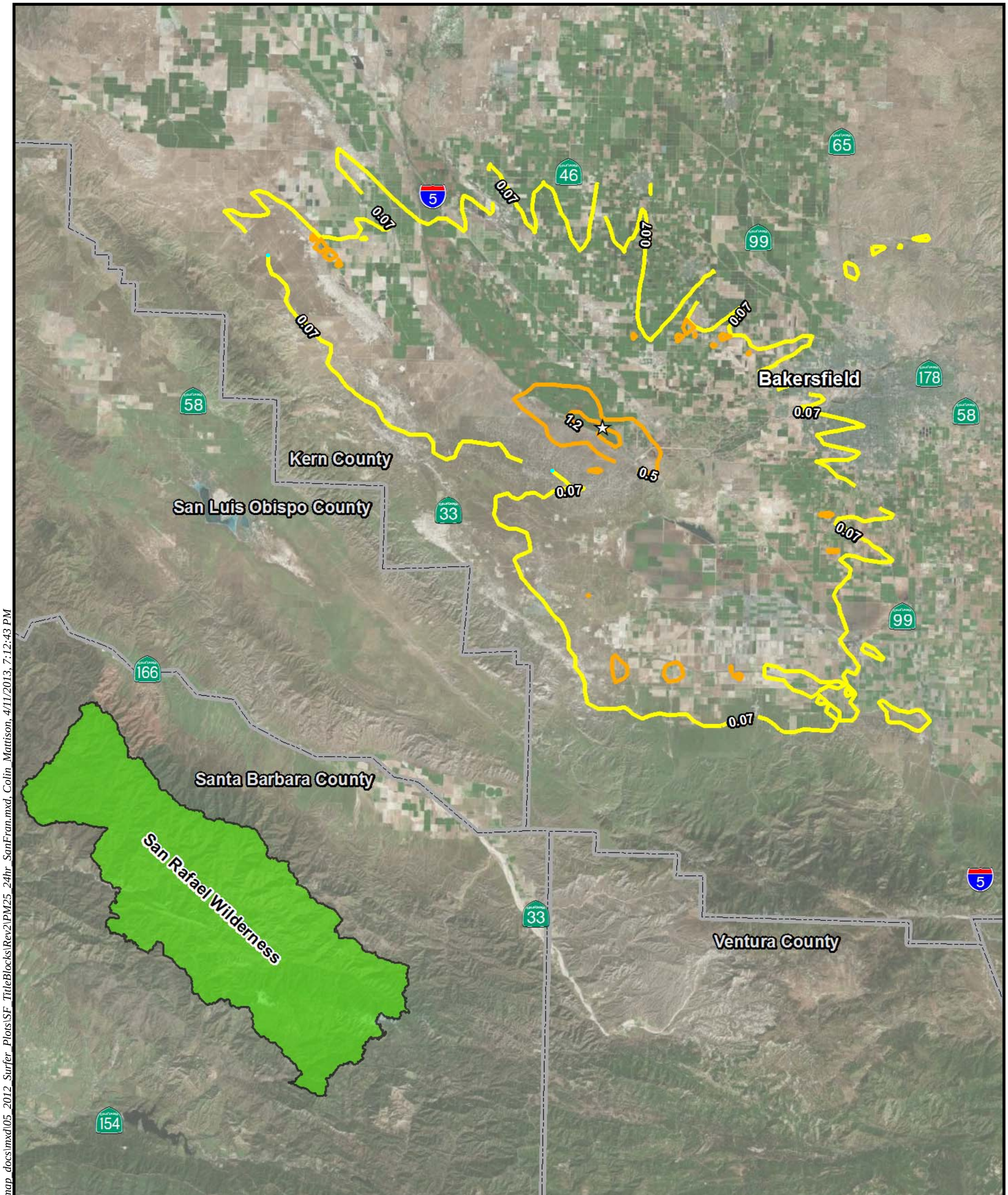
April 2013
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 6-4

Path: G:\gis\projects\1577\28068052\map_docs\mxd\05_2012_Surfer_Plots\SF_TitleBlocks\Rev2\PM10_24hr_SanFran.mxd, Colin_Mattison, 4/11/2013, 6:03:00 PM



Project Site
Class I SIL $PM_{2.5}$ 24-hour 0.07 µg/m^3
$PM_{2.5}$ 24-hour Concentration Isopleths (µg/m^3)
County Boundary
San Rafael Wilderness Area

SOURCES:
Contours (URS, 2012), San Rafael Wilderness (USFS, 2009)
County Boundary, Streets (ESRI, 2007), Aerial (Bing Maps, 2012)

0 5 10 Kilometers

EXTENT OF $PM_{2.5}$ 24-HOUR CLASS I SIL FROM HECA OPERATIONS

April 2013 Hydrogen Energy California (HECA)
28068052 Kern County, California

URS

FIGURE 6-5

Path: G:\gis\projects\1577\28068052\map_docs\mxd\05_2012_Surfer_Plots\SF_TitleBlocks\Rev2\PM25_24hr_SanFran.mxd, Colin_Mattison, 4/11/2013, 7:12:43 PM

6.2 AIR QUALITY RELATED VALUES

6.2.1 Class I Areas

The updated Q/d value for the HECA Project for the San Rafael Wilderness Area is still less than 5, while the updated Q/d values for the Domelands Wilderness Area and Sequoia National Park Class I Areas are still less than 3. Therefore, HECA did not prepare Class I Area Air Quality Relate Values (AQRV) analyses based on Federal Land Managers' Air Quality Related Values Work Group (FLAG) and U.S. Forest Service guidance.

6.2.2 Class II Area Visibility Analysis

Sequoia National Forest and Los Padres National Forest Class II areas are approximately 50 kilometers or farther from HECA, and the updated Q/d analysis is still less than 6. Per the FLAG guidance screening technique, impacts would continue to be less than significant. However, a Class II visibility analysis was requested by USEPA Region 9 after the ATC/PSD Application submittal.

The Class II visibility analysis was submitted in October 2012 for the Elk Hills area that lies south of the facility. Onsite normal daily emission rates for HECA stationary sources for NO_X, particulate matter, and primary NO_2 emissions for the nitric acid unit remained the same. Therefore the Level I screening visibility analysis submitted in October 2012 is still valid for the Class II area, and no significant impact to visibility was predicted.

6.3 SOILS AND VEGETATION ANALYSES

All Project modeled impacts continue to be below levels that have shown potential soil and vegetation response, as presented in the ATC/PSD Application, and these predictions also continue to be below the primary and secondary NAAQS and CAAQS.

A comparison of the maximum concentrations predicted due to the HECA Project revisions, and the screening concentrations listed in the USEPA document, are shown in Revised Table 6-2.

As demonstrated in the following table, maximum Project-related predicted NO_2, CO, SO_2, and H_2S concentrations are still below the USEPA screening concentrations, and thus below the levels at which adverse effects to vegetation or soils are expected to occur. Therefore, pollutant emissions from the HECA Project are not expected to have adverse soils and vegetative impacts.

6.4 GROWTH-INDUCED IMPACTS

There are no changes to the land uses or zoning designations surrounding the area of the Project Site. The existing character of the immediate area surrounding the Project Site will remain unchanged by the development of the Project. None of the Project refinements will cause changes to the previously presented analysis.

Revised Table 6-2
Comparison of Maximum HECA Concentrations and USEPA Screening Concentrations

Pollutant	Modeled Averaging Time	Predicted Concentration[1] (μg/m^3)	Background Concentration (μg/m^3)	Total Concentration (μg/m^3)	USEPA AQRV Screening Concentration (μg/m^3)	USEPA AQRV Screening Averaging Time
SO_2	1-Hour	532	42	574	917	1-Hour
	3-Hour	260	26	286	786	3-Hour
	Annual	0.1	13	13.1	18	Annual
NO_2	1-Hour	187	140	327	3,760	4 and 8-Hour
					564	Weekly
	Annual	1.6	26	28	94	Annual
PM_{10}	24-Hour	4.0	264	268	N/A	N/A
	Annual	0.6	54	54.6	N/A	N/A
CO	8-Hour	392	2,485	2,877	1,800,000	Weekly
H_2S	1-Hour	29.3	N/A	29.3	28,000	4-Hour

Notes:

AQRV = air quality related value
CO = carbon monoxide
H_2S = hydrogen sulfide
μg/m^3 = micrograms per cubic meter
NO_2 = nitrogen dioxide
PM_{10} = particulate matter of 10 microns or smaller
SO_2 = sulfur dioxide
VOC = volatile organic compound

7.1 NEW SOURCE REVIEW EMISSION REDUCTION CREDITS

Based on revised operational emissions data, and applying the appropriate ratios, the calculation of offsets is presented in Revised Table 7-1.

To demonstrate compliance with SJVAPCD rules, the Project is required to provide emission offsets in the form of ERCs equal to increases in gross emissions of NO_X, SO_X, PM_{10}, and VOCs that will result from the operation of the Project, minus the specified thresholds. The Project proposes to further mitigate emissions of these pollutants beyond applicable offset requirements by offsetting the full amount of the Project net emission increase.

SJVAPCD Rule 2201 Section 4.8 specifies distance ratios that must be applied in determining the quantity of ERCs to be provided for a new source. For all pollutants, the distance ratio applicable is 1.5 to 1.

The Project will use SO_X ERCs to offset PM_{10} emissions on an inter-pollutant basis. The SJVAPCD has developed an inter-pollutant trading ratio for SO_X to PM_{10} of 1:1, and concluded that this is protective of managing regional particulate matter impacts and progress towards attainment.

Rule 2201 Section 4.14.1 requires that emissions from new stationary sources be modeled to determine if the emissions cause or make worse a violation of an AAQS. The modeled impact of $PM_{2.5}$ emissions from the Project exceeds the SJVAPCD daily and annual significance impact levels for $PM_{2.5}$ (as shown in Section 4.2.1.5); thus, offsets for $PM_{2.5}$ will be provided. The offsets will mitigate the total $PM_{2.5}$ emissions from all stationary sources, including emissions from emergency equipment (otherwise exempt from emission offsets). Please note that the Project is not a major source of $PM_{2.5}$ emissions, as defined in Rule 2201, because its emissions of $PM_{2.5}$ are less than 100 ton/year; therefore, offsets are not explicitly required. Offsets are provided to mitigate modeled impacts from $PM_{2.5}$. Because $PM_{2.5}$ is a subset of PM_{10}, the SO_X ERCs will offset both PM_{10} and $PM_{2.5}$ emissions.

HECA has procured sufficient ERCs to satisfy these offset requirements. The ERCs that have been procured are detailed in Revised Table 7-2.

7.2 GENERAL CONFORMITY AND CEQA MITIGATION

As required by 40 Code of Federal Regulations 93, Subpart B, an evaluation of the General Conformity was performed for the HECA Project for all the affected nonattainment and maintenance areas in the states of California, Arizona, and New Mexico. Criteria pollutant emissions generated in each Project-affected area from activities associated with the Project construction and operation were calculated and compared to the General Conformity *de minimis* thresholds to assess whether a General Conformity Determination (GCD) is required.

The General Conformity evaluation was conducted for both alternatives. The estimated emissions indicate that the total direct and indirect construction and operational emissions of CO, PM_{10}, $PM_{2.5}$, and SO_2 are below the applicable General Conformity thresholds for all years of construction and operation in all nonattainment and maintenance areas for both Alternatives 1

Revised Table 7-1
Emission Reduction Credits Determination

	NO_X	SO_X[2]	PM_{10}	$PM_{2.5}$[3,4]	CO	VOC
Gross Emissions, lb/yr	318,094	63,799	180,880	160,215	544,198	69,948
SJVAPCD Requirements						
Offset Threshold Levels per Section 4.5.3 of DR2201, lb/yr	20,000	54,750	29,200	200,000	200,000	20,000
Required ERCs, lb/yr[1]	297,588	9,046	151,633	160,215	—	49,737
Offsets Triggered?	yes	yes	yes	yes[6]	no[5]	yes
Offset Ratio (1:X)	1.5	1.5	1.5	1.5	NA	1.5
Required ERCs with offset ratio, lb/yr	446,382	13,569	227,450	240,323	—	74,606
ERCs in Possession, lb/yr	522,400	266,000	0	0	0	104,250
Inter-pollutant offset, lb/yr	—	-240,323	227,450	240,323	—	—
ERCs Surplus (Needed), lb/yr	76,018	12,109	0	0	—	29,644
Additional Mitigation for CEQA (CEC)						
Required ERCs, lb/yr	318,094	63,799	180,880	160,215	—	69,948
ERCs in Possession, lb/yr	522,400	266,000	0	0	—	104,250
Inter-pollutant offset, lb/yr	—	-180,880	180,880	160,215	—	—
ERCs Surplus (Needed), lb/yr	204,306	21,320	0	0	—	34,302

Notes:

1 Required ERCs excludes emissions from the exempt emergency generators and fire pumps, except for $PM_{2.5}$.
2 Ratio of 1:1 used to apply SO_X certificates to PM_{10} emissions
3 Major Source of $PM_{2.5}$ is defined as 100 TPY as of July 15, 2008
4 Federal and SJVAPCD New Source Review offset trigger for $PM_{2.5}$ emissions is 100 TPY.
5 per Section 4.6.1 of DR2201, “Emission Offsets shall not be required for the following: Increases in carbon monoxide in attainment areas if the applicant demonstrates to the satisfaction of the Air Pollution Control Officer, that the Ambient Air Quality Standards are not violated in the areas to be affected, and such emissions will be consistent with Reasonable Further Progress, and will not cause or contribute to a violation of Ambient Air Quality Standards.”
6 Although ERCs are not required for minor sources of $PM_{2.5}$, SJVAPCD requires offsets of project emissions if modeling shows the potential to cause or make worse a violation of the $PM_{2.5}$ AAQS.

Revised Table 7-2
ERCs Procured by HECA

Source	Address	Method of Reduction	ERC Certificate Number	Pollutant	lbs/yr
Big West of California, LLC	6500 Refinery Ave, Bakersfield, CA Section: NE27, Township: 29S, Range: 27E	Shut-down of Catalytic Cracker, Fluid Coker, and CO Boiler	S-3273-2	NO_X	482,000
	6451 Rosedale Hwy, Area I, Bakersfield, CA Section: NE27, Township: 29S, Range: 27E	Shut-down of Tail Gas Incinerator, 2007027A	S-3275-5	SO_X	168,000
Aer Glan Energy LLC	20807 Stockdale Hwy, Bakersfield, CA Section: NE06, Township: 30S, Range: 26E	Shut-down of Entire Stationary Source	S-3305-1	VOC	58,500
			S-3557-1	VOC	45,750
G.I.C. Financial Services, Inc.	11535 E Mountain View Ave., Kingsburg, CA	Install Selective Catalytic Reduction, SCR, and Scrubber and convert from fuel oil to natural gas	C-1058-2	NO_X	40,400
			C-1058-5	SO_X	98,000

and 2. Both Alternatives 1 and 2 have identical NO_X and VOC construction emissions, and exceed the conformity thresholds in 2014 and 2015 for VOC and all years for NO_X. Alternative 2 NO_X emissions are higher than those of Alternative 1 in the San Joaquin Valley Air Basin (SJVAB), although both Alternatives are greater than the GCD threshold for all years. Therefore, Alternative 2 NO_X emissions are used in the evaluation. The construction of HECA is anticipated to start in 2013 and to be completed in 2017. The anticipated Project commercial operation start date is September 2017. During calendar year 2017, both construction activities and operational activities will occur. A General Conformity evaluation for NO_X during construction and operation, and for VOC during construction in the SJVAB, was prepared and submitted to the Department of Energy and the SJVAPCD.

SJVAPCD has developed CEQA significance thresholds for non-permitted equipment and activities during construction and operations. In addition to the conformity thresholds exceedances described above, during construction the $PM_{10}/PM_{2.5}$ threshold of 15 tons/yr will be exceeded.

The Project will enter into an enforceable commitment with the SJVAPCD to participate in its Emission Reduction Incentive Program. The HECA Project's participation in the Emission Reduction Incentive Program will provide pound-for-pound offsets of emissions that exceed the General Conformity and CEQA thresholds to offset all emissions subject to General Conformity and CEQA down to zero. The offsets will cover NO_X emissions during all years of construction and operations, VOCs during all years of construction, as the Conformity and CEQA threshold is exceeded in 2014 and 2015, and PM_{10} during all years of construction, as the CEQA threshold is exceeded in 2013, 2014, and 2015. Through this mechanism, construction and operational emissions of NO_X, and construction emissions of VOC, and PM_{10} from the Project will be fully offset, and the federal action will conform to the SIP pursuant to Title 40, Code of Federal Regulations, Part 93, Subpart B, Section 93.158(a)(2).

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APPENDIX A

REVISED OPERATIONAL CRITERIA POLLUTANT EMISSIONS

HECA Total Combined Annual Criteria Pollutant Emissions

Equipment \ Pollutant	NO_X	CO	VOC	SO_2	PM_{10}	$PM_{2.5}$
	tons/year					
HRSG/CTG [(1)]	106.5	89.0	15.1	17.1	54.0	54.0
Feedstock Dryer[(1)]	17.0	12.7	2.4	2.8	5.6	5.6
Auxiliary Boiler	1.4	8.6	0.9	0.5	1.2	1.2
Tail Gas Thermal Oxidizer	13.7	11.4	0.3	10.7	0.5	0.5
CO_2 Vent		125.1	3.8			
Gasification Flare	2.5	18.5	0.05	0.08	0.24	0.24
Rectisol Flare	0.7	0.8	0.01	0.3	0.03	0.03
SRU Flare	0.1	0.2	0.003	0.4	0.006	0.006
Cooling Towers [(2)]					25.5	15.3
Emergency Generators[(3)]	0.2	0.8	0.1	0.001	0.02	0.02
Fire Water Pump	0.09	0.2	0.01	0.0003	0.001	0.001
Nitric Acid Unit	16.8					
Urea Pastillation Unit					0.2	0.2
Ammonium Nitrate Unit					0.8	0.8
Ammonia Startup Heater	0.04	0.15	0.02	0.01	0.02	0.02
Material Handling [(4)]					2.4	2.3
Fugitives [(5)]	0.005	4.8	12.2	0.1	0.1	0.03
Total Annual	**159.0**	**272.1**	**35.0**	**31.9**	**90.4**	**80.1**

Source: HECA Project

Notes:

(1) Total annual HRSG and Feedstock Dryer emissions represent the maximum annual emissions during normal operations plus startup and shutdown emissions

(2) Includes contributions from all three cooling towers

(3) Includes contributions from both emergency generators

(4) Material handling emissions are shown as the contribution of all dust collection points.

(5) Fugitives include leakage from piping and fugitive dust from vehicles.

CO = carbon monoxide

HRSG=Heat Recovery Steam Generator

CTG = combustion turbine generator

NO_X = nitrogen oxides

PM_{10}= particulate matter less than 10 microns in diameter

$PM_{2.5}$ =particulate matter less than 2.5 microns in diameter

SO_2 = sulfur dioxide

VOCs = volatile organic compounds

Basis: MHI GT - Model: M501GAC

With PSA Off-gas and H2-rich Gas Duct Firing

Maximum Emissions based on Case 1 - On-peak with duct-firing at 97F ambient

CGT Max Fuel Input =	2583	x 10^6 Btu/hr (HHV) of syngas
Duct Firing Max Fuel Input =	278	x 10^6 Btu/hr (HHV) of PSA Off-gas and H2-rich syngas
Total combined flue gas downstream of duct burners =	196,300	lbmol/hr (wet)
Water concentration =	12.9	vol %
O2 (wet) =	10.5	vol %
HRSG stack gas =	255,463	lbmol/hr, dry, corrected to 15% O2

Total HRSG Flue Gas Emission Rates with Duct Firing of PSA Off-gas and H2-rich syngas

	Emission Factors lb/10^6 Btu (HHV)	Basis
NOx	0.011	2.5 ppmc
CO	0.008	3 ppmc
VOC	0.0015	1 ppmc
$PM_{10}/PM_{2.5}$	0.008	filterable (front-half) + condensible (back half)
SO2**	0.002	2 ppmv total sulfur in syngas, 10 ppmv sulfur in PSA Off-gas
NH3		5 ppmc ammonia slip

Notes: Emission Factors are based on the maximum emissions from all of the cases examined (On-peak and Off-peak)
ppmc denotes ppm by volume, dry, corrected to 15% O2
** Maximum SO2 emission occurs for OFF-peak, 97 deg F (Case 2)

Maximum short-term emissions from HRSG stack, normal operations on peak

HRSG Emissions	lb/hr	Basis
NOx	25.0	Case 1 (ON Peak, 97 deg Ambient)
CO	18.3	Case 1 (ON Peak, 97 deg Ambient)
VOC	3.5	Case 1 (ON Peak, 97 deg Ambient)
$PM_{10}/PM_{2.5}$	12.9	Case 3 (ON Peak, 39 deg Ambient)
SO2**	4.1	Case 2 (OFF Peak, 97 deg Ambient)
NH3	18.5	Case 1 (ON Peak, 97 deg Ambient)

	Exhaust gas (lbmol/hr)	Exit velocity (m/s)	Exhaust flow (ft3/sec)	Exit velocity (ft/sec)
min HRSG fluegas to HRSG stack during ON peak (Case 1) =	167,092	15.06	22,356.58	49.42
Min HRSG fluegas to HRSG stack during OFF Peak (Case 2) =	126,704	11.42	16,952.70	37.47
HRSG fluegas to HRSG stack during ON Peak (Case 3) =	176,804	15.94	23,655.98	52.29

Annual average emissions from HRSG Stack
Basis: Case 5 (ON Peak, Avg. Ambient)

HRSG Emissions	lb/hr
NOx	24.9
CO	18.2
VOC	3.5
$PM_{10}/PM_{2.5}$	12.8
SO2*	4.1
NH3	18.4

	Exhaust gas (lbmol/hr)	Exit velocity (m/s)
HRSG fluegas to HRSG stack (Case 5) =	171,498	15.46

Maximum short-term emissions from feedstock dryer stack

Feedstock Dryer Emissions	lb/hr	Basis
NOx	4.4	Case 1 (ON Peak, 97 deg Ambient)
CO	3.2	Case 1 (ON Peak, 97 deg Ambient)
VOC	0.6	Case 1 (ON Peak, 97 deg Ambient)
$PM_{10}/PM_{2.5}$	1.4	Case 3 (ON Peak, 39 deg Ambient)
SO2	0.9	Case 2 (OFF Peak, 97 deg Ambient)
NH3	3.2	Case 1 (ON Peak, 97 deg Ambient)

*Baghouse PM control to 0.001 gr/dscf

Annual average emissions from feedstock dryer stack
Basis: Case 5 (ON Peak, Avg. Ambient)

Feedstock Dryer Emissions	lb/hr
NOx	4.2
CO	3.1
VOC	0.6
$PM_{10}/PM_{2.5}$	1.4
SO2	0.7
NH3	3.1

*Baghouse PM control to 0.001 gr/dscf

CTG/HRSG and Feedstock Dryer — Emissions Summary

4/19/2013

	Exhaust gas (lbmol/hr)	Exit velocity (m/s)
Min HRSG fluegas to feedstock dryer (Case 4) =	28,788	5.84
HRSG fluegas to feedstock dryer (Case 5) =	29,102	5.90

Note: Feedstock dryer emission rates are relatively constant for both On- and OFF-peak operation.

Startup/Shutdown - HRSG Stack & Coal Drying Stack

Information provided by MHI

Expected Emissions vs. CTG Load (Natural Gas)				
	CTG load			
	80%	40%	20%	units
NOx	42	25	18	ppmc
CO	130	2900	5000	ppmc
VOC	1.1	9	50	ppmc
$PM_{10}/PM_{2.5}$	15	15	15	lb/hr
SOx*	0.4	0.4	0.4	ppmc

* 0.4 ppmc SO2 in fluegas corresponds to about 12.6 ppmv total sulfur in natural gas fuel.

Expected Emissions vs. CTG Load (Syngas)		
	CTG load	
	40%	units
NOx	19	ppmc
CO	39	ppmc
VOC	2	ppmc
$PM_{10}/PM_{2.5}$	13	lb/hr
SOx	2	ppmvw

Compound	**lb/lbmol**
NO2	46.01
CO	28.01
VOC	16.04
SO2	64.06
NH3	17.03

HRSG/Coal Drying Total Exhaust Flow Basis								
Load/Fuel	80% on NG		40% on NG		20% on NG		40% on Syngas	
O2 mol% (wet)	11.41%		14.15%		15.22%		11.74%	
H2O mol% (wet)	14.10%		10.63%		9.28%		10.50%	
MW	27.79	lb/lbmol	28.05	lb/lbmol	28.16	lb/lbmol	27.66	lb/lbmol
HRSG flue gas*	167,600	lbmol/hr	138,400	lbmol/hr	127,400	lbmol/hr	140,200	lbmol/hr
NOx Stack Conc (assumed)	4	ppmc	25	ppmc	18	ppmc	10	ppmc
CO Stack Conc (assumed)	5	ppmc	400	ppmc	1000	ppmc	20	ppmc
VOC Stack Conc (assumed)	2	ppmc	9	ppmc	50	ppmc	2	ppmc
NH3 slip	5	ppmc	0		0		5	ppmc
Turbine Fuel Flow							14,218	lbmol/hr
HRSG flue gas (wet)	4,657,604	lb/hr	3,882,120	lb/hr	3,587,584	lb/hr	3,877,932	lb/hr
HRSG flue gas (dry, corrected to 15% O2)	185,516	lbmol/hr	106,371	lbmol/hr	81,062	lbmol/hr	165,183	lbmol/hr
Duct Burner Gas HHV							85	MMBtu/hr
Coal Drying Flow (wet)			480,180	lb/hr			480,180	lb/hr

*Includes gas routed to feedstock dryer.

HRSG Startup

Step	Duration (hrs)		SO2	NOx	CO	$PM_{10}/PM_{2.5}$	VOC	NH3	Description	Flow (lbmol/hr)	Exhaust flow (ft3/sec)	Exit velocity (ft/sec)	Exit velocity (m/s)
1. 20% on NG	0.5	lb/hr	2.1	67.1	2270	15.0	65	0	CTG ignition and synchronization	127,400	17,045.88	37.68	11.48
		lb	1.0	33.6	1135	7.5	32.4	0.0					
2. 40% on NG	2	lb/hr	2.4	107.2	1044	13.1	13	0	HRSG/STG Warm-up, Ramp CTG to 40%	121,300	16,229.71	35.88	10.93
		lb	4.8	214	2088	26.3	26.8	0.0					
3. 40% on Syngas	2	lb/hr	2.4	66.6	81	13	4.6	12.3	CTG fuel change over, Start up PSA/Ammonia/Urea Plant	123,100	16,470.54	36.41	11.10
		lb	5	133	162	26	9	24.6					
Tons/Startup			**0.01**	**0.19**	**1.69**	**0.03**	**0.03**	**0.01**					

*Coal drying starts at step 2 above.

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Coal Drying Startup

Step	Duration (hrs)		SO2	NOx	CO	$PM_{10}/PM_{2.5}$	VOC	NH3	Description	Flow (lbmol/hr)	Exhaust flow (ft3/sec)	Exit velocity (ft/sec)	Exit velocity (m/s)
2. 40% on NG	2	lb/hr	0.3	15.1	147.4	0.9	1.9	0.0	Gasifier fuel changeover	17,100	2,287.95	11.38	3.47
		lb	0.7	30.3	294.7	1.9	3.8	0.0					
3. 40% on Syngas	2	lb/hr	0.3	9.4	11.5	0.9	0.7	1.7	GTG fuel change over, Start up PSA/Ammonia/Urea Plant	17,400	2,328.09	11.58	3.53
		lb	0.7	19	23	2	1	3.5					
Tons/Startup			**0.00**	**0.02**	**0.16**	**0.00**	**0.00**	**0.00**					

*PM emission rate based on 0.001 grain/dscf

HRSG Shutdown														
Step	Duration (hrs)		SO2	NOx	CO	$PM_{10}/PM_{2.5}$	VOC	NH3	Description	Flow (lbmol/hr)	Exhaust flow (ft3/sec)	Exit velocity (ft/sec)	Exit velocity (m/s)
1. 40% on Syngas	4	lb/hr	2.4	66.6	81.0	13	4.6	12.3	PSA, Ammonia and Urea plant shutdown, Gasifier to 60%, CTG to 40%	123,100	16,470.54	36.41	11.10
		lb	9.6	266	324	52.6	18.5	49.2					
2. 40% on NG	3	lb/hr	2.7	122	1191	15.0	15.3	0.0	CTG fuel change over, Gasifier depressurization	138,400	18,517.65	40.93	12.48
		lb	8.2	367	3574	45.0	45.9	0.0					
3. 20% on NG	2	lb/hr	2.1	67.1	2270	15.0	64.8	0.0	Minimum plant load on NG	127,400	17,045.88	37.68	11.48
		lb	4.2	134	4539	30.0	129.7	0.0					
Tons/Shutdown			**0.01**	**0.38**	**4.22**	**0.06**	**0.10**	**0.02**					

Coal Drying Shutdown													
Step	Duration (hrs)		SO2	NOx	CO	$PM_{10}/PM_{2.5}$	VOC	NH3	Description	Flow (lbmol/hr)	Exhaust flow (ft3/sec)	Exit velocity (ft/sec)	Exit velocity (m/s)
1. 40% on Syngas	4	lb/hr	0.3	9.4	11.5	0.9	0.7	1.7	PSA, Ammonia and Urea plant shutdown, Gasifier to 60%, CTG to 40%	17,400	2,328.09	11.58	3.53
		lb	1.4	37.6	45.8	3.8	2.6	7.0					
Tons/Startup			**0.00**	**0.02**	**0.02**	**0.00**	**0.00**	**0.00**					

*PM emission rate based on 0.001 grain/dscf

CTG steady state operation at 80% load on natural gas for 2 weeks per year

HRSG Emissions - Natural Gas Operations													
Step	Duration (hrs)		SO2	NOx (4 ppmc)	CO (5 ppmc)	$PM_{10}/PM_{2.5}$	VOC (2 ppmc)	NH3 (5 ppmc)	Description	Flow (lbmol/hr)	Exhaust flow (ft3/sec)	Exit velocity (ft/sec)	Exit velocity (m/s)
1. 80% on NG	336	lb/hr	4.7	34.1	26.0	15.0	5.9	15.8	CTG operation at 80% load on NG	150,700	20,163.37	44.57	13.59
		lb	1596	11469	8727	5040	1995	5298					
Tons/yr			**0.80**	**5.73**	**4.36**	**2.52**	**1.00**	**2.65**					
Natural gas heat input (HHV)	2400	Emission Factors lb/MMBtu (HHV)	0.002	0.015	0.011	0.007	0.003	0.007					

Heat Input = 2167x10^6 Btu/hr, LHV (approx 2400x10^6 btu/hr, HHV)

HRSG & Feedstock Dryer Maximum Annual Operation Emissions

	HRSG, ton/yr				Gasifier Feedstock Dryer, ton/yr		
	SU & SD	**Normal Op**	**Nat Gas BU**	**Total**	**SU & SD**	**Normal Op**	**Total**
NOx	1.15	99.6	5.73	106.5	0.09	16.9	17.0
CO	11.8	72.8	4.36	89.0	0.36	12.4	12.7
VOC	0.26	13.9	1.00	15.1	0.01	2.4	2.4
$PM_{10}/PM_{2.5}$	0.19	51.3	2.52	54.0	0.01	5.6	5.6
SO2*	0.032	16.3	0.80	17.1	0.00	2.8	2.8
NH3	0.07	73.6	2.65	76.4	0.01	12.5	12.5

Maximum Annual Operation:

SU & SD	2	per year
Normal op	8000	hr/yr
Nat gas op	336	hr/yr

Annualized Startup/Shut down Emission rate for NO2 1-hr NAAQS				
Source	**HRSG**		**Feedstock Dryer**	
Emission Scenario	Annualized rate for all events	Normal On-peak (Case 1)	Annualized rate for all events	Normal On-peak (Case 1)
Emission rate (lb/hr)	24.32	25.01	3.88	4.4

Normal operations are higher, therefore normal operating emissions used in NAAQS modeling

CALCULATIONS FOR COMBINED CYCLE EMISSIONS

Basis: MHI Data for 501GAC, 1 on 1 with O2 Blown Gasifier (Lee Ranch Coal 75cal%/ Carson High Sulfur Coke 25cal%)

	Case 1	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**
Ambient temp, deg F	97	97	39	39	65	65
ON Peak/OFF Peak	ON	OFF	ON	OFF	ON	OFF
HRSG Flue Gas Split to Feedstock Dryer						
Flue gas to feedstock dryer, lbmol/hr (wet)	29,208	28,996	28,996	28,788	29,102	28,996
Flue gas to HRSG stack, lbmol/hr (w)	167,092	126,704	176,804	142,412	171,498	135,904
Feedstock Dryer Stack Emissions						
NOx, lb/hr	4.4	4.3	4.1	3.8	4.2	4.0
CO, lb/hr	3.2	3.1	3.0	2.8	3.1	2.9
VOC, lb/hr	0.61	0.59	0.57	0.52	0.59	0.55
Particulate, lb/hr (3)	1.4	1.4	1.4	1.4	1.4	1.4
SO2, lb/hr	0.7	0.9	0.7	0.8	0.7	0.8
NH3, lb/hr	3.23	3.16	3.0	2.8	3.1	2.9
HRSG Stack Emissions						
NOx, lb/hr	25.01	18.7	24.96	18.7	24.9	18.6
CO, lb/hr	18.3	13.6	18.2	13.6	18.2	13.6
VOC, lb/hr	3.48	2.60	3.47	2.59	3.47	2.59
Particulate, lb/hr	12.77	12.21	12.89	12.48	12.82	12.36
SO2, lb/hr	4.06	4.09	4.09	4.03	4.07	3.98
NH3, lb/hr	18.5	13.8	18.4	13.8	18.4	13.8

Notes:
(1) "ppmc" denotes parts per million by volume, dry, corrected to 15% O2
(2) Sulfur in the PSA Off-gas is based on the total sulfur quantity in the feed to the PSA
(3) PM emission from feedstock dryer based on stack baghouse outlet dust loading of 0.001 grain/dscf.

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Description

Mainly used for startups, could be used for other purposes, primarily during power block outages.

Maximum steam generation 150,000 lb/hr
Maximum heat release 213 10^6 Btu/hr, HHV
Natural gas fuel, only

Emission factors		
	lb/10^6 Btu, HHV	Basis
SO2	0.00204	12.65 ppmv total sulfur in pipeline natural gas (max short-term)
NOx	0.006	Low NOx burner and SCR, 5 ppmvd (3% O2)
CO	0.037	50 ppmvd (3% O2)
$PM_{10}/PM_{2.5}$	0.005	Similar equipment from previous project
VOC	0.004	Similar equipment from previous project
NH3	0.0022	5 ppmvd (3% O2) NH3 slip

Emissions		
	Max short-term lb/hr (1)	Annual average ton/yr (2)
SO2	0.4	0.48
NOx	1.3	1.4
CO	7.9	8.6
$PM_{10}/PM_{2.5}$	1.07	1.17
VOC	0.85	0.93
NH3	0.47	0.51

Notes:

(1) Maximum 1-hr, 3-hr, 8-hr, and 24-hr average emission rates.

(2) Maximum annual capacity factor of 25% (i.e., annual fuel consumption less than 0.25 x 8760 hr/yr x 213 million Btu/hr = 466 billion Btu/yr)

Description

The Tail Gas Thermal Oxidizer (TGTO) is primarily intended to safely dispose of SRU tail gas in the event of an emergency or upset. The TGTO will also be be used to dispose of waste gas during SRU startups and to futher dispose of miscellaneous vent streams from the gasification area. These vent streams may contain trace amounts of reduced sulfur compounds and/or ammonia that could cause nuisance odors if vented directly to the atmosphere.

The TGTO will also be used to dispose of sulfur bearing waste gas during intermittent post-shutdown SRU passivation. In this operation natural gas is fired in the SRU burners to oxidize and remove residual sulfur for safety reasons prior to opening the process equipment for major maintenance such as catalyst changeout. This operation is expected to occur no more than once per year.

Finally, the TGTO will be used to safely oxidize and dispose of H2S, SO2, and sulfur vapor from the occasional "presulfiding" of tail gas hydrogenation catalyst. Presulfiding, which activates new catalyst oxide loaded in the reactor prior to normal operation, consists of recirculating steam-heated hydrogen and nitrogen through the hydrogenation catalyst. The hydrogen reacts with a layer of elemental sulfur on the fresh catalyst material to form sulfides which activate the catalyst. A purge is withdrawn from the recirculating hydrogen stream to remove H2S, SO2, and other sulfur products and direct them to the TGTO for safe disposal. This operation is also expected to occur less than once per year.

Process Vent Disposal

Assume nominal natural gas fuel consumption = 13 million Btu/hr

Assume an allowance of 2 lb/hr SO2 emission to account for sulfur in the various vent streams plus fuel.

Emission Calculations

NOx =	0.24	lb/10^6 Btu, HHV (based on previous project, 54 ppmvd @ 3% O2)
=	3.1	lb/hr
CO =	0.2	lb/10^6 Btu, HHV (based on previous project, 74 ppmvd @ 3% O2)
=	2.6	lbhr
SO2 =	2	lb/hr
VOC =	0.006	lb/10^6 Btu, HHV (AP-42, Table1.4 -2)
=	0.1	lb/hr
$PM_{10}/PM_{2.5}$ =	0.008	lb/10^6 Btu, HHV (AP-42, Table1.4 -2)
=	0.1	lb/hr

SRU startup natural gas combustion products disposal

Waste gas

Natural gas fuel 80 x 10^6 Btu/hr, HHV

Emission Calculations

(emission factors same as above)

NOx =	0.24	lb/10^6 Btu, HHV
=	19.2	lbhr
CO =	0.2	lb/10^6 Btu, HHV
=	16.0	lbhr
SO2 =	0.00204	lb/10^6 Btu, HHV
=	0.16	lbhr
VOC =	0.006	lb/10^6 Btu, HHV
=	0.48	lbhr
$PM_{10}/PM_{2.5}$ =	0.008	lb/10^6 Btu, HHV
=	0.64	lbhr

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SRU "passivation" combustion products disposal

Waste gas

Combustion products from natural gas warming 80 x 10^6 Btu/hr, HHV

Sulfur in waste gas = 75 lb/hr (as SO2)

Emission Calculations

(emission factors same as above)

NOx =	0.24	lb/10^6 Btu, HHV
=	19.2	lbhr
CO =	0.2	lb/10^6 Btu, HHV
=	16.0	lbhr
SO2 =	75	lb/hr
VOC =	0.006	lb/10^6 Btu, HHV
=	0.48	lbhr
PM10 =	0.008	lb/10^6 Btu, HHV
=	0.64	lbhr

TGTU Hydrogenation Catalyst Presulfiding

Sulfur in purge gas = 125 lb/hr (as SO2)

This activity will require

TGTO natural gas assist fuel = 13 x 10^6 Btu/hr, HHV

The annual hours of normal operation include this espisode natural gas usage

Maximum Short-term Emission Rates	lb/hr	**Annualized Startup Emission rate for NO2 & SO2 1-hr NAAQS** lb/hr	
NOx	22.3	3.119	Normal operations are higher, therefore normal operating emissions used in NAAQS modeling
CO	18.6		
SO2	125	2.447	Annualized emissions are higher, therefore annualized emissions are used in NAAQS modeling
VOC	0.6		
$PM_{10}/PM_{2.5}$	0.7		

Annual Emission Calculations
Assumed annual operating scenario
TGTO normal operation for disposing miscellaneous vent gas

		8314	hr/yr
NOx =	13.0 ton/yr		
CO =	10.8 ton/yr		
SO2 =	8.3 ton/yr		
VOC =	0.32 ton/yr		
$PM_{10}/PM_{2.5}$ =	0.43 ton/yr		
SRU startup hrs/yr =		48	(approx 2 events @ 80 x 10^6 Btu/hr)
NOx =	0.461 ton/yr		
CO =	0.3840 ton/yr		
SO2 =	0.0039 ton/yr		
VOC =	0.0115 ton/yr		
$PM_{10}/PM_{2.5}$ =	0.0154 ton/yr		
SRU passivation hrs/yr =		24	
NOx =	0.230 ton/yr		
CO =	0.192 ton/yr		
SO2 =	0.900 ton/yr		
VOC =	0.006 ton/yr		
PM10 =	0.008 ton/yr		
TGTU presulfiding hrs/yr =24		24	(one event per yr)
SO2 =	1.50 ton/yr		
Total annual emission			
NOx =	13.7 ton/yr		
CO =	11.4 ton/yr		
SO2 =	10.7 ton/yr		
VOC =	0.3 ton/yr		
$PM_{10}/PM_{2.5}$ =	0.5 ton/yr		

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CO2 Vent Maximum Operations

Short-term Emission Rates

Total flow =	767,435	lb/hr		
=	17,724	lbmol/hr		
H2S =	10	ppmv		
=	6.0	lb/hr		
COS =	10	ppmv		
	10.6	lb/hr		
CO =	1000	ppmv	(ranges from 500 to 1000 ppmv)	
=	496.3	lb/hr		11910.308
methanol (MeOH) =	40	ppmv		
=	22.7	lb/hr		
benzene (Bz) =	4	ppmv		
=	5.5	lb/hr		
VOC =	44	ppmv (MeOH + Bz)		
=	28.2	lb/hr (MeOH + Bz)		677.18606

Annual Emissions

Assume	21	days/yr CO2 venting at full rate	
Total annual flow =	193,394	ton/yr	
For methanol calculations assume			
Average flow capacity for year =	85%	of maximum (varies between 70% - 100%)	
Average Annual Flow =	7,592,821	lbmol/yr	
methanol (MeOH) =	20	ppmv	average annual emission rate
H2S =	1.5	ton/yr (based on 10 ppmv)	
COS =	2.7	ton/yr (as COS, based on 10 ppmv)	
CO =	125.1	ton/yr (based on 1000 ppmv)	
methanol (MeOH) =	2.4	ton/yr (as MeOH, based on 20 ppmv)	
benzene (Bz) =	1.4	ton/yr (as Bz, based on 4 ppmv)	
VOC =	3.8	ton/yr (MeOH + Bz, based on 24 ppmv)	

Note: These emissions represent the maximum emissions associated with Infrequent venting of product CO2.

1) Vent gas methanol concentrations are based on process licensor data. The methanol concentration is expected to be 18-20 ppm, but could be as high as 40 ppm associated short-term operational conditions such as transient impacts on the wash column.

2) Annual emission rates are based on 504 hours per year of full venting for H2S, COS, CO and Benzene and the average venting of 85% flow rate for Methanol.

Emission factors

	lb/10^6 Btu, HHV	Basis
Normal Operation (each flare) - pilots only, natural gas fuel		
SO2	0.00204	12.65 ppmv total sulfur in pipeline natural gas
NOx	0.068	Supplier data
CO	0.08	Supplier data
$PM_{10}/PM_{2.5}$	0.003	Supplier data
VOC	0.0013	99% VOC destruction for typical natural gas
Gasifier Startup - waste gases or H2-rich gas to Gasification Flare		
SO2	0.002	Startup - no sulfur in startup feed
NOx	0.068	Supplier data
CO (1)	2	Supplier data (98% destruction of CO in waste gas)
CO (2)	0.37	Supplier data
$PM_{10}/PM_{2.5}$	0.008	Supplier data
VOC	0.0015	no VOC in waste gas or H2-rich gas

(1) Unshifted syngas
(2) Shifted syngas

Short-term Emission Calculations

Normal Operation - include pilots only, natural gas fuel
Maximum emissions include max of startup or shutdown plus pilot

Gasification Flare pilot fuel = 0.5 x 10^6 Btu/hr
SRU and Rectisol Flares pilot fuel = 0.3 x 10^6 Btu/hr, each

	Pilot	Max hourly emissions	Max daily emissions
	lb/hr	lb/hr	lb/hr
Gasification Flare			
SO2	0.00102	6.0	3.3
NOx	0.03	199.0	99.9
CO	0.04	4772.0	761.7
$PM_{10}/PM_{2.5}$	0.0015	19.3	9.9
VOC	0.0007	3.8	2.1
SRU Flare			
SO2	0.0006	18.4	18.4
NOx	0.020	2.5	2.5
CO	0.0240	2.9	2.9
$PM_{10}/PM_{2.5}$	0.0009	0.1	0.1
VOC	0.0004	0.05	0.05
Rectisol Flare			
SO2	0.0006	15.0	15.0
NOx	0.020	29.3	29.3
CO	0.0240	34.4	34.4
$PM_{10}/PM_{2.5}$	0.0009	1.3	1.3
VOC	0.0004	0.6	0.6

Startup/Shutdown - Gasification Flare

*Based on Startup/Shutdown Procedures provided by MHI for the PurGen One Project

Startup								
Step	Duration (hrs)	Heat Input (mmbtu/hr)		SO2	Nox	CO	$PM_{10}/PM_{2.5}$	VOC
2. Flaring NG	3	2,926	lb/hr	6.0	199.0	234.1	8.8	3.8
			lb	17.9	597.0	702.3	26.3	11.4
3. Flaring Unshifted Syngas	2	2,386	lb/hr	5.5	162.2	4772.0	19.1	3.6
			lb	11.0	324.5	9544.0	38.2	7.2
4. Flaring Shifted Syngas	5	2,413	lb/hr	5.5	164.1	892.8	19.3	3.6
			lb	27.7	820.4	4464.1	96.5	18.1
Tons/Startup				**0.03**	**0.87**	**7.36**	**0.08**	**0.02**

Shutdown								
Step	hrs	mmbtu/hr		SO2	Nox	CO	$PM_{10}/PM_{2.5}$	VOC
1. Flaring Shifted Syngas	4	2,413	lb/hr	5.5	164	893	19.3	3.6
			lb	22	656	3,571	77	14
Tons/Shutdown				**0.01**	**0.33**	**1.79**	**0.04**	**0.01**

Gasification Flare

Pilot gas = 4380 x 10^6 Btu

2 startups/shutdowns per year

Gasification Flare Annual Emissions

	ton/yr		
	S/U and S/D	**Pilot**	**Total**
SO2	0.08	0.004	0.083
NOx	2.40	0.149	2.547
CO	18.28	0.175	18.457
$PM_{10}/PM_{2.5}$	0.238	0.007	0.245
VOC	0.05	0.003	0.054

Annualized Startup/Shut down Emission rate for NO2 1-hr NAAQS

lb/hr
0.55

Startup/Shutdown Operation - SRU Flare

Acid gas vent to elevated flare prior to introducng to SRU

Acid gas = 4600 lb/hr SO2 = 72 lbmol/hr H2S

Assume 99.6% sulfur removal for caustic scrubber:

Scrubbed acid gas = 18.4 lb/hr SO2

plus approx 25,000 to 140,000 scf/hr of mostly CO2 and other inerts

Assume 36 x10^6 Btu/hr of natural gas assist fuel

added to scrubbed acid gas for flaring.

Approximate heating value of mixed gas to flare

= 36 x10^6 Btu /(140,000 + 36,000) scf

= 205 Btu/scf, adequate for combustion

Estimated Startup SRU Flare Emissions - flaring scrubbed acid gas

	lb/hr
SO2	18.4
NOx	2.4
CO	2.9
$PM_{10}/PM_{2.5}$	0.11
VOC	0.05

99.6% effective caustic scrubber

(Emissions for NOX, CO, PM10, and VOC based on factors for natural gas pilots above)

SRU Flare

SRU startup vent gas to flare 1) = 40 hr /yr
Pilot gas = 2628 x 10^6 Btu

SRU Flare Annual Emissions

	ton/yr		
	S/U and S/D	**Pilot**	**Total**
SO2	0.368	0.003	0.371
NOx	0.049	0.09	0.14
CO	0.058	0.11	0.16
$PM_{10}/PM_{2.5}$	0.002	0.004	0.006
VOC	0.001	0.002	0.003

Annualized Startup/Shut down Emission rate for NO2 1-hr NAAQS

lb/hr
0.01

Startup Operation - Rectisol Flare

CO2 gas vent to Rectisol Flare until within product specification
Vent gas flow = 4,542 lbmol/hr = 430 x 10^6 Btu/hr, HHV
Sulfur in vent gas = 50 ppmv,max

Estimated Startup Rectisol Flare Emissions

	lb/hr
SO2	15
NOx	29.2
CO	34.4
$PM_{10}/PM_{2.5}$	1.3
VOC	0.6

(Emissions for NOX, CO, PM10, and VOC based on factors for natural gas pilots above)

Rectisol Flare

Rectisol startup vent gas to flare = 40 hr /yr
Pilot gas = 2628 x 10^6 Btu

Rectisol Flare Annual Emissions

	ton/yr		
	S/U and S/D	**Pilot**	**Total**
SO2	0.30	0.003	0.303
NOx	0.58	0.1	0.674
CO	0.69	0.1	0.793
$PM_{10}/PM_{2.5}$	0.03	0.004	0.030
VOC	0.01	0.002	0.013

Annualized Startup/Shut down Emission rate for NO2 1-hr NAAQS

lb/hr
0.13

Flare Stack Parameters

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Parameter	Rectisol Flare (during startup and shutdown)	Rectisol Flare (during normal pilot gas mode)	Rectisol Flare Annualized for NO2 1-hr NAAQS	Gasification Flare (during startup flare nitrogen)	Gasification Flare (during startup flare unshifted syngas gas)	Gasification Flare (during startup flare shifted syngas, sweet)	Gasification Flare (during normal pilot gas mode)	Gasification Flare annualized for NO2 1-hr NAAQS	SRU Flare (during Gasifier Startup and Shutdown)	SRU Flare (during normal pilot gas mode)	SRU Flare Annualized for NO2 1-hr NAAQS
Heat release rate for flare+pilot, (10^6 Btu/hr HHV)	430	0.3	2.263	2,926	2,386	2,413	0.5	4.526	36	0.3	0.464
H = Total Heat release rate (cal/s)	3.01E+07	2.10E+04	1.58E+05	2.05E+08	1.67E+08	1.69E+08	3.50E+04	3.17E+05	2.52E+06	2.10E+04	3.25E+04
Fb = Buoyancy flux	5.00E+02	3.49E-01	2.63E+00	3.40E+03	2.77E+03	2.80E+03	5.81E-01	5.26E+00	4.18E+01	3.49E-01	5.40E-01
Q_H = sensible heat release rate	1.35E+07	9.45E+03	7.13E+04	9.22E+07	7.52E+07	7.60E+07	1.57E+04	1.43E+05	1.13E+06	9.45E+03	1.46E+04
Actual Stack height (m)	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2
GEP stack height for modeling (m)	65	65	65	65	65	65	65	65	65	65	65
AERMOD Input parameters											
He = Effective stack height (m) as calculated in SCREEN3	82.13	65.53	66.39	107.84	103.85	104.06	65.68	66.94	70.23	65.53	65.65
T = Stack temperature (K)	1273	1273	1273	1273	1273	1273	1273	1273	1273	1273	1273
v = Exit velocity (m/s)	20	20	20	20	20	20	20	20	20	20	20
d = effective stack diameter (m)	3.636	0.096	0.264	9.486	8.565	8.614	0.124	0.373	1.052	0.096	0.119

Flare stack parameters are based on calculated using the SCREEN3 technique
Fb = Buoyancy flux = 1.66 x 10-5 x H
QH = sensible heat release rate = 0.45 x H
He = Effective stack height (m) = Hs + 4.56E-03 * H^0.478
BTU/hr to cal/sec 0.06999882

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Cooling Tower Operating Data and Emission Calculation				
Parameter	**Process**	**Power Block**	**ASU**	**Basis**
Cooling water (CW) circulation rate, gpm	162,582	95,500	44,876	Typical plant performance
CW circulation rate, million lb/hr	81	48	22	
CW dissolved solids, ppmw	9,000	9,000	2,000	(See note)
Drift, fraction of circulating CW	0.0005%	0.0005%	0.0005%	Expected BACT
PM10 emission rate, lb/hr	3.658	2.149	0.2	Calculated
PM10 emission rate, ton/yr	15.2	9.3	0.9	Calculated
PM2.5 emission rate, lb/hr	2.2	1.3	0.1	PM2.5 portion is equal to 60% of PM10
PM2.5 emission rate, ton/yr	9.1	5.6	0.6	PM2.5 portion is equal to 60% of PM10
Annual operation (hours/yr)	8314	8668	8314	
Cells per cooling tower	11	10	4	

Notes: Basis: Supplier data

Assumed maximum TDS in circulating cooling water, normally TDS will be less.

Each tower assumed to operate at full capacity, when operating.

Cooling water circulation rates and dissolved solids concentrations may vary, but in combination will not exceed the stated particulate emission rates.

Portion of PM10 that is PM2.5 60%

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Emergency Generator - Expected Emergency Operation and Maintenance

Total Hours of Operation	50	hr/yr
Generator Specification	2,922	Bhp

Generator Pollutant Emission Factors (per generator)

NOx (g/Bhp/hr)	0.50
CO (g/Bhp/hr)	2.60
VOC (g/Bhp/hr)	0.30
SO_2 (g/Bhp/hr)	N/A
PM_{10} = $PM_{2.5}$ (g/Bhp/hr)	0.07

Source: CARB Tier 4 Interim Standard

Generator Pollutant Emission Rates (per generator)

	Generator Emissions			
Pollutant	**lb/hr**	**lb/day**	**lb/yr**	**ton/yr**
NOx	3.22	3.22	161.04	0.08
CO	16.75	16.75	837.43	0.42
VOC	1.93	1.93	96.63	0.05
SO_2	0.03	0.03	1.40	0.00
PM_{10} = $PM_{2.5}$	0.45	0.45	22.55	0.01

Fuel sulfur content =	15	ppmw
SO_2 emissions =	0.20	lb SO_2/1000 gal
Fuel flow	140.00	gal/hr

Pounds per day assumes 1 hour of operation for maintenance and testing per engine.

Please note that there are two generators; all emissions are shown for individual generators.

Modeling Worst-Case 1 hr Emissions (per generator)

		Annualized lb/hr for NO2 1-hr NAAQS
NOx (g/sec)	0.4	0.0184
CO (g/sec)	2.1	
SO_2 (g/sec)	0.004	

Only NOx, CO, and SO_2 are considered for an average 1-hour Ambient Air Quality Standard.

Parameters

Days per year:	365
Hours per day:	24
Minutes per hour:	60
Seconds per minute:	60

Modeling Worst-Case 3 hr Emissions (per generator)

SO_2 (lb/3-hr)	0.03
SO_2 (g/sec)	0.001

Only SO_2 is considered for an average 3-hour Ambient Air Quality Standard.
Pounds per 3-hr assumes 1 hour of operation.

Modeling Worst-Case 8 hr Emissions (per generator)

CO (lb/8-hr)	16.75
CO (g/sec)	0.26

Only CO is considered for an average 8-hour Ambient Air Quality Standard.
Pounds per 8-hr assumes 1 hour of operation.

Modeling Worst-Case 24 Hour Emissions (per generator)

SO_2 (lb/24-hr)	0.03
SO_2 (g/sec)	0.0001
PM_{10} = $PM_{2.5}$ (lb/24-hr)	0.45
PM_{10} = $PM_{2.5}$ (g/sec)	0.002

Only SO_2 and PM are considered for an average 24-hour Ambient Air Quality Standard.
Pounds per 24-hr assumes 1 hour of operation.

Modeling Annual Average Emissions (per generator)

		Annual Emissions (tons/yr) per generator	both generators
NOx (g/sec)	0.002	0.081	0.161
CO (g/sec)	0.012	0.419	0.837
VOC (g/sec)	0.001	0.048	0.097
SO_2 (g/sec)	0.00002	0.001	0.001
PM_{10} = $PM_{2.5}$ (g/sec)	0.0003	0.011	0.023

4/19/2013

Fire Water Pump - Expected Emergency Operation and Maintenance

Total Hours of Operation	100	hr/yr
Fire Water Pump Specification	556	Bhp

Fire Water Pump Pollutant Emission Factors

NOx (g/Bhp/hr)	1.50
CO (g/Bhp/hr)	2.60
VOC (g/Bhp/hr)	0.14
SO_2 (g/Bhp/hr)	N/A
$PM_{10} = PM_{2.5}$ (g/Bhp/hr)	0.015

Source: CARB Tier 4 Interim Standard

Fire Water Pump Pollutant Emission Rates

	Fire Water Pump Emissions			
Pollutant	**lb/hr**	**lb/day**	**lb/yr**	**ton/yr**
NOx	1.84	3.68	183.86	0.1
CO	3.19	6.37	318.69	0.2
VOC	0.17	0.34	17.16	0.01
SO_2	0.01	0.01	0.56	0.0003
$PM_{10} = PM_{2.5}$	0.02	0.04	1.84	0.00

Fuel sulfur content =	15	ppmw
SO_2 emissions =	0.20	lb SO_2/1000 gal
Fuel flow	28.00	gal/hr

Pounds per day assumes two (2) hours of operation for maintenance and testing.

Modeling Worst-Case 1 hr Emissions

		Annualized lb/hr for NO2 1-hr NAAQS
NOx (g/sec)	0.2	0.02
CO (g/sec)	0.4	
SO_2 (g/sec)	0.0007	

Only NOx, CO, and SO_2 are considered for an average 1-hour Ambient Air Quality Standard

Parameters

Days per year:	365
Hours per day:	24
Minutes per hour:	60
Seconds per minute:	60

Modeling Worst-Case 3 hr Emissions

SO_2 (lb/3-hr)	0.01
SO_2 (g/sec)	0.0005

Only SO_2 is considered for an average 3-hour Ambient Air Quality Standard.
Pounds per 3-hr assumes two (2) hours of operation.

Modeling Worst-Case 8 hr Emissions

CO (lb/8-hr)	6.37
CO (g/sec)	0.1

Only CO is considered for an average 8-hour Ambient Air Quality Standard.
Pounds per 8-hr assumes two (2) hours of operation.

Modeling Worst-Case 24 Hour Emissions

SO_2 (lb/24-hr)	0.01
SO_2 (g/sec)	0.0001
$PM_{10} = PM_{2.5}$ (lb/24-hr)	0.04
$PM_{10} = PM_{2.5}$ (g/sec)	0.0002

Only SO_2 and PM are considered for an average 24-hour Ambient Air Quality Standard.
Pounds per 24-hr assumes two (2) hours of operation.

Modeling Annual Average Emissions

		tons/yr
NOx (g/sec)	0.003	0.092
CO (g/sec)	0.005	0.159
VOC (g/sec)	0.0002	0.009
SO_2 (g/sec)	0.00001	0.000
$PM_{10} = PM_{2.5}$ (g/sec)	0.00003	0.001

Ammonia Synthesis Plant Startup Heater

Maximum heat release	56	10^6 Btu/hr, HHV
Maximum annual usage:	7,840	10^6 Btu/yr, HHV
(equivalent to	140	hours @ full capacity)

Emission factors

	lb/10^6 Btu, HHV	Basis
SO2	0.00204	12.65 ppmv total sulfur in pipeline natural gas (max short-term)
NOx	0.011	Low NOx burner, 9 ppmvd (3% O2)
CO	0.037	50 ppmvd (3% O2)
$PM_{10}/PM_{2.5}$	0.005	Similar equipment from previous project
VOC	0.004	Similar equipment from previous project

	Max short-term lb/hr	Annual average ton/yr
SO2	0.1	0.0080
NOx	0.6	0.0427
CO	2.1	0.1450
$PM_{10}/PM_{2.5}$	0.3	0.0196
VOC	0.2	0.0157

Used only for Ammonia Plant Startup only.
Natural gas fuel

Annualized Startup Emission rate for NO2 1-hr NAAQS

lb/hr
0.010

Urea Absorber Emission Calculation

HECA

Plant Capacity =	1,720	stpd
Urea Absorber NH3 =	13.1	lb/hr
Annual operating hours	8052	hours/year

Emissions provided by Casale for the HECA project.

Urea Pastillation Emission Calculation

Reference Plant

Plant Max Capacity =	3,855	stpd
Total Air Flow =	21,000	m^3/hr
Ammonia Concentration =	50	mg/m^3
Urea Dust =	0.001	gr/dscf

HECA

Plant Capacity =	1,720	stpd
NH3 Emission =	1.03	lb/hr
Urea Dust Emission =	0.05	lb/hr
Annual operating hours	8052	hours/year
PM Annual Emissions =	0.20	tons/yr

Reference plant information provided by Sandvik Fellbach for the SCS PurGen One project.
All PM emissions are PM2.5 or smaller

Nitric Acid Plant Emission Calculation

HECA

Nitric Acid Production =	501	STPD
NOx Emissions Factor* =	0.20	lb/T
NOx Emissions =	4.18	lb/hr
NH3 Emissions =	1.0	lb/hr
Annual operating hours	8052	hours/year
NOx Annual Emissions =	16.8	tons/yr

*Emission factor based on use of the Udhe EnviNOx system. Approx 15 ppmv NOx in vent gas and 10 ppm ammonia slip
50% NO2/NOx in-stack ratio used in NAAQS modeling

Ammonium Nitrate Plant Emission Calculation

HECA

Ammonium Nitrate Production =	636	STPD
PM Emissions =	0.20	lb/hr
Annual operating hours	8052	hours/year
PM Annual Emissions =	0.81	tons/yr

Vendor provided emission rate
All PM emissions are PM2.5 or smaller

Material Handling Emissions								Stack Parameters for Modeling			
Emission Pt ID	**Operating Capacity**		**Flow**	**Grain Loading**	**Emissions [3]**			**Stack Diameter**	**Stack Height**	**Stack velocity**	**Stack velocity**
Coal/Coke Storage and Handling	hr/day	day/week	ACFM	gr/dscf	Total (lb/hr)	Total (tons/yr)		ft	ft	(ft/sec)	(m/s)
17 Feedstock Rail Unloading Vent	6	5	20,000	0.001	0.17	0.13		3	30	47.2	14.4
19 Feedstock Transfer Tower 2 [1]	12	7	1,500	0.001	0.01	0.03		0.83	100	46.2	14.1
18 Feedstock Crusher Vent	12	7	12,600	0.001	0.11	0.24		2.5	100	42.8	13.0
20 Feedstock Truck Unloading Vent	12	5	80,000	0.001	0.69	1.07		6	60	47.2	14.4
21 Feedstock Bunkers Vent	12	7	12,600	0.001	0.11	0.24		2.5	230	42.8	13.0
22 Feedstock Transfer Tower 1	12	5	1,500	0.001	0.01	0.02		0.83	100	46.2	14.1
Urea Storage and Handling											
30 Urea Bucket Elevator	24	7	1,500	0.001	0.01	0.06		0.83	50	46.2	14.1
31 Urea Transfer Tower 1	24	7	1,500	0.001	0.01	0.06		0.83	100	46.2	14.1
32 Urea Transfer Tower 2	24	1.75	1,500	0.001	0.01	0.01		0.83	100	46.2	14.1
33 Urea Transfer Tower 3	24	3.5	1,500	0.001	0.01	0.03		0.83	100	46.2	14.1
34 Urea Transfer Tower 4	24	1.75	1,500	0.001	0.01	0.01		0.83	100	46.2	14.1
35 Urea Transfer Tower 5	8	5	1,500	0.001	0.01	0.01		0.83	100	46.2	14.1
23 Urea Loading Vent	8	5	20,000	0.001	0.17	0.18		3	110	47.2	14.4
Gasification Solids Storage and Handling											
28 Gasification Solids Bucket Elevator	24	7	3,000	0.001	0.03	0.11		1.17	30	46.5	14.2
25 Gasification Solids Pad - stacking[2]	24	7	39.3 tph	NA	0.006	0.03		NA	NA	NA	NA
25 Gasification Solids Pad - reclaim[2]	24	7	39.3 tph	NA	0.011	0.05		NA	NA	NA	NA
37 Gasification Solids Transfer Tower	8	3	3,000	0.001	0.03	0.02		1.17	75	46.5	14.2
29 Gasification Solids Loading Vent	8	3	10,000	0.001	0.09	0.05		2	110	53.1	16.2
Fluxant Silo											
Fluxant Unloading Vent	24	1.75	1,500	0.001	0.01	0.01		0.83	90	45.9	14.0
				Total =	**1.51**	**2.35**					

Notes:

(1) Two identical dust collectors are provied for Item 19; only one will operate at a given time.

(2) Fugitive particulate emissions from gasification solids handling on the drying pad are calculated using the following formula:

Emission Unit	**Moisture Content (%)**	**Emission Factor (lb/ton)**	**Emission Rate (lb/hr)**	**Emission Rate (tons/yr)**	**Emission Factor (lb/ton)**	**Emission Rate (lb/hr)**	**Emission Rate (tons/yr)**
		PM_{10}	**PM_{10}**	**PM_{10}**	**$PM_{2.5}$**	**$PM_{2.5}$**	**$PM_{2.5}$**
Gassification Solids - stacking	12	1.57E-04	0.006	0.027	2.38E-05	0.001	0.004
Gassification Solids - reclaim	8	2.78E-04	0.011	0.048	4.20E-05	0.002	0.007

Notes:
Material Handling Emission Factor AP-42 Section 13.2.4.3, Equation (1)

$E = k(0.0032)(U/5)^{1.3}/(M/2)^{1.4}$

where:	PM_{10}	$PM_{2.5}$
E = emissions in lb/tons		
k = particle size multiplier	0.35	0.053
U = mean wind speed (mph)	7.61	
M = material moisture content (%)	see above	
material handled	39.3 ton/hr	

(3) PM emissions are PM2.5 or smaller for all sources, except for the Gasification Solids Pad see Note (2)

Source	HRSG Stack[(2)] ON-Peak	HRSG Stack[(2)] OFF-Peak	Gasification Feedstock Dryer Stack[(3)]	Urea Absorber	Urea Pastillation Bldg Stack	Nitric Acid Plant Stack	Gasification Flare	CO2 Vent	Aux Boiler
Stack height, ft above grade [(1)]	213	213	305	170	50	120	250	355	80
Stack diameter, ft	24	24	16	0.83	1.5	8	(NA)	3.5	4.5
Stack outlet temp, deg F	200	200	200	104	ambient	267	(NA)	ambient	300
Stack exit flow, act ft3/sec	22,357	16,953	3,852	14	111	840	varies per scenario	1,765	480
Stack exit velocity (ft/sec)	49.42	37.47	19.16	25.14	62.81	16.71		183.45	30.18
Stack exit velocity (m/sec)	15.06	11.42	5.84	7.66	19.15	5.09		55.92	9.20

Source	SRU Flare	Rectisol Flare	Power Cooling Towers (per cell)[(4)]	Process Cooling Towers (per cell)[(4)]	ASU Cooling Tower (per cell)[(4)]	Tail Gas Oxidizer	Fire Pump Engine	Diesel Generator (ea.)	Ammonia Plant SU Heater	Ammonium Nitrate Vent
Stack height, ft above grade [(1)]	250	250	65	65	55	165	20	20	80	55
Stack diameter, ft	(NA)	(NA)	25	29	30	2.5	0.7	1.2	3.5	0.17
Stack outlet temp, deg F	(NA)	(NA)	75	75	75	1200	850	760	300	100
Stack exit flow, act ft3/sec	varies per scenario	varies per scenario	14,230	18,480	18,500	250	60	250	180	0.3
Stack exit velocity (ft/sec)			28.99	27.98	26.17	50.93	155.91	221.05	18.71	13.75
Stack exit velocity (m/sec)			8.84	8.53	7.98	15.52	47.52	67.38	5.70	4.19

Notes:
(1) Actual stack hieght for flares. Effective stack height for modeling was calculated based on GEP height of 65 meters. See Flare Stack Parameters tab in this workbook.
(2) Stack outlet temperature shown for HRSG is the estimated stack temperature after power cycle optimization. Case 1 On-Peak Power exit flow rate, Case 2 Off-Peak Power exit flow rate
(3) Flow rate shown in table for feedstock dryer is based on full load syn gas combustion for Case 4 (relatively constant for varying power plant loads and ambient temperatures).
(4) 10 cells estimated for power block cooling tower; 11 cells estimated for process cooling tower, and 4 cells estimated for the ASU cooling tower.
(5) Flare gas heat release, 10^6 Btu/hr, HHV; first value is normal pilot gas, second value is the maximum startup heat release

FUGITIVE EMISSIONS CALCULATIONS
Hydrogen Energy California, LLC
Hydrogen Energy California (HECA) Project

STREAM SPECIATION

	Weight %																								
	Gasification Block												Fertilizer Complex										Gasification Block	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18a	18b	19	20	21	22	23
Stream	Methanol	Syn Gas	Not Used	Shifted Syn Gas	Propylene	Sour Water	H_2S Laden Methanol	CO_2 Laden Methanol	Acid Gas	Ammonia Laden Gas	Sulfur	SRU Tail Gas	Low NH3 Concentration	Moderate NH3 Concentration	High NH3 Concentration	Low CO2 Concentration	Moderate CO2 Concentration	High CO2 Concentration	CO2 Product and Purification Compres	Urea CO2 Compressor	NO2	HNO3	PSA Off Gas	Lower Benzene Concentration	Higher Benzene Concentration
Fluid Phase	Liquid	Vapor		Vapor	Liquid & Vapor	Liquid	Liquid	Liquid	Vapor	Vapor	Liquid	Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Vapor	Vapor	Vapor
Compound																									
Carbon dioxide (CO_2)	0.00%	8.02%		59.90%	0.00%	1.98%	15.64%	27.34%	49.76%	60.57%	0.00%	65.26%	5.77%	37.53%	0.76%	18.90%	37.53%	97.76%	97.76%	100.00%	0.00%	0.00%	14.72%	47.80%	7.30%
Carbon monoxide (CO)	0.00%	43.27%		2.97%	0.00%	0.01%	0.01%	0.01%	2.05%	0.22%	0.00%	2.46%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	8.58%	0.00%	0.00%
Methane (CH_4)	0.00%	0.59%		0.60%	0.00%	0.00%	0.00%	0.01%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	3.10%	0.00%	0.00%
Hydrogen Sulfide (H_2S)	0.00%	0.58%		0.62%	0.00%	0.05%	0.92%	0.00%	28.46%	1.35%	0.02%	1.99%	0.00%	0.00%	0.00%	0.00%	0.00%	1.56%	0.00%	0.00%	0.00%	0.00%	0.00%	4.20%	0.80%
Ammonia (NH_3)	0.00%	0.14%		0.11%	0.00%	0.70%	0.00%	0.00%	0.00%	20.15%	0.00%	0.00%	15.59%	49.17%	97.98%	31.31%	49.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Sulfur dioxide (SO_2)	0.00%	0.00%		0.00%	0.00%	0.00%	0.00%	0.00%	3.12%	0.00%	0.00%	0.38%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Hydrogen Chloride (HCl)	0.00%	0.00%		0.00%	0.00%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Nitric acid (HNO_3)	0.00%	0.00%		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	56.22%	0.00%	0.02%	0.02%
Nitrogen dioxide (NO_2)	0.00%	0.00%		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	7.28%	0.00%	0.00%	0.02%	0.02%
Carbonyl Sulfide (COS)	0.00%	0.24%		0.00%	0.00%	0.08%	0.00%	0.00%	2.71%	2.09%	0.00%	0.29%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Methanol (CH_3OH)	99.74%	0.00%		0.00%	0.00%	0.00%	79.06%	72.36%	1.51%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.40%	0.03%	0.00%	0.00%	0.00%	0.03%	46.30%	86.80%
Propylene (C_3H_6)	0.00%	0.00%		0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Benzene (C_6H_6)	0.00%	0.00%		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.80%	5.10%
Hydrogen Cyanide (HCN)	0.00%	0.01%		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Other (Inerts)	0.26%	47.15%		35.81%	0.00%	97.14%	4.35%	0.27%	12.39%	15.58%	99.98%	29.62%	78.61%	13.30%	1.26%	49.74%	13.30%	0.26%	2.14%	0.00%	92.71%	43.78%	73.58%	0.90%	0.00%
Total	**100.0%**	**100.0%**		**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Percentage of VOC of the stream *	**99.74%**	**0.25%**		**0.01%**	**100.00%**	**0.08%**	**79.07%**	**72.36%**	**4.23%**	**2.13%**	**0.00%**	**0.29%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.41%**	**0.04%**	**0.00%**	**0.00%**	**0.00%**	**0.03%**	**47.10%**	**91.90%**

Note:
- Per District policy (SSP-2015), VOC emissions are not assessed to components handling fluid streams with a VOC content of 10% of less by weight.
- The following compounds are included as VOCs, although not all compounds are found in the gas in each process area: CH3OH, C3H6, COS, C6H6, and HCN.

EMISSION FACTORS

Equipment Type	Service	Emission Factor* (kg/hr/source)	Emission Factor (lb/hr/source)	Control Efficiency *
Valves	Gas	0.00597	0.0132	92%
Valves	Light liquid	0.00403	0.0089	88%
Valves	Heavy liqui	0.00023	0.0005	0%
Pump seals	Light liquid	0.0199	0.0439	100%
Pump seals	Heavy liqui	0.00862	0.0190	0%
Compressor seals	Gas	0.228	0.5027	100%
Pressure relief valves	Gas	0.104	0.2293	0%
Connectors	All	0.00183	0.0040	93%
Open-ended lines	All	0.0017	0.0037	0%
Sampling connectors	All	0.015	0.0331	0%

Notes:
- Emission factors and control efficiencies are from EPA's 1995 "Protocol for Equipment Leak Emission Estimates".
- Emission factors are from Table 2-1 (SOCMI Average Emission Factors).
- Control efficiencies are from Table 5-2 (Control Effectiveness for an LDAR Program at a SOCMI Process Unit).
- The plant will implement an LDAR program for the process streams identified as #1, 5, 7-10, and 12-23. Therefore, the control efficiencies for valves and connectors will apply to those streams.
- All light liquid pump seals and compressor seals will have dual mechanical seals and barrier fluid maintained at a higher pressure than the pump fluid or compressed gas, thus these control efficiency are from Table 5-1.
- Emission are conservative since many of these streams are not as volatile as the streams that the SOCMI factors were developed for.

STREAM COMPONENT COUNTS

Stream	Count																									Total All Streams
	Gasification Block												Fertilizer Complex											Gasification Block		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18a	18b	19	20	21	22	23	
	Methanol	Syn Gas	Not Used	Shifted Syn Gas	Propylene	Sour Water	H_2S Laden Methanol	CO_2 Laden Methanol	Acid Gas	Ammonia Laden Gas	Sulfur	SRU Tail Gas	Low NH3 Concentration	Moderate NH3 Concentration	High NH3 Concentration	Low CO2 Concentration	Moderate CO2 Concentration	High CO2 Concentration	CO2 Product and Purification Compressors	Urea CO2 Compressor	NO2	HNO3	PSA Off Gas	Lower Benzene Concentration	Higher Benzene Concentration	
Fluid Phase	Liquid	Vapor		Vapor	Liquid & Vapor	Liquid	Liquid	Liquid	Vapor	Vapor	Liquid	Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Vapor	Vapor	Vapor	
Component																										
Valves - Gas	0	69		342	36	0	0	0	122	98	0	66	197	6	147	20	6	506	0	0	5	0	164	18	0	**1799**
Valves - Light Liquid	257	0		0	546	0	290	285	0	0	0	0	105	2	206	107	0	0	0	0	0	66	0	134	87	**2082**
Valves - Heavy Liquid	0	0		0	0	366	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**383**
Pumps - Light Liquid	4	0		0	0	0	6	6	0	0	0	0	6	0	4	6	0	0	0	0	0	2	0	4	2	**40**
Pumps - Heavy Liquid	0	0		0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**8**
Compressors	0	0		0	2	0	0	0	0	0	0	5	0	0	0	0	0	0	10	2	0	0	5	0	0	**24**
Connectors	824	208		1024	1642	958	962	932	388	252	118	276	826	44	886	400	34	1446	0	0	34	188	540	474	276	**12732**
Total	**1085**	**277**		**1366**	**2226**	**1332**	**1258**	**1223**	**510**	**350**	**135**	**347**	**1134**	**52**	**1243**	**532**	**40**	**1952**	**10**	**2**	**39**	**256**	**709**	**630**	**365**	**17067**

Note:
- Values shown for number of sources were multiplied by the following factors to account for unknown emission sources: Valves: 1.5; Connectors: 2.
- Each compressor stage considered as a separate compressor.

CALCULATED CONTROLLED EMISSIONS BY COMPONENT (LB/HR)

Stream	Emissions (lb/hr)																									Total All Streams
	Gasification Block												Fertilizer Complex											Gasification Block		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18a	18b	19	20	21	22	23	
	Methanol	Syn Gas	Not Used	Shifted Syn Gas	Propylene	Sour Water	H_2S Laden Methanol	CO_2 Laden Methanol	Acid Gas	Ammonia Laden Gas	Sulfur	SRU Tail Gas	Low NH3 Concentration	Moderate NH3 Concentration	High NH3 Concentration	Low CO2 Concentration	Moderate CO2 Concentration	High CO2 Concentration	CO2 Product and Purification	Urea CO2 Compressor	NO2	HNO3	PSA Off Gas	Lower Benzene Concentration	Higher Benzene Concentration	
Fluid Phase	Liquid	Vapor		Vapor	Liquid & Vapor	Liquid	Liquid	Liquid	Vapor	Vapor	Liquid	Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Vapor	Vapor	Vapor	
Component																										
Valves - Gas	0.00E+00	9.08E-01		4.50E+00	3.79E-02	0.00E+00	0.00E+00	0.00E+00	1.28E-01	1.03E-01	0.00E+00	8.69E-01	2.07E-01	6.32E-03	1.55E-01	2.05E-02	6.32E-03	5.32E-01	0.00E+00	0.00E+00	4.74E-03	0.00E+00	1.72E-01	1.90E-02	0.00E+00	**7.67**
Valves - Light Liquid	2.73E-01	0.00E+00		0.00E+00	5.82E-01	0.00E+00	3.09E-01	3.04E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.12E-01	1.60E-03	2.19E-01	1.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.04E-02	0.00E+00	1.42E-01	9.28E-02	**2.22**
Valves - Heavy Liquid	0.00E+00	0.00E+00		0.00E+00	0.00E+00	1.86E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.37E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.19**
Pumps - Light Liquid	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00**
Pumps - Heavy Liquid	0.00E+00	0.00E+00		0.00E+00	0.00E+00	1.52E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.15**
Compressors	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00**
Connectors	2.33E-01	8.39E-01		4.13E+00	4.64E-01	3.87E+00	2.72E-01	2.63E-01	1.10E-01	7.12E-02	4.76E-01	1.11E+00	2.33E-01	1.24E-02	2.50E-01	1.13E-01	9.60E-03	4.08E-01	0.00E+00	0.00E+00	9.60E-03	5.31E-02	1.53E-01	1.34E-01	7.79E-02	**13.29**
Total	**0.51**	**1.75**		**8.63**	**1.08**	**4.20**	**0.58**	**0.57**	**0.24**	**0.17**	**0.48**	**1.98**	**0.55**	**0.02**	**0.62**	**0.25**	**0.02**	**0.94**	**0.00**	**0.00**	**0.01**	**0.12**	**0.32**	**0.30**	**0.17**	**23.53**

- The plant will implement an LDAR program for the process streams identified as #1, 5, 7-10, and 13-23. Therefore, the control efficiencies will apply to those streams.

CALCULATED CONTROLLED EMISSIONS BY COMPOUND (LB/HR)

Stream	Emissions (lb/hr)																									Total All Streams
	Gasification Block												Fertilizer Complex										Gasification Block			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18a	18b	19	20	21	22	23	
	Methanol	Syn Gas	Not Used	Shifted Syn Gas	Propylene	Sour Water	H_2S Laden Methanol	CO_2 Laden Methanol	Acid Gas	Ammonia Laden Gas	Sulfur	SRU Tail Gas	Low NH3 Concentration	Moderate NH3 Concentration	High NH3 Concentration	Low CO2 Concentration	Moderate CO2 Concentration	High CO2 Concentration	CO2 Product and Purification	Urea CO2 Compressor	NO2	HNO3	PSA Off Gas	Lower Benzene Concentration	Higher Benzene Concentration	
Fluid Phase	Liquid	Vapor		Vapor	Liquid & Vapor	Liquid	Liquid	Liquid	Vapor	Vapor	Liquid	Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Vapor	Vapor	Vapor	
Compound																										
CO_2	0.00E+00	1.40E-01		5.17E+00	0.00E+00	8.33E-02	9.08E-02	1.55E-01	1.18E-01	1.05E-01	0.00E+00	1.29E+00	3.19E-02	7.64E-03	4.73E-03	4.67E-02	5.98E-03	9.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.78E-02	1.41E-01	1.25E-02	**8.37**
CO	0.00E+00	7.56E-01		2.56E-01	0.00E+00	3.07E-04	3.25E-05	7.20E-05	4.86E-03	3.77E-04	0.00E+00	4.87E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.40E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.79E-02	0.00E+00	0.00E+00	**1.09**
CH_4	0.00E+00	1.03E-02		5.17E-02	0.00E+00	1.26E-05	2.61E-05	7.32E-05	4.75E-06	1.51E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.65E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-02	0.00E+00	0.00E+00	**0.07**
H_2S	5.42E-07	1.01E-02		5.33E-02	0.00E+00	2.09E-03	5.37E-03	5.67E-07	6.76E-02	2.34E-03	8.82E-05	3.94E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.46E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E-02	1.37E-03	**0.21**
NH_3	0.00E+00	2.48E-03		9.18E-03	0.00E+00	2.93E-02	0.00E+00	0.00E+00	0.00E+00	3.50E-02	0.00E+00	0.00E+00	8.61E-02	1.00E-02	6.11E-01	7.74E-02	7.83E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.87**
SO_2	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.40E-03	0.00E+00	0.00E+00	7.62E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.02**
HCl	0.00E+00	1.22E-05		0.00E+00	0.00E+00	1.98E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00**
HNO_3	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.44E-06	6.94E-02	0.00E+00	5.03E-05	2.91E-05	**0.07**
NO_2	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-03	0.00E+00	0.00E+00	5.03E-05	2.91E-05	**0.00**
COS	0.00E+00	4.27E-03		3.28E-04	0.00E+00	3.24E-03	2.38E-05	5.08E-08	6.45E-03	3.62E-03	0.00E+00	5.84E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.69E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.02**
CH_3OH	5.05E-01	0.00E+00		8.63E-05	0.00E+00	0.00E+00	4.59E-01	4.10E-01	3.59E-03	3.82E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.77E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.67E-05	1.37E-01	1.48E-01	**1.67**
C_3H_6	0.00E+00	0.00E+00		0.00E+00	1.08E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**1.08**
C_6H_6	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.36E-03	8.71E-03	**0.01**
HCN	1.42E-05	1.29E-04		1.73E-05	0.00E+00	1.18E-04	1.74E-05	1.02E-05	5.46E-06	7.02E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.30E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00**
Total VOC	**5.05E-01**	**4.40E-03**		**4.32E-04**	**1.08E+00**	**3.35E-03**	**4.59E-01**	**4.10E-01**	**1.00E-02**	**3.70E-03**	**0.00E+00**	**5.84E-03**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**3.86E-03**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**8.67E-05**	**1.39E-01**	**1.57E-01**	**2.79**

Notes:
- Per District policy (SSP-2015), VOC emissions are not assessed to components handling fluid streams with a VOC content of 10% of less by weight.
- The following compounds are included as VOCs, although not all compounds are found in the gas in each process area: CH3OH, C3H6, COS, C6H6, and HCN.

CALCULATED CONTROLLED EMISSIONS BY COMPOUND (TONS/YEAR)

Stream	Emissions (tons/year)																									Total All Streams
	Gasification Block												Fertilizer Complex										Gasification Block			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18a	18b	19	20	21	22	23	
	Methanol	Syn Gas	Not Used	Shifted Syn Gas	Propylene	Sour Water	H_2S Laden Methanol	CO_2 Laden Methanol	Acid Gas	Ammonia Laden Gas	Sulfur	SRU Tail Gas	Low NH3 Concentration	Moderate NH3 Concentration	High NH3 Concentration	Low CO2 Concentration	Moderate CO2 Concentration	High CO2 Concentration	CO2 Product and Purification	Urea CO2 Compressor	NO2	HNO3	PSA Off Gas	Lower Benzene Concentration	Higher Benzene Concentration	
Fluid Phase	Liquid	Vapor		Vapor	Liquid & Vapor	Liquid	Liquid	Liquid	Vapor	Vapor	Liquid	Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Vapor	Vapor	Vapor	
Compound																										
CO_2	0.00E+00	6.14E-01		2.26E+01	0.00E+00	3.65E-01	3.98E-01	6.79E-01	5.18E-01	4.61E-01	0.00E+00	5.67E+00	1.40E-01	3.34E-02	2.07E-02	2.05E-01	2.62E-02	4.03E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.09E-01	6.18E-01	5.46E-02	**36.68**
CO	0.00E+00	3.31E+00		1.12E+00	0.00E+00	1.34E-03	1.42E-04	3.15E-04	2.13E-02	1.65E-03	0.00E+00	2.13E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.80E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-01	0.00E+00	0.00E+00	**4.79**
CH_4	0.00E+00	4.51E-02		2.26E-01	0.00E+00	5.52E-05	1.14E-04	3.20E-04	2.08E-05	6.62E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.41E-02	0.00E+00	0.00E+00	**0.32**
H_2S	2.37E-06	4.41E-02		2.34E-01	0.00E+00	9.15E-03	2.35E-02	2.48E-06	2.96E-01	1.03E-02	3.86E-04	1.72E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.43E-02	5.98E-03	**0.91**
NH_3	0.00E+00	1.09E-02		4.02E-02	0.00E+00	1.28E-01	0.00E+00	0.00E+00	0.00E+00	1.53E-01	0.00E+00	0.00E+00	3.77E-01	4.38E-02	2.68E+00	3.39E-01	3.43E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**3.81**
SO_2	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.24E-02	0.00E+00	0.00E+00	3.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.07**
HCl	0.00E+00	5.36E-05		0.00E+00	0.00E+00	8.69E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.01**
HNO_3	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E-05	3.04E-01	0.00E+00	2.20E-04	1.27E-04	**0.30**
NO_2	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.57E-03	0.00E+00	0.00E+00	2.20E-04	1.27E-04	**0.00**
COS	0.00E+00	1.87E-02		1.44E-03	0.00E+00	1.42E-02	1.04E-04	2.22E-07	2.82E-02	1.59E-02	0.00E+00	2.56E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.24E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.10**
CH_3OH	2.21E+00	0.00E+00		3.78E-04	0.00E+00	0.00E+00	2.01E+00	1.80E+00	1.57E-02	1.68E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.80E-04	5.99E-01	6.49E-01	**7.30**
C_3H_6	0.00E+00	0.00E+00		0.00E+00	4.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**4.75**
C_6H_6	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-02	3.81E-02	**0.05**
HCN	6.24E-05	5.66E-04		7.56E-05	0.00E+00	5.15E-04	7.63E-05	4.47E-05	2.39E-05	3.08E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.20E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00**
Total VOC	**2.21E+00**	**1.93E-02**		**1.89E-03**	**4.75E+00**	**1.47E-02**	**2.01E+00**	**1.80E+00**	**4.40E-02**	**1.62E-02**	**0.00E+00**	**2.56E-02**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**1.69E-02**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**3.80E-04**	**6.09E-01**	**6.87E-01**	**12.20**

Note:
- The following compounds are included as VOCs, although not all compounds are found in the gas in each process area: CH3OH, C3H6, COS, C6H6, and HCN.

VOLUME SOURCES EMISSION RATES FOR MODELING

Compound	Emission Rate (lb/hr)											
	Gasification Unit						Fertilizer Complex					
	GASIFICATION (Stream #2)	SHIFT (Stream #4 and #6)	AGR (Stream #1, #5, #7, #8, and #9)	Sour Water Stripper (Stream #10)	SRU (Stream #11 and #12)	Benzene (Stream #22 and #23)	UAN Unit (Stream #19 and #20)	Urea Unit (Stream #14, #16, and #17)	Ammonia Unit (Stream #13 and #15)	CO2 Compression (Stream #18 and	Urea CO2 Compressor (Stream #18b)	PSA Unit (Stream #21)
CO_2	4.67E-02	2.63E+00	3.64E-01	1.05E-01	6.47E-01	1.54E-01	0.00E+00	3.02E-02	1.83E-02	9.20E-01	0.00E+00	4.78E-02
CO	2.52E-01	1.28E-01	4.96E-03	3.77E-04	2.44E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.40E-05	0.00E+00	2.79E-02
CH_4	3.43E-03	2.59E-02	1.04E-04	1.51E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.65E-05	0.00E+00	1.01E-02
H_2S	3.35E-03	2.77E-02	7.30E-02	2.34E-03	1.97E-02	1.38E-02	0.00E+00	0.00E+00	0.00E+00	1.46E-02	0.00E+00	0.00E+00
NH_3	8.28E-04	1.92E-02	0.00E+00	3.50E-02	0.00E+00	0.00E+00	0.00E+00	4.76E-02	3.49E-01	0.00E+00	0.00E+00	0.00E+00
SO_2	0.00E+00	0.00E+00	7.40E-03	0.00E+00	3.81E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HCl	4.08E-06	9.92E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HNO_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.94E-05	6.94E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.94E-05	1.04E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
COS	1.42E-03	1.78E-03	6.47E-03	3.62E-03	2.92E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.69E-05	0.00E+00	0.00E+00
CH_3OH	0.00E+00	4.32E-05	1.38E+00	3.82E-06	0.00E+00	2.85E-01	0.00E+00	0.00E+00	0.00E+00	3.77E-03	0.00E+00	8.67E-05
C_3H_6	0.00E+00	0.00E+00	1.08E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C_6H_6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HCN	4.31E-05	6.75E-05	4.73E-05	7.02E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.30E-07	0.00E+00	0.00E+00

Compound	Emission Rate (lb/yr)											
	Gasification Unit						Fertilizer Complex					
	GASIFICATION (Stream #2)	SHIFT (Stream #4 and #6)	AGR (Stream #1, #5, #7, #8, and #9)	Sour Water Stripper (Stream #10)	SRU (Stream #11 and #12)	Benzene (Stream #22 and #23)	UAN Unit (Stream #19 and #20)	Urea Unit (Stream #14, #16, and #17)	Ammonia Unit (Stream #13 and #15)	CO2 Compression (Stream #18 and #18a)	Urea CO2 Compressor (Stream #18b)	PSA Unit (Stream #21)
CO_2	4.09E+02	2.30E+04	3.19E+03	9.22E+02	5.67E+03	1.35E+03	0.00E+00	2.64E+02	1.60E+02	8.06E+03	0.00E+00	4.19E+02
CO	2.21E+03	1.12E+03	4.35E+01	3.30E+00	2.13E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.60E-01	0.00E+00	2.44E+02
CH_4	3.00E+01	2.27E+02	9.11E-01	1.32E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-01	0.00E+00	8.82E+01
H_2S	2.94E+01	2.43E+02	6.39E+02	2.05E+01	1.73E+02	1.21E+02	0.00E+00	0.00E+00	0.00E+00	1.28E+02	0.00E+00	0.00E+00
NH_3	7.26E+00	1.68E+02	0.00E+00	3.07E+02	0.00E+00	0.00E+00	0.00E+00	4.17E+02	3.06E+03	0.00E+00	0.00E+00	0.00E+00
SO_2	0.00E+00	0.00E+00	6.48E+01	0.00E+00	3.34E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HCl	3.57E-02	8.69E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HNO_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.95E-01	6.08E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.95E-01	9.14E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
COS	1.25E+01	1.56E+01	5.67E+01	3.17E+01	2.56E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.49E-01	0.00E+00	0.00E+00
CH_3OH	0.00E+00	3.78E-01	1.21E+04	3.35E-02	0.00E+00	2.50E+03	0.00E+00	0.00E+00	0.00E+00	3.30E+01	0.00E+00	7.59E-01
C_3H_6	0.00E+00	0.00E+00	9.49E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C_6H_6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.69E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HCN	3.78E-01	5.91E-01	4.15E-01	6.15E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.40E-03	0.00E+00	0.00E+00

Volume Source Parameters

Number of Volume Sources	3	2	1	1	2	1	1	2	2	1	1	1
Horizontal dimension (m)	28.00	35.00	48.00	16.00	16.00	24.00	24.00	12.00	24.00	20.00	24.00	24.00
Release height (m)	39.62	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10
Horizontal dimension (m)	13.02	16.28	22.33	7.44	7.44	11.16	11.16	5.58	11.16	9.30	11.16	11.16
Vertical dimension (m)	36.86	5.67	5.67	5.67	5.67	5.67	5.67	5.67	5.67	5.67	5.67	5.67
Vertical dimension used for calcs (ft)	260.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00

Note:
- Emissions are divided by the number of volume sources.

Methanol and Diesel Tanks

4/19/2013

Hydrogen Energy California, LLC
Hydrogen Energy California (HECA) Project

Methanol storage tank parameters and fugitive emissions

Tank ID	Description	Uncontrolled VOC Emissions	Peak Month VOC Emissions	Daily VOC Emissions	Annual VOC emissions
		lb/month	lb/month	lb/day	lb/year
Methanol	Working Loss (33,000 gal pumped in)	82.24	0.0185	-	-
	Breathing Loss	1353.84	0.3049	0.0102	
	Total Breathing and Working Loss		-	0.0287	3.93

Methanol Vent Scrubber Efficiency		
Pre-scrubber	17.76%	methanol
Post-scrubber	40	ppm methanol
Control Efficiency	99.977%	

Methanol concentration information provided by Fluor
Uncontrolled emissions calculated using TANKS model
Peak daily emissions include losses during filling the entire tank plus breathing losses

Tank ID	Description	Capacity	Turnovers per year	Annual VOC emissions
		gal	#	lb/year
Diesel 1	800 gal Diesel generator #1	800	0.75	0.56
Diesel 2	800 gal Diesel generator #2	800	0.75	0.56
Diesel FWP	400 gal Diesel fire pump	400	0.3	0.34

VOC emissions calculated using TANKS model

			Tank							
Tank ID	Description	Type	Shell Length / Height	Shell Diameter	Max liquid height	Average liquid height	Working volume	Turnovers per year	Net throughput	Is tank heated
			ft	ft	ft	ft	gal	#	gal/yr	
Diesel 1	800 gal Diesel generator #1	Horizontal Fixed Roof	5.5	5	N/A	N/A	800	0.75	600	N
Diesel 2	800 gal Diesel generator #1	Horizontal Fixed Roof	5.5	5	N/A	N/A	800	0.75	600	N
Diesel FWP	400 gal Diesel fire pump	Horizontal Fixed Roof	5.3	4	N/A	N/A	400	0.3	120	N
Methanol	600,000 gallon tank	Vertical Fixed Roof	48	46.25	46	4	540,000	0.66	396000	N

		Roof			Shell	
Tank ID	Description	Roof height ft	Color	Condition	Color	Condition
Diesel 1	800 gal Diesel generator #1	N/A	Grey - med	Good	Grey - med	Good
Diesel 2	800 gal Diesel generator #1	N/A	Grey - med	Good	Grey - med	Good
Diesel FWP	400 gal Diesel fire pump	N/A	Grey - med	Good	Grey - med	Good
Methanol	600,000 gallon tank	5	Grey - med	Good	Grey - med	Good

ASSUMPTIONS

Estimates of tank length and diameter based on capacity and example tanks from this website: http://www.tank-depot.com/product.aspx?id=258&c=400
Assumed color of roof and shell is grey medium
Methanol tank dimensions from Figure 2-47 of the AFC, "Preliminary Emissions Sources Plot Plan."
Methanol - assumed minimum liquid height is 10% of max, took average of max and this assumed minimum

Tank ID	Description	Capacity	Usage	Duration	Net throughput[1]	Turnovers per year
		gal	gal/hr	hrs/year	gal/yr	#
Diesel 1	800 gal Diesel generator #1	800	100	6	600	0.75
Diesel 2	800 gal Diesel generator #1	800	100	6	600	0.75
Diesel FWP	400 gal Diesel fire pump	400	20	6	120	0.3
Methanol	600,000 gallon tank	600000	45	8760	396000	0.66

Notes

1 throughput based on 33,000 gal/month for 12 months

Summary of Transportation Vehicles and Routes - Alternative 1

4/19/2013

Commodity Handled	Flux Additive	Petcoke	Coal	Liquid Sulfur	Gasification	Urea	UAN	Equipment	Miscellaneous
Expected plant operation									
The plant will operate 24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day
The plant will operate 333 days / year	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr
Shipment by trucks	100 %	100 %	0 %	75 %	25 %	25 %	50 %	100 %	100 %
Shipment by train	0 %	0 %	100 %	25 %	75 %	75 %	50 %	0 %	0 %
Production rate									
Estimated Normal Flow / day	175 tons / day	1,140 tons / day	4,580 tons / day	100 tons / day	950 tons / day	1,720 tons / day	1,400 tons / day		
Annualized transfer rate	59,000 tons / yr	380,000 tons / yr	1,526,000 tons / yr	34,000 tons / yr	317,000 tons / yr	573,000 tons / yr	467,000 tons / yr		
Estimated Maximum Flow day	240 tons / day	2,000 tons / day (3)	6,500 tons / day (4)	200 tons / day (5)	1,900 tons / day (6)	3,440 tons / day (6)	2,800 tons / day (6)		
Truck Shipments									
Truck Capacity	25 tons / truck	25 tons / truck		25 tons / truck	25 tons / truck	25 tons / truck	25 tons / truck	25 tons / truck	25 tons / truck
Estimated trucks loads for normal operation / day	7 trucks / day	46 trucks / day		3 trucks / day	10 trucks / day	18 trucks / day	28 trucks / day	3 trucks / day	11 trucks / day
Estimated trucks loads for normal operation / yr	2,360 truck / yr	15,200 truck / yr		1,020 truck / yr	3,170 truck / yr	5,730 truck / yr	9,340 truck / yr	1,000 truck/yr	1,330 truck/yr
Estimated trucks loads for maximum transfer/day	10 trucks / day	80 trucks / day		6 trucks / day	19 trucks / day	35 trucks / day	56 trucks / day	5 trucks / day	7 trucks / day
Train Shipments									
Railcar Capacity			117 tons / car	100 tons / car	100 tons / car	100 tons / car	100 tons/day		
Railcars per Train			111 cars/train	60 cars/train	60 cars/train	60 cars/train	60 cars/train		
Estimated railcars for normal operation / day			40 cars / day	0.25 cars / day	8 cars / day	13 cars / day	7 cars / day		
Estimated railcar loads for normal operation / yr			13,100 cars / yr	85 cars / yr	3,170 cars / yr	4,298 cars / yr	2,335 cars / yr		
Estimated railcars for maximum transfer / day			200 cars / day	1 cars / day	19 cars / day	26 cars / day	14 cars / day		
Basis	- 91% availability Flux is assumed to be 3% of combined feed - 7 days/week receiving normal transfer - Max Transfer Daily Rate: 5 days/week receiving fluxant required for normal feed for 7-day supply -25 tons/truck	- 91% availability - 25% petcoke (heat - 25 ton/truck - 7 days/week receiving normal transfer - 25% excess truck -Max Transfer Daily Rate: 5 days/week receiving petcoke required for max feed for 7 day supply -unloading station is sized with 25% excess capacity -unloading rate in tons/hr	- 91% availability - 75% coal (heat input) per year - 117 tons/car -Max Transfer Daily Rate: 5 days/week receiving coal required for normal feed for 7-day supply - Unloading station to be able to empty 2 trains/day with 100 railcars in each train - unloading rate in tons / hr 4,000	- 91% availability - High sulfur case - 100 tons/day - 25 ton/truck - Station can move up to 25% of production by rail	- 91% availability - 75% coal max annual average - 100% capable by rail - 25% capable by truck - Train loading station is to be able to load 100 % of production	- 91% availability - 75% by rail	- 91% availability - 50% by rail		
Traffic route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route
Destination/Origin Address Distance Route	Riverside, CA 180 miles I-5, Stockdale Hwy, Morris Road, Station Road	Carson Refinery 1801 E Sepulveda, Carson 140 Miles Alameda 405 Fwy 5 Fwy Stockdale hwy Morris Road Station Road Station Road	None	California Sulfur 2509 E Grant Street, Wilmington 142 Miles Grant Henry Ford Alameda 405 Fwy 5 Fwy Stockdale hwy Morris Road Station Road	Various 80 Mile radius 40 mile radius Station Road Morris Road Stockdale Hywy 5 Fwy	Various 40 mile radius Station Road Morris Road Stockdale Hywy 5 Fwy	Various 40 mile radius Station Road Morris Road Stockdale Hywy 5 Fwy	Various 40 mile radius 5 fwy Stockdale Hwy Dairy Road	Various 40 mile radius 5 fwy Stockdale Hwy Dairy Road
	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route
Destination/Origin Address Distance Route	None	None	Elk Ranch New Mexico 794 miles Kern County: 132.2 miles (County Line near Boron, CA to north property line of plant) Mine to Boron, CA: 662 miles Total Distance: 794.2 miles	In SJVAPCD	CEMEX, Victorville 198 miles SJVR/BNSF	Oregon/Washington 628 Miles SJVR/UPRR	Calamco Port Rd G15, Stockton, CA 264 miles	None	None

Notes

1) Equipment Maintenance Trucks are considered to be 2% of the total trucks per day for the feed and product operation.
2) Miscellaneous trucks are considered to be 3% of the total trucks per day for the feed and product operation
3) The maximum daily transfer rate of petcoke is based on supplying 7-days of maximum petcoke required feed (factored from the normal flow rate at 25% to a max flow at 30% of feed on a heat input basis) in 5 days, and rounded upward to 2 significant figures.
4) The maximum daily transfer rate of coal is based on supplying 7-days of normal coal required feed (75% of feedstock on a heat input basis) in 5 days and rounded upward to 2 significant figures.
5) The maximum flow rate of sulfur is 2 times the normal production
6) The number of railcars for transfer of coal is based on emptying two unit trains a day.
7) The net capacity of liquid sulfur transport by railcar is 100 short tons per car.
8) The flux addition is assumed to be up to 3% of the feedstock on a mass basis.
9) Maximum daily transfer rate is based on supplying 7-days of normal Flux required feed in 5 days.
10) On the maximum train day, there may be one coal train and one product train, or two coal trains onsite. Maximum of 2 trains per day.
11) The maximum number of trucks that would service the site in a given day would be 164. This is less than the total of the maximum transfer/day as not all material would be delivered or removed from the site at maximum capacity on the same day.

Maximum Daily Distribution of Vehicle for Feedstock and Product Delivery

ALTERNATIVE 1 (Rail)

Truck Source	Maximum Trucks/Day
Flux Additive	7
Petcoke	46
Coal	
Liquid Sulfur	3
Gasification Solids	10
Ammonia	
Urea	18
UAN-32	28
Equipment Maintenance	3
Miscellaneous Activities	4
additional trucks to account for max day	45
Total Truck Trips	164

Truck Distribution Modeled (Trucks/Day)

petcoke trucks =	68
fluxant & product trucks =	89
misc trucks =	7
Total	**164**

This table represents the maximum number of trucks that would visit the site on a given day. Although more material could be transferred on a given day (as presented in the previous table), all material will not be tranferred at the maximum rate on the same day.
The 45 additional trucks could be a combination of petcoke, fluxant or product trucks.
Thus for modeling puposes the additional trucks were distributed evenly to the 2 unloading areas, the petcoke unloading area and the fluxant and product unloading area.

Only Alternative 1 was modeled as the emissions were higher for this alternative.

ALTERNATIVE 2 (Truck)

Truck Source	Maximum Trucks/Day
Flux Additive	7
Petcoke	46
Coal	184
Liquid Sulfur	4
Gasification Solids	38
Ammonia	0
Urea	69
UAN-32	56
Equipment Maintenance	3
Miscellaneous Activities	4
additional trucks to account for max day	125
Total Truck Trips	536

This table represents the maximum number of trucks that would visit the site on a given day. Although more material could be transferred on a given day (as presented in the previous table), all material will not be tranferred at the maximum rate on the same day.
The 125 additional trucks could be a combination of petcoke, fluxant or product trucks.

Calculations for Trucks Operation Modeling

Data Supplied By Client					
Parameter	Petcoke Trucks		Fluxant & Product Trucks		Miscellaneous Trucks
	Running Emissions	Idling Emissions	Running Emissions	Idling Emissions	Running Emissions
Distance Traveled (mi)*	0.96		2.49		2.20
Per Truck Idle Time (hr)		0.083		0.083	
Maximum number of trucks or loads:					
1-hr	7	7	9	9	7
3-hr	20	20	27	27	7
8-hr	54	54	71	71	7
24-hr	68	68	89	89	7
Annual average trucks or loads	15,200	15,200	21,620	21,620	2,330

EMFAC2007 Emission Factors + Fugitive Dust (g/mi or g/idle-hour) For Truck Model year 2010

	Petcoke Trucks		Fluxant & Product Trucks		Miscellaneous Trucks
Pollutant	Running Emissions (g/mile/trk)	Idling Emissions (g/idle-hour/trk)	Running Emissions (g/mile/trk)	Idling Emissions (g/idle-hour/trk)	Running Emissions (g/mile/trk)
CO	3.03	43.69	3.03	43.69	3.03
NOx	5.43	122.65	5.43	122.65	5.43
ROG	1.39	7.74	1.39	7.74	1.39
SOx	0.03	0.06	0.03	0.06	0.03
PM10 *	0.92	0.11	0.92	0.11	0.92
PM2.5 *	0.29	0.10	0.29	0.10	0.29

EMFAC2007 is the approved federal model for vehicle combustion emissions

* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007

PM factors from EMFAC = combustion exhaust + tire wear + break wear

EMFAC emissions are for fleet year 2010 travelling at 10 mph.

1-hr Emission Rates for AERMOD (g/s) all trucks

	Petcoke Trucks		Fluxant & Product Trucks		Miscellaneous Trucks
Pollutant	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions
CO	5.470E-03	6.877E-03	1.861E-02	9.001E-03	1.295E-02
NOx	9.803E-03	1.931E-02	3.335E-02	2.527E-02	2.321E-02
ROG	2.507E-03	1.219E-03	8.529E-03	1.595E-03	5.937E-03
SOx	5.419E-05	9.759E-06	1.843E-04	1.277E-05	1.283E-04
PM10	1.656E-03	1.794E-05	5.634E-03	2.349E-05	3.922E-03
PM2.5	5.283E-04	1.637E-05	1.797E-03	2.143E-05	1.251E-03

3-hr Emission Rates for AERMOD (g/s) all trucks

	Petcoke Trucks		Fluxant & Product Trucks		Miscellaneous Trucks
Pollutant	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions
CO	5.470E-03	6.877E-03	1.861E-02	9.001E-03	1.295E-02
NOx	9.803E-03	1.931E-02	3.335E-02	2.527E-02	2.321E-02
ROG	2.507E-03	1.219E-03	8.529E-03	1.595E-03	5.937E-03
SOx	5.419E-05	9.759E-06	1.843E-04	1.277E-05	1.283E-04
PM10	1.656E-03	1.794E-05	5.634E-03	2.349E-05	3.922E-03
PM2.5	5.283E-04	1.637E-05	1.797E-03	2.143E-05	1.251E-03

8-hour Emission Rates for AERMOD (g/s) all trucks

	Coke and Coal Trucks (@ 10 mph)		Fluxant & Product Trucks		Miscellaneous Trucks @ 10 mph
Pollutant	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions
CO	5.470E-03	6.877E-03	1.861E-02	9.001E-03	1.295E-02
NOx	9.803E-03	1.931E-02	3.335E-02	2.527E-02	2.321E-02
ROG	2.507E-03	1.219E-03	8.529E-03	1.595E-03	5.937E-03
SOx	5.419E-05	9.759E-06	1.843E-04	1.277E-05	1.283E-04
PM10	1.656E-03	1.794E-05	5.634E-03	2.349E-05	3.922E-03
PM2.5	5.283E-04	1.637E-05	1.797E-03	2.143E-05	1.251E-03

24-hour Emission Rates for AERMOD (g/s) all trucks

Pollutant	Petcoke Trucks		Fluxant & Product Trucks		Miscellaneous Trucks
	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions
CO	2.279E-03	2.865E-03	7.753E-03	3.750E-03	1.295E-02
NOx	4.085E-03	8.044E-03	1.389E-02	1.053E-02	2.321E-02
ROG	1.045E-03	5.079E-04	3.554E-03	0.000E+00	5.937E-03
SOx	2.258E-05	4.066E-06	7.681E-05	5.322E-06	1.283E-04
PM10	6.901E-04	7.477E-06	2.348E-03	9.786E-06	3.922E-03
PM2.5	2.201E-04	6.821E-06	7.488E-04	8.927E-06	1.251E-03

Annual Emission Rates for AERMOD (g/s) all trucks

Pollutant	Petcoke Trucks		Fluxant & Product Trucks		Miscellaneous Trucks
	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions
CO	1.396E-03	1.755E-03	5.160E-03	2.496E-03	4.921E-04
NOx	2.501E-03	4.926E-03	9.247E-03	7.007E-03	8.820E-04
ROG	6.398E-04	3.110E-04	2.365E-03	4.424E-04	2.256E-04
SOx	1.383E-05	2.490E-06	5.112E-05	3.542E-06	4.876E-06
PM10	4.2264E-04	4.5789E-06	1.5624E-03	6.5129E-06	1.4902E-04
PM2.5	1.3481E-04	4.1772E-06	4.9838E-04	5.9416E-06	4.7534E-05

Volume, Line Sources

Guidance for Air Dispersion Modeling, SJVAPCD, 2007 and Section 1.2.2 of Volume II of ISC User's Guide

2.3.2 Oyo=12W/2.15			
Truck Traveling vol src		Truck Idling pt src	
6	ft Release height	12.6	ft Release height
12	ft Width	0.1	m diam
66.97674419	ft init horz dim Syo	51.71	m/s vel
5.58	ft init vert dim Szo	366	K Temp
		199.134	F Temp

Volume, Stand Alone

Guidance for Air Dispersion Modeling, SJVAPCD, 2007

2.3.2 + modelers judgement + ISC guidance	
Truck Traveling vol src	
6	ft Release height
12	ft Width
2.790697674	ft init horz dim Syo
5.58	ft init vert dim Szo

Fugitive Dust on Paved Road

4/19/2013

AP 42 13.2.1 Paved Roads, updated January 2011

For a daily basis,
E = [k (sL)^0.91 x (W)^1.02](1-P/4N)   (2)

P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period
W = average weight (tons) of vehicles traveling the road
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading (g/m^2)

Table 13.2.1-1
PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

	k
	g/VMT
PM2.5	0.25
PM10	1.00

Large Trucks

				Empty truck	full truck	Load Capacity	
W=	17.5	tons, average		5	30	25	tons
sL=	0.031	g/m2	Default value from URBEMIS 9.2 for Kern County				
P=	36	days/year Buttonwillow Station 1940-2011, WRCC					

E=
0.19149 g/VMT PM2.5 large delivery trucks
0.76594 g/VMT PM10 large delivery trucks

Operation and Maintenance Vehicles

W=	3	tons	
sL=	0.031	g/m2	Default value from URBEMIS 9.2 for Kern County
P=	36	days/year Buttonwillow Station 1940-2011, WRCC	

E=
0.03169 g/VMT PM2.5 large delivery trucks
0.12675 g/VMT PM10 large delivery trucks
#vol sources= 10

Fugitive Dust on Paved Road

4/19/2013

Fertilizer Product + Sulfur Product trucks + Gas Solids trucks + Fluxant Additive trucks

89 max trucks/day for sulfur, gasification solids, urea, UAN, fluxant additive   24 hrs/day

4000 meters, approximate length of road for product trucks: eastern fenceline to southern fenceline to middle loop and back out the opposite way
2.49 miles

0.47593 grams PM2.5/truck/day	42.358 g PM2.5/day for all product trucks	1.7649 g PM2.5/hr
1.90373 grams PM10/truck/day	169.432 g PM10/day for all product trucks	7.0597 g PM10/hr

volume source in model

73	2.4177E-02 g PM2.5/hr/volume source
	9.6708E-02 g PM10/hr/volume source

Coke feedstock trucks (no coal by truck)

68 max feedstock trucks/day

1539 meters, approximate length of road loop to truck feedstock unloading facility on east side
0.96 miles

0.18312 grams PM2.5/truck/day	12.452 g PM2.5/day for all product trucks	0.5188 g PM2.5/hr
0.73246 grams PM10/truck/day	49.807 g PM10/day for all product trucks	2.0753 g PM10/hr

volume source in model

34	1.5260E-02 g PM2.5/hr/volume source
	6.1038E-02 g PM10/hr/volume source

Miscellaneous Delivery Trucks/Equipment Maintenance

7 max trucks/day

3540 meters, approximate length of road from end of product truck south road, along southern fenceline, north toward main site, to parking lot and back
2.20 miles

0.421 grams PM2.5/truck/day	2.948 g PM2.5/day for all product trucks	0.1229 g PM2.5/hr
1.685 grams PM10/truck/day	11.794 g PM10/day for all product trucks	0.4914 g PM10/hr

volume source in model

5	2.4570E-02 g PM2.5/hr/volume source
	9.8280E-02 g PM10/hr/volume source

Summary of On-Site Operations Truck Emissions — Emissions Summary

4/19/2013

Transportation Information

- Onsite Vehicle = 20 trucks
- Vehicle year= 2010
- Maximum annual mileage = 10,000 miles/truck-year

Notes

- Information Provided By Applicant
- Information Provided By Applicant
- All routine vehicular traffic is anticipated to travel exclusively on paved roads
- Assumed 15 mph average speed within HECA facility

Calculations for Trucks Operation Modeling per Truck

	Onsite O&M Trucks
Mileage	
1-hr	1
3-hr	3
8-hr	9
24-hr	27
Annual average trucks or loads	10000

EMFAC2007 Emission Factors (g/mi) For Truck Model year 2010

	AERMOD	
Pollutant	Gas LHDT1	Diesel LHDT2
CO	0.229	0.920
NOx	0.064	0.672
ROG	0.014	0.085
SOx	0.011	0.005
PM10 *	0.167	0.176
PM2.5 *	0.054	0.062

EMFAC2007 is the approved federal model for vehicle combustion emissions
* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007
PM factors from EMFAC = combustion exhaust + tire wear + break wear
EMFAC emissions are for fleet year 2010 travelling at 15 mph.

1-hr Emission Rates for AERMOD (g/s) all trucks

	AERMOD	
Pollutant	Gas LHDT1	Diesel LHDT2
CO	1.45E-03	5.83E-03
NOx	4.06E-04	4.26E-03
ROG	8.88E-05	5.39E-04
SOx	6.98E-05	3.17E-05
PM10	1.06E-03	1.11E-03
PM2.5	3.40E-04	3.91E-04

3-hr Emission Rates for AERMOD (g/s) all trucks

	AERMOD	
Pollutant	Gas LHDT1	Diesel LHDT2
CO	1.45E-03	5.83E-03
NOx	4.06E-04	4.26E-03
ROG	8.88E-05	5.39E-04
SOx	6.98E-05	3.17E-05
PM10	1.06E-03	1.11E-03
PM2.5	3.40E-04	3.91E-04

8-hour Emission Rates for AERMOD (g/s) all trucks

	AERMOD	
Pollutant	Gas LHDT1	Diesel LHDT2
CO	1.45E-03	5.83E-03
NOx	4.06E-04	4.26E-03
ROG	8.88E-05	5.39E-04
SOx	6.98E-05	3.17E-05
PM10	1.06E-03	1.11E-03
PM2.5	3.40E-04	3.91E-04

24-hour Emission Rates for AERMOD (g/s) all trucks

	AERMOD	
Pollutant	Gas LHDT1	Diesel LHDT2
CO	1.45E-03	5.83E-03
NOx	4.06E-04	4.26E-03
ROG	8.88E-05	5.39E-04
SOx	6.98E-05	3.17E-05
PM10	1.06E-03	1.11E-03
PM2.5	3.40E-04	3.91E-04

Annual Emission Rates for AERMOD (g/s) all trucks

	AERMOD	
Pollutant	Gas LHDT1	Diesel LHDT2
CO	1.45E-03	5.83E-03
NOx	4.06E-04	4.26E-03
ROG	8.88E-05	5.39E-04
SOx	6.98E-05	3.17E-05
PM10	1.06E-03	1.11E-03
PM2.5	3.40E-04	3.91E-04

4/19/2013

Assumed Number of Unit Trains (incoming/outgoing)

Averaging Period	Coal Unit Trains (incoming)	Unit Trains of Product (outgoing)	Maximum Total Trains per period
1-hr	1	1	1
3-hr	1	1	2
8-hr	2	1	2
24-hr	2	1	2
Annual average unit trains	119	165	284

# Cars Per train	111	60	

On maximum train day, may have one coal train and one product train, or two coal trains onsite. Max of 2 trains per day.

	Switching Engine/ Rail car movers	Line-Haul Engine for Coal Train	Line-Haul Engine for Product Trains
Engine Power Rating (hp)		4400	3000
Notch Operation		1	1
Notch percentage of hp		5.0%	5.0%
Avg Notch horsepower	260	220	150
# of engines per train	1	2	2
hours to unload/load each train		2	1
max operating hours (hrs/day)	8		
max operating hours (hrs/year)	1248		

The majority of the time the line-haul engine will operate in Notch 1 or idling, therefore emissions were conservatively estimated for Notch 1 horsepower.

Notch percentage presented in PORT OF LONG BEACH AIR EMISSIONS INVENTORY for 2007 (POLB, Jan 2009) derived from EPA data.

For each coal train it takes 2 hours to complete the onsite loop to unload

For each product train it takes 1 hour to load

Switching Engine Emission Factors	**CO**	**NOx**	**PM10**	**PM2.5**	**SO2**	**VOC**
Tier 3 Emission Factor (g/bhp-hr)	1.83	4.50	0.08	0.08	0.12	0.27
Emissions (lbs/hr /engine)	1.05	2.58	0.05	0.04	0.07	0.16
Line-Haul Emission Factors						
Tier 3 Emission Factor (g/bhp-hr)	1.28	4.95	0.08	0.08	0.09	0.14
Coal Train Emissions (lbs/hr /engine)	0.62	2.40	0.04	0.04	0.04	0.07
Product Train Emissions (lbs/hr /engine)	0.42	1.64	0.03	0.03	0.03	0.05

1-hr Emission Rates

	CO	NOx	PM10	PM2.5	SO2	VOC
	1-hr Emission Rates (lb/hr) all trains					
Switching engines	1.05	2.58	0.05	0.04	0.07	0.16
Line-haul coal engines	1.24	4.80	0.08	0.08	0.09	0.13
	1-hr Emission Rates for AERMOD (lb/hr) all trains divided by number of volume sources					
All On-site Trains	2.2E-02	7.1E-02	1.2E-03	1.2E-03	1.5E-03	2.8E-03

During a given hour either the line-haul engines for the coal train or product train operate, not both, thus emissions from the larger coal trains are only included in the peak hour emissions.

3-hr Emission Rates

	CO	NOx	PM10	PM2.5	SO2	VOC
	3-hr Emission Rates (lb/period) all trains					
Switching engines	3.14	7.73	0.14	0.13	0.21	0.47
Line-haul coal engines	2.48	9.59	0.16	0.15	0.18	0.27
Line-haul product engines	0.85	3.27	0.05	0.05	0.06	0.09
	3-hr Emission Rates for AERMOD (lb/hr) all trains divided by number of volume sources					
All On-site Trains	2.1E-02	6.6E-02	1.1E-03	1.1E-03	1.4E-03	2.6E-03

In the maximum operations 3 hour period, the switching engine operates up to 3 hours, 1 coal train unloads in 2 hours and 1 product train loads in 1 hour.

8-hour Emission Rates

	CO	NOx	PM10	PM2.5	SO2	VOC
	8-hr Emission Rates (lb/period) all trains					
Switching engines	8.38	20.62	0.37	0.36	0.57	1.25
Line-haul coal engines	4.96	19.19	0.31	0.30	0.35	0.53
Line-haul product engines	0.00	0.00	0.00	0.00	0.00	0.00
	8-hr Emission Rates for AERMOD (lb/hr) all trains divided by number of volume sources					
All On-site Trains	1.6E-02	4.8E-02	8.1E-04	7.9E-04	1.1E-03	2.1E-03

In the maximum operations 8 hour period, the switching engine operates up to 8 hours, and either 2 coal trains or 1 coal train and 1 product train
since there are higher emissions from coal trains, emissions were estimated based on 2 coal trains.

24-hour Emission Rates

	CO	NOx	PM10	PM2.5	SO2	VOC
	24-hr Emission Rates (lb/period) all trains					
Switching engines	8.38	20.62	0.37	0.36	0.57	1.25
Line-haul coal engines	4.96	19.19	0.31	0.30	0.35	0.53
Line-haul product engines	0.00	0.00	0.00	0.00	0.00	0.00
	24-hr Emission Rates for AERMOD (lb/hr) all trains divided by number of volume sources					
All On-site Trains	5.3E-03	1.6E-02	2.7E-04	2.6E-04	3.7E-04	7.2E-04

In the maximum operations 24 hour period, the switching engine operates up to 24 hours, and either 2 coal trains or 1 coal train and 1 product train
since there are higher emissions from coal trains, emissions were estimated based on 2 coal trains.

Annual Emission Rates

	CO	NOx	PM10	PM2.5	SO2	VOC
	Annual Emission Rates (tons/period) all trains					
Switching engines	0.65	1.61	0.03	0.03	0.04	0.10
Line-haul coal engines	0.15	0.57	0.01	0.01	0.01	0.02
Line-haul product engines	0.07	0.27	0.00	0.00	0.00	0.01
	Annual Emission Rates for AERMOD (tons/yr) all trains divided by number of volume sources					
All On-site Trains	8.4E-03	2.4E-02	4.1E-04	3.9E-04	5.7E-04	1.2E-03

AERMOD source parameters
Volume sources spaces every 20 widths

Width	10	ft
Release Height	15	ft
Sigma Y	93	ft
Sigma Z	14	ft
# of volumes	104	

Guidance for Air Dispersion Modeling, SJVAPCD, 2007 and Section 1.2.2 of Volume II of ISC User's Guide

Emission Factors For all Locomotives
SOx
g/gal
1.88

Locomotive Application	Conversion Factor (bhp-hr/gal)
Large Line-haul & Passenger	20.8
Small Line-haul	18.2
Switching	15.2

Notes:
New line-haul engines will be AC locomotives such as the GE Evolution Series, that meet Tier 3 emissions
New switching engines will meet Tier 3 emissions, they may be the Titan Trackmobile railcar movers or similar
EPA’s Technical Highlights: Emission Factors for Locomotives, 2009 (http://www.epa.gov/nonroad/locomotv/420f09025.pdf).
Based on 300 ppm sulfur diesel fuel.
VOC emissions can be assumed to be equal to 1.053 times the HC emissions
$PM_{2.5}$ Fraction of PM_{10}, = 0.97
Line-haul engine emissions of CO, NOx, PM, and HC are based on EPA Tier 2+ and Tier 3 emission factors.

APPENDIX B

REVISED TOXIC AIR CONTAMINANT EMISSIONS

Hydrogen Energy California (HECA) Project
April 19, 2013
Emissions Summary

Compound	CAS #	Annual Rate (TPY)	CTG/HRSG Stack (lb/yr)	Feedstock 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)	Manufacturing Complex (lb/yr)	Onsite Truck (lb/yr)	Onsite Train (lb/yr)	Fugitives (lb/yr)
Acetaldehyde	75-07-0	2.13E-02	3.62E+01	6.38E+00																
Ammonia*	7664-41-7	1.54E+02	1.53E+05	2.50E+04				1.03E+03									1.22E+05			7.61E+03
Antimony	7440-36-0	1.30E-02	2.21E+01	3.90E+00																
Arsenic	7440-38-2	2.85E-02	4.82E+01	8.51E+00	5.33E-02	8.70E-02	2.40E-02	8.89E-02	1.49E-03			1.43E-02	7.75E-04	3.78E-03	2.17E-02					
Benzene	71-43-2	1.47E+00	4.82E+01	8.51E+00				9.33E-01	1.57E-02			1.50E-01	8.14E-03	3.97E-02	2.28E-01	2.79E+03				9.69E+01
Beryllium	7440-41-7	3.08E-03	5.22E+00	9.22E-01				5.33E-03	8.96E-05			8.56E-04	4.65E-05	2.27E-04	1.30E-03					
Cadmium	7440-43-9	1.14E-01	1.93E+02	3.40E+01				4.89E-01	8.21E-03			7.85E-02	4.26E-03	2.08E-02	1.19E-01					
Carbon Disulfide	75-15-0	5.44E-01	9.24E+02	1.63E+02																
Carbonyl Sulfide	463-58-1	2.79E+00														5.37E+03				2.09E+02
Chromium	7440-47-3	6.49E-03	1.02E+01	1.81E+00				6.22E-01	1.05E-02			9.99E-02	5.42E-03	2.64E-02	1.52E-01					
Chromium (hexavalent)	18540-29-9	1.81E-03	3.07E+00	5.43E-01																
Cobalt	7440-48-4	3.10E-03	5.22E+00	9.22E-01				3.73E-02	6.27E-04			5.99E-03	3.25E-04	1.59E-03	9.11E-03					
Copper*	7440-50-8	2.94E-04			1.03E-02	1.69E-02	4.66E-03	3.78E-01	6.35E-03			6.06E-02	3.29E-03	1.61E-02	9.22E-02					
Cyanides	57-12-5	6.91E-02	1.15E+02	2.02E+01																3.35E+00
Fluoride*	1101	1.44E-03			9.31E-01	1.52E+00	4.20E-01													
Formaldehyde	50-00-0	2.25E-01	3.42E+02	6.03E+01				3.33E+01	5.60E-01			5.35E+00	2.91E-01	1.42E+00	8.13E+00					
Hexane	110-54-3	5.89E-01						8.00E+02	1.34E+01			1.28E+02	6.97E+00	3.40E+01	1.95E+02					
Hydrochloric Acid	7647-01-0	1.62E-01	2.61E+02	4.61E+01																1.75E+01
Hydrogen Fluoride (hydrofluoric acid)	7664-39-3	5.91E-01	1.00E+03	1.77E+02																
Hydrogen Sulfide	7783-06-4	2.44E+00														3.04E+03				1.83E+03
Lead	7439-92-1	6.62E-03	1.13E+01	1.99E+00																
Manganese	7439-96-5	1.65E-02	2.09E+01	3.69E+00	2.66E+00	4.35E+00	1.20E+00	1.69E-01	2.84E-03			2.71E-02	1.47E-03	7.18E-03	4.12E-02					
Mercury	7439-97-6	4.88E-03	3.82E+00	5.77E+00				1.16E-01	1.94E-03			1.85E-02	1.01E-03	4.91E-03	2.82E-02					
Methanol	67-56-1	9.73E+00														4.87E+03				1.46E+04
Methyl Bromide (Bromomethane)	74-83-9	5.64E-01	9.59E+02	1.69E+02																
Methylene Chloride (Dichloromethane)	75-09-2	2.60E-02	4.42E+01	7.80E+00																
Naphthalene	91-20-3	2.98E-02	5.02E+01	8.87E+00				2.71E-01	4.55E-03			4.35E-02	2.36E-03	1.15E-02	6.61E-02					
Nickel	7440-02-0	5.30E-03	7.84E+00	1.38E+00				9.33E-01	1.57E-02			1.50E-01	8.14E-03	3.97E-02	2.28E-01					
Nitric Acid*	7697-37-2	3.04E-01																		6.09E+02
Phenol	108-95-2	4.35E-01	7.40E+02	1.31E+02																
Propylene*	115-07-1	4.75E+00																		9.49E+03
Selenium	7782-49-2	6.70E-03	1.13E+01	1.99E+00	4.43E-02	7.23E-02	2.00E-02	1.07E-02	1.79E-04			1.71E-03	9.30E-05	4.53E-04	2.60E-03					
Sulfuric Acid and Sulfates*	7664-93-9	1.12E+00	1.91E+03	3.37E+02																
Toluene	108-88-3	1.50E-03	6.63E-01	1.17E-01				1.51E+00	2.54E-02			2.43E-01	1.32E-02	6.42E-02	3.69E-01					
Vanadium*	7440-62-2	7.52E-04						1.02E+00	1.72E-02			1.64E-01	8.91E-03	4.34E-02	2.49E-01					
Diesel Particulate Matter*	DPM	7.14E-02								4.51E+01	1.84E+00							2.01E+01	7.56E+01	
2-Methylnaphthalene	91-57-6	7.85E-06						1.07E-02	1.79E-04			1.71E-03	9.30E-05	4.53E-04	2.60E-03					
3-Methylchloranthrene	56-49-5	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
7,12-Dimethylbenz(a)anthracene	57-97-6	5.23E-06						7.11E-03	1.19E-04			1.14E-03	6.20E-05	3.02E-04	1.73E-03					
Acenaphthene	83-32-9	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Acenaphthylene	208-96-8	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Anthracene	120-12-7	7.85E-07						1.07E-03	1.79E-05			1.71E-04	9.30E-06	4.53E-05	2.60E-04					
Benz(a)anthracene	56-55-3	2.78E-05	4.62E-02	8.16E-03				8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Benzo(a)pyrene	50-32-8	3.93E-07						5.33E-04	8.96E-06			8.56E-05	4.65E-06	2.27E-05	1.30E-04					
Benzo(b)fluoranthene	205-99-2	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Benzo(g,h,i)perylene	191-24-2	3.93E-07						5.33E-04	8.96E-06			8.56E-05	4.65E-06	2.27E-05	1.30E-04					
Benzo(k)fluoranthene	207-08-9	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Chrysene	218-01-9	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Dibenzo(a,h)anthracene	53-70-3	3.93E-07						5.33E-04	8.96E-06			8.56E-05	4.65E-06	2.27E-05	1.30E-04					
Dichlorobenzene	106-46-7	3.93E-04						5.33E-01	8.96E-03			8.56E-02	4.65E-03	2.27E-02	1.30E-01					
Fluoranthene	206-44-0	9.81E-07						1.33E-03	2.24E-05			2.14E-04	1.16E-05	5.67E-05	3.25E-04					
Fluorene	86-73-7	9.16E-07						1.24E-03	2.09E-05			2.00E-04	1.08E-05	5.29E-05	3.04E-04					
Indeno(1,2,3-cd)pyrene	193-39-5	5.89E-07						8.00E-04	1.34E-05			1.28E-04	6.97E-06	3.40E-05	1.95E-04					
Phenanathrene	85-01-8	5.56E-06						7.55E-03	1.27E-04			1.21E-03	6.59E-05	3.21E-04	1.84E-03					
Pyrene	129-00-0	1.64E-06						2.22E-03	3.73E-05			3.57E-04	1.94E-05	9.44E-05	5.42E-04					
Total Combined HAPs and TACs (tpy)		**180.38**	**79.76**	**13.11**	**0.00**	**0.00**	**0.00**	**0.93**	**0.01**	**0.02**	**0.00**	**0.07**	**0.00**	**0.02**	**0.10**	**8.03**	**61.04**	**0.01**	**0.04**	**1.72E+01**
Total HAPs* (tpy)		**19.90**	**2.43**	**0.43**	**0.00**	**0.00**	**0.00**	**0.42**	**0.01**	**0.00**	**0.00**	**0.07**	**0.00**	**0.02**	**0.10**	**8.03**	**0.00**	**0.00**	**0.00**	**8.38E+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.

Hydrogen Energy California, LLC
Hydrogen Energy California (HECA) Project
19-Apr-2013

Annual emissions based on 100 percent load at annual average temperature (65°F)

CT Fuel Input (Yearly Average - 65°F) =	2,537	10^6 Btu/hr (higher heating value)
Duct Burner Heat Input (Yearly Average - 65°F) =	290	10^6 Btu/hr (higher heating value)
Total HRSG Heat Input (Yearly Average - 65°F) =	2,827	10^6 Btu/hr (higher heating value)

Hourly emissions based on 100 percent load at average high ambient temperature (97°F)

CT Fuel Input (Avg. High Ambient - 97°F) =	2,583	10^6 Btu/hr (higher heating value)
Duct Burner Heat Input (97°F) =	278	10^6 Btu/hr (higher heating value)
Total HRSG Heat Input (97°F) =	2,861	10^6 Btu/hr (higher heating value)

HRSG		
HRSG (Firing Syngas) Normal Operating Hours =	8000	hr/yr
HRSG (Firing Natural Gas) Normal Operating Hours =	336	hr/yr
HRSG Startup Hours =	9	hr/yr
HRSG Shutdown Hours =	18	hr/yr
Total HRSG Operating Hours	**8,363**	**hr/yr**

Feedstock Dryer		
Feedstock Dryer Normal Operating Hours =	8000	hr/yr
Feedstock Dryer Startup Hours =	8	hr/yr
Feedstock Dryer Shutdown Hours =	8	hr/yr
Total Feedstock Dryer Operating Hours	**8,016**	**hr/yr**

Exhaust from HRSG normal operation would be splitted into	**85%**	**to HRSG stack**
	15%	**to Feedstock dryer stack**

			HRSG + Feedstock Dryer					
			Toal Hourly Combined Emission	**Total Annual Combined Emissions**	**CTG/HRSG Stack**		**Feedstock Dryer Stack**	
Compound	**CAS #**	**Emission Factor** ($lb/10^{12}$ Btu coal)	**Hourly** (lb/hr)	**Annual** (lb/yr)	**Hourly** (lb/hr)	**Annual** (lb/yr)	**Hourly** (lb/hr)	**Annual** (lb/yr)
Acetaldehyde	75-07-0	1.8	5.15E-03	4.26E+01	4.38E-03	3.62E+01	7.72E-04	6.38E+00
Ammonia	7664-41-7	5 ppm	2.17E+01	1.78E+05	1.85E+01	1.53E+05	3.20E+00	2.50E+04
Antimony	7440-36-0	1.1	3.15E-03	2.60E+01	2.68E-03	2.21E+01	4.72E-04	3.90E+00
Arsenic	7440-38-2	2.4	6.87E-03	5.67E+01	5.84E-03	4.82E+01	1.03E-03	8.51E+00
Benz(a)anthracene	56-55-3	0.0023	6.58E-06	5.44E-02	5.59E-06	4.62E-02	9.87E-07	8.16E-03
Benzene	71-43-2	2.4	6.87E-03	5.67E+01	5.84E-03	4.82E+01	1.03E-03	8.51E+00
Beryllium	7440-41-7	0.26	7.44E-04	6.15E+00	6.32E-04	5.22E+00	1.12E-04	9.22E-01
Cadmium	7440-43-9	9.6	2.75E-02	2.27E+02	2.33E-02	1.93E+02	4.12E-03	3.40E+01
Carbon disulfide	75-15-0	46	1.32E-01	1.09E+03	1.12E-01	9.24E+02	1.97E-02	1.63E+02
Chromium (hexavalent)	18540-29-9	0.15	4.38E-04	3.62E+00	3.72E-04	3.07E+00	6.57E-05	5.43E-01
Chromium	7440-47-3	0.51	1.46E-03	1.21E+01	1.24E-03	1.02E+01	2.19E-04	1.81E+00
Cobalt	7440-48-4	0.26	7.44E-04	6.15E+00	6.32E-04	5.22E+00	1.12E-04	9.22E-01
Cyanides	57-12-5	5.7	1.63E-02	1.35E+02	1.39E-02	1.15E+02	2.45E-03	2.02E+01
Formaldehyde	50-00-0	17	4.86E-02	4.02E+02	4.13E-02	3.42E+02	7.30E-03	6.03E+01
Hydrochloric acid	7647-01-0	13	3.72E-02	3.07E+02	3.16E-02	2.61E+02	5.58E-03	4.61E+01
Hydrogen fluoride (Hydrofluoric acid)	7664-39-3	50	1.43E-01	1.18E+03	1.22E-01	1.00E+03	2.15E-02	1.77E+02
Lead	7439-92-1	0.56	1.60E-03	1.32E+01	1.36E-03	1.13E+01	2.40E-04	1.99E+00
Manganese	7439-96-5	1.0	2.98E-03	2.46E+01	2.53E-03	2.09E+01	4.46E-04	3.69E+00
Mercury	7439-97-6	see notes	1.18E-03	9.59E+00	4.57E-04	3.82E+00	7.20E-04	5.77E+00
Methyl bromide (Bromomethane)	74-83-9	47.7	1.36E-01	1.13E+03	1.16E-01	9.59E+02	2.05E-02	1.69E+02
Methylene chloride (Dichloromethane)	75-09-2	2.2	6.29E-03	5.20E+01	5.35E-03	4.42E+01	9.44E-04	7.80E+00
Naphthalene	91-20-3	2.5	7.15E-03	5.91E+01	6.08E-03	5.02E+01	1.07E-03	8.87E+00
Nickel	7440-02-0	0.39	1.12E-03	9.22E+00	9.48E-04	7.84E+00	1.67E-04	1.38E+00
Phenol	108-95-2	36.8	1.05E-01	8.70E+02	8.95E-02	7.40E+02	1.58E-02	1.31E+02
Selenium	7782-49-2	0.56	1.60E-03	1.32E+01	1.36E-03	1.13E+01	2.40E-04	1.99E+00
Sulfuric acid and sulfates	7664-93-9	95	2.72E-01	2.25E+03	2.31E-01	1.91E+03	4.08E-02	3.37E+02
Toluene	108-88-3	0.033	9.44E-05	7.80E-01	8.03E-05	6.63E-01	1.42E-05	1.17E-01

Notes:

1) For the normal operating scenario, the unit will primarily fire syngas with natural gas as a backup fuel.

2) Emission factors are taken from Wabash River test data and the National Energy Technology Laboratory, U.S. Dept of Energy, Major Environmental Aspects of Gasification-based Power Generation Technologies, Final Report, December 2002.

3) Ammonia slip from the SCR (5 parts per million volume dry @ 15 percent O_2) - provided by Fluor - see Criteria Pollutant emission spreadsheet for details.

4) Btu = British thermal units.

5) Mercury (Hg) emission estimates are based on the following assumptions for the worst-case 100% coal scenario:

Total gasifier coal feed rate	5023	stpd			
Hg concentration in coal feed	0.13	ppmw			
Total Hg in coal feed	1.306	lb/day	0.0544	lb/hr	
Uncontrolled Feedstock dryer Hg emission from volatilization (MHI est)	0.067	lb/day	0.0028	lb/hr	
Feedstock dryer Hg emissions control efficiency	75%				
Controlled Feedstock dryer Hg emission from volatilization	0.0168	lb/day	0.00070	lb/hr	
Total Controlled Feedstock dryer Hg emission from volatilization + HRSG flue gas	0.0173	lb/day	**0.000720**	lb/hr	
Hg in syngas from gasifier	1.289	lb/day	0.0537	lb/hr	
Control efficiency of the mercury cleanup in the syngas	99%				
Controlled HG emissions in HRSG flue gas	0.013	lb/day	0.000537	lb/hr	
Controlled HG emissions from the HRSG stack	0.011	lb/day	**0.000457**	lb/hr	
Total Hg emissions from HRSG + Feedstock dryer	0.028	lb/day	0.001177	lb/hr	
Total Hg emissions from HRSG + Feedstock dryer			0.0029	lb/GWh	
Gross power output			405	MW	A low gross power rate is used to ensure the emission performance standard is conservative

6) The emission rates of natural gas firing (startup, shutdown, and 336 hours of steady state operation) were calculated based on the emission factors used for the syngas firing.

7) Approximiately 15% of the HRSG exhaust is directed to the Feedstock dryer where is passes over pulverized Feedstock to dry it before it is injected into the gasifier. Therefore, it was assumed that HRSG/Feedstock dryer exhaust is split based on 85%/15%. No exhaust will be directed to the Feedstock dryer during natural gas operations or portions of startup and shutdown.

8) Annual emissions for both HRSG and Feedstock dryer based on the higher hours of operation of the HRSG

Cooling Tower Operating Parameters

	Power Block	Process Area	ASU
Cooling water (CW) circulation rate, gpm =	95,500	162,582	44,876
CW circulation rate (million lb/hr) =	48	81	22
CW dissolved solids (ppmw) =	9,000	9,000	2,000
Drift, fraction of circulating CW =	0.0005%	0.0005%	0.0005%
Cooling Tower Operating Hours	8,668	8,314	8,314
Number of cells in tower	10	11	4

Assumed maximum TDS in circulating cooling water, normally TDS will be less.

Power Block Cooling Tower

Compound	CAS # / OEHHA reference #	Emission Factor (ppm)	Hourly (lb/hr)	Annual (lb/yr)	Hourly per Cell (lb/hr)	Annual per Cell (lb/yr)
Arsenic	7440-38-2	0.026	6.15E-06	5.33E-02	6.15E-07	5.33E-03
Copper	7440-50-8	0.005	1.19E-06	1.03E-02	1.19E-07	1.03E-03
Fluoride	1101	0.45	1.07E-04	9.31E-01	1.07E-05	9.31E-02
Manganese	7439-96-5	1.29	3.07E-04	2.66E+00	3.07E-05	2.66E-01
Selenium	7784-49-2	0.02	5.11E-06	4.43E-02	5.11E-07	4.43E-03

Notes:

1) The emissions are based on the concentrations of each constituent found in the raw cooling water analysis, cycles of concentration, and drift rate.
2) Arsenic ppm value shown taken as average of analytical test results (Fruit Growers Laboratory).
3) Copper ppm value shown is one-half of stated detection limit.
4) Fluoride ppm value shown taken as average of analytical test results (Fruit Growers Laboratory).
5) Manganese ppm value shown taken as average of analytical test results (Fruit Growers Laboratory).
6) Selenium ppm value shown taken as average of analytical test results (DWR).

Process Area Cooling Tower

Compound	CAS # / OEHHA reference #	Emission Factor (ppm)	Hourly (lb/hr)	Annual (lb/yr)	Hourly per Cell (lb/hr)	Annual per Cell (lb/yr)
Arsenic	7440-38-2	0.026	1.05E-05	8.70E-02	9.51E-07	7.91E-03
Copper	7440-50-8	0.005	2.03E-06	1.69E-02	1.85E-07	1.54E-03
Fluoride	1101	0.45	1.83E-04	1.52E+00	1.66E-05	1.38E-01
Manganese	7439-96-5	1.29	5.23E-04	4.35E+00	4.75E-05	3.95E-01
Selenium	7784-49-2	0.02	8.70E-06	7.23E-02	7.91E-07	6.57E-03

Notes:

1) The emissions are based on the concentrations of each constituent found in the raw cooling water analysis, cycles of concentration, and drift rate.
2) Arsenic ppm value shown taken as average of analytical test results (Fruit Growers Laboratory).
3) Copper ppm value shown is one-half of stated detection limit.
4) Fluoride ppm value shown taken as average of analytical test results (Fruit Growers Laboratory).
5) Manganese ppm value shown taken as average of analytical test results (Fruit Growers Laboratory).
6) Selenium ppm value shown taken as average of analytical test results (DWR).

ASU Cooling Tower

Compound	CAS # / OEHHA reference #	Emission Factor (ppm)	Hourly (lb/hr)	Annual (lb/yr)	Hourly per Cell (lb/hr)	Annual per Cell (lb/yr)
Arsenic	7440-38-2	0.026	2.89E-06	2.40E-02	7.22E-07	6.00E-03
Copper	7440-50-8	0.005	5.61E-07	4.66E-03	1.40E-07	1.17E-03
Fluoride	1101	0.45	5.05E-05	4.20E-01	1.26E-05	1.05E-01
Manganese	7439-96-5	1.29	1.44E-04	1.20E+00	3.61E-05	3.00E-01
Selenium	7784-49-2	0.02	2.40E-06	2.00E-02	6.00E-07	4.99E-03

Notes:

1) The emissions are based on the concentrations of each constituent found in the raw cooling water analysis, cycles of concentration, and drift rate.
2) Arsenic ppm value shown taken as average of analytical test results (Fruit Growers Laboratory).
3) Copper ppm value shown is one-half of stated detection limit.
4) Fluoride ppm value shown taken as average of analytical test results (Fruit Growers Laboratory).
5) Manganese ppm value shown taken as average of analytical test results (Fruit Growers Laboratory).
6) Selenium ppm value shown taken as average of analytical test results (DWR).

Auxiliary Boiler — HAP Emissions Summary

Hydrogen Energy California, LLC — *19-Apr-2013*
Hydrogen Energy California (HECA) Project

Operating Parameters

Auxiliary Boiler Heat Input =	213	10^6 Btu/hr (HHV)
Natural gas heating value =	1,050	Btu/scf
Fuel usage =	0.203	10^6 scf/hr
Auxiliary Boiler Operating Hours =	2,190	hours per year

Compound	CAS #	Emission Factor ($lb/10^6$ scf)	Hourly (lb/hr)	Annual (lb/yr)
Ammonia	7664-41-7	5 ppm	4.69E-01	1.03E+03
Arsenic	7440-38-2	2.00E-04	4.06E-05	8.89E-02
Benzene	71-43-2	2.10E-03	4.26E-04	9.33E-01
Beryllium	7440-41-7	1.20E-05	2.43E-06	5.33E-03
Cadmium	7440-43-9	1.10E-03	2.23E-04	4.89E-01
Chromium	7440-47-3	1.40E-03	2.84E-04	6.22E-01
Cobalt	7440-48-4	8.40E-05	1.70E-05	3.73E-02
Copper	7440-50-8	8.50E-04	1.72E-04	3.78E-01
Formaldehyde	50-00-0	7.50E-02	1.52E-02	3.33E+01
Hexane	110-54-3	1.80E+00	3.65E-01	8.00E+02
Manganese	7439-96-5	3.80E-04	7.71E-05	1.69E-01
Mercury	7439-97-6	2.60E-04	5.27E-05	1.16E-01
Naphthalene	91-20-3	6.10E-04	1.24E-04	2.71E-01
Nickel	7440-02-0	2.10E-03	4.26E-04	9.33E-01
Selenium	7782-49-2	2.40E-05	4.87E-06	1.07E-02
Toluene	108-88-3	3.40E-03	6.90E-04	1.51E+00
Vanadium	7440-62-2	2.30E-03	4.67E-04	1.02E+00
Benzo(a)pyrene	50-32-8	1.20E-06	2.43E-07	5.33E-04
Benz(a)anthracene	56-55-3	1.80E-06	3.65E-07	8.00E-04
Benzo(b)fluoranthene	205-99-2	1.80E-06	3.65E-07	8.00E-04
Chrysene	218-01-9	1.80E-06	3.65E-07	8.00E-04
Dibenzo(a,h)anthracene	53-70-3	1.20E-06	2.43E-07	5.33E-04
Dichlorobenzene	106-46-7	1.20E-03	2.43E-04	5.33E-01
Indeno(1,2,3-cd)pyrene	193-39-5	1.80E-06	3.65E-07	8.00E-04
2-Methylnaphthalene	91-57-6	2.40E-05	4.87E-06	1.07E-02
3-Methylchloranthrene	56-49-5	1.80E-06	3.65E-07	8.00E-04
7,12-Dimethylbenz(a)anthracene	57-97-6	1.60E-05	3.25E-06	7.11E-03
Acenaphthene	83-32-9	1.80E-06	3.65E-07	8.00E-04
Acenaphthylene	208-96-8	1.80E-06	3.65E-07	8.00E-04
Anthracene	120-12-7	2.40E-06	4.87E-07	1.07E-03
Benzo(g,h,i)perylene	191-24-2	1.20E-06	2.43E-07	5.33E-04
Benzo(k)fluoranthene	207-08-9	1.80E-06	3.65E-07	8.00E-04
Fluoranthene	206-44-0	3.00E-06	6.09E-07	1.33E-03
Fluorene	86-73-7	2.80E-06	5.68E-07	1.24E-03
Phenanathrene	85-01-8	1.70E-05	3.45E-06	7.55E-03
Pyrene	129-00-0	5.00E-06	1.01E-06	2.22E-03

Notes:

1) Emission factors (lb/106 scf) are from EPA AP-42, Chapter 1.4, Table 1.4-3 and 1.4-4.

2) Ammonia slip from the SCR (5 parts per million volume dry @ 15 percent O_2) - provided by Fluor - see Criteria Pollutant emission spreadsheet for details.

Ammonia Plant Startup Heater — HAP Emissions Summary

Hydrogen Energy California, LLC — *19-Apr-2013*
Hydrogen Energy California (HECA) Project

Operating Parameters

Heat Input =	56	10^6 Btu/hr (HHV)
Natural gas heating value =	1,050	Btu/scf
Fuel usage =	0.053	10^6 scf/hr
Operating Hours =	140	hours per year

Compound	CAS #	Emission Factor ($lb/10^6$ scf)	Hourly (lb/hr)	Annual (lb/yr)
Arsenic	7440-38-2	2.00E-04	1.07E-05	1.49E-03
Benzene	71-43-2	2.10E-03	1.12E-04	1.57E-02
Beryllium	7440-41-7	1.20E-05	6.40E-07	8.96E-05
Cadmium	7440-43-9	1.10E-03	5.87E-05	8.21E-03
Chromium	7440-47-3	1.40E-03	7.47E-05	1.05E-02
Cobalt	7440-48-4	8.40E-05	4.48E-06	6.27E-04
Copper	7440-50-8	8.50E-04	4.53E-05	6.35E-03
Formaldehyde	50-00-0	7.50E-02	4.00E-03	5.60E-01
Hexane	110-54-3	1.80E+00	9.60E-02	1.34E+01
Manganese	7439-96-5	3.80E-04	2.03E-05	2.84E-03
Mercury	7439-97-6	2.60E-04	1.39E-05	1.94E-03
Naphthalene	91-20-3	6.10E-04	3.25E-05	4.55E-03
Nickel	7440-02-0	2.10E-03	1.12E-04	1.57E-02
Selenium	7782-49-2	2.40E-05	1.28E-06	1.79E-04
Toluene	108-88-3	3.40E-03	1.81E-04	2.54E-02
Vanadium	7440-62-2	2.30E-03	1.23E-04	1.72E-02
Benzo(a)pyrene	50-32-8	1.20E-06	6.40E-08	8.96E-06
Benz(a)anthracene	56-55-3	1.80E-06	9.60E-08	1.34E-05
Benzo(b)fluoranthene	205-99-2	1.80E-06	9.60E-08	1.34E-05
Chrysene	218-01-9	1.80E-06	9.60E-08	1.34E-05
Dibenzo(a,h)anthracene	53-70-3	1.20E-06	6.40E-08	8.96E-06
Dichlorobenzene	106-46-7	1.20E-03	6.40E-05	8.96E-03
Indeno(1,2,3-cd)pyrene	193-39-5	1.80E-06	9.60E-08	1.34E-05
2-Methylnaphthalene	91-57-6	2.40E-05	1.28E-06	1.79E-04
3-Methylchloranthrene	56-49-5	1.80E-06	9.60E-08	1.34E-05
7,12-Dimethylbenz(a)anthracene	57-97-6	1.60E-05	8.53E-07	1.19E-04
Acenaphthene	83-32-9	1.80E-06	9.60E-08	1.34E-05
Acenaphthylene	208-96-8	1.80E-06	9.60E-08	1.34E-05
Anthracene	120-12-7	2.40E-06	1.28E-07	1.79E-05
Benzo(g,h,i)perylene	191-24-2	1.20E-06	6.40E-08	8.96E-06
Benzo(k)fluoranthene	207-08-9	1.80E-06	9.60E-08	1.34E-05
Fluoranthene	206-44-0	3.00E-06	1.60E-07	2.24E-05
Fluorene	86-73-7	2.80E-06	1.49E-07	2.09E-05
Phenanathrene	85-01-8	1.70E-05	9.07E-07	1.27E-04
Pyrene	129-00-0	5.00E-06	2.67E-07	3.73E-05

Notes:

1) Emission factors (lb/106 scf) are from EPA AP-42, Chapter 1.4, Table 1.4-3 and 1.4-4.

Gasification Flare	**HAP Emissions Summary**
Hydrogen Energy California, LLC	*19-Apr-2013*
Hydrogen Energy California (HECA) Project	

Operating Parameters

Reference HHV = 1,050 btu/scf

Gasification Flare - Normal Operating Emissions From Pilot

Total Hours of Pilot Operation = 8,760 hr/yr

Flare Pilot Fuel Use = 0.5 10^6 Btu/hr

Gasification Flare - Operating Emissions During Gasifier Startup and Shutdown

	10^6 Btu/yr	Hours per year
Total Flare SU/SD Operation =	70,528	28
Flaring NG-Firing Rate =	2,926	6
Wet Unshifted Gas-Firing Rate =	2,386	4
Dry Shifted Gas-Firing Rate =	2,413	18

Compound	**CAS #**	**Emission Factor** (lb/10^6 scf)	**Emission Factor** (lb/10^6 Btu)	**Hourly** (lb/hr)	**Annual** (lb/yr)
Arsenic	7440-38-2	2.00E-04	1.90E-07	5.57E-04	1.43E-02
Benzene	71-43-2	2.10E-03	2.00E-06	5.85E-03	1.50E-01
Beryllium	7440-41-7	1.20E-05	1.14E-08	3.34E-05	8.56E-04
Cadmium	7440-43-9	1.10E-03	1.05E-06	3.07E-03	7.85E-02
Chromium	7440-47-3	1.40E-03	1.33E-06	3.90E-03	9.99E-02
Cobalt	7440-48-4	8.40E-05	8.00E-08	2.34E-04	5.99E-03
Copper	7440-50-8	8.50E-04	8.10E-07	2.37E-03	6.06E-02
Formaldehyde	50-00-0	7.50E-02	7.14E-05	2.09E-01	5.35E+00
Hexane	110-54-3	1.80E+00	1.71E-03	5.02E+00	1.28E+02
Manganese	7439-96-5	3.80E-04	3.62E-07	1.06E-03	2.71E-02
Mercury	7439-97-6	2.60E-04	2.48E-07	7.25E-04	1.85E-02
Naphthalene	91-20-3	6.10E-04	5.81E-07	1.70E-03	4.35E-02
Nickel	7440-02-0	2.10E-03	2.00E-06	5.85E-03	1.50E-01
Selenium	7782-49-2	2.40E-05	2.29E-08	6.69E-05	1.71E-03
Toluene	108-88-3	3.40E-03	3.24E-06	9.48E-03	2.43E-01
Vanadium	7440-62-2	2.30E-03	2.19E-06	6.41E-03	1.64E-01
Benzo(a)pyrene	50-32-8	1.20E-06	1.14E-09	3.34E-06	8.56E-05
Benz(a)anthracene	56-55-3	1.80E-06	1.71E-09	5.02E-06	1.28E-04
Benzo(b)fluoranthene	205-99-2	1.80E-06	1.71E-09	5.02E-06	1.28E-04
Chrysene	218-01-9	1.80E-06	1.71E-09	5.02E-06	1.28E-04
Dibenzo(a,h)anthracene	53-70-3	1.20E-06	1.14E-09	3.34E-06	8.56E-05
Dichlorobenzene	106-46-7	1.20E-03	1.14E-06	3.34E-03	8.56E-02
Indeno(1,2,3-cd)pyrene	193-39-5	1.80E-06	1.71E-09	5.02E-06	1.28E-04
2-Methylnaphthalene	91-57-6	2.40E-05	2.29E-08	6.69E-05	1.71E-03
3-Methylchloranthrene	56-49-5	1.80E-06	1.71E-09	5.02E-06	1.28E-04
7,12-Dimethylbenz(a)anthracene	57-97-6	1.60E-05	1.52E-08	4.46E-05	1.14E-03
Acenaphthene	83-32-9	1.80E-06	1.71E-09	5.02E-06	1.28E-04
Acenaphthylene	208-96-8	1.80E-06	1.71E-09	5.02E-06	1.28E-04
Anthracene	120-12-7	2.40E-06	2.29E-09	6.69E-06	1.71E-04
Benzo(g,h,i)perylene	191-24-2	1.20E-06	1.14E-09	3.34E-06	8.56E-05
Benzo(k)fluoranthene	207-08-9	1.80E-06	1.71E-09	5.02E-06	1.28E-04
Fluoranthene	206-44-0	3.00E-06	2.86E-09	8.36E-06	2.14E-04
Fluorene	86-73-7	2.80E-06	2.67E-09	7.80E-06	2.00E-04
Phenanathrene	85-01-8	1.70E-05	1.62E-08	4.74E-05	1.21E-03
Pyrene	129-00-0	5.00E-06	4.76E-09	1.39E-05	3.57E-04

Notes:

1) Annual operation assumes total pilot operation of 8,760 hr/yr and plus gasifier startup and shutdown.

2) Emission factors (lb/10^6 scf) are from EPA AP-42, Chapter 1.4, Table 1.4-3 and 1.4-4.

SRU Flare	**HAP Emissions Summary**
Hydrogen Energy California, LLC	*19-Apr-2013*
Hydrogen Energy California (HECA) Project	

Operating Parameters

Reference HHV =	1,050	btu/scf

SRU Flare - Normal Operating Emissions From Pilot

Total Hours of Pilot Operation =	8,760	hr/yr
Elevated Flare Pilot Fuel Use =	0.3	10^6 Btu/hr

SRU Flare - Operating Emissions During Gasifier Startup and Shutdown

Total Flare Operation During SU/SD =	40.0	hr/yr
Natural Gas Heat Rate (assist gas) =	36.0	10^6 Btu/hr

Compound	CAS #	Emission Factor (lb/10^6 scf)	Emission Factor (lb/10^6 Btu)	Hourly (lb/hr)	Annual (lb/yr)
Arsenic	7440-38-2	2.00E-04	1.90E-07	6.91E-06	7.75E-04
Benzene	71-43-2	2.10E-03	2.00E-06	7.26E-05	8.14E-03
Beryllium	7440-41-7	1.20E-05	1.14E-08	4.15E-07	4.65E-05
Cadmium	7440-43-9	1.10E-03	1.05E-06	3.80E-05	4.26E-03
Chromium	7440-47-3	1.40E-03	1.33E-06	4.84E-05	5.42E-03
Cobalt	7440-48-4	8.40E-05	8.00E-08	2.90E-06	3.25E-04
Copper	7440-50-8	8.50E-04	8.10E-07	2.94E-05	3.29E-03
Formaldehyde	50-00-0	7.50E-02	7.14E-05	2.59E-03	2.91E-01
Hexane	110-54-3	1.80E+00	1.71E-03	6.22E-02	6.97E+00
Manganese	7439-96-5	3.80E-04	3.62E-07	1.31E-05	1.47E-03
Mercury	7439-97-6	2.60E-04	2.48E-07	8.99E-06	1.01E-03
Naphthalene	91-20-3	6.10E-04	5.81E-07	2.11E-05	2.36E-03
Nickel	7440-02-0	2.10E-03	2.00E-06	7.26E-05	8.14E-03
Selenium	7782-49-2	2.40E-05	2.29E-08	8.30E-07	9.30E-05
Toluene	108-88-3	3.40E-03	3.24E-06	1.18E-04	1.32E-02
Vanadium	7440-62-2	2.30E-03	2.19E-06	7.95E-05	8.91E-03
Benzo(a)pyrene	50-32-8	1.20E-06	1.14E-09	4.15E-08	4.65E-06
Benz(a)anthracene	56-55-3	1.80E-06	1.71E-09	6.22E-08	6.97E-06
Benzo(b)fluoranthene	205-99-2	1.80E-06	1.71E-09	6.22E-08	6.97E-06
Chrysene	218-01-9	1.80E-06	1.71E-09	6.22E-08	6.97E-06
Dibenzo(a,h)anthracene	53-70-3	1.20E-06	1.14E-09	4.15E-08	4.65E-06
Dichlorobenzene	106-46-7	1.20E-03	1.14E-06	4.15E-05	4.65E-03
Indeno(1,2,3-cd)pyrene	193-39-5	1.80E-06	1.71E-09	6.22E-08	6.97E-06
2-Methylnaphthalene	91-57-6	2.40E-05	2.29E-08	8.30E-07	9.30E-05
3-Methylchloranthrene	56-49-5	1.80E-06	1.71E-09	6.22E-08	6.97E-06
7,12-Dimethylbenz(a)anthracene	57-97-6	1.60E-05	1.52E-08	5.53E-07	6.20E-05
Acenaphthene	83-32-9	1.80E-06	1.71E-09	6.22E-08	6.97E-06
Acenaphthylene	208-96-8	1.80E-06	1.71E-09	6.22E-08	6.97E-06
Anthracene	120-12-7	2.40E-06	2.29E-09	8.30E-08	9.30E-06
Benzo(g,h,i)perylene	191-24-2	1.20E-06	1.14E-09	4.15E-08	4.65E-06
Benzo(k)fluoranthene	207-08-9	1.80E-06	1.71E-09	6.22E-08	6.97E-06
Fluoranthene	206-44-0	3.00E-06	2.86E-09	1.04E-07	1.16E-05
Fluorene	86-73-7	2.80E-06	2.67E-09	9.68E-08	1.08E-05
Phenanathrene	85-01-8	1.70E-05	1.62E-08	5.88E-07	6.59E-05
Pyrene	129-00-0	5.00E-06	4.76E-09	1.73E-07	1.94E-05

Notes:

1) Annual operation assumes total pilot operation of 8,760 hr/yr plus gasifier startup and shutdown with assist gas.

2) Emission factors (lb/10^6 scf) are from EPA AP-42, Chapter 1.4, Table 1.4-3 and 1.4-4.

Hydrogen Energy California, LLC *19-Apr-2013*
Hydrogen Energy California (HECA) Project

Operating Parameters

Reference HHV = 1,050 btu/scf

Operating Parameters - Normal Operating Emissions From Pilot

Rectisol Flare Pilot Firing Rate = 0.3 MMBtu/hr
Annual Operating Hours = 8,760 hr/yr

Rectisol Flare - Operating Emissions During Rectisol Startup and Shutdown

Total Flare Operation During SU/SD = 40 hr/yr
Heat Rate of Vent Gas, HHV = 430 10^6 Btu/hr

Compound	CAS Number	Emission Factor ($lb/10^6$ scf)	Emission Factor (lb/MMBtu)	Hourly (lb/hr)	Annual (lb/yr)
Arsenic	7440-38-2	2.00E-04	1.90E-07	8.20E-05	3.78E-03
Benzene	71-43-2	2.10E-03	2.00E-06	8.61E-04	3.97E-02
Beryllium	7440-41-7	1.20E-05	1.14E-08	4.92E-06	2.27E-04
Cadmium	7440-43-9	1.10E-03	1.05E-06	4.51E-04	2.08E-02
Chromium	7440-47-3	1.40E-03	1.33E-06	5.74E-04	2.64E-02
Cobalt	7440-48-4	8.40E-05	8.00E-08	3.44E-05	1.59E-03
Copper	7440-50-8	8.50E-04	8.10E-07	3.48E-04	1.61E-02
Formaldehyde	50-00-0	7.50E-02	7.14E-05	3.07E-02	1.42E+00
Hexane	110-54-3	1.80E+00	1.71E-03	7.38E-01	3.40E+01
Manganese	7439-96-5	3.80E-04	3.62E-07	1.56E-04	7.18E-03
Mercury	7439-97-6	2.60E-04	2.48E-07	1.07E-04	4.91E-03
Naphthalene	91-20-3	6.10E-04	5.81E-07	2.50E-04	1.15E-02
Nickel	7440-02-0	2.10E-03	2.00E-06	8.61E-04	3.97E-02
Selenium	7782-49-2	2.40E-05	2.29E-08	9.84E-06	4.53E-04
Toluene	108-88-3	3.40E-03	3.24E-06	1.39E-03	6.42E-02
Vanadium	7440-62-2	2.30E-03	2.19E-06	9.43E-04	4.34E-02
Benzo(a)pyrene	50-32-8	1.20E-06	1.14E-09	4.92E-07	2.27E-05
Benz(a)anthracene	56-55-3	1.80E-06	1.71E-09	7.38E-07	3.40E-05
Benzo(b)fluoranthene	205-99-2	1.80E-06	1.71E-09	7.38E-07	3.40E-05
Chrysene	218-01-9	1.80E-06	1.71E-09	7.38E-07	3.40E-05
Dibenzo(a,h)anthracene	53-70-3	1.20E-06	1.14E-09	4.92E-07	2.27E-05
Dichlorobenzene	106-46-7	1.20E-03	1.14E-06	4.92E-04	2.27E-02
Indeno(1,2,3-cd)pyrene	193-39-5	1.80E-06	1.71E-09	7.38E-07	3.40E-05
2-Methylnaphthalene	91-57-6	2.40E-05	2.29E-08	9.84E-06	4.53E-04
3-Methylchloranthrene	56-49-5	1.80E-06	1.71E-09	7.38E-07	3.40E-05
7,12-Dimethylbenz(a)anthracene	57-97-6	1.60E-05	1.52E-08	6.56E-06	3.02E-04
Acenaphthene	83-32-9	1.80E-06	1.71E-09	7.38E-07	3.40E-05
Acenaphthylene	208-96-8	1.80E-06	1.71E-09	7.38E-07	3.40E-05
Anthracene	120-12-7	2.40E-06	2.29E-09	9.84E-07	4.53E-05
Benzo(g,h,i)perylene	191-24-2	1.20E-06	1.14E-09	4.92E-07	2.27E-05
Benzo(k)fluoranthene	207-08-9	1.80E-06	1.71E-09	7.38E-07	3.40E-05
Fluoranthene	206-44-0	3.00E-06	2.86E-09	1.23E-06	5.67E-05
Fluorene	86-73-7	2.80E-06	2.67E-09	1.15E-06	5.29E-05
Phenanathrene	85-01-8	1.70E-05	1.62E-08	6.97E-06	3.21E-04
Pyrene	129-00-0	5.00E-06	4.76E-09	2.05E-06	9.44E-05

Notes:

1) Annual operation assumes total pilot operation of 8,760 hr/yr plus rectisol startup and shutdown.
2) Emission factors ($lb/10^6$ scf) are from EPA AP-42, Chapter 1.4, Table 1.4-3 and 1.4-4.

Tail Gas Thermal Oxidizer — HAP Emissions Summary

Hydrogen Energy California, LLC — *19-Apr-2013*
Hydrogen Energy California (HECA) Project

Operating Parameters

Normal Operations		
Tail Gas Thermal Oxidizer Heat Input =	13	10^6 Btu/hr (HHV)
Natural gas heating value =	1,050	Btu/scf
Fuel usage =	0.012	10^6 scf/hr
Tail Gas Thermal Oxidizer Operating Hours =	8,314	hr/yr
Startup & Shutdown Operations		
Heat Input =	80	10^6 Btu/hr (HHV)
Fuel usage =	0.076	10^6 scf/hr
Startup & Shutdown Hours per year =	72	hr/yr

Compound	CAS #	Emission Factor (lb/10^6 scf)	Hourly (lb/hr)	Annual (lb/yr)
Arsenic	7440-38-2	2.00E-04	1.77E-05	2.17E-02
Benzene	71-43-2	2.10E-03	1.86E-04	2.28E-01
Beryllium	7440-41-7	1.20E-05	1.06E-06	1.30E-03
Cadmium	7440-43-9	1.10E-03	9.74E-05	1.19E-01
Chromium	7440-47-3	1.40E-03	1.24E-04	1.52E-01
Cobalt	7440-48-4	8.40E-05	7.44E-06	9.11E-03
Copper	7440-50-8	8.50E-04	7.53E-05	9.22E-02
Formaldehyde	50-00-0	7.50E-02	6.64E-03	8.13E+00
Hexane	110-54-3	1.80E+00	1.59E-01	1.95E+02
Manganese	7439-96-5	3.80E-04	3.37E-05	4.12E-02
Mercury	7439-97-6	2.60E-04	2.30E-05	2.82E-02
Naphthalene	91-20-3	6.10E-04	5.40E-05	6.61E-02
Nickel	7440-02-0	2.10E-03	1.86E-04	2.28E-01
Selenium	7782-49-2	2.40E-05	2.13E-06	2.60E-03
Toluene	108-88-3	3.40E-03	3.01E-04	3.69E-01
Vanadium	7440-62-2	2.30E-03	2.04E-04	2.49E-01
Benzo(a)pyrene	50-32-8	1.20E-06	1.06E-07	1.30E-04
Benz(a)anthracene	56-55-3	1.80E-06	1.59E-07	1.95E-04
Benzo(b)fluoranthene	205-99-2	1.80E-06	1.59E-07	1.95E-04
Chrysene	218-01-9	1.80E-06	1.59E-07	1.95E-04
Dibenzo(a,h)anthracene	53-70-3	1.20E-06	1.06E-07	1.30E-04
Dichlorobenzene	106-46-7	1.20E-03	1.06E-04	1.30E-01
Indeno(1,2,3-cd)pyrene	193-39-5	1.80E-06	1.59E-07	1.95E-04
2-Methylnaphthalene	91-57-6	2.40E-05	2.13E-06	2.60E-03
3-Methylchloranthrene	56-49-5	1.80E-06	1.59E-07	1.95E-04
7,12-Dimethylbenz(a)anthracene	57-97-6	1.60E-05	1.42E-06	1.73E-03
Acenaphthene	83-32-9	1.80E-06	1.59E-07	1.95E-04
Acenaphthylene	208-96-8	1.80E-06	1.59E-07	1.95E-04
Anthracene	120-12-7	2.40E-06	2.13E-07	2.60E-04
Benzo(g,h,i)perylene	191-24-2	1.20E-06	1.06E-07	1.30E-04
Benzo(k)fluoranthene	207-08-9	1.80E-06	1.59E-07	1.95E-04
Fluoranthene	206-44-0	3.00E-06	2.66E-07	3.25E-04
Fluorene	86-73-7	2.80E-06	2.48E-07	3.04E-04
Phenanathrene	85-01-8	1.70E-05	1.51E-06	1.84E-03
Pyrene	129-00-0	5.00E-06	4.43E-07	5.42E-04

Notes:
1) Emission factors (lb/10^6 scf) are from EPA AP-42, Chapter 1.4, Table 1.4-3 and 1.4-4.

Hydrogen Energy California, LLC *19-Apr-2013*
Hydrogen Energy California (HECA) Project

Operating Parameters

Annual operating parameters

Maximum Hours of Operation = 504 hr/yr

For methanol calculations

Average flow capacity for year = 85% of maximum (varies between 70% - 100%)

Compound	CAS #	Molecular Weight	Short-term Emission Factor	Long-term Emission Factor	Maximum Hourly Flow	Annual Flow	Hourly	Annual	Annual
		lb/lb-mol	(ppm)	(ppm)	lb/hr	ton/yr	(lb/hr)	(lb/yr)	(ton/yr)
Carbonyl Sulfide	463-58-1	60	10	10	767,435	193,394	10.65	5367	2.68
Hydrogen Sulfide	7783-06-4	34	10	10	767,435	193,394	6.04	3044	1.52
Benzene	71-43-2	78	4	4	767,435	193,394	5.54	2791	1.40
Methanol	67-56-1	32	40	20	767,435	164,385	22.71	4865	2.43

Notes:

1) Vent gas methanol concentrations are based on process licensor data. The methanol concentration is expected to be 18-20 ppm, but could be as high as 40 ppm associated short-term operational conditions such as transient impacts on the wash column.

2) Annual emission rates are based on 504 hours per year of full venting for COS, H2S and benzene and the average venting of 85% flow rate for methanol.

3) VOC emissions calculated from benzene and methanol emissions, reported on a methane basis.

Emergency Diesel Generator — HAP Emissions Summary

Hydrogen Energy California, LLC — *19-Apr-2013*
Hydrogen Energy California (HECA) Project

Operating Parameters

Emergency Generator Specification =	2,922	Bhp
Emergency Generator Operating Hours =	50	hr/yr

PLEASE NOTE THAT THERE ARE TWO GENERATORS; EMISSION SHOWN IS FOR INDIVIDUAL GENERATORS.

Compound	CAS # /OEHHA reference #	Emission Factor (g/Bhp/hr)	Hourly (lb/hr)	Annual (lb/yr)
Diesel Particulate Matter	9901	0.07	4.51E-01	2.25E+01

Note:

1) Emission factor shown is based on U.S. EPA Tier 4 non-road diesel engine emissions standards.
2) Emission rate shown is for individual generator. There are two generators associated with the Project.

Emergency Diesel Firewater Pump — HAP Emissions Summary

Hydrogen Energy California, LLC — *19-Apr-2013*
Hydrogen Energy California (HECA) Project

Operating Parameters

Fire Water Pump Specification =	556	Bhp
Fire Water Pump Operating Hours =	100	hr/yr

Compound	CAS # /OEHHA reference #	Emission Factor (g/Bhp/hr)	Hourly (lb/hr)	Annual (lb/yr)
Diesel Particulate Matter	9901	0.015	1.84E-02	1.84E+00

Note:

1) Emission factor shown is based on U.S. EPA Tier 4 non-road diesel engine emissions standards.

Urea Absorber

Urea Absorber Operating Hours = 8,052 hr/yr

Compound	CAS #	Hourly (lb/hr)	Annual (lb/yr)
Ammonia (NH3)	8013-59-0	13.10	105,481

Note:

1) Emission rate was estimated based on reference plant information. See criteria pollutant emission calculations. Annual operation includes hours for plant startup.

Urea Pastillation

Urea Pastillation Operating Hours = 8,052 hr/yr

Compound	CAS #	Hourly (lb/hr)	Annual (lb/yr)
Ammonia (NH3)	8013-59-0	1.03	8,316

Note:

1) Emission rate was estimated based on reference plant information. See criteria pollutant emission calculations. Annual operation includes hours for plant startup.

Nitric Acid Unit

Nitric Acid Unit Operating Hours = 8,052 hr/yr

Compound	CAS #	Hourly (lb/hr)	Annual (lb/yr)
Ammonia (NH3)	8013-59-0	1.03	8,282

Note:

1) Emission rate was estimated based on reference plant information. See criteria pollutant emission calculations. Annual operation includes hours for plant startup.

Hydrogen Energy California, LLC *19-Apr-2013*
Hydrogen Energy California (HECA) Project

Alternative 1

Data Supplied By Client						
	Onsite Petcoke and Coal Trucks(@ 10 mph)		Fluxant & Product Truck (@ 10 mph)		Miscellaneous Truck (@ 10 mph)	Onsite O&M Trucks (@ 15 mph)
Parameter	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Running Emissions Diesel LHDT2
Distance Traveled (mile)	0.96		2.49		2.20	1.00
Per Truck Idle Time (hour)		0.083		0.083		
No. Volume Sources On and Offsite on Stn Road	34	2	73	6	5	10
Maximum number of trucks or loads						
1-hour	7	7	9	9	7	10
Annual average	15,200	15,200	21,620	21,620	2,330	100000
EMFAC2007 Emission Factors (g/mi/trk or g/idle-hour/trk)						
PM_{10}	0.087	0.114	0.087	0.114	0.087	0.024

EMFAC emissions are for fleet year 2010. PM10 emission factor does not include tire wear or break wear contributions.
Feedstock and Product truck emissions are for HHD diesel trucks. O&M trucks are light heavy-duty 2 trucks.

PM10 Emission Rates

	Petcoke and Coal Trucks (@ 10 mph)		Fluxant & Product Trucks (@ 10 mph)		Miscellaneous Truck (@ 10 mph)	Onsite O&M Trucks (@ 15 mph)
Emission Rates for HARP	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Running Emissions Diesel LHDT2
1-hr PM_{10} (pounds per hour)	1.2E-03	1.4E-04	4.2E-03	1.9E-04	3.0E-03	5.3E-04
Annual PM_{10} (pounds per year)	2.8E+00	3.2E-01	1.0E+01	4.5E-01	9.8E-01	5.3E+00

HARP Inputs - Annual and Hourly Emission Rates per Volume Source

	Onsite Petcoke and Coal Trucks (@ 10 mph)		Fluxant & Product Trucks (@ 10 mph)		Miscellaneous Truck (@ 10 mph)	Onsite O&M Trucks (@ 15 mph)
	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Idling Emissions (at each Idle Point)	Running Emissions	Running Emissions
Max PM_{10} pounds per hour per volume source	3.7E-05	7.1E-05	5.8E-05	3.1E-05	5.9E-04	5.3E-05
PM_{10} pounds per year per volume source	8.2E-02	1.6E-01	1.4E-01	7.5E-02	2.0E-01	5.3E-01

Maximum Number of Unit Trains	Coal Unit Train (incoming)	Product Unit Train (outgoing)	Maximum Total Trains per period
1-hour	1	1	1
Annual average	119	165	284

	Switching Engine	Line-haul Engine for Coal Train	Line-haul Engine for Product Train
PM10 Emission Factor (g/bhp-hr)	0.08	0.08	0.08
Conversion Factor (bhp-hr/gal)	15.2	20.8	20.8
PM10 Emissions (lbs/hr /engine)	0.046	0.039	0.026
Engine Power Rating (hp)		4400	3000
Notch Operation		1	1
Notch percentage of hp		5.0%	5.0%
Avg Notch horsepower	260	220	150
# of engines per train	1	2	2
hours to unload/load each train		2	1
max operating hours (hrs/year)	1248		
Number of Volume Sources in AERMOD/HARP	104		

Notes:

Emission factors from EPA's Technical Highlights: Emission Factors for Locomotives, 2009 (http://www.epa.gov/nonroad/locomotv/420f09025.pdf).
The majority of the time the line-haul engine will operate in Notch 1 or idling, therefore emissions were conservatively estimated for Notch 1 horsepower.
Notch percentage presented in PORT OF LONG BEACH AIR EMISSIONS INVENTORY for 2007 (POLB, Jan 2009) derived from EPA data.
New line-haul engines will be AC locomotives such as the GE Evolution Series, that meet Tier 3 emissions
New switching engines will meet Tier 3 emissions, they may be the Titan Trackmobile railcar movers or similar

PM10 Emission Rates

	Switching Engine Emissions	Coal Line-haul Engine Emissions	Product Line-haul Engine Emissions
1-hr PM_{10} (pounds per hour)	0.05	0.08	0.00
Annual PM_{10} (pounds per year)	57.18	18.45	8.72

During a given hour either the line-haul engines for the coal train or product train operate, not both, thus emissions from the larger coal trains are only included in the peak hour emissions.

HARP Inputs - Annual and Hourly Emission Rates per Volume Source

Diesel Particulate Matter	Onsite Train Emissions
Max PM_{10} pounds per hour per volume source	1.2E-03
PM_{10} pounds per year per volume source	8.1E-01

FUGITIVE EMISSIONS CALCULATIONS
Hydrogen Energy California, LLC
Hydrogen Energy California (HECA) Project

STREAM SPECIATION

Weight %

Stream	Gasification Block											
	1	2	3	4	5	6	7	8	9	10	11	12
	Methanol	Syn Gas	Not Used	Shifted Syn Gas	Propylene	Sour Water	H_2S Laden Methanol	CO_2 Laden Methanol	Acid Gas	Ammonia Laden Gas	Sulfur	SRU Tail Gas
Fluid Phase	Liquid	Vapor		Vapor	Liquid & Vapor	Liquid	Liquid	Liquid	Vapor	Vapor	Liquid	Vapor
Compound												
Carbon dioxide (CO_2)	0.00%	8.02%		59.90%	0.00%	1.98%	15.64%	27.34%	49.76%	60.57%	0.00%	65.26%
Carbon monoxide (CO)	0.00%	43.27%		2.97%	0.00%	0.01%	0.01%	0.01%	2.05%	0.22%	0.00%	2.46%
Methane (CH_4)	0.00%	0.59%		0.60%	0.00%	0.00%	0.00%	0.01%	0.00%	0.01%	0.00%	0.00%
Hydrogen Sulfide (H_2S)	0.00%	0.58%		0.62%	0.00%	0.05%	0.92%	0.00%	28.46%	1.35%	0.02%	1.99%
Ammonia (NH_3)	0.00%	0.14%		0.11%	0.00%	0.70%	0.00%	0.00%	0.00%	20.15%	0.00%	0.00%
Sulfur dioxide (SO_2)	0.00%	0.00%		0.00%	0.00%	0.00%	0.00%	0.00%	3.12%	0.00%	0.00%	0.38%
Hydrogen Chloride (HCl)	0.00%	0.00%		0.00%	0.00%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Nitric acid (HNO_3)	0.00%	0.00%		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Nitrogen dioxide (NO_2)	0.00%	0.00%		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Carbonyl Sulfide (COS)	0.00%	0.24%		0.00%	0.00%	0.08%	0.00%	0.00%	2.71%	2.09%	0.00%	0.29%
Methanol (CH_3OH)	99.74%	0.00%		0.00%	0.00%	0.00%	79.06%	72.36%	1.51%	0.00%	0.00%	0.00%
Propylene (C_3H_6)	0.00%	0.00%		0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Benzene (C_6H_6)	0.00%	0.00%		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Hydrogen Cyanide (HCN)	0.00%	0.01%		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04%	0.00%	0.00%
Other (Inerts)	0.26%	47.15%		35.81%	0.00%	97.14%	4.35%	0.27%	12.39%	15.58%	99.98%	29.62%
Total	**100.0%**	**100.0%**		**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Percentage of VOC of the stream *	**99.74%**	**0.25%**		**0.01%**	**100.00%**	**0.08%**	**79.07%**	**72.36%**	**4.23%**	**2.13%**	**0.00%**	**0.29%**

Stream	Fertilizer Complex											Gasification Block	
	13	14	15	16	17	18	18a	18b	19	20	21	22	23
	Low NH3 Concentration	Moderate NH3 Concentration	High NH3 Concentration	Low CO2 Concentration	Moderate CO2 Concentration	High CO2 Concentration	CO2 Product and Purification Compressors	Urea CO2 Compressor	NO2	HNO3	PSA Off Gas	Lower Benzene Concentration	Higher Benzene Concentration
Fluid Phase	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Vapor	Vapor	Vapor
Compound													
Carbon dioxide (CO_2)	5.77%	37.53%	0.76%	18.90%	37.53%	97.76%	97.76%	100.00%	0.00%	0.00%	14.72%	47.80%	7.30%
Carbon monoxide (CO)	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	8.58%	0.00%	0.00%
Methane (CH_4)	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	3.10%	0.00%	0.00%
Hydrogen Sulfide (H_2S)	0.00%	0.00%	0.00%	0.00%	0.00%	1.56%	0.00%	0.00%	0.00%	0.00%	0.00%	4.20%	0.80%
Ammonia (NH_3)	15.59%	49.17%	97.98%	31.31%	49.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Sulfur dioxide (SO_2)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Hydrogen Chloride (HCl)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Nitric acid (HNO_3)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	56.22%	0.00%	0.02%	0.02%
Nitrogen dioxide (NO_2)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	7.28%	0.00%	0.00%	0.02%	0.02%
Carbonyl Sulfide (COS)	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Methanol (CH_3OH)	0.00%	0.00%	0.00%	0.00%	0.00%	0.40%	0.03%	0.00%	0.00%	0.00%	0.03%	46.30%	86.80%
Propylene (C_3H_6)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Benzene (C_6H_6)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.80%	5.10%
Hydrogen Cyanide (HCN)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Other (Inerts)	78.61%	13.30%	1.26%	49.74%	13.30%	0.26%	2.14%	0.00%	92.71%	43.78%	73.58%	0.90%	0.00%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Percentage of VOC of the stream *	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.41%**	**0.04%**	**0.00%**	**0.00%**	**0.00%**	**0.03%**	**47.10%**	**91.90%**

Note:
- Per District policy (SSP-2015), VOC emissions are not assessed to components handling fluid streams with a VOC content of 10% of less by weight.
- The following compounds are included as VOCs, although not all compounds are found in the gas in each process area: CH3OH, C3H6, COS, C6H6, and HCN.

EMISSION FACTORS

Equipment Type	Service	Emission Factor* (kg/hr/source)	Emission Factor (lb/hr/source)	Control Efficiency*
Valves	Gas	0.00597	0.0132	92%
Valves	Light liquid	0.00403	0.0089	88%
Valves	Heavy liquid	0.00023	0.0005	0%
Pump seals	Light liquid	0.0199	0.0439	100%
Pump seals	Heavy liquid	0.00862	0.0190	0%
Compressor seals	Gas	0.228	0.5027	100%
Pressure relief valves	Gas	0.104	0.2293	0%
Connectors	All	0.00183	0.0040	93%
Open-ended lines	All	0.0017	0.0037	0%
Sampling connectors	All	0.015	0.0331	0%

Notes:
- Emission factors and control efficiencies are from EPA's 1995 "Protocol for Equipment Leak Emission Estimates".
- Emission factors are from Table 2-1 (SOCMI Average Emission Factors).
- Control efficiencies are from Table 5-2 (Control Effectiveness for an LDAR Program at a SOCMI Process Unit).
- The plant will implement an LDAR program for the process streams identified as #1, 5, 7-10, and 12-23. Therefore, the control efficiencies for valves and connectors will apply to those streams.
- All light liquid pump seals and compressor seals will have dual mechanical seals and barrier fluid maintained at a higher pressure than the pump fluid or compressed gas, thus these control efficiency are from Table 5-1.
- Emission are conservative since many of these streams are not as volatile as the streams that the SOCMI factors were developed for.

STREAM COMPONENT COUNTS

Count

Stream	Gasification Block											
	1	2	3	4	5	6	7	8	9	10	11	12
	Methanol	Syn Gas	Not Used	Shifted Syn Gas	Propylene	Sour Water	H_2S Laden Methanol	CO_2 Laden Methanol	Acid Gas	Ammonia Laden Gas	Sulfur	SRU Tail Gas
Fluid Phase	Liquid	Vapor		Vapor	Liquid & Vapor	Liquid	Liquid	Liquid	Vapor	Vapor	Liquid	Vapor
Component												
Valves - Gas	0	69		342	36	0	0	0	122	98	0	66
Valves - Light Liquid	257	0		0	546	0	290	285	0	0	0	0
Valves - Heavy Liquid	0	0		0	0	366	0	0	0	0	17	0
Pumps - Light Liquid	4	0		0	0	0	6	6	0	0	0	0
Pumps - Heavy Liquid	0	0		0	0	8	0	0	0	0	0	0
Compressors	0	0		0	2	0	0	0	0	0	0	5
Connectors	824	208		1024	1642	958	962	932	388	252	118	276
Total	**1085**	**277**		**1366**	**2226**	**1332**	**1258**	**1223**	**510**	**350**	**135**	**347**

Stream	Fertilizer Complex											Gasification Block		
	13	14	15	16	17	18	18a	18b	19	20	21	22	23	
	Low NH3 Concentration	Moderate NH3 Concentration	High NH3 Concentration	Low CO2 Concentration	Moderate CO2 Concentration	High CO2 Concentration	CO2 Product and Purification Compressors	Urea CO2 Compressor	NO2	HNO3	PSA Off Gas	Lower Benzene Concentration	Higher Benzene Concentration	**Total All Streams**
Fluid Phase	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Vapor	Vapor	Vapor	
Component														
Valves - Gas	197	6	147	20	6	506	0	0	5	0	164	18	0	**1799**
Valves - Light Liquid	105	2	206	107	0	0	0	0	0	66	0	134	87	**2082**
Valves - Heavy Liquid	0	0	0	0	0	0	0	0	0	0	0	0	0	**383**
Pumps - Light Liquid	6	0	4	6	0	0	0	0	0	2	0	4	2	**40**
Pumps - Heavy Liquid	0	0	0	0	0	0	0	0	0	0	0	0	0	**8**
Compressors	0	0	0	0	0	0	10	2	0	0	5	0	0	**24**
Connectors	826	44	886	400	34	1446	0	0	34	188	540	474	276	**12732**
Total	**1134**	**52**	**1243**	**532**	**40**	**1952**	**10**	**2**	**39**	**256**	**709**	**630**	**365**	**17067**

Note:
- Values shown for number of sources were multiplied by the following factors to account for unknown emission sources: Valves: 1.5; Connectors: 2.
- Each compressor stage considered as a separate compressor.

CALCULATED CONTROLLED EMISSIONS BY COMPONENT (LB/HR)

Stream	Emissions (lb/hr)																									Total All Streams
	Gasification Block												Fertilizer Complex											Gasification Block		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18a	18b	19	20	21	22	23	
	Methanol	Syn Gas	Not Used	Shifted Syn Gas	Propylene	Sour Water	H_2S Laden Methanol	CO_2 Laden Methanol	Acid Gas	Ammonia Laden Gas	Sulfur	SRU Tail Gas	Low NH3 Concentration	Moderate NH3 Concentration	High NH3 Concentration	Low CO2 Concentration	Moderate CO2 Concentration	High CO2 Concentration	CO2 Product and Purification Compressors	Urea CO2 Compressor	NO2	HNO3	PSA Off Gas	Lower Benzene Concentration	Higher Benzene Concentration	
Fluid Phase	Liquid	Vapor		Vapor	Liquid & Vapor	Liquid	Liquid	Liquid	Vapor	Vapor	Liquid	Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Vapor	Vapor	Vapor	
Component																										
Valves - Gas	0.00E+00	9.08E-01		4.50E+00	3.79E-02	0.00E+00	0.00E+00	0.00E+00	1.28E-01	1.03E-01	0.00E+00	8.69E-01	2.07E-01	6.32E-03	1.55E-01	2.05E-02	6.32E-03	5.32E-01	0.00E+00	0.00E+00	4.74E-03	0.00E+00	1.72E-01	1.90E-02	0.00E+00	**7.67**
Valves - Light Liquid	2.73E-01	0.00E+00		0.00E+00	5.82E-01	0.00E+00	3.09E-01	3.04E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.12E-01	1.60E-03	2.19E-01	1.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.04E-02	0.00E+00	1.42E-01	9.28E-02	**2.22**
Valves - Heavy Liquid	0.00E+00	0.00E+00		0.00E+00	0.00E+00	1.86E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.37E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.19**
Pumps - Light Liquid	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00**
Pumps - Heavy Liquid	0.00E+00	0.00E+00		0.00E+00	0.00E+00	1.52E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.15**
Compressors	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00**
Connectors	2.33E-01	8.39E-01		4.13E+00	4.64E-01	3.87E+00	2.72E-01	2.63E-01	1.10E-01	7.12E-02	4.76E-01	1.11E+00	2.33E-01	1.24E-02	2.50E-01	1.13E-01	9.60E-03	4.08E-01	0.00E+00	0.00E+00	9.60E-03	5.31E-02	1.53E-01	1.34E-01	7.79E-02	**13.29**
Total	**0.51**	**1.75**		**8.63**	**1.08**	**4.20**	**0.58**	**0.57**	**0.24**	**0.17**	**0.48**	**1.98**	**0.55**	**0.02**	**0.62**	**0.25**	**0.02**	**0.94**	**0.00**	**0.00**	**0.01**	**0.12**	**0.32**	**0.30**	**0.17**	**23.53**

- The plant will implement an LDAR program for the process streams identified as #1, 5, 7-10, and 13-23. Therefore, the control efficiencies will apply to those streams.

CALCULATED CONTROLLED EMISSIONS BY COMPOUND (LB/HR)

Stream	Emissions (lb/hr)																									Total All Streams
	Gasification Block												Fertilizer Complex											Gasification Block		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18a	18b	19	20	21	22	23	
	Methanol	Syn Gas	Not Used	Shifted Syn Gas	Propylene	Sour Water	H_2S Laden Methanol	CO_2 Laden Methanol	Acid Gas	Ammonia Laden Gas	Sulfur	SRU Tail Gas	Low NH3 Concentration	Moderate NH3 Concentration	High NH3 Concentration	Low CO2 Concentration	Moderate CO2 Concentration	High CO2 Concentration	CO2 Product and Purification Compressors	Urea CO2 Compressor	NO2	HNO3	PSA Off Gas	Lower Benzene Concentration	Higher Benzene Concentration	
Fluid Phase	Liquid	Vapor		Vapor	Liquid & Vapor	Liquid	Liquid	Liquid	Vapor	Vapor	Liquid	Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Vapor	Vapor	Vapor	
Compound																										
CO_2	0.00E+00	1.40E-01		5.17E+00	0.00E+00	8.33E-02	9.08E-02	1.55E-01	1.18E-01	1.05E-01	0.00E+00	1.29E+00	3.19E-02	7.64E-03	4.73E-03	4.67E-02	5.98E-03	9.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.78E-02	1.41E-01	1.25E-02	**8.37**
CO	0.00E+00	7.56E-01		2.56E-01	0.00E+00	3.07E-04	3.25E-05	7.20E-05	4.86E-03	3.77E-04	0.00E+00	4.87E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.40E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.79E-02	0.00E+00	0.00E+00	**1.09**
CH_4	0.00E+00	1.03E-02		5.17E-02	0.00E+00	1.26E-05	2.61E-05	7.32E-05	4.75E-06	1.51E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.65E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-02	0.00E+00	0.00E+00	**0.07**
H_2S	5.42E-07	1.01E-02		5.33E-02	0.00E+00	2.09E-03	5.37E-03	5.67E-07	6.76E-02	2.34E-03	8.82E-05	3.94E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.46E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E-02	1.37E-03	**0.21**
NH_3	0.00E+00	2.48E-03		9.18E-03	0.00E+00	2.93E-02	0.00E+00	0.00E+00	0.00E+00	3.50E-02	0.00E+00	0.00E+00	8.61E-02	1.00E-02	6.11E-01	7.74E-02	7.83E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.87**
SO_2	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.40E-03	0.00E+00	0.00E+00	7.62E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.02**
HCl	0.00E+00	1.22E-05		0.00E+00	0.00E+00	1.98E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00**
HNO_3	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.44E-06	6.94E-02	0.00E+00	5.03E-05	2.91E-05	**0.07**
NO_2	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-03	0.00E+00	0.00E+00	5.03E-05	2.91E-05	**0.00**
COS	0.00E+00	4.27E-03		3.28E-04	0.00E+00	3.24E-03	2.38E-05	5.08E-08	6.45E-03	3.62E-03	0.00E+00	5.84E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.69E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.02**
CH_3OH	5.05E-01	0.00E+00		8.63E-05	0.00E+00	0.00E+00	4.59E-01	4.10E-01	3.59E-03	3.82E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.77E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.67E-05	1.37E-01	1.48E-01	**1.67**
C_3H_6	0.00E+00	0.00E+00		0.00E+00	1.08E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**1.08**
C_6H_6	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.36E-03	8.71E-03	**0.01**
HCN	1.42E-05	1.29E-04		1.73E-05	0.00E+00	1.18E-04	1.74E-05	1.02E-05	5.46E-06	7.02E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.30E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00**
Total VOC	**5.05E-01**	**4.40E-03**		**4.32E-04**	**1.08E+00**	**3.35E-03**	**4.59E-01**	**4.10E-01**	**1.00E-02**	**3.70E-03**	**0.00E+00**	**5.84E-03**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**3.86E-03**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**8.67E-05**	**1.39E-01**	**1.57E-01**	**2.79**

Notes:
- Per District policy (SSP-2015), VOC emissions are not assessed to components handling fluid streams with a VOC content of 10% of less by weight.
- The following compounds are included as VOCs, although not all compounds are found in the gas in each process area: CH3OH, C3H6, COS, C6H6, and HCN.

CALCULATED CONTROLLED EMISSIONS BY COMPOUND (TONS/YEAR)

Stream	Emissions (tons/year)																									Total All Streams
	Gasification Block												Fertilizer Complex											Gasification Block		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18a	18b	19	20	21	22	23	
	Methanol	Syn Gas	Not Used	Shifted Syn Gas	Propylene	Sour Water	H_2S Laden Methanol	CO_2 Laden Methanol	Acid Gas	Ammonia Laden Gas	Sulfur	SRU Tail Gas	Low NH3 Concentration	Moderate NH3 Concentration	High NH3 Concentration	Low CO2 Concentration	Moderate CO2 Concentration	High CO2 Concentration	CO2 Product and Purification Compressors	Urea CO2 Compressor	NO2	HNO3	PSA Off Gas	Lower Benzene Concentration	Higher Benzene Concentration	
Fluid Phase	Liquid	Vapor		Vapor	Liquid & Vapor	Liquid	Liquid	Liquid	Vapor	Vapor	Liquid	Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Liquid & Vapor	Vapor	Vapor	Vapor	Vapor	Vapor	Liquid	Vapor	Vapor	Vapor	
Compound																										
CO_2	0.00E+00	6.14E-01		2.26E+01	0.00E+00	3.65E-01	3.98E-01	6.79E-01	5.18E-01	4.61E-01	0.00E+00	5.67E+00	1.40E-01	3.34E-02	2.07E-02	2.05E-01	2.62E-02	4.03E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.09E-01	6.18E-01	5.46E-02	**36.68**
CO	0.00E+00	3.31E+00		1.12E+00	0.00E+00	1.34E-03	1.42E-04	3.15E-04	2.13E-02	1.65E-03	0.00E+00	2.13E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.80E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-01	0.00E+00	0.00E+00	**4.79**
CH_4	0.00E+00	4.51E-02		2.26E-01	0.00E+00	5.52E-05	1.14E-04	3.20E-04	2.08E-05	6.62E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.41E-02	0.00E+00	0.00E+00	**0.32**
H_2S	2.37E-06	4.41E-02		2.34E-01	0.00E+00	9.15E-03	2.35E-02	2.48E-06	2.96E-01	1.03E-02	3.86E-04	1.72E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.43E-02	5.98E-03	**0.91**
NH_3	0.00E+00	1.09E-02		4.02E-02	0.00E+00	1.28E-01	0.00E+00	0.00E+00	0.00E+00	1.53E-01	0.00E+00	0.00E+00	3.77E-01	4.38E-02	2.68E+00	3.39E-01	3.43E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**3.81**
SO_2	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.24E-02	0.00E+00	0.00E+00	3.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.07**
HCl	0.00E+00	5.36E-05		0.00E+00	0.00E+00	8.69E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.01**
HNO_3	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E-05	3.04E-01	0.00E+00	2.20E-04	1.27E-04	**0.30**
NO_2	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.57E-03	0.00E+00	0.00E+00	2.20E-04	1.27E-04	**0.00**
COS	0.00E+00	1.87E-02		1.44E-03	0.00E+00	1.42E-02	1.04E-04	2.22E-07	2.82E-02	1.59E-02	0.00E+00	2.56E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.24E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.10**
CH_3OH	2.21E+00	0.00E+00		3.78E-04	0.00E+00	0.00E+00	2.01E+00	1.80E+00	1.57E-02	1.68E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.80E-04	5.99E-01	6.49E-01	**7.30**
C_3H_6	0.00E+00	0.00E+00		0.00E+00	4.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**4.75**
C_6H_6	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-02	3.81E-02	**0.05**
HCN	6.24E-05	5.66E-04		7.56E-05	0.00E+00	5.15E-04	7.63E-05	4.47E-05	2.39E-05	3.08E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.20E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**0.00**
Total VOC	**2.21E+00**	**1.93E-02**		**1.89E-03**	**4.75E+00**	**1.47E-02**	**2.01E+00**	**1.80E+00**	**4.40E-02**	**1.62E-02**	**0.00E+00**	**2.56E-02**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**1.69E-02**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**3.80E-04**	**6.09E-01**	**6.87E-01**	**12.20**

Note:
- The following compounds are included as VOCs, although not all compounds are found in the gas in each process area: CH3OH, C3H6, COS, C6H6, and HCN.

VOLUME SOURCES EMISSION RATES FOR MODELING

Compound	Emission Rate (lb/hr)											
	Gasification Unit						Fertilizer Complex					
	GASIFICATION (Stream #2)	SHIFT (Stream #4 and #6)	AGR (Stream #1, #5, #7, #8, and #9)	Sour Water Stripper (Stream #10)	SRU (Stream #11 and #12)	Benzene (Stream #22 and #23)	UAN Unit (Stream #19 and #20)	Urea Unit (Stream #14, #16, and #17)	Ammonia Unit (Stream #13 and #15)	CO2 Compression (Stream #18 and #18a)	Urea CO2 Compressor (Stream #18b)	PSA Unit (Stream #21)
CO_2	4.67E-02	2.63E+00	3.64E-01	1.05E-01	6.47E-01	1.54E-01	0.00E+00	3.02E-02	1.83E-02	9.20E-01	0.00E+00	4.78E-02
CO	2.52E-01	1.28E-01	4.96E-03	3.77E-04	2.44E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.40E-05	0.00E+00	2.79E-02
CH_4	3.43E-03	2.59E-02	1.04E-04	1.51E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.65E-05	0.00E+00	1.01E-02
H_2S	3.35E-03	2.77E-02	7.30E-02	2.34E-03	1.97E-02	1.38E-02	0.00E+00	0.00E+00	0.00E+00	1.46E-02	0.00E+00	0.00E+00
NH_3	8.28E-04	1.92E-02	0.00E+00	3.50E-02	0.00E+00	0.00E+00	0.00E+00	4.76E-02	3.49E-01	0.00E+00	0.00E+00	0.00E+00
SO_2	0.00E+00	0.00E+00	7.40E-03	0.00E+00	3.81E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HCl	4.08E-06	9.92E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HNO_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.94E-05	6.94E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.94E-05	1.04E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
COS	1.42E-03	1.78E-03	6.47E-03	3.62E-03	2.92E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.69E-05	0.00E+00	0.00E+00
CH_3OH	0.00E+00	4.32E-05	1.38E+00	3.82E-06	0.00E+00	2.85E-01	0.00E+00	0.00E+00	0.00E+00	3.77E-03	0.00E+00	8.67E-05
C_3H_6	0.00E+00	0.00E+00	1.08E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C_6H_6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HCN	4.31E-05	6.75E-05	4.73E-05	7.02E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.30E-07	0.00E+00	0.00E+00

Compound	Emission Rate (lb/yr)											
	Gasification Unit						Fertilizer Complex					
	GASIFICATION (Stream #2)	SHIFT (Stream #4 and #6)	AGR (Stream #1, #5, #7, #8, and #9)	Sour Water Stripper (Stream #10)	SRU (Stream #11 and #12)	Benzene (Stream #22 and #23)	UAN Unit (Stream #19 and #20)	Urea Unit (Stream #14, #16, and #17)	Ammonia Unit (Stream #13 and #15)	CO2 Compression (Stream #18 and #18a)	Urea CO2 Compressor (Stream #18b)	PSA Unit (Stream #21)
CO_2	4.09E+02	2.30E+04	3.19E+03	9.22E+02	5.67E+03	1.35E+03	0.00E+00	2.64E+02	1.60E+02	8.06E+03	0.00E+00	4.19E+02
CO	2.21E+03	1.12E+03	4.35E+01	3.30E+00	2.13E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.60E-01	0.00E+00	2.44E+02
CH_4	3.00E+01	2.27E+02	9.11E-01	1.32E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-01	0.00E+00	8.82E+01
H_2S	2.94E+01	2.43E+02	6.39E+02	2.05E+01	1.73E+02	1.21E+02	0.00E+00	0.00E+00	0.00E+00	1.28E+02	0.00E+00	0.00E+00
NH_3	7.26E+00	1.68E+02	0.00E+00	3.07E+02	0.00E+00	0.00E+00	0.00E+00	4.17E+02	3.06E+03	0.00E+00	0.00E+00	0.00E+00
SO_2	0.00E+00	0.00E+00	6.48E+01	0.00E+00	3.34E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HCl	3.57E-02	8.69E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HNO_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.95E-01	6.08E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.95E-01	9.14E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
COS	1.25E+01	1.56E+01	5.67E+01	3.17E+01	2.56E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.49E-01	0.00E+00	0.00E+00
CH_3OH	0.00E+00	3.78E-01	1.21E+04	3.35E-02	0.00E+00	2.50E+03	0.00E+00	0.00E+00	0.00E+00	3.30E+01	0.00E+00	7.59E-01
C_3H_6	0.00E+00	0.00E+00	9.49E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C_6H_6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.69E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HCN	3.78E-01	5.91E-01	4.15E-01	6.15E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.40E-03	0.00E+00	0.00E+00

Volume Source Parameters

Number of Volume Sources	3	2	1	1	2	1	1	2	2	1	1	1
Horizontal dimension (m)	28.00	35.00	48.00	16.00	16.00	24.00	24.00	12.00	24.00	20.00	24.00	24.00
Release height (m)	39.62	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10
Horizontal dimension (m)	13.02	16.28	22.33	7.44	7.44	11.16	11.16	5.58	11.16	9.30	11.16	11.16
Vertical dimension (m)	36.86	5.67	5.67	5.67	5.67	5.67	5.67	5.67	5.67	5.67	5.67	5.67
Vertical dimension used for calcs (ft)	260.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00

Note:

- Emissions are divided by the number of volume sources.

Methanol Tank

Hydrogen Energy California, LLC *19-Apr-2013*
Hydrogen Energy California (HECA) Project

Methanol storage tank parameters and fugitive emissions

Tank ID	Description	Uncontrolled VOC Emissions	Peak Month VOC Emissions	Daily VOC Emissions	Annual VOC emissions
		lb/month	lb/month	lb/day	lb/year
Methanol	Working Loss (33,000 gal pumped in)	82.24	0.0185	-	-
	Breathing Loss	1353.84	0.3049	0.0102	
	Total Breathing and Working Loss		-	0.0287	3.93

Methanol Vent Scrubber Efficiency		
Pre-scrubber	17.76%	methanol
Post-scrubber	40	ppm methanol
Control Efficiency	99.977%	

Methanol concentration information provided by Fluor
Uncontrolled emissions calculated using TANKS model
Peak daily emissions include losses during filling the entire tank plus breathing losses

HECA Project
Major Source Emission Calculations with Significance Thresholds for PSD

Total Reduced Sulfur

Pollutant	Annual Rate (tons per year)	TRS as H2S (tons/yr)	Molecular Wt	Source of emissions	Significance Threshold (tons/yr)	Significant?
Hydrogen Sulfide	2.44	2.44	34	CO_2 vent and fugitives		
Carbonyl Sulfide	2.79	1.58	60	CO_2 vent and fugitives		
	Total	**4.02**			10.00	no

TRS definition: the total reduced sulfur contained in hydrogen sulfide, mercaptans, dimethyl sulfide, dimethyl disulfide or other organic sulfide compounds, all expressed as hydrogen sulfide. Sulfur dioxide, sulfur trioxide, or sulfuric acid are not to be included in the determination of TRS.

Reduced Sulfur Compounds

Pollutant	Annual Rate (tons per year)	RSC as H2S (tons/yr)	Molecular Wt	Source of emissions	Significance Threshold (tons/yr)	Significant?
Hydrogen Sulfide	2.44	2.44	34	CO_2 vent and fugitives		
Carbon Disulfide	0.54	0.24	76	CTG/HRSG and coal dryer		
Carbonyl Sulfide	2.79	1.58	60	CO_2 vent and fugitives		
	Total	**4.26**			10.00	no

Reduced sulfur compounds means H2S, carbonyl sulfide (COS), and carbon disulfide (CS2).

Sulfuric Acid Mist

Pollutant	Annual Rate (tons per year)	Significance Threshold (tons/yr)	Significant ?	Source of emissions
Sulfuric Acid Mist	1.12	7.00	no	CTG/HRSG and coal dryer

Hydrogen Sulfide

Pollutant	Annual Rate (tons per year)	Significance Threshold (tons/yr)	Significant ?	Source of emissions
Hydrogen Sulfide	2.44	10.00	no	CO_2 vent and fugitives

Fluorides

Pollutant	Annual Rate (tons per year)	Significance Threshold (tons/yr)	Significant ?	Source of emissions
Fluoride	0.001	3.00	no	Cooling towers

Lead

Pollutant	Annual Rate (tons per year)	Significance Threshold (tons/yr)	Significant ?	Source of emissions
Lead	0.007	0.60	no	CTG/HRSG and coal dryer

Pollutants listed above are in 40 CFR 52.21 (as of Apr 6, 2012)

APPENDIX C

REVISED OPERATIONAL TRANSPORTATION EMISSIONS FOR ALTERNATIVE 1

Summary of Applicable Operational Emissions for General Conformity (Alternative 1) - 2017 Overlapping with Construction

Federal NAAQS Nonattainment or Maintenance Area General Name and State	Detailed Status in Nonattainment or Maintenance Area	Authority Agency	Basis to Estimate the Offsite Transportation Distance	Emission Sources / Applicable General Conformity Thresholds / Comparisons	Project Operational Annual Emission Rates - for General Conformity (tpy)					
					CO	NOx	PM10	PM2.5	SO2	VOC
San Joaquin Valley, CA	8-Hour Ozone (2008) Nonattainment - Extreme PM2.5 Nonattainment CO Maintenance - Maderate - Fresno, CA (Part of Fresno County), Modesto, CA (Part of Stanislaus County), Stockton, CA (Part of San Joaquin County)	SJVAPCD	**Construction** - Entire SJVAPCD jurisdiction area (one way trip: trucks = worker vehicles = 20 miles)	Onsite Construction Equipment	2.65	3.84	0.48	0.27	0.00	0.83
				Onsite Trucks	0.15	0.34	0.09	0.03	0.00	0.09
				Onsite Vehicles	0.08	0.01	0.22	0.02	0.00	0.01
				Onsite Total	**2.88**	**4.18**	**0.79**	**0.32**	**0.01**	**0.93**
				Offsite Linears Equipment	0.00	0.00	0.00	0.00	0.00	0.00
				Offsite Trucks	1.02	5.16	0.42	0.21	0.00	0.22
				Offsite Vehicles	5.98	0.72	0.20	0.07	0.01	0.18
				Offsite Total	**6.99**	**5.87**	**0.61**	**0.28**	**0.01**	**0.41**
				Total Construction Emission (ton/yr)	**9.87**	**10.06**	**1.40**	**0.60**	**0.02**	**1.34**
	PM10 Maintenance		**Operation** - Entire SJVAPCD jurisdiction area (one way trip: trains = 63 to 287 miles, trucks = 40 to 80 miles, worker vehicles = 20 miles)	Offsite Train	2.31	8.93	0.14	0.14	0.16	0.25
				Offsite Truck	1.85	3.05	0.84	0.25	0.02	0.26
				Offsite Workers Commuting	1.39	0.16	0.35	0.09	0.00	0.04
				Onsite Train	0.29	0.82	0.01	0.01	0.02	0.04
				Onsite Truck	0.21	0.33	0.05	0.02	0.00	0.05
				Total Operation Emissions	**6.05**	**13.29**	**1.40**	**0.52**	**0.21**	**0.64**
				Total Construction and Operation Overlapping Emissions	**15.92**	**23.35**	**2.80**	**1.12**	**0.23**	**1.98**
				Applicable General Conformity *de minimis* Thresholds	**100**	**10**	**100**	**100**	**100**	**10**
				Less Than Thresholds?	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**
Los Angeles-South Coast Air Basin, CA	8-Hour Ozone (2008) Nonattainment - Extreme PM10 Nonattainment - Serious PM2.5 Nonattainment NO2 Maintenance CO Maintenance - Serious	SCAQMD	Entire SCAQMD jurisdiction area (one way trip: trucks = 88 to 150 miles)	Offsite Train	0.00	0.00	0.00	0.00	0.00	0.00
				Offsite Truck	1.72	2.84	0.78	0.24	0.02	0.24
				Total Emissions	**1.72**	**2.84**	**0.78**	**0.24**	**0.02**	**0.24**
				Applicable General Conformity *de minimis* Thresholds	**100**	**10**	**70**	**100**	**100**	**10**
				Less Than Thresholds?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Kern County (East Kern), CA	8-Hour Ozone (2008) Nonattainment - Marginal PM10 Nonattainment - Serious	EKAPCD	Entire EKAPCD jurisdiction area (one way trip: trains = 62 to 83 miles)	Offsite Train		4.86	0.08			0.13
				Offsite Truck		0.00	0.00			0.00
				Total Emissions		**4.86**	**0.08**			**0.13**
				Applicable General Conformity *de minimis* Thresholds		**100**	**70**			**100**
				Less Than Thresholds?		**Yes**	**Yes**			**Yes**
Los Angeles-San Bernardino Counties (West Mojave Desert), CA	8-Hour Ozone (2008) Nonattainment - Severe 15 (Part of San Bernardino and Los Angeles Counties)	MDAQMD	Los Angeles-San Bernardino Counties (West Mojave Desert) - 8-hr Ozone (2008) NAA (one way trip: trains = 120	Offsite Train		8.27				0.23
				Offsite Truck		0.00				0.00
				Total Emissions		**8.27**				**0.23**
				Applicable General Conformity *de minimis* Thresholds		**25**				**25**
				Less Than Thresholds?		**Yes**				**Yes**
San Bernardino County, CA (Mojave Desert)	PM10 Nonattainment - Moderate	MDAQMD	Entire MDAQMD jurisdiction area (one way trip: trains = 204 miles)	Offsite Train			0.23			
				Offsite Truck			0.00			
				Total Emissions			**0.23**			
				Applicable General Conformity *de minimis* Thresholds			**100**			
				Less Than Thresholds?			**Yes**			
Sacramento Metro, CA	8-Hour Ozone (2008) Nonattainment - Severe 15 PM10 Nonattainment - Moderate (Sacramento County) PM2.5 Nonattainment CO Maintenance - Moderate - Sacramento, CA (Part of Placer, Sacramento and Yolo Counties)	SMAQMD	Entire SMAQMD jurisdiction area (one way trip: trains = 80 miles)	Offsite Train	0.20	0.77	0.01	0.01	0.01	0.02
				Offsite Truck	0.00	0.00	0.00	0.00	0.00	0.00
				Total Emissions	**0.20**	**0.77**	**0.01**	**0.01**	**0.01**	**0.02**
				Applicable General Conformity *de minimis* Thresholds	**100**	**25**	**100**	**100**	**100**	**25**
				Less Than Thresholds?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Yuba City-Marysville, CA	PM2.5 Nonattainment (Sutter and Part of Yuba Counties)	FRAQMD	Yuba City-Marysville, CA - PM2.5 NAA (one way trip: trains = 50 miles)	Offsite Train		0.48		0.01	0.01	0.01
				Offsite Truck		0.00		0.00	0.00	0.00
				Total Emissions		**0.48**		**0.01**	**0.01**	**0.01**
				Applicable General Conformity *de minimis* Thresholds		**100**		**100**	**100**	**100**
				Less Than Thresholds?		**Yes**		**Yes**	**Yes**	**Yes**
Chico, CA	8-Hour Ozone (2008) Nonattainment - Marginal (Butte County) PM2.5 Nonattainment (Part of Butte County) CO Maintenance - Moderate (Part of Butte County)	BCAQMD	Chico, CA - 8-Hour Ozone (2008) NAA - Entire Butte County (one way trip: trains = 50 miles)	Offsite Train	0.12	0.48		0.01	0.01	0.01
				Offsite Truck	0.00	0.00		0.00	0.00	0.00
				Total Emissions	**0.12**	**0.48**		**0.01**	**0.01**	**0.01**
				Applicable General Conformity *de minimis* Thresholds	**100**	**100**		**100**	**100**	**100**
				Less Than Thresholds?	**Yes**	**Yes**		**Yes**	**Yes**	**Yes**

Summary of Applicable Operational Emissions for General Conformity (Alternative 1) - 2017 Overlapping with Construction

Hydrogen Energy California LLC *3/05/2013 revision*
HECA Project

NAAs in State of Arizona	8-Hour Ozone (2008) Nonattainment - Marginal - Phoenix-Mesa, AZ (Part of Maricopa and Pinal County) PM10 Nonattainment (Moderate, Serious, or Maintenance) (12 Counties) PM2.5 Nonattainment - Nogales, AZ (Part of Santa Cruz County), West Central Pinal, AZ (West Pinal County) SO2 Nonattainment - Hayden (Pinal County), AZ (Part of Pinal County), Maintenance - San Manual (Pinal County), AZ, Ajo (Pima County), AZ, Douglas (Cochise County), AZ, Miami (Gila County), AZ CO Maintenance - Serious - Phoenix, AZ. (Part of Maricopa)	ADEQ	Entire ADEQ jurisdiction area (one way trip: trains = 364 miles)	Offsite Train	6.48	25.08	0.41	0.39	0.46	0.69
				Offsite Truck	0.00	0.00	0.00	0.00	0.00	0.00
				Total Emissions	**6.48**	**25.08**	**0.41**	**0.39**	**0.46**	**0.69**
				Applicable General Conformity *de minimis* Thresholds	**100**	**100**	**70**	**100**	**100**	**100**
				Less Than Thresholds?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
NAAs in State of New Mexico	PM10 Nonattainment - Moderate - Anthony, NM (Dona Ana County) CO Maintenance (Bernalillo County) SO2 Maintenance - Grant Co, NM	NMED-AQB	Entire NMED-AQB jurisdiction area (one way trip: trains = 102 miles to coal mine site)	Offsite Train	1.81		1.40		0.13	
				Offsite Truck	0.00		0.00		0.00	
				Total Emissions	**1.81**		**1.40**		**0.13**	
				Applicable General Conformity *de minimis* Thresholds	**100**		**100**		**100**	
				Less Than Thresholds?	**Yes**		**Yes**		**Yes**	

Notes:

1. The associated emissions from the onsite worker travel are negligible
2. To simplify the analysis, the biggest area among all detailed NAA areas was conservativly used to estimate the emissions in each main NAA category area.
   For State of Arizona and New Mexico the total distances accross each state along the train routes were conservativly used to estimate the emissions in NAA.
3. The distance for trains and trucks are varied depending on the type to materials transporting and their destinations.
4. In MDAQMD, it is important to note that the size of the ozone NAA and PM10 NAA area are different and the ozone NAA is smaller than PM10 NAA. Therefore, the train route (distance) within MDAQMD in ozone nonattainment area is smaller than the distance in PM10 nonattainment area.
5. ACRONYMS AND ABBREVIATIONS
   MDAQMD = Mojave Desert Air Quality Management District
   SCAQMD = South Coast Air Quality Management District
   EKAPCD = East Kern County Air Pollution Control District
   SMAQMD = Sacramento Metro Air Quality Management District
   BCAQMD = Butte County Air Quality Management District
   FRAQMD = Feather River Air Quality Management District
   ADEQ = Arizona Department of Environmental Quality
   NMED-AQB = New Mexico Environment Department - Air Quality Bureau
6. Construction of the project is expected to complete in June 2017 and the operation will start from September. Therefore, the operational emissions were scaled from the entire year of project operation.

Summary of Applicable Operational Emissions for General Conformity (Alternative 1) - 2018 and Beyond

Hydrogen Energy California LLC *3/05/2013 revision*
HECA Project

Federal NAAQS Nonattainment or Maintenance Area General Name and State	Detailed Status in Nonattainment or Maintenance Area	Authority Agency	Basis to Estimate the Offsite Transportation Distance	Emission Sources / Applicable General Conformity Thresholds / Comparisons	Project Operational Annual Emission Rates - for General Conformity (tpy)					
					CO	**NOx**	**PM10**	**PM2.5**	**SO2**	**VOC**
San Joaquin Valley, CA	8-Hour Ozone (2008) Nonattainment - Extreme PM2.5 Nonattainment CO Maintenance - Moderate - Fresno, CA (Part of Fresno County), Modesto, CA (Part of Stanislaus County), Stockton, CA (Part of San Joaquin County) PM10 Maintenance	SJVAPCD	Entire SJVAPCD jurisdiction area (one way trip: trains = 63 to 287 miles, trucks = 40 to 80 miles, workers= 20 miles)	Offsite Train	6.93	26.80	0.43	0.42	0.49	0.74
				Offsite Truck	5.56	9.15	2.51	0.76	0.07	0.77
				Offsite Workers Commuting	4.17	0.48	1.05	0.28	0.01	0.13
				Onsite Train	0.87	2.45	0.04	0.04	0.06	0.12
				Onsite Truck	0.63	0.98	0.15	0.05	0.01	0.16
				Total Emissions	**18.16**	**39.87**	**4.19**	**1.55**	**0.63**	**1.93**
				Applicable General Conformity *de minimis* Thresholds	**100**	**10**	**100**	**100**	**100**	**10**
				Less Than Thresholds?	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**
Los Angeles-South Coast Air Basin, CA	8-Hour Ozone (2008) Nonattainment - Extreme PM10 Nonattainment - Serious PM2.5 Nonattainment NO2 Maintenance CO Maintenance - Serious	SCAQMD	Entire SCAQMD jurisdiction area (one way trip: trucks = 88 to 150 miles)	Offsite Train	0.00	0.00	0.00	0.00	0.00	0.00
				Offsite Truck	5.17	8.52	2.34	0.71	0.06	0.72
				Total Emissions	**5.17**	**8.52**	**2.34**	**0.71**	**0.06**	**0.72**
				Applicable General Conformity *de minimis* Thresholds	**100**	**10**	**70**	**100**	**100**	**10**
				Less Than Thresholds?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Kern County (East Kern), CA	8-Hour Ozone (2008) Nonattainment - Marginal PM10 Nonattainment - Serious	EKAPCD	Entire EKAPCD jurisdiction area (one way trip: trains = 62 to 83 miles)	Offsite Train		14.57	0.24			0.40
				Offsite Truck		0.00	0.00			0.00
				Total Emissions		**14.57**	**0.24**			**0.40**
				Applicable General Conformity *de minimis* Thresholds		**100**	**70**			**100**
				Less Than Thresholds?		**Yes**	**Yes**			**Yes**
Los Angeles-San Bernardino Counties (West Mojave Desert), CA	8-Hour Ozone (2008) Nonattainment - Severe 15 (Part of San Bernardino and Los Angeles Counties)	MDAQMD	Los Angeles-San Bernardino Counties (West Mojave Desert) - 8-hr Ozone (2008) NAA (one way trip: trains = 120 miles)	Offsite Train		24.80				0.69
				Offsite Truck		0.00				0.00
				Total Emissions		**24.80**				**0.69**
				Applicable General Conformity *de minimis* Thresholds		**25**				**25**
				Less Than Thresholds?		**Yes**				**Yes**
San Bernardino County, CA (Mojave Desert)	PM10 Nonattainment - Moderate	MDAQMD	Entire MDAQMD jurisdiction area (one way trip: trains = 204 miles)	Offsite Train			0.70			
				Offsite Truck			0.00			
				Total Emissions			**0.70**			
				Applicable General Conformity *de minimis* Thresholds			**100**			
				Less Than Thresholds?			**Yes**			
Sacramento Metro, CA	8-Hour Ozone (2008) Nonattainment - Severe 15 PM10 Nonattainment - Moderate (Sacramento County) PM2.5 Nonattainment CO Maintenance - Moderate - Sacramento, CA (Part of Placer, Sacramento and Yolo Counties)	SMAQMD	Entire SMAQMD jurisdiction area (one way trip: trains = 80 miles)	Offsite Train	0.59	2.30	0.04	0.04	0.04	0.06
				Offsite Truck	0.00	0.00	0.00	0.00	0.00	0.00
				Total Emissions	**0.59**	**2.30**	**0.04**	**0.04**	**0.04**	**0.06**
				Applicable General Conformity *de minimis* Thresholds	**100**	**25**	**100**	**100**	**100**	**25**
				Less Than Thresholds?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Yuba City-Marysville, CA	PM2.5 Nonattainment (Sutter and Part of Yuba Counties)	FRAQMD	Yuba City-Marysville, CA - PM2.5 NAA (one way trip: trains = 50 miles)	Offsite Train		1.44		0.02	0.03	0.04
				Offsite Truck		0.00		0.00	0.00	0.00
				Total Emissions		**1.44**		**0.02**	**0.03**	**0.04**
				Applicable General Conformity *de minimis* Thresholds		**100**		**100**	**100**	**100**
				Less Than Thresholds?		**Yes**		**Yes**	**Yes**	**Yes**
Chico, CA	8-Hour Ozone (2008) Nonattainment - Marginal (Butte County) PM2.5 Nonattainment (Part of Butte County) CO Maintenance - Moderate (Part of Butte County)	BCAQMD	Chico, CA - 8-Hour Ozone (2008) NAA - Entire Butte County (one way trip: trains = 50 miles)	Offsite Train	0.37	1.44		0.02	0.03	0.04
				Offsite Truck	0.00	0.00		0.00	0.00	0.00
				Total Emissions	**0.37**	**1.44**		**0.02**	**0.03**	**0.04**
				Applicable General Conformity *de minimis* Thresholds	**100**	**100**		**100**	**100**	**100**
				Less Than Thresholds?	**Yes**	**Yes**		**Yes**	**Yes**	**Yes**

Summary of Applicable Operational Emissions for General Conformity (Alternative 1) - 2018 and Beyond

Hydrogen Energy California LLC *3/05/2013 revision*
HECA Project

NAAs in State of Arizona	8-Hour Ozone (2008) Nonattainment - Marginal - Phoenix-Mesa, AZ (Part of Maricopa and Pinal County) PM10 Nonattainment (Moderate, Serious, or Maintenance) (12 Counties) PM2.5 Nonattainment - Nogales, AZ (Part of Santa Cruz County), West Central Pinal, AZ (West Pinal County) SO2 Nonattainment - Hayden (Pinal County), AZ (Part of Pinal County), Maintenance - San Manual (Pinal County), AZ, Ajo (Pima County), AZ, Douglas (Cochise County), AZ, Miami (Gila County), AZ CO Maintenance - Serious - Phoenix, AZ. (Part of Maricopa)	ADEQ	Entire ADEQ jurisdiction area (one way trip: trains = 364 miles)	Offsite Train	19.45	75.23	1.22	1.18	1.37	2.08
				Offsite Truck	0.00	0.00	0.00	0.00	0.00	0.00
				Total Emissions	**19.45**	**75.23**	**1.22**	**1.18**	**1.37**	**2.08**
				Applicable General Conformity *de minimis* Thresholds	**100**	**100**	**70**	**100**	**100**	**100**
				Less Than Thresholds?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
NAAs in State of New Mexico	PM10 Nonattainment - Moderate - Anthony, NM (Dona Ana County) CO Maintenance (Bernalillo County) SO2 Maintenance - Grant Co, NM	NMED-AQB	Entire NMED-AQB jurisdiction area (one way trip: trains = 102 miles to coal mine site)	Offsite Train	5.42		4.21		0.38	
				Offsite Truck	0.00		0.00		0.00	
				Total Emissions	**5.42**		**4.21**		**0.38**	
				Applicable General Conformity *de minimis* Thresholds	**100**		**100**		**100**	
				Less Than Thresholds?	**Yes**		**Yes**		**Yes**	

Notes:

1. The associated emissions from the onsite worker travel are negligible
2. To simplify the analysis, the biggest area among all detailed NAA areas was conservativly used to estimate the emissions in each main NAA category area.
   For State of Arizona and New Mexico the total distances accross each state along the train routes were conservativly used to estimate the emissions in NAA.
3. The distance for trains and trucks are varied depending on the type to materials transporting and their destinations.
4. In MDAQMD, it is important to note that the size of the ozone NAA and PM10 NAA area are different and the ozone NAA is smaller than PM10 NAA. Therefore, the train route (distance) within MDAQMD in ozone nonattainment area is smaller than the distance in PM10 nonattainment area.
5. ACRONYMS AND ABBREVIATIONS
   MDAQMD = Mojave Desert Air Quality Management District
   SCAQMD = South Coast Air Quality Management District
   EKAPCD = East Kern County Air Pollution Control District
   SMAQMD = Sacramento Metro Air Quality Management District
   BCAQMD = Butte County Air Quality Management District
   FRAQMD = Feather River Air Quality Management District
   ADEQ = Arizona Department of Environmental Quality
   NMED-AQB = New Mexico Environment Department - Air Quality Bureau

3/05/2013 revision

Annual Number of Train Cars (incoming/outgoing)

	Coal Cars (incoming)	Liquid Sulfur Cars (outgoing)	Gasification Cars (outgoing)	Ammonia Cars (outgoing)	Urea Cars (outgoing)	UAN Cars (outgoing)	Maximum Total Trains per period
Annual average number of train cars	13100	85	3170	0	4298	2335	22988

		Line-Haul Engine for Product Trains				
	Line-Haul Engine for Coal Train	Liquid Sulfur	Gasification	Ammonia	Urea	UAN
ton-mile/gallon	480	480	480	480	480	480
Train car capacity (ton)	117	100	100	0	100	100
Unloaded train car weight (ton)	25	25	25	25	25	25

480 ton-mile/gallon is based on 2009 *class I rail freight fuel consumption and travel* data (Association of American Railroads, *Railroad Facts*)

	Coal Trains			Liquid Sulfur Product Train			Gasification Solid Product Train		
Area	Miles traveled per Train (mile/engine) - One Way *	Coal Train (ton-miles/year) - Round Trip	Fuel Use for Coal Train (gal/year) - Round Trip	Miles traveled per Train (mile/engine) - One Way	Product Train (ton-miles/year) - Round Trip	Fuel Use for Product Train (gal/year) - Round Trip	Miles traveled per Train (mile/engine) - One Way	Product Train (ton-miles/year) - Round Trip	Fuel Use for Product Train (gal/year) - Round Trip
San Joaquin Valley, CA	63	137,825,100	287,126	150	1,912,500	3,984	63	29,956,500	62,407
Kern County (East Kern), CA	62	135,637,400	282,568		0	0	83	39,457,775	82,201
San Bernardino County, CA (Mojave Desert) (PM10 nonattainment)	204	445,196,950	927,461		0	0	52	24,734,725	51,529
Los Angeles-San Bernardino Counties (West Mojave Desert), CA - (Ozone nonattainment)	120	262,524,000	546,906		0	0		0	0
State of Arizona (PM10 nonattainment, the maximum distance)	364	796,322,800	1,658,947		0	0		0	0
State of New Mexico	102	222,051,550	462,591		0	0		0	0

* Since exact route of coal train was not determined yet, It was assumed that the coal train would travel across the maximum distance of the nonattainment area for all pollutants in Arizona.

	Ammonia Product Train			Urea Product Train			UAN Product Train		
Area	Miles traveled per Train (mile/engine) - One Way	Product Train (ton-miles/year) - Round Trip	Fuel Use for Product Train (gal/year) - Round Trip	Miles traveled per Train (mile/engine) - One Way	Product Train (ton-miles/year) - Round Trip	Fuel Use for Product Train (gal/year) - Round Trip	Miles traveled per Train (mile/engine) - One Way	Product Train (ton-miles/year) - Round Trip	Fuel Use for Product Train (gal/year) - Round Trip
San Joaquin Valley, CA	0	0	0	287	185,007,375	385,418	264	92,466,000	192,631
Sacramento Metro, CA		0	0	80	51,570,000	107,434		0	0
Yuba City-Marysville, CA		0	0	50	32,231,250	67,146		0	0
Chico, CA		0	0	50	32,231,250	67,146		0	0
Other Area in State of California		0	0	161	103,784,625	216,210		0	0

3/05/2013 revision

offsite locomotive travelling speed in average	40	mph
ratio of required horsepower (empty train/full train)	0.76	
locomotive load factor	28%	

Train Type	Coal	Liquid Sulfur	Gasification Solids	Ammonia	Urea	UAN
Railcar Capacity (ton)	117	100	100	-	100	100
Locomotive Engine Power (hp, each)	4,400	3,000	3,000	3,000	3,000	3,000
Railcars per train	111	60	60	60	60	60
Numbers of locomotive engine per train	6	2	2	2	2	2
Total ton of material per locomotive engine	2,165	3,000	3,000	-	3,000	3,000
Total # locomotive engines needed to transport material per year	706	3	106		144	78
Total # locomotive engines needed for returning trains per year	536	2	80	-	109	59
Total locomotive hours per year in San Joaquin Valley, CA	1,956	20	294	-	1,818	906
Total locomotive hours per year in Kern County (East Kern), CA	1,925		387			
Total locomotive hours per year in San Bernardino County, CA (Mojave Desert) (PM10 nonattainment)	6,319		243			
Total locomotive hours per year in Los Angeles-San Bernardino Counties (West Mojave Desert), CA - (Ozone nonattainment)	3,726					
Total locomotive hours per year in Arizona (PM10 nonattainment, the maximum distance)	11,303					
Total locomotive hours per year in Arizona (PM2.5 nonattainment)	621					
Total locomotive hours per year in Arizona (Ozone nonattainment)	3,105					
Total locomotive hours per year in State of Arizona	6,210					
Total locomotive hours per year in State of New Mexico	3,152					
Total locomotive hours per year in Sacramento Metro, CA					507	
Total locomotive hours per year in Yuba City-Marysville, CA					317	
Total locomotive hours per year in Chico, CA					317	
Total locomotive hours per year in Other Area in the rest State of California and State of Oregon/State of Washington					1,020	

3/05/2013 revision

	Line-Haul Emission Factors	CO	NOx	PM10	PM2.5	SO2	VOC
	Tier 3 Emission Factor (g/bhp-hr)	1.28	4.95	0.08	0.08	0.09	0.14
	Tier 3 Emission Factor (g/gal)	26.62	102.96	1.66	1.61	1.88	2.85

Annual Emission Rates by Area

Area	Train Types	CO	NOx	PM10	PM2.5	SO2	VOC
		Annual Emission Rates (tons/year) all trains					
San Joaquin Valley, CA	Line-haul coal engines	3.37	13.02	0.21	0.20	0.24	0.36
	Line-haul liquid sulfur product engines	0.02	0.09	0.00	0.00	0.00	0.00
	Line-haul gasification product engines	0.34	1.33	0.02	0.02	0.02	0.04
	Line-haul ammonia product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Line-haul urea product engines	2.13	8.25	0.13	0.13	0.15	0.23
	Line-haul UAN product engines	1.06	4.11	0.07	0.06	0.08	0.11
	Total Trains (ton/yr)	**6.93**	**26.80**	**0.43**	**0.42**	**0.49**	**0.74**
Kern County (East Kern), CA	Line-haul coal engines	3.31	12.81	0.21	0.20	0.23	0.35
	Line-haul gasification product engines	0.45	1.76	0.03	0.03	0.03	0.05
	Total Trains (ton/yr)	**3.77**	**14.57**	**0.24**	**0.23**	**0.27**	**0.40**
San Bernardino County, CA (Mojave Desert) (PM10 nonattainment)	Line-haul coal engines	10.88	42.06	0.68	0.66	0.77	1.16
	Line-haul gasification product engines	0.28	1.10	0.02	0.02	0.02	0.03
	Total Trains (ton/yr)	**11.16**	**43.16**	**0.70**	**0.68**	**0.79**	**1.19**
Los Angeles-San Bernardino Counties (West	Line-haul coal engines	6.41	24.80	0.40	0.39	0.45	0.69
	Line-haul gasification product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Total Trains (ton/yr)	**6.41**	**24.80**	**0.40**	**0.39**	**0.45**	**0.69**
State of Arizona	Line-haul coal engines	19.45	75.23	1.22	1.18	1.37	2.08
	Total Trains (ton/yr)	**19.45**	**75.23**	**1.22**	**1.18**	**1.37**	**2.08**
Sacramento Metro, CA	Line-haul urea product engines	0.59	2.30	0.04	0.04	0.04	0.06
	Total Trains (ton/yr)	**0.59**	**2.30**	**0.04**	**0.04**	**0.04**	**0.06**
Yuba City-Marysville, CA	Line-haul urea product engines	0.37	1.44	0.02	0.02	0.03	0.04
	Total Trains (ton/yr)	**0.37**	**1.44**	**0.02**	**0.02**	**0.03**	**0.04**
Chico, CA	Line-haul urea product engines	0.37	1.44	0.02	0.02	0.03	0.04
	Total Trains (ton/yr)	**0.37**	**1.44**	**0.02**	**0.02**	**0.03**	**0.04**
Other Area in California and State of Oregon/State of Washington	Line-haul urea product engines	1.20	4.63	0.07	0.07	0.08	0.13
	Total Trains (ton/yr)	**1.20**	**4.63**	**0.07**	**0.07**	**0.08**	**0.13**
State of New Mexico	Line-haul coal engines	5.42	20.98	0.34	0.33	0.38	0.58
	Total Trains (ton/yr)	**5.42**	**20.98**	**0.34**	**0.33**	**0.38**	**0.58**

EPA Estimated Locomotive (line-haul) Average Emission Rates by Tiers

Tier	Emission Factor (g/bhp-hr) CO	NO_X	PM	HC
Uncontrolled	1.28	13.00	0.32	0.48
Tier 0	1.28	8.60	0.32	0.48
Tier 0+	1.28	7.20	0.20	0.30
Tier 1	1.28	6.70	0.32	0.47
Tier 1+	1.28	6.70	0.20	0.29
Tier 2	1.28	4.95	0.18	0.26
Tier 2+ and Tier 3	1.28	4.95	0.08	0.13
Tier 4	1.28	1.00	0.015	0.04

3/05/2013 revision

Emission Factors For all Locomotives
SOx [3]
g/gal
1.88

Locomotive Application	Conversion Factor (bhp-hr/gal)
Large Line-haul & Passenger	20.8
Small Line-haul	18.2
Switching	15.2

Note:

(1) EPA's Technical Highlights: Emission Factors for Locomotives, 2009 (http://www.epa.gov/nonroad/locomotv/420f09025.pdf).

(2) Line-haul engine emissions of CO, NOx, PM, and HC are based on EPA Tier 2+ and Tier 3 emission factors.

(3) Based on 300 ppm sulfur diesel fuel.

(4) VOC emissions can be assumed to be equal to 1.053 times the HC emissions

(5) $PM_{2.5}$ Fraction of PM_{10}, = 0.97

(6) No off-site switching or idling was assumed for train transportation.

(7) Average line haul locomotive load factor was obtained from Table 5.12 of The Port Of Long Beach - 2007 Air Emissions Inventory (http://www.polb.com/civica/filebank/blobdload.asp?BlobID=6021)

Summary of Truck Emissions - HECA

3/05/2013 revision

Calculations for Trucks Operations

Data Supplied By Client							
Parameter	Coke Trucks (Max @ 50 or 60 mph)	Liquid Sulfur Product Trucks (Max @ 50 or 60 mph)	Gasification Product Trucks (Max @ 50 or 60 mph)	Ammonia Product Trucks (Max @ 50 or 60 mph)	Urea Product Trucks (Max @ 50 or 60 mph)	UAN Sulfur Product Trucks (Max @ 50 or 60 mph)	Equipment and Miscellaneous Trucks (Max @ 50 or 60 mph)
	Running Emissions	Running Emissions	Running Emissions	Running Emissions	Running Emissions	Running Emissions	Running Emissions
Distance traveled per truck in San Joaquin Valley, CA (mi)	104	104	160	0	80	80	92
Distance traveled per truck in Los Angeles-South Coast Air Basin, CA (mi)	176	180	0	0	0	0	151
Maximum number of trucks or loads:							
Annual average trucks or loads	15,200	1,020	3,170	0	5,730	9,340	4,690

No off-site idling was assumed for truck transportation.
Distance traveled per truck is based on round-trip.

EMFAC2007 Emission Factors + Fugitive Dust (g/mi) For Truck Model year 2010, Scenario year 2015

Pollutant	Coke and Coal Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)	Liquid Sulfur Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)	Gasification Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)	Ammonia Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)	Urea Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)	UAN Sulfur Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)	Equipment and Miscelleneous Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)
CO	1.32	1.32	1.32	1.32	1.32	1.32	1.32
NOx	2.17	2.17	2.17	2.17	2.17	2.17	2.17
ROG	0.18	0.18	0.18	0.18	0.18	0.18	0.18
SOx	0.02	0.02	0.02	0.02	0.02	0.02	0.02
PM10 *	0.60	0.60	0.60	0.60	0.60	0.60	0.60
PM2.5 *	0.18	0.18	0.18	0.18	0.18	0.18	0.18

EMFAC2007 is the approved federal model for vehicle combustion emissions
* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007
PM factors from EMFAC = combustion exhaust + tire wear + break wear
The maximum emission factor from either truck speed at 50 mph or 60 mph was used.
Most California highways have speed limits of 60 or 70 mph and large trucks travel more slowly than the speed limit.

Annual Emission Rates in ton/yr all trucks

Pollutant	Coke and Coal Trucks (Max @ 50 or 60 mph) Running Emissions	Liquid Sulfur Product Trucks (Max @ 50 or 60 Running Emissions	Gasification Product Trucks (Max @ 50 or 60 Running Emissions	Ammonia Product Trucks (Max @ 50 or 60 mph) Running Emissions	Urea Product Trucks (Max @ 50 or 60 mph) Running Emissions	UAN Sulfur Product Trucks (Max @ 50 or 60 mph) Running Emissions	Equipment and Miscelleneous Trucks (Max Running Emissions	Total Truck Emission Rates (tons/yr)
San Joaquin Valley, CA								
CO	2.29	0.15	0.74	0.00	0.66	1.08	0.63	**5.56**
NOx	3.78	0.25	1.21	0.00	1.09	1.78	1.03	**9.15**
ROG	0.32	0.02	0.10	0.00	0.09	0.15	0.09	**0.77**
SOx	0.03	0.00	0.01	0.00	0.01	0.01	0.01	**0.07**
PM10	1.04	0.07	0.33	0.00	0.30	0.49	0.28	**2.51**
PM2.5	0.31	0.02	0.10	0.00	0.09	0.15	0.09	**0.76**
Los Angeles-South Coast Air Basin, CA								
CO	3.88	0.27	0.00	0.00	0.00	0.00	1.03	**5.17**
NOx	6.39	0.44	0.00	0.00	0.00	0.00	1.69	**8.52**
ROG	0.54	0.04	0.00	0.00	0.00	0.00	0.14	**0.72**
SOx	0.05	0.00	0.00	0.00	0.00	0.00	0.01	**0.06**
PM10	1.76	0.12	0.00	0.00	0.00	0.00	0.46	**2.34**
PM2.5	0.53	0.04	0.00	0.00	0.00	0.00	0.14	**0.71**

Summary of Worker Commute Vehicle Emissions - HECA

3/05/2013 revision

Calculations for Worker Commute Vehicle Operation

OFFSITE - 50 MPH								EF (g/mile)					
Onroad Vehicle	Fuel Type	Vehicle Type	Total Number of Workers per day	Daily Vehicle Count	Round Trip Distance (miles/vehicle/day)	Trips per day	VMT (Annual)	CO	NOx	PM_{10}	$PM_{2.5}$	SO_2	TOC
Personal Commuting Vehicles	G/D	LDA/ LDT	200	154	40.0	1	2,246,154	1.6825	0.1930	0.4234	0.1134	3.50E-03	0.0540

Assumptions:

Assumed average distance traveled off site for all employees commuting will be 20 miles

times 2 for return trip = 40 miles

365 days per year

Number of workers per commuter vehicle = 1.3

EMFAC2007 emissions are for fleet mix years 1971-2015 travelling at 50 mph.

Area	Description	CO	NOx	PM10	PM2.5	SO2	VOC
		Annual Emission Rates (tons/year) all worker commute vehicles					
San Joaquin Valley, CA	Personal Commuting Vehicles	4.17	0.48	1.05	0.28	0.01	0.13

Fugitive Dust on Paved Road

3/05/2013 revision

AP 42 13.2.1 Paved Roads, updated January 2011

For a daily basis,

E = [k (sL)^0.91 x (W)^1.02](1-P/4N) (2)

P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period
W = average weight (tons) of vehicles traveling the road
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading (g/m^2)

Table 13.2.1-1
PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

	k
	g/VMT
PM2.5	0.25
PM10	1.00

Fleet mix on highway

W=	9.1	tons, average	
sL=	0.031	g/m2	Default value from URBEMIS 9.2 for Kern County
P=	36	days/year Buttonwillow Station 1940-2011, WRCC	

E=

0.09836	g/VMT PM2.5
0.39344	g/VMT PM10

Vehicle weight (tons)		fraction of each vehicle type
1.6	passenger vehicles	0.75
40	large trucks	0.18
9	2-4 axle trucks	0.07

9.1 weighted average for all vehicles (ton)

On I-5 near the Project, 75% of all vehicles are passenger vehicles,
of the remaining vehicle, 73% are 5-axle trucks and the remainder are 2-4 axle trucks.
From information provided by California Department of Transportation for the traffic analysis.

Industrial Wind Erosion, AP-42 Section 13.2.5

Emission factor (g/m^2-yr) = k Σ P_i (from i=1,N) (Equation 2) *3/05/2013 revision*

Erosion Potential (P_i) (g/m^2) = 58 $(u^* - u_t^*)^2$ + 25$(u^* - u_t^*)$ (Equation 3)

0.5	k =	PM_{10} particle size multiplier
0.075	k =	$PM_{2.5}$ particle size multiplier
1	N =	number of disturbances per year
33.76	A =	exposed area of coal, m^2, per car (Table 4.1, Jan 2008 Connell Hatch: exposed area = 33.76 m^2)

Use Equation (1) to determine friction velocity:

$u(z) = u^* / 0.4 \times \ln(z/z_0)$

17.88	u(z) =	fastest mile (m/s) (based on speed of train)
0.2	z =	distance at which wind speed is measured (m) (based on the height above the coal cars at which wind flow would be laminar; assumed this height is equal to the difference between the height of the locomotive engine and the trailing coal cars)
0.003	z_0 =	roughness height for uncrusted coal pile (m), from Table 13.2.5-2
1.70	u^* =	friction velocity (m/s), solved for using Equation 1
0.55	u_t^* =	threshold friction velocity (m/s); Table 13.2.5-2 value for ground coal (surrounding coal pile)

Erosion Potential

	P =	105.9	g/m^2	erosion potential corresponding to the observed (or probable) fastest mile of wind for the i^{th} period between disturbances, g/m^2
Annual	A =	442,256.0	m^2/yr	exposed area of coal per car (m^2) times number of cars per year

Unmitigated Emissions

Emission factor (g/m^2-yr) = k Σ P_i (from i=1,N)

E =	23,423,432	grams PM_{10} / year
	25.82	tons PM_{10} / year
E =	3,513,515	grams $PM_{2.5}$ / year
	3.87	tons $PM_{2.5}$ / year

Mitigation Efficiency of Surfactant: **85%**

* HECA will be requiring the coal supplier to apply a surfactant to the coal transported by rail to reduce fugitive losses during transport. Surfactant achieves at least an 85% control efficiency.

Mitigated PM_{10}: **3.87 tons PM_{10} / year**

Mitigated $PM_{2.5}$: **0.58 tons $PM_{2.5}$ / year**

* It has been assumed that all emitted PM will be lost during the first 100 miles of the trip and has thus all been assigned to New Mexico. Maximum train speed (and thus wind speed) will certainly be reached within this time, and according to AP-42 Section 13.2.5.1, "particulate emission rates tend to decay rapidly (half-life of a few minutes) during an erosion event."

40	train speed, mph
0.447	m/s per 1 mph
453.6	grams per pound
2000	pounds per ton
13,100	Required rail car loads per year at normal operation (cars/yr)

Summary of Transportation Vehicles and Routes

3/05/2013 revision

Commodity Handled	Petcoke	Coal	Liquid Sulfur	Gasification Solids	Urea	UAN-32	Equipment Maintenance (1)	Miscellaneous Activities (2)
Expected plant operation								
Expected plant operation is 8000 hours / year								
The plant will operate 24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day
The plant will operate 333 days / year	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr
Shipment by trucks	100 %	0 %	75 %	25 %	25 %	50 %	100 %	100 %
Shipment by train	0 %	100 %	25 %	75 %	75 %	50 %	0 %	0 %
Production rate								
Required Normal Flow / day	1,140 tons / day	4,580 tons / day	100 tons / day	950 tons / day	1,720 tons / day	1,400 tons / day		
Required Normal Flow / year	380,000 tons / yr	1,526,000 tons / yr	34,000 tons / yr	317,000 tons / yr	573,000 tons / yr	467,000 tons / yr		
Required Maximum Flow day	2,000 tons / day (3)	6,500 tons / day (4)	200 tons / day (5)	1,900 tons / day (6)	3,440 tons / day (6)	2,800 tons / day (6)		
Truck Shipments								
Truck Capacity	25 tons / truck		25 tons / truck	25 tons / truck	25 tons / truck	25 tons / truck	25 tons / truck	25 tons / truck
Required trucks loads for normal operation / day	46 trucks / day		3 trucks / day	10 trucks / day	18 trucks / day	28 trucks / day	3 trucks / day	11 trucks / day
Required trucks loads for normal operation / yr	15,200 truck / yr		1,020 truck / yr	3,170 truck / yr	5,730 truck / yr	9,340 truck / yr	1,000 truck / yr	3,690 truck / yr
Required trucks loads for maximum operation /day	80 trucks / day		6 trucks / day	19 trucks / day	35 trucks / day	56 trucks / day	5 trucks / day	17 trucks / day
Train Shipments								
Railcar Capacity		117 tons / car	100 tons / car	100 tons / car	100 tons / car	100 tons / car		
Required railcars for normal operation / day		40 cars / day	0.25 cars / day	8 cars / day	13 cars / day	7 cars / day		
Required railcar loads for normal operation / yr		13,100 cars / yr	85 cars / yr	3,170 cars / yr	4,298 cars / yr	2,335 cars / yr		
Required railcars for maximum operation / day		200 cars / day	1 cars / day	19 cars / day	26 cars / day	14 cars / day		
Basis	- 91% availability	- 91% availability	- 91% availability	- 91% availability	- 91% availability	- 91% availability		
	- 25% petcoke (heat input) per year	- 75% coal (heat input) per year	- High sulfur case - 100 tons/day	- 75% coal max annual average	- 75% by rail	- 75% by rail		
	- 25 ton/truck	- 117 tons/car	- 25 ton/truck	- 100% capable by rail	-empty 45 day storage in 10 days	-empty 45 day storage in 10 days		
	- 7 days/week receiving	- 100% coal for maximum	- Weekdays only	- 25% capable by truck				
	- 25% excess truck movement capacity	- Rack sized to handle two trains/day -	- Can only move up to 25% of production by rail	- Maximun is double the daily average rate				
Traffic route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route
Destination/Origin	Carson Refinery	None	California Sulfur	Various	Various	Various	Various	Various
Address	1801 E Sepulveda, Carson		2509 E Grant Street, Wilmington					
Distance	140 Miles		142 Miles	80 Mile radius	40 mile radius	40 mile radius	40 mile radius	40 mile radius
Route	Alameda 405 Fwy 5 Fwy Stockdale hwy Morris Road Station Road Station Road		Grant Henry Ford Alameda 405 Fwy 5 Fwy Stockdale hwy Morris Road Station Road	40 mile radius Station Road Morris Road Stockdale Hywy 5 Fwy	Station Road Morris Road Stockdale Hywy 5 Fwy	Station Road Morris Road Stockdale Hywy 5 Fwy	5 fwy Stockdale Hwy Dairy Road	5 fwy Stockdale Hwy Dairy Road
Rail Route	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route
Destination/Origin	None	Elk Ranch New Mexico	In SJVAPCD	CEMEX, Victorville	Oregon/Washington	Calamco	None	None
Address						Port Rd G15, Stockton, CA		
Distance		794 miles		198 miles	628 Miles	264 miles		
Route		Kern County: 132.2 miles (County Line near Boron, CA to north prop Mine to Boron, CA: 662 miles Total Distance: 794.2 miles		SJVR/BNSF	SJVR/UPRR			

Notes

1) Equipment Maintenance Trucks are considered to be 2% of the total trucks per day for the feed and product operation.
2) Miscellaneous trucks are considered to be 3% of the total trucks per day for the feed and product operation plus a small number of additional trucks to provide additives to the gasification.
3) The maximum flow rate of coke is ratioed up from the normal flow rate at 25% to 30% of feed
4) The maximum daily transfer rate of coal is based on supplying 7-days of normal coal required feed (75% of feedstock on a heat input basis) in 5 days and rounded upward to 2 significant figures.
5) The maximum flow rate of sulfur is 2 times the normal production
6) The maximum flow rate of these commodities is 2 times the normal production
7) The sources of flow data used in the Production Rate calculation were based on the flow rates provided in "Conference Note: Rail and Truck Traffic - Planning Session" and the "FertilizerProductMovement Update", 01-25-12.

Calculations for Trucks Operation onsite

Assumed Number of Unit Trains (incoming/outgoing)

Averaging Period	Coal Unit Trains (incoming)	Unit Trains of Product (outgoing)	Maximum Total Trains per period
Annual average unit trains	119	165	284

# Cars Per train	111	60	
maximum # Cars Per day	200-240	42-46	

	Switching Enigne/ Rail car movers	Line-Haul Engine for Coal Train	Line-Haul Engine for Product Trains
Engine Power Rating (hp)		4400	3000
Notch Operation		1	1
Notch percentage of hp		5.0%	5.0%
Avg Notch horsepower	260	220	150
# of engines per train	1	2	2
hours to unload/load each train		2	1
max operating hours (hrs/day)	8		
max operating hours (hrs/year)	1248		

The majority of the time the line-haul engine will operate in Notch 1 or idling, therefore emissions were conservatively estimated for Notch 1 horsepower.

Notch percentage presented in PORT OF LONG BEACH AIR EMISSIONS INVENTORY for 2007 (POLB, Jan 2009) derived from EPA data.

For each coal train it takes 2 hours to complete the onsite loop to unload

For each product train it takes 1 hour to load

	CO	NOx	PM10	PM2.5	SO2	VOC
Switching Engine Emission Factors						
Tier 3 Emission Factor (g/bhp-hr)	1.83	4.50	0.08	0.08	0.12	0.27
Emissions (lbs/hr /engine)	1.05	2.58	0.05	0.04	0.07	0.16
Line-Haul Emission Factors						
Tier 3 Emission Factor (g/bhp-hr)	1.28	4.95	0.08	0.08	0.09	0.14
Coal Train Emissions (lbs/hr /engine)	0.62	2.40	0.04	0.04	0.04	0.07
Product Train Emissions (lbs/hr /engine)	0.42	1.64	0.03	0.03	0.03	0.05

Annual Emission Rates in tons/year

	CO	NOx	PM10	PM2.5	SO2	VOC
Switching engines	0.65	1.61	0.03	0.03	0.04	0.10
Line-haul coal engines	0.15	0.57	0.01	0.01	0.01	0.02
Line-haul product engines	0.07	0.27	0.00	0.00	0.00	0.01

Emission Factors For all Locomotives

SOx
g/gal
1.88

Locomotive Application	Conversion Factor (bhp-hr/gal)
Large Line-haul & Passenger	20.8
Small Line-haul	18.2
Switching	15.2

Notes:

New line-haul engines will be AC locomotives such as the GE Evolution Series, that meet Tier 3 emissions
New switching engines will meet Tier 3 emissions, they may be the Titan Trackmobile railcar movers or similar
Emission factors from EPA’s Technical Highlights: Emission Factors for Locomotives, 2009 (http://www.epa.gov/nonroad/locomotv/420f09025.pdf).
SO2 emissions Based on 300 ppm sulfur diesel fuel.
VOC emissions can be assumed to be equal to 1.053 times the HC emissions
$PM_{2.5}$ Fraction of PM_{10}, = 0.97
Line-haul engine emissions of CO, NOx, PM, and HC are based on EPA Tier 2+ and Tier 3 emission factors.

Calculations for Trucks Operation onsite

Data Supplied By Client					
Parameter	**Petcoke Trucks**		**Product Trucks**		**Miscellaneous Trucks**
	Running Emissions	**Idling Emissions**	**Running Emissions**	**Idling Emissions**	**Running Emissions**
Distance Traveled (mi)*	0.96		2.49		2.20
Per Truck Idle Time (hr)		0.083		0.083	
Maximum number of trucks or loads:					
Annual average trucks or loads	15,200	15,200	19,260	19,260	4,690

EMFAC2007 Emission Factors + Fugitive Dust (g/mi or g/idle-hour) For Truck Model year 2010

	Petcoke Trucks		**Product Trucks**		**Miscellaneous Trucks**
Pollutant	**Running Emissions (g/mile/trk)**	**Idling Emissions (g/idle-hour/trk)**	**Running Emissions (g/mile/trk)**	**Idling Emissions (g/idle-hour/trk)**	**Running Emissions (g/mile/trk)**
CO	3.03	43.69	3.03	43.69	3.03
NOx	5.43	122.65	5.43	122.65	5.43
ROG	1.39	7.74	1.39	7.74	1.39
SOx	0.03	0.06	0.03	0.06	0.03
PM10 *	0.92	0.11	0.92	0.11	0.92
PM2.5 *	0.29	0.10	0.29	0.10	0.29

EMFAC2007 is the approved federal model for vehicle combustion emissions

* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007

PM factors from EMFAC = combustion exhaust + tire wear + break wear

EMFAC emissions are for fleet year 2010 travelling at 10 mph.

Annual Emission Rates in g/s For All Trucks

	Petcoke Trucks		**Product Trucks**		**Miscellaneous Trucks**		
Pollutant	**Running Emissions**	**Idling Emissions (at each Idle Point)**	**Running Emissions**	**Idling Emissions (at each Idle Point)**	**Running Emissions**	**TOTAL (g/s)**	**TOTAL (tpy)**
CO	1.40E-03	1.755E-03	4.596E-03	2.224E-03	9.906E-04	1.10E-02	3.81E-01
NOx	2.501E-03	4.926E-03	8.238E-03	6.242E-03	1.775E-03	2.37E-02	8.23E-01
ROG	6.398E-04	3.110E-04	2.107E-03	3.941E-04	4.541E-04	3.91E-03	1.36E-01
SOx	1.383E-05	2.490E-06	4.554E-05	3.155E-06	9.814E-06	7.48E-05	2.60E-03
PM10	4.226E-04	4.579E-06	1.392E-03	5.802E-06	3.000E-04	2.12E-03	7.39E-02
PM2.5	1.348E-04	4.177E-06	4.440E-04	5.293E-06	9.568E-05	6.84E-04	2.38E-02

Volume, Line Sources

Guidance for Air Dispersion Modeling, SJVAPCD, 2007 and Section 1.2.2 of Volume II of ISC User's Guide			
2.3.2 Oyo=12W/2.15			
Truck Traveling vol src		Truck Idling pt src	
6	ft Release height	12.6	ft Release height
12	ft Width	0.1	m diam
66.98	ft init horz dim Syo	51.71	m/s vel
5.58	ft init vert dim Szo	366	K Temp
		199.134	F Temp

Volume, Stand Alone

Guidance for Air Dispersion Modeling, SJVAPCD, 2007	
2.3.2 + modelers judgement + ISC guidance	
Truck Traveling vol src	
6	ft Release height
12	ft Width
2.79	ft init horz dim Syo
5.58	ft init vert dim Szo

3/05/2013 revision

Calculations for Trucks Operation onsite

Transportation Information		**Notes**
- Onsite Vehicle =	20 trucks	- Information Provided By Applicant
- Vehicle year=	2010	- Information Provided By Applicant
- Maximum annual mileage =	10,000 miles/truck-year	- All routine vehicular traffic is anticipated to travel exclusively on paved roads
		- Assumed 15 mph average speed within HECA facility

EMFAC2007 Emission Factors (g/mi) For Truck Model year 2010

Pollutant	Emission Factors in g/mi	
	Gas LHDT1	Diesel LHDT2
CO	0.229	0.920
NOx	0.064	0.672
ROG	0.014	0.085
SOx	0.011	0.005
PM10 *	0.167	0.176
PM2.5 *	0.054	0.062

EMFAC2007 is the approved federal model for vehicle combustion emissions
* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007
PM factors from EMFAC = combustion exhaust + tire wear + break wear
EMFAC emissions are for fleet year 2010 travelling at 15 mph.

Annual Emission Rates in g/s From All Trucks

Pollutant	Emissions in g/s			
	Gas LHDT1	Diesel LHDT2	TOTAL (g/s)	TOTAL (tpy)
CO	1.45E-03	5.83E-03	7.29E-03	0.253
NOx	4.06E-04	4.26E-03	4.67E-03	0.162
ROG	8.88E-05	5.39E-04	6.28E-04	0.022
SOx	6.98E-05	3.17E-05	1.01E-04	0.004
PM10	1.06E-03	1.11E-03	2.17E-03	0.076
PM2.5	3.40E-04	3.91E-04	7.32E-04	0.025

Fugitive Dust on Paved Road

3/05/2013 revision

AP 42 13.2.1 Paved Roads, updated January 2011

Calculations for Trucks Operation onsite

For a daily basis,

E = [k (sL)^0.91 x (W)^1.02](1-P/4N) (2)

P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period
W = average weight (tons) of vehicles traveling the road
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading (g/m^2)

	k
	g/VMT
PM2.5	0.25
PM10	1.00

Table 13.2.1-1
PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

Large Trucks

			Empty truck	full truck	Load Capacity	
W=	17.5	tons, average	5	30	0	tons
sL=	0.031	g/m2 Default value from URBEMIS 9.2 for Kern County				
P=	36	days/year Buttonwillow Station 1940-2011, WRCC				

E=

0.19149 g/VMT PM2.5 large delivery trucks
0.76594 g/VMT PM10 large delivery trucks

Operation and Maintenance Vehicles

W= 3 tons
sL= 0.031 g/m2 Default value from URBEMIS 9.2 for Kern County
P= 36 days/year Buttonwillow Station 1940-2011, WRCC

E=

0.03169 g/VMT PM2.5 O&M trucks
0.12675 g/VMT PM10 O&M trucks

APPENDIX D

REVISED OPERATIONAL TRANSPORTATION EMISSIONS FOR ALTERNATIVE 2

Summary of Applicable Operational Emissions for General Conformity (Alternative 2) - 2017 Overlapping with Construction

Hydrogen Energy California LLC
HECA Project

3/05/2013 revision

Federal NAAQS Nonattainment or Maintenance Area General Name and State	Detailed Status in Nonattainment or Maintenance Area	Authority Agency	Basis to Estimate the Offsite Transportation Distance	Emission Sources / Applicable General Conformity Thresholds / Comparisons	Project Operational Annual Emission Rates - for General Conformity (tpy)					
					CO	NOx	PM10	PM2.5	SO2	VOC
San Joaquin Valley, CA	8-Hour Ozone (2008) Nonattainment - Extreme PM2.5 Nonattainment CO Maintenance - Maderate - Fresno, CA (Part of Fresno County), Modesto, CA (Part of Stanislaus County), Stockton, CA (Part of San Joaquin County) PM10 Maintenance	SJVAPCD	**Construction** - Entire SJVAPCD jurisdiction area (one way trip: trucks = worker vehicles = 20 miles)	Onsite Construction Equipmen	2.65	3.84	0.48	0.27	0.00	0.83
				Onsite Trucks	0.15	0.34	0.09	0.03	0.00	0.09
				Onsite Vehicles	0.08	0.01	0.22	0.02	0.00	0.01
				Onsite Total	**2.88**	**4.18**	**0.79**	**0.32**	**0.01**	**0.93**
				Offsite Linears Equipment	0.00	0.00	0.00	0.00	0.00	0.00
				Offsite Trucks	1.02	5.16	0.42	0.21	0.00	0.22
				Offsite Vehicles	5.98	0.72	0.20	0.07	0.01	0.18
				Offsite Total	**6.99**	**5.87**	**0.61**	**0.28**	**0.01**	**0.41**
				Total Construction Emission	**9.87**	**10.06**	**1.40**	**0.60**	**0.02**	**1.34**
			Operation - Entire SJVAPCD jurisdiction area (one way trip: trains = 70 miles, trucks = 26.5 to 80 miles, workers= 20 miles)	Offsite Train	1.25	4.82	0.08	0.08	0.09	0.13
				Offsite Truck	5.20	8.56	2.35	0.71	0.06	0.72
				Offsite Workers Commuting	1.39	0.16	0.35	0.09	0.00	0.04
				Onsite Train	0.00	0.00	0.00	0.00	0.00	0.00
				Onsite Truck	0.51	0.99	0.10	0.03	0.00	0.15
				Total Operation Emissions	**8.34**	**14.53**	**2.88**	**0.91**	**0.16**	**1.05**
				Total Construction and Operation Overlapping Emissions	**18.21**	**24.59**	**4.28**	**1.51**	**0.17**	**2.39**
				Applicable General Conformity *de minimis* Thresholds	**100**	**10**	**100**	**100**	**100**	**10**
				Less Than Thresholds?	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**
Los Angeles-South Coast Air Basin, CA	8-Hour Ozone (2008) Nonattainment - Extreme PM10 Nonattainment - Serious PM2.5 Nonattainment NO2 Maintenance CO Maintenance - Serious	SCAQMD	Entire SCAQMD jurisdiction area (one way trip: trucks = 88 to 150 miles)	Offsite Train	0.00	0.00	0.00	0.00	0.00	0.00
				Offsite Truck	1.75	2.89	0.79	0.24	0.02	0.24
				Total Emission	**1.75**	**2.89**	**0.79**	**0.24**	**0.02**	**0.24**
				Conformity De minimis (ton/yr)	**100**	**10**	**70**	**100**	**100**	**10**
				Less than De minimis?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Kern County (East Kern), CA	8-Hour Ozone (2008) Nonattainment - Marginal PM10 Nonattainment - Serious	EKAPCD	Entire EKAPCD jurisdiction area (one way trip: trains = 62 miles)	Offsite Train		4.27	0.07			0.12
				Offsite Truck		0.00	0.00			0.00
				Total Emission		**4.27**	**0.07**			**0.12**
				Conformity De minimis (ton/yr)		**100**	**70**			**100**
				Less than De minimis?		**Yes**	**Yes**			**Yes**
Los Angeles-San Bernardino Counties (West Mojave Desert), CA	8-Hour Ozone (2008) Nonattainment - Severe 15 (Part of San Bernardino and Los Angeles Counties)	MDAQMD	Los Angeles-San Bernardino Counties (West Mojave Desert) - 8-hr Ozone (2008) NAA (one way trip: trains = 120 miles)	Offsite Train		8.27				0.23
				Offsite Truck		0.00				0.00
				Total Emission		**8.27**				**0.23**
				Conformity De minimis (ton/yr)		**25**				**25**
				Less than De minimis?		**Yes**				**Yes**
San Bernardino County, CA (Mojave Desert)	PM10 Nonattainment - Moderate	MDAQMD	Entire MDAQMD jurisdiction area (one way trip: trains = 204 miles)	Offsite Train			0.23			
				Offsite Truck			0.00			
				Total Emission			**0.23**			
				Conformity De minimis (ton/yr)			**100**			
				Less than De minimis?			**Yes**			
Sacramento Metro, CA	8-Hour Ozone (2008) Nonattainment - Severe 15 PM10 Nonattainment - Moderate (Sacramento County) PM2.5 Nonattainment CO Maintenance - Moderate - Sacramento, CA (Part of Placer, Sacramento and Yolo Counties)	SMAQMD	Entire SMAQMD jurisdiction area (one way trip: trains = 0 miles)	Offsite Train	0.00	0.00	0.00	0.00	0.00	0.00
				Offsite Truck	0.00	0.00	0.00	0.00	0.00	0.00
				Total Emission	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
				Conformity De minimis (ton/yr)	**NA**	**25**	**100**	**100**	**100**	**25**
				Less than De minimis?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Yuba City-Marysville, CA	PM2.5 Nonattainment (Sutter and Part of Yuba Counties) 1-Hour Ozone (Yuba City)	FRAQMD	Yuba City-Marysville, CA - PM2.5 NAA (one way trip: trains = 0 miles)	Offsite Train		0.00		0.00	0.00	0.00
				Offsite Truck		0.00		0.00	0.00	0.00
				Total Emission		**0.00**		**0.00**	**0.00**	**0.00**
				Conformity De minimis (ton/yr)		**100**		**100**	**100**	**100**
				Less than De minimis?		**Yes**		**Yes**	**Yes**	**Yes**
Chico, CA	8-Hour Ozone (2008) Nonattainment - Marginal (Butte County) PM2.5 Nonattainment (Part of Butte County) CO Maintenance - Moderate (Part of Butte County)	BCAQMD	Chico, CA - 8-Hour Ozone (2008) NAA - Entire Butte County (one way trip: trains = 0 miles)	Offsite Train	0.00	0.00		0.00	0.00	0.00
				Offsite Truck	0.00	0.00		0.00	0.00	0.00
				Total Emission	**0.00**	**0.00**		**0.00**	**0.00**	**0.00**
				Conformity De minimis (ton/yr)	**NA**	**100**		**100**	**100**	**100**
				Less than De minimis?	**Yes**	**Yes**		**Yes**	**Yes**	**Yes**

Summary of Applicable Operational Emissions for General Conformity (Alternative 2) - 2017 Overlapping with Construction

Hydrogen Energy California LLC *3/05/2013 revision*
HECA Project

Federal NAAQS Nonattainment or Maintenance Area General Name and State	Detailed Status in Nonattainment or Maintenance Area	Authority Agency	Basis to Estimate the Offsite Transportation Distance	Emission Sources / Applicable General Conformity Thresholds / Comparisons	Project Operational Annual Emission Rates - for General Conformity (tpy)					
					CO	NOx	PM10	PM2.5	SO2	VOC
NAAs in State of Arizona	8-Hour Ozone (2008) Nonattainment - Marginal - Phoenix-Mesa, AZ (Part of Maricopa and Pinal County) PM10 Nonattainment (Moderate, Serious, or Maintenance) (12 Counties) PM2.5 Nonattainment - Nogales, AZ (Part of Santa Cruz County), West Central Pinal, AZ (West Pinal County) SO2 Nonattainment - Hayden (Pinal County), AZ (Part of Pinal County), Maintenance - San Manual (Pinal County), AZ, Ajo (Pima County), AZ, Douglas (Cochise County), AZ, Miami (Gila County), AZ CO Maintenance - Serious - Phoenix, AZ. (Part of Maricopa)	ADEQ	Entire ADEQ jurisdiction area (one way trip: trains = 364 miles)	Offsite Train	6.48	25.08	0.41	0.39	0.46	0.69
				Offsite Truck	0.00	0.00	0.00	0.00	0.00	0.00
				Total Emission	**6.48**	**25.08**	**0.41**	**0.39**	**0.46**	**0.69**
				Conformity De minimis (ton/yr)	**100**	**100**	**70**	**100**	**100**	**100**
				Less than De minimis?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
NAAs in State of New Mexico	PM10 Nonattainment - Moderate - Anthony, NM (Dona Ana County) CO Maintenance (Bernalillo County) SO2 Maintenance - Grant Co, NM	NMED-AQB	Entire NMED-AQB jurisdiction area (one way trip: trains = 102 miles to coal mine site)	Offsite Train	1.81		1.40		0.13	
				Offsite Truck	0.00		0.00		0.00	
				Total Emission	**1.81**		**1.40**		**0.13**	
				Conformity De minimis (ton/yr)	**100**		**100**		**100**	
				Less than De minimis?	**Yes**		**Yes**		**Yes**	

Notes:

1. The associated emissions from the onsite worker travel are negligible
2. To simplify the analysis, the biggest area among all detailed NAA areas was conservativly used to estimate the emissions in each main NAA category area.
   For State of Arizona and New Mexico the total distances accross each state along the train routes were conservativly used to estimate the emissions in NAA.
3. The distance for trains and trucks are varied depending on the type to materials transporting and their destinations.

ozone nonattainment area is smaller than the distance in PM10 nonattainment area.

5. ACRONYMS AND ABBREVIATIONS
   MDAQMD = Mojave Desert Air Quality Management District
   SCAQMD = South Coast Air Quality Management District
   EKAPCD = East Kern County Air Pollution Control District
   SMAQMD = Sacramento Metro Air Quality Management District
   BCAQMD = Butte County Air Quality Management District
   FRAQMD = Feather River Air Quality Management District
   ADEQ = Arizona Department of Environmental Quality
   NMED-AQB = New Mexico Environment Department - Air Quality Bureau
6. Construction of the project is expected to complete in June 2017 and the operation will start from September. Therefore, the operational emissions were scaled from the entire year of project operation.

Summary of Applicable Operational Emissions for General Conformity (Alternative 2) - 2018 and Beyond

Hydrogen Energy California LLC *3/05/2013 revision*
HECA Project

Federal NAAQS Nonattainment or Maintenance Area General Name and State	Detailed Status in Nonattainment or Maintenance Area	Authority Agency	Basis to Estimate the Offsite Transportation Distance	Emission Sources / Applicable General Conformity Thresholds / Comparisons	Project Operational Annual Emission Rates - for General Conformity (tpy)					
					CO	NOx	PM10	PM2.5	SO2	VOC
San Joaquin Valley, CA	8-Hour Ozone (2008) Nonattainment - Extreme PM2.5 Nonattainment CO Maintenance - Maderate - Fresno, CA (Part of Fresno County), Modesto, CA (Part of PM10 Maintenance	SJVAPCD	Entire SJVAPCD jurisdiction area (one way trip: trains = 70 miles, trucks = 26.5 to 80 miles, workers= 20 miles)	Offsite Train	3.74	14.47	0.23	0.23	0.26	0.40
				Offsite Truck	15.59	25.67	7.05	2.12	0.19	2.17
				Offsite Workers Commuting	4.17	0.48	1.05	0.28	0.01	0.13
				Onsite Train	0.00	0.00	0.00	0.00	0.00	0.00
				Onsite Truck	1.52	2.97	0.30	0.10	0.01	0.45
				Total Emission	**25.02**	**43.59**	**8.64**	**2.73**	**0.47**	**3.16**
				Conformity De minimis (ton/yr)	**100**	**10**	**100**	**100**	**100**	**10**
				Less than De minimis?	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**
Los Angeles-South Coast Air Basin, CA	8-Hour Ozone (2008) Nonattainment - Extreme PM10 Nonattainment - Serious PM2.5 Nonattainment NO2 Maintenance CO Maintenance - Serious	SCAQMD	Entire SCAQMD jurisdiction area (one way trip: trucks = 88 to 150 miles)	Offsite Train	0.00	0.00	0.00	0.00	0.00	0.00
				Offsite Truck	5.26	8.67	2.38	0.72	0.06	0.73
				Total Emission	**5.26**	**8.67**	**2.38**	**0.72**	**0.06**	**0.73**
				Conformity De minimis (ton/yr)	**100**	**10**	**70**	**100**	**100**	**10**
				Less than De minimis?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Kern County (East Kern), CA	8-Hour Ozone (2008) Nonattainment - Marginal PM10 Nonattainment - Serious	EKAPCD	Entire EKAPCD jurisdiction area (one way trip: trains = 62 miles)	Offsite Train		12.81	0.21			0.35
				Offsite Truck		0.00	0.00			0.00
				Total Emission		**12.81**	**0.21**			**0.35**
				Conformity De minimis (ton/yr)		**100**	**70**			**100**
				Less than De minimis?		**Yes**	**Yes**			**Yes**
Los Angeles-San Bernardino Counties (West Mojave Desert), CA	8-Hour Ozone (2008) Nonattainment - Severe 15 (Part of San Bernardino and Los Angeles Counties)	MDAQMD	Los Angeles-San Bernardino Counties (West Mojave Desert) - 8-hr Ozone (2008) NAA (one way trip: trains = 120 miles)	Offsite Train		24.80				0.69
				Offsite Truck		0.00				0.00
				Total Emission		**24.80**				**0.69**
				Conformity De minimis (ton/yr)		**25**				**25**
				Less than De minimis?		**Yes**				**Yes**
San Bernardino County, CA (Mojave Desert)	PM10 Nonattainment - Moderate	MDAQMD	Entire MDAQMD jurisdiction area (one way trip: trains = 204 miles)	Offsite Train			0.68			
				Offsite Truck			0.00			
				Total Emission			**0.68**			
				Conformity De minimis (ton/yr)			**100**			
				Less than De minimis?			**Yes**			
Sacramento Metro, CA	8-Hour Ozone (2008) Nonattainment - Severe 15 PM10 Nonattainment - Moderate (Sacramento County) PM2.5 Nonattainment CO Maintenance - Moderate - Sacramento, CA (Part of Placer, Sacramento and Yolo Counties)	SMAQMD	Entire SMAQMD jurisdiction area (one way trip: trains = 0 miles)	Offsite Train	0.00	0.00	0.00	0.00	0.00	0.00
				Offsite Truck	0.00	0.00	0.00	0.00	0.00	0.00
				Total Emission	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
				Conformity De minimis (ton/yr)	**NA**	**25**	**100**	**100**	**100**	**25**
				Less than De minimis?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Yuba City-Marysville, CA	PM2.5 Nonattainment (Sutter and Part of Yuba	FRAQMD	Yuba City-Marysville, CA - PM2.5 NAA (one way trip: trains = 0 miles)	Offsite Train		0.00		0.00	0.00	0.00
				Offsite Truck		0.00		0.00	0.00	0.00
				Total Emission		**0.00**		**0.00**	**0.00**	**0.00**
				Conformity De minimis (ton/yr)		**100**		**100**	**100**	**100**
				Less than De minimis?		**Yes**		**Yes**	**Yes**	**Yes**
Chico, CA	8-Hour Ozone (2008) Nonattainment - Marginal (Butte County) PM2.5 Nonattainment (Part of Butte County) CO Maintenance - Moderate (Part of Butte County)	BCAQMD	Chico, CA - 8-Hour Ozone (2008) NAA - Entire Butte County (one way trip: trains = 0 miles)	Offsite Train	0.00	0.00		0.00	0.00	0.00
				Offsite Truck	0.00	0.00		0.00	0.00	0.00
				Total Emission	**0.00**	**0.00**		**0.00**	**0.00**	**0.00**
				Conformity De minimis (ton/yr)	**NA**	**100**		**100**	**100**	**100**
				Less than De minimis?	**Yes**	**Yes**		**Yes**	**Yes**	**Yes**

Summary of Applicable Operational Emissions for General Conformity (Alternative 2) - 2018 and Beyond

Hydrogen Energy California LLC *3/05/2013 revision*
HECA Project

Federal NAAQS Nonattainment or Maintenance Area General Name and State	Detailed Status in Nonattainment or Maintenance Area	Authority Agency	Basis to Estimate the Offsite Transportation Distance	Emission Sources / Applicable General Conformity Thresholds / Comparisons	Project Operational Annual Emission Rates - for General Conformity (tpy)					
					CO	NOx	PM10	PM2.5	SO2	VOC
NAAs in State of Arizona	8-Hour Ozone (2008) Nonattainment - Marginal - Phoenix-Mesa, AZ (Part of Maricopa and Pinal County) PM10 Nonattainment (Moderate, Serious, or Maintenance) (12 Counties) PM2.5 Nonattainment - Nogales, AZ (Part of Santa Cruz County), West Central Pinal, AZ (West Pinal County) SO2 Nonattainment - Hayden (Pinal County), AZ (Part of Pinal County), Maintenance - San Manual (Pinal County), AZ, Ajo (Pima County), AZ, Douglas (Cochise County), AZ, Miami (Gila County), AZ CO Maintenance - Serious - Phoenix, AZ. (Part of Maricopa)	ADEQ	Entire ADEQ jurisdiction area (one way trip: trains = 364 miles)	Offsite Train	19.45	75.23	1.22	1.18	1.37	2.08
				Offsite Truck	0.00	0.00	0.00	0.00	0.00	0.00
				Total Emission	**19.45**	**75.23**	**1.22**	**1.18**	**1.37**	**2.08**
				Conformity De minimis (ton/yr)	**100**	**100**	**70**	**100**	**100**	**100**
				Less than De minimis?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
NAAs in State of New Mexico	PM10 Nonattainment - Moderate - Anthony, NM (Dona Ana County) CO Maintenance (Bernalillo County) SO2 Maintenance - Grant Co, NM	NMED-AQB	Entire NMED-AQB jurisdiction area (one way trip: trains = 102 miles to coal mine site)	Offsite Train	5.42		4.21		0.38	
				Offsite Truck	0.00		0.00		0.00	
				Total Emission	**5.42**		**4.21**		**0.38**	
				Conformity De minimis (ton/yr)	**100**		**100**		**100**	
				Less than De minimis?	**Yes**		**Yes**		**Yes**	

Notes:

1. The associated emissions from the onsite worker travel are negligible
2. To simplify the analysis, the biggest area among all detailed NAA areas was conservativly used to estimate the emissions in each main NAA category area.
   For State of Arizona and New Mexico the total distances accross each state along the train routes were conservativly used to estimate the emissions in NAA.
3. The distance for trains and trucks are varied depending on the type to materials transporting and their destinations.

nonattainment area is smaller than the distance in PM10 nonattainment area.

5. ACRONYMS AND ABBREVIATIONS
   MDAQMD = Mojave Desert Air Quality Management District
   SCAQMD = South Coast Air Quality Management District
   EKAPCD = East Kern County Air Pollution Control District
   SMAQMD = Sacramento Metro Air Quality Management District
   BCAQMD = Butte County Air Quality Management District
   FRAQMD = Feather River Air Quality Management District
   ADEQ = Arizona Department of Environmental Quality
   NMED-AQB = New Mexico Environment Department - Air Quality Bureau

Annual Number of Train Cars (incoming/outgoing)

	Coal Cars (incoming)	Liquid Sulfur Cars (outgoing)	Gasification Cars (outgoing)	Ammonia Cars (outgoing)	Urea Cars (outgoing)	UAN Cars (outgoing)	Maximum Total Trains per period
Annual average number of train cars	13100	0	0	0	0	0	13100

		Line-Haul Engine for Product Trains				
	Line-Haul Engine for Coal Train	Liquid Sulfur	Gasification	Ammonia	Urea	UAN
ton-mile/gallon	480	480	480	480	480	480
Train car capacity (ton)	117	100	100	0	100	100
Unloaded train car weight (ton)	25	25	25	25	25	25

480 ton-mile/gallon is based on 2009 *class I rail freight fuel consumption and travel* data (Association of American Railroads, *Railroad Facts*)

	Coal Trains			Liquid Sulfur Product Train			Gasification Solid Product Train		
Area	Miles traveled per Train (mile/engine) - One Way *	Coal Train (ton-miles/year) - Round Trip	Fuel Use for Coal Train (gal/year) - Round Trip	Miles traveled per Train (mile/engine) - One Way	Product Train (ton-miles/year) - Round Trip	Fuel Use for Product Train (gal/year) - Round Trip	Miles traveled per Train (mile/engine) - One Way	Product Train (ton-miles/year) - Round Trip	Fuel Use for Product Train (gal/year) - Round Trip
SJVAPCD	70	153,139,000	319,028	0	0	0	0	0	0
EKAPCD	62	135,637,400	282,568		0	0	0	0	0
MDAQMD (PM10 nonattainment and the maximum distance)	204	445,196,950	927,461		0	0	0	0	0
MDAQMD (Ozone nonattainment)	120	262,524,000	546,906		0	0		0	0
Arizona (PM10 nonattainment and the maximum distance)	364	796,322,800	1,658,947		0	0		0	0
New Mexico	102	222,051,550	462,591		0	0		0	0

* Since exact route of coal train was not determined yet, It was assumed that the coal train would travel across the maximum distance of the nonattainment area for all pollutants in Arizona.

	Ammonia Product Train			Urea Product Train			UAN Product Train		
Area	Miles traveled per Train (mile/engine) - One Way	Product Train (ton-miles/year) - Round Trip	Fuel Use for Product Train (gal/year) - Round Trip	Miles traveled per Train (mile/engine) - One Way	Product Train (ton-miles/year) - Round Trip	Fuel Use for Product Train (gal/year) - Round Trip	Miles traveled per Train (mile/engine) - One Way	Product Train (ton-miles/year) - Round Trip	Fuel Use for Product Train (gal/year) - Round Trip
SJVAPCD	0	0	0	0	0	0	0	0	0
Sacramento Metro		0	0	0	0	0		0	0
Yuba City-Marysville		0	0	0	0	0		0	0
Chico		0	0	0	0	0		0	0
Other Area in California and Oregon/Washington		0	0	0	0	0		0	0

offsite locomotive travelling speed in average	40	mph
ratio of required horsepower (empty train/full train)	0.76	
locomotive load factor	28%	

Train Type	Coal	Liquid Sulfur	Gasification Solids	Ammonia	Urea	UAN
Railcar Capacity (ton)	117	100	100	-	100	100
Locomotive Engine Power (hp, each)	4,400	3,000	3,000		3,000	3,000
Railcars per train	111	60	60		60	60
Numbers of locomotive engine per train	6	2	2		2	2
Total ton of material per locomotive engine	2,165	3,000	3,000		3,000	3,000
Total # locomotive engines needed to transport material per year	706	-	-		-	-
Total # locomotive engines needed for returning trains per year	536	-	-		-	-
Total locomotive hours per year in SJVAPCD	2,174					
Total locomotive hours per year in EKAPCD	1,925					
Total locomotive hours per year in MDAQMD (PM10 nonattainment and the maximum distance)	6,319					
Total locomotive hours per year in MDAQMD (Ozone nonattainment)	3,726					
Total locomotive hours per year in Arizona (PM10 nonattainment and the maximum distance)	11,303					
Total locomotive hours per year in Arizona (PM2.5 nonattainment)	621					
Total locomotive hours per year in Arizona (Ozone nonattainment)	3,105					
Total locomotive hours per year in Arizona (SO2 and CO nonattainment)	6,210					
Total locomotive hours per year in New Mexico	3,152					
Total locomotive hours per year in Sacramento Metro						
Total locomotive hours per year in Yuba City-Marysville						
Total locomotive hours per year in Chico						
Total locomotive hours per year in Other Area in California and Oregon/Washington						

	Line-Haul Emission Factors	CO	NOx	PM10	PM2.5	SO2	VOC
	Tier 3 Emission Factor (g/bhp-hr)	1.28	4.95	0.08	0.08	0.09	0.14
	Tier 3 Emission Factor (g/gal)	26.62	102.96	1.66	1.61	1.88	2.85

Annual Emission Rates by Area

Area		CO	NOx	PM10	PM2.5	SO2	VOC
		Annual Emission Rates (tons/year) all trains					
SJVAPCD (San Joaquin Valley), CA	Line-haul coal engines	3.74	14.47	0.23	0.23	0.26	0.40
	Line-haul liquid sulfur product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Line-haul gasification product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Line-haul ammonia product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Line-haul urea product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Line-haul UAN product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Total Trains (ton/yr)	**3.74**	**14.47**	**0.23**	**0.23**	**0.26**	**0.40**
EKAPCD (East Kern County), CA	Line-haul coal engines	3.31	12.81	0.21	0.20	0.23	0.35
	Line-haul gasification product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Total Trains (ton/yr)	**3.31**	**12.81**	**0.21**	**0.20**	**0.23**	**0.35**
MDAQMD (PM10 nonattainment and total distance)	Line-haul coal engines	10.88	42.06	0.68	0.66	0.77	1.16
	Line-haul gasification product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Total Trains (ton/yr)	**10.88**	**42.06**	**0.68**	**0.66**	**0.77**	**1.16**
MDAQMD (Ozone nonattainment)	Line-haul coal engines	6.41	24.80	0.40	0.39	0.45	0.69
	Line-haul gasification product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Total Trains (ton/yr)	**6.41**	**24.80**	**0.40**	**0.39**	**0.45**	**0.69**
Arizona	Line-haul coal engines	19.45	75.23	1.22	1.18	1.37	2.08
	Total Trains (ton/yr)	**19.45**	**75.23**	**1.22**	**1.18**	**1.37**	**2.08**
Sacramento Metro, CA	Line-haul urea product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Total Trains (ton/yr)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Yuba City-Marysville, CA	Line-haul urea product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Total Trains (ton/yr)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Chico, CA	Line-haul urea product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Total Trains (ton/yr)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Other Area in California and Oregon/Washington	Line-haul urea product engines	0.00	0.00	0.00	0.00	0.00	0.00
	Total Trains (ton/yr)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
New Mexico	Line-haul coal engines	5.42	20.98	0.34	0.33	0.38	0.58
	Total Trains (ton/yr)	**5.42**	**20.98**	**0.34**	**0.33**	**0.38**	**0.58**

EPA Estimated Locomotive Average Emission Rates by Tiers

Tier	Emission Factor (g/bhp-hr) CO	NO_X	PM	HC
Uncontrolled	1.28	13.00	0.32	0.48
Tier 0	1.28	8.60	0.32	0.48
Tier 0+	1.28	7.20	0.20	0.30
Tier 1	1.28	6.70	0.32	0.47
Tier 1+	1.28	6.70	0.20	0.29
Tier 2	1.28	4.95	0.18	0.26
Tier 2+ and Tier 3	1.28	4.95	0.08	0.13
Tier 4	1.28	1.00	0.015	0.04

Emission Factors For all Locomotives
SOx (3)
g/gal
1.88

Locomotive Application	Conversion Factor (bhp-hr/gal)
Large Line-haul & Passenger	20.8
Small Line-haul	18.2
Switching	15.2

Note:
(1) EPA's Technical Highlights: Emission Factors for Locomotives, 2009 (http://www.epa.gov/nonroad/locomotv/420f09025.pdf).
(2) Line-haul engine emissions of CO, Nox, PM, and HC are based on EPA Tier 3.
(3) Based on 300 ppm sulfur diesel fuel.
(4) VOC emissions can be assumed to be equal to 1.053 times the HC emissions
(5) $PM_{2.5}$ Fraction of PM_{10}, = 0.97
(6) No off-site switching or idling was assumed for train transportation.
(7) Average line haul locomotive load factor was obtained from Table 5.12 of The Port Of Long Beach - 2007 Air Emissions Inventory (http://www.polb.com/civica/filebank/blobdload.asp?BlobID=6021)

Summary of Truck Emissions - HECA

3/05/2013 revision

Calculations for Trucks Operation

Data Supplied By Client							
Parameter	Coke Trucks (Max @ 50 or 60 mph)	Coal Trucks (Max @ 50 or 60 mph)	Liquid Sulfur Product Trucks (Max @ 50 or 60 mph)	Gasification Product Trucks (Max @ 50 or 60 mph)	Urea Product Trucks (Max @ 50 or 60 mph)	UAN Sulfur Product Trucks (Max @ 50 or 60 mph)	Equipment and Miscellaneous Trucks (Max @ 50 or 60 mph)
	Running Emissions	Running Emissions	Running Emissions	Running Emissions	Running Emissions	Running Emissions	Running Emissions
Distance traveled per truck in San Joaquin Valley, CA (mi)	104	53	104	160	80	80	92
Distance traveled per truck in Los Angeles-South Coast Air Basin, CA (mi)	176	0	180	0	0	0	151
Maximum number of trucks or loads:							
Annual average trucks or loads	15,200	61,040	1,360	12,680	22,920	18,680	4,690

No off-site idling was assumed for truck transportation.
Distance traveled per truck is based on round-trip.

EMFAC2007 Emission Factors + Fugitive Dust (g/mi) For Truck Model year 2010, Scenario year 2015

Pollutant	Coke Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)	Coal Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)	Liquid Sulfur Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)	Gasification Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)	Urea Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)	UAN Sulfur Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)	Equipment and Miscelleneous Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk)
CO	1.32	1.32	1.32	1.32	1.32	1.32	1.32
NOx	2.17	2.17	2.17	2.17	2.17	2.17	2.17
ROG	0.18	0.18	0.18	0.18	0.18	0.18	0.18
SOx	0.02	0.02	0.02	0.02	0.02	0.02	0.02
PM10 *	0.60	0.60	0.60	0.60	0.60	0.60	0.60
PM2.5 *	0.18	0.18	0.18	0.18	0.18	0.18	0.18

EMFAC2007 is the approved federal model for vehicle combustion emissions
* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007
PM factors from EMFAC = combustion exhaust + tire wear + break wear
The maximum emission factor from either truck speed at 50 mph or 60 mph was used.
Most California highways have speed limits of 60 or 70 mph and large trucks travel more slowly than the speed limit.

Annual Emission Rates in ton/yr all trucks

Pollutant	Coke Trucks (Max @ 50 or 60 mph) Running Emissions	Coal Trucks (Max @ 50 or 60 mph) Running Emissions	Liquid Sulfur Product Trucks (Max @ 50 or 60 Running Emissions	Gasification Product Trucks (Max @ 50 or 60 Running Emissions	Urea Product Trucks (Max @ 50 or 60 mph) Running Emissions	UAN Sulfur Product Trucks (Max @ 50 or 60 mph) Running Emissions	Equipment and Miscelleneous Trucks (Max Running Emissions	Total Truck Emission Rates (tons/yr)
San Joaquin Valley, CA								
CO	2.29	4.69	0.21	2.94	2.66	2.17	0.63	**15.59**
NOx	3.78	7.73	0.34	4.85	4.38	3.57	1.03	**25.67**
ROG	0.32	0.65	0.03	0.41	0.37	0.30	0.09	**2.17**
SOx	0.03	0.06	0.00	0.04	0.03	0.03	0.01	**0.19**
PM10	1.04	2.12	0.09	1.33	1.20	0.98	0.28	**7.05**
PM2.5	0.31	0.64	0.03	0.40	0.36	0.30	0.09	**2.12**
Los Angeles-South Coast Air Basin, CA								
CO	3.88	0.00	0.36	0.00	0.00	0.00	1.03	**5.26**
NOx	6.39	0.00	0.58	0.00	0.00	0.00	1.69	**8.67**
ROG	0.54	0.00	0.05	0.00	0.00	0.00	0.14	**0.73**
SOx	0.05	0.00	0.00	0.00	0.00	0.00	0.01	**0.06**
PM10	1.76	0.00	0.16	0.00	0.00	0.00	0.46	**2.38**
PM2.5	0.53	0.00	0.05	0.00	0.00	0.00	0.14	**0.72**

Summary of Worker Commute Vehicle Emissions - HECA

3/05/2013 revision

Calculations for Worker Commute Vehicle Operation

OFFSITE - 50 MPH								EF (g/mile)					
Onroad Vehicle	Fuel Type	Vehicle Type	Total Number of Workers per day	Daily Vehicle Count	Round Trip Distance (miles/vehicle/day)	Trips per day	VMT (Annual)	CO	NOx	PM_{10}	$PM_{2.5}$	SO_2	TOC
Personal Commuting Vehicles	G/D	LDA/ LDT	200	154	40.0	1	2,246,154	1.6825	0.1930	0.4234	0.1134	3.50E-03	0.0540

Assumptions:

Assumed average distance traveled off site for all employees commuting will be 20 miles

times 2 for return trip = 40 miles

365 days per year

Number of workers per commuter vehicle = 1.3

EMFAC2007 emissions are for fleet mix years 1971-2015 travelling at 50 mph.

Area	Description	Annual Emission Rates (tons/year) all worker commute vehicles					
		CO	NOx	PM10	PM2.5	SO2	VOC
San Joaquin Valley, CA	Personal Commuting Vehicles	4.17	0.48	1.05	0.28	0.01	0.13

Fugitive Dust on Paved Road

3/05/2013 revision

AP 42 13.2.1 Paved Roads, updated January 2011

For a daily basis,
E = [k (sL)^0.91 x (W)^1.02](1-P/4N) (2)

P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period
W = average weight (tons) of vehicles traveling the road
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading (g/m^2)

	k
	g/VMT
PM2.5	0.25
PM10	1.00

Table 13.2.1-1
PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

Fleet mix on highway

W=	9.1	tons, average
sL=	0.031	g/m2 Default value from URBEMIS 9.2 for Kern County
P=	36	days/year Buttonwillow Station 1940-2011, WRCC

E=
0.09836 g/VMT PM2.5
0.39344 g/VMT PM10

Vehicle weight (tons)		fraction of each vehicle type
1.6	passenger vehicles	0.75
40	large trucks	0.18
9	2-4 axle trucks	0.07

9.1 weighted average for all vehicles (ton)

On I-5 near the Project, 75% of all vehicles are passenger vehicles,
of the remaining vehicle, 73% are 5-axle trucks and the remainder are 2-4 axle trucks.
From information provided by California Department of Transportation for the traffic analysis.

Industrial Wind Erosion, AP-42 Section 13.2.5

Emission factor (g/m^2-yr) = k Σ P_i (from i=1,N) (Equation 2) 3/05/2013 revision

Erosion Potential (P_i) (g/m^2) = 58 $(u^* - u_t^*)^2 + 25(u^* - u_t^*)$ (Equation 3)

0.5	k =	PM_{10} particle size multiplier
0.075	k =	$PM_{2.5}$ particle size multiplier
1	N =	number of disturbances per year
33.76	A =	exposed area of coal, m^2, per car (Table 4.1, Jan 2008 Connell Hatch: exposed area = 33.76 m^2)

Use Equation (1) to determine friction velocity:

$u(z) = u^* / 0.4 \times \ln(z/z_0)$

17.88	u(z) =	fastest mile (m/s) (based on speed of train)
0.2	z =	distance at which wind speed is measured (m) (based on the height above the coal cars at which wind flow would be laminar; assumed this height is equal to the difference between the height of the locomotive engine and the trailing coal cars)
0.003	z_0 =	roughness height for uncrusted coal pile (m), from Table 13.2.5-2
1.70	u^* =	friction velocity (m/s), solved for using Equation 1
0.55	u_t^* =	threshold friction velocity (m/s); Table 13.2.5-2 value for ground coal (surrounding coal pile)

Erosion Potential

	P =	105.9	g/m^2	erosion potential corresponding to the observed (or probable) fastest mile of wind for the i^{th} period between disturbances, g/m^2
Annual	A =	442,256.0	m^2/yr	exposed area of coal per car (m^2) times number of cars per year

Unmitigated Emissions

Emission factor (g/m^2-yr) = k Σ P_i (from i=1,N)

E =	23,423,432	grams PM_{10} / year
	25.82	tons PM_{10} / year
E =	3,513,515	grams $PM_{2.5}$ / year
	3.87	tons $PM_{2.5}$ / year

Mitigation Efficiency of Surfactant: **85%**

* HECA will be requiring the coal supplier to apply a surfactant to the coal transported by rail to reduce fugitive losses during transport. Surfactant achieves at least an 85% control efficiency.

Mitigated PM_{10}: **3.87 tons PM_{10} / year**

Mitigated $PM_{2.5}$: **0.58 tons $PM_{2.5}$ / year**

* It has been assumed that all emitted PM will be lost during the first 100 miles of the trip and has thus all been assigned to New Mexico. Maximum train speed (and thus wind speed) will certainly be reached within this time, and according to AP-42 Section 13.2.5.1, "particulate emission rates tend to decay rapidly (half-life of a few minutes) during an erosion event."

40	train speed, mph
0.447	m/s per 1 mph
453.6	grams per pound
2000	pounds per ton
13,100	Required rail car loads per year at normal operation (cars/yr)

Summary of Transportation Vehicles and Routes

3/05/2013 revision

Commodity Handled	Petcoke	Coal	Liquid Sulfur	Gasification Solids	Urea	UAN-32	Equipment Maintenance (1)	Miscellaneous Activities (2)
Expected plant operation								
Expected plant operation is 8000 hours / year								
The plant will operate 24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day	24 hours / day
The plant will operate 333 days / year	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr	333 days / yr
Shipment by trucks	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Shipment by train	0 %	100 %	0 %	0 %	0 %	0 %	0 %	0 %
Production rate								
Required Normal Flow / day	1,140 tons / day	4,580 tons / day	100 tons / day	950 tons / day	1,720 tons / day	1,400 tons / day		
Required Normal Flow / year	380,000 tons / yr	1,526,000 tons / yr	34,000 tons / yr	317,000 tons / yr	573,000 tons / yr	467,000 tons / yr		
Required Maximum Flow day	2,000 tons / day (3)	6,500 tons / day (4)	200 tons / day (5)	1,900 tons / day (6)	3,440 tons / day (6)	2,800 tons / day (6)		
Truck Shipments								
Truck Capacity	25 tons / truck	25 tons / truck	25 tons / truck	25 tons / truck	25 tons / truck	25 tons / truck	25 tons / truck	25 tons / truck
Required trucks loads for normal operation / day	46 trucks / day	184 trucks / day	4 trucks / day	38 trucks / day	69 trucks / day	56 trucks / day	3 trucks / day	11 trucks / day
Required trucks loads for normal operation / yr	15,200 truck / yr	61,040 truck / yr	1,360 truck / yr	12,680 truck / yr	22,920 truck / yr	18,680 truck / yr	1,000 truck / yr	3,690 truck / yr
Required trucks loads for maximum operation /day	80 trucks / day	260 trucks / day	8 trucks / day	76 trucks / day	138 trucks / day	112 trucks / day	5 trucks / day	17 trucks / day
Train Shipments								
Railcar Capacity		117 tons / car	100 tons / car	100 tons / car	100 tons / car	100 tons / car		
Required railcars for normal operation / day		40 cars / day	0 cars / day	0 cars / day	0 cars / day	0 cars / day		
Required railcar loads for normal operation / yr		13,100 cars / yr	0 cars / yr	0 cars / yr	0 cars / yr	0 cars / yr		
Required railcars for maximum operation / day		200 cars / day	0 cars / day	0 cars / day	0 cars / day	0 cars / day		
Basis	- 91% availability	- 91% availability	- 91% availability	- 91% availability	- 91% availability	- 91% availability		
	- 25% petcoke (heat input) per year	- 75% coal (heat input) per year	- High sulfur case - 100 tons/day	- 75% coal max annual average				
	- 25 ton/truck	- 117 tons/car	- 25 ton/truck		-empty 45 day storage in 10 days	-empty 45 day storage in 10 days	,	
	- 7 days/week receiving	- 100% coal for maximum	- Weekdays only		10 days	10 days		
	- 25% excess truck movement capacity	- Rack sized to handle two trains/day		- Maximum is double the daily average rate				
Traffic route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route	Truck Route
Destination/Origin	Carson Refinery	Wasco rail terminal to site	California Sulfur	Various	Various	Various	Various	Various
Address	1801 E Sepulveda, Carson		2509 E Grant Street, Wilmington					
Distance	140 miles	26.5 miles	142 miles	80 mile radius	40 mile radius	40 mile radius	40 mile ratius	40 mile ratius
Route	Alameda 405 Fwy 5 Fwy Stockdale hwy Morris Road Station Road		Grant Henry Ford Alameda 405 Fwy 5 Fwy Stockdale hwy Morris Road Station Road	40 mile radius Station Road Morris Road Stockdale Hywy 5 Fwy	Station Road Morris Road Stockdale Hywy 5 Fwy	Station Road Morris Road Stockdale Hywy 5 Fwy	5 fwy Stockdale Hwy Dairy Road	5 fwy Stockdale Hwy Dairy Road
	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route	Rail Route
Destination/Origin	None	Elk Ranch New Mexico	None	None	None	None	None	None
Address								
Distance		801 miles						
Route		Kern County: 139.2 miles (County Line near Boron, CA to north property line of plant) Mine to Boron, CA: 662 miles Total Distance: 801.2 miles						

Notes

1) Equipment Maintenance Trucks are considered to be 2% of the total trucks per day for the feed and product operation.
2) Miscellaneous trucks are considered to be 3% of the total trucks per day for the feed and product operation.
3) The maximum flow rate of coke is ratioed up from the normal flow rate at 25% to 30% of feed
4) The maximum flow rate of coal is ratioed up from the normal flow rate at 75% to 100% of feed
5) The maximum flow rate of sulfur is 2 times the normal production
6) The maximum flow rate of these commodities is 2 times the normal production
7) The sources of flow data used in the Production Rate calculation were based on the flow rates provided in "Conference Note: Rail and Truck Traffic - Planning Session" and the "FertilizerProductMovement Update", 01-25-12.

Calculations for Trucks Operation onsite

Data Supplied By Client					
Parameter	**Petcoke and Coal Trucks**		**Product Trucks**		**Miscellaneous Trucks**
	Running Emissions	**Idling Emissions**	**Running Emissions**	**Idling Emissions**	**Running Emissions**
Distance Traveled (mi)*	0.96		2.49		2.20
Per Truck Idle Time (hr)		0.083		0.083	
Maximum number of trucks or loads:					
Annual average trucks or loads	76,240	76,240	55,640	55,640	4,662

EMFAC2007 Emission Factors + Fugitive Dust (g/mi or g/idle-hour) For Truck Model year 2010

	Coke and Coal Trucks		**Product Trucks**		**Miscellaneous Trucks**
Pollutant	**Running Emissions (g/mile/trk)**	**Idling Emissions (g/idle-hour/trk)**	**Running Emissions (g/mile/trk)**	**Idling Emissions (g/idle-hour/trk)**	**Running Emissions (g/mile/trk)**
CO	3.03	43.69	3.03	43.69	3.03
NOx	5.43	122.65	5.43	122.65	5.43
ROG	1.39	7.74	1.39	7.74	1.39
SOx	0.03	0.06	0.03	0.06	0.03
PM10 *	0.92	0.11	0.92	0.11	0.92
PM2.5 *	0.29	0.10	0.29	0.10	0.29

EMFAC2007 is the approved federal model for vehicle combustion emissions

* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007

PM factors from EMFAC = combustion exhaust + tire wear + break wear

EMFAC emissions are for fleet year 2010 travelling at 10 mph.

Annual Emission Rates in g/s For All Trucks

	Coke and Coal Trucks		**Product Trucks**		**Miscellaneous Trucks**		
Pollutant	**Running Emissions**	**Idling Emissions (at each Idle Point)**	**Running Emissions**	**Idling Emissions (at each Idle Point)**	**Running Emissions**	**TOTAL (g/s)**	**TOTAL (tpy)**
CO	7.000E-03	8.802E-03	1.328E-02	6.423E-03	9.846E-04	3.65E-02	1.27E+00
NOx	1.255E-02	2.471E-02	2.380E-02	1.803E-02	1.765E-03	8.09E-02	2.81E+00
ROG	3.209E-03	1.560E-03	6.087E-03	1.139E-03	4.513E-04	1.24E-02	4.33E-01
SOx	6.936E-05	1.249E-05	1.316E-04	9.116E-06	9.755E-06	2.32E-04	8.07E-03
PM10	2.120E-03	2.297E-05	4.021E-03	1.676E-05	2.982E-04	6.48E-03	2.25E-01
PM2.5	6.762E-04	2.095E-05	1.283E-03	1.529E-05	9.511E-05	2.09E-03	7.27E-02

Volume, Line Sources

Guidance for Air Dispersion Modeling, SJVAPCD, 2007 and Section 1.2.2 of Volume II of ISC User's Guide			
2.3.2 Oyo=12W/2.15			
Truck Traveling vol src		Truck Idling pt src	
6	ft Release height	12.6	ft Release height
12	ft Width	0.1	m diam
66.98	ft init horz dim Syo	51.71	m/s vel
5.58	ft init vert dim Szo	366	K Temp
		199.134	F Temp

Volume, Stand Alone

Guidance for Air Dispersion Modeling, SJVAPCD, 2007	
2.3.2 + modelers judgement + ISC guidance	
Truck Traveling vol src	
6	ft Release height
12	ft Width
2.79	ft init horz dim Syo
5.58	ft init vert dim Szo

Summary of On-Site Operations Truck Emissions — Emissions Summary

3/05/2013 revision

Transportation Information		Notes
- Onsite Vehicle =	20 trucks	- Information Provided By Applicant
- Vehicle year=	2010	- Information Provided By Applicant
- Maximum annual mileage =	10,000 miles/truck-year	- All routine vehicular traffic is anticipated to travel exclusively on paved roads
		- Assumed 15 mph average speed within HECA facility

EMFAC2007 Emission Factors (g/mi) For Truck Model year 2010

	Emission Factors in g/mi	
Pollutant	Gas LHDT1	Diesel LHDT2
CO	0.229	0.920
NOx	0.064	0.672
ROG	0.014	0.085
SOx	0.011	0.005
PM10 *	0.167	0.176
PM2.5 *	0.054	0.062

EMFAC2007 is the approved federal model for vehicle combustion emissions

* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007

PM factors from EMFAC = combustion exhaust + tire wear + break wear

EMFAC emissions are for fleet year 2010 travelling at 15 mph.

Annual Emission Rates in g/s From All Trucks

	Emissions in g/s			
Pollutant	Gas LHDT1	Diesel LHDT2	TOTAL (g/s)	TOTAL (tpy)
CO	1.45E-03	5.83E-03	7.29E-03	0.253
NOx	4.06E-04	4.26E-03	4.67E-03	0.162
ROG	8.88E-05	5.39E-04	6.28E-04	0.022
SOx	6.98E-05	3.17E-05	1.01E-04	0.004
PM10	1.06E-03	1.11E-03	2.17E-03	0.076
PM2.5	3.40E-04	3.91E-04	7.32E-04	0.025

Fugitive Dust on Paved Road

3/05/2013 revision

AP 42 13.2.1 Paved Roads, updated January 2011

For a daily basis,
E = [k (sL)^0.91 x (W)^1.02](1-P/4N)   (2)

P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period
W = average weight (tons) of vehicles traveling the road
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading (g/m^2)

	k
	g/VMT
PM2.5	0.25
PM10	1.00

Table 13.2.1-1
PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

Large Trucks

			Empty truck	full truck	Load Capacity
W=	17.5	tons, average	5	30	0 tons
sL=	0.031	g/m2 Default value from URBEMIS 9.2 for Kern County			
P=	36	days/year Buttonwillow Station 1940-2011, WRCC			

E=
0.19149 g/VMT PM2.5 large delivery trucks
0.76594 g/VMT PM10 large delivery trucks

Operation and Maintenance Vehicles

W=	3	tons
sL=	0.031	g/m2 Default value from URBEMIS 9.2 for Kern County
P=	36	days/year Buttonwillow Station 1940-2011, WRCC

E=
0.03169 g/VMT PM2.5 large delivery trucks
0.12675 g/VMT PM10 large delivery trucks

APPENDIX E

REVISED OPERATIONAL GREENHOUSE GAS EMISSIONS

Hydrogen Energy California LLC *5/1/2013*
HECA Project

HECA Maximum Annual CO2e Emissions

Source	Permitted CO2e Emissions (tonne/year)
CTG/HRSG Hydrogen-Rich Fuel and PSA Off-gas	267,117
CTG/HRSG Natural Gas	44,772
CO_2 Vent	175,493
SF_6 Circuit breakers	86
Flares	8,257
Thermal Oxidizer	6,048
Emergency generators and fire pump	181
Auxiliary boiler	24,782
Ammonia Synthesis Plant Startup Heater	417
Urea Absorber Vents	116
Nitric Acid Unit	12,659
Fugitives	42
Total CO2e Annual Emissions	**539,971**

Notes:

Maximum permitted emissions include periods of startup and shutdown.

HECA Annual CO2 Emissions for SB1368 Emission Performance Standard

Sources of CO2	Total	Power	Fertilizer	Allocation
	CO2 Emissions (tons/yr)			
CTG/HRSG burning syngas/PSA off-gas	283,181	183,784	99,396	C
CTG/HRSG burning natural gas	49,304	49,304	-	P
CO2 Vent	193,446	125,547	67,900	C
Flares pilot	564	366	198	C
Flares SU/SD	8,534	5,538	2,995	C
Thermal Oxidizer standby	6,323	4,104	2,219	C
Thermal Oxidizer SU/SD, maintenance	337	219	118	C
Emergency Engines	115	-	-	exempt
Auxiliary Boiler	27,290	17,711	9,579	C
Ammonia Start-Up Heater	459	-	459	F
Urea Absorber Vents	128	-	128	F
Nitric Acid Unit	0	-	-	F
Fugitives	39	26	14	C
Total Emissions attributable to each Section				
Total Early Operations	569,721	386,599	183,006	
Total Mature Operations	422,333	290,944	131,273	
Total Steady State Operations	290,350	188,279	101,956	

Syngas allocation by section (daily average)		
P	Power	64.9%
F	Fertilizer	35.1%
C	Common	

HECA Power Generation for SB1368 Emission Performance Standard

Power Balance	Unit	On-Peak	Off-Peak	Daily Average
Power Generation				
Gross Output	MW	416.0	315.2	382.4
Allocation to Power	MW	412.5	303.9	376.3
Allocation to Fertilizer	MW	3.5	11.3	6.1
Auxiliary Power				
Common	MW	85.7	86.0	
Power	MW	12.7	12.4	
Fertilizer	MW	52.1	65.6	
Syngas Allocation				
To Power Block	%	71.3%	52.1%	64.9%
To Fertilizer	%	28.7%	47.9%	35.1%
Power Allocation				
IGCC Net Output (w/o Fertilizer)	MW	338.7	246.6	308.1
IGCC Net Output	MW-hr/year			2,464,574
Natural Gas-Fired Net Power Output	MW			300
Natural Gas-Fired Power Production	MW-hr/year			100,800
Fertilizer Power Consumption	MW	(73.2)	(95.5)	(80.6)

SB1368 Emission Performance Standard

	Early Operations (Maximum Permitted)	Mature Operations	Steady-State Syngas Operations
Total CO_2 Annual Emissions Attributable to Power Production (ton/yr)	386,599	290,944	188,279
Net Power Output (MWh)	2,565,374	2,565,374	2,464,574
CO_2 EPS (lb/MWh)	301	227	153

Notes:
Emissions presented include CO2 from the turbine during startups and shutdowns.
Emissions from the emergency engines are exempt from the SB1368 standard.
The annual power output does not include the megawatts generated during startup and shutdown, thus the EPS may be conservatively high.

Scenario definitions:

Early Operations - expected to last approximately 2 years, during which time hydrogen-rich fuel availability will be approximately 65 to 75 percent. During this period, all sources are expected to be operated at maximum operating conditions, including two plant start-ups and shut-downs. The CO2 vent is included with maximum permitted venting emissions of up to 504 hours at full capacity.

Mature Operations - expected to occur after the first 2 years of commercial operation, when the hydrogen-rich fuel availability will be approximately 85 percent. At this stage, significantly less venting is expected to occur; thus, CO2 vent emissions are estimated based on approximately 10 days of venting at 50 percent capacity (or 120 hours of venting at 100 percent capacity). All other sources are operated at maximum operating conditions, including two plant start-ups and shut-downs.

Steady State Operations - which occur in the same time frame as mature operations; that is, after the 2 years of early operation. In this scenario, emissions are estimated based on maximum operating conditions, excluding start-ups, shut-downs and CO2 venting. Emissions from operation of the CTG/HRSG on syngas are included; no natural gas use is included.

Hydrogen Energy California LLC *5/1/2013*
HECA Project

GHG emissions are numerically depicted as metric tons (tonne) of carbon dioxide equivalents (CO_2e). CO_2e represents CO_2 plus the additional warming potential from CH_4 and N_2O. CH_4 and N_2O have 21 and 310 times the warming potential of CO_2, respectively.

Natural Gas GHG Emission Factors

CO_2 =	53.06	kg/MMBtu =	116.98	lb/MMBtu
CH_4 =	0.001	kg/MMBtu =	0.002	lb/MMBtu
N_2O =	0.0001	kg/MMBtu =	0.00022	lb/MMBtu

Diesel GHG Emission Factors

CO_2 =	10.15	kg/gal =	22.38	lb/gal
CH_4 =	0.0004	kg/gal =	0.001	lb/gal
N_2O =	0.0001	kg/gal =	0.0002	lb/gal

CO_2, CH_4, and N_2O emission factors are taken from Appendix C of the California Climate Action Registry (CCAR) General Reporting Protocol Version 3.1 (Jan 2009)

Turbine - Burning Hydrogen-Rich Fuel - released to HRSG and Feedstock Dryer Stacks

Operating Hours	8012	hr/yr		
Heat Input (HHV)	2,537	MMBtu/hr		
CO_2 =	163,244	tonne/yr		
CH_4 =	288	tonne/yr =	6,043	tonne CO_2e/yr
N_2O =	2.03	tonne/yr =	630	tonne CO_2e/yr
			Total tonne CO_2e/yr =	169,917

Syngas GHG Emission Factors		
CO_2 =	17.7	lb/MMBtu
CH_4 =	0.03	lb/MMBtu

HRSG heat input rate is based Case 5, average ambient temperature and peak load.
Operating hours include startup and shutdown operations
Although N2O emissions are expected to be lower than from the combustion of natural gas, N2O emissions were conservatively estimated using the natural gas emission factor.

Duct burner - Burning Hydrogen-Rich Fuel - released to HRSG and Feedstock Dryer Stacks

Operating Hours	8000	hr/yr		
Heat Input (HHV)	165	MMBtu/hr		
CO_2 =	10,603	tonne/yr		
CH_4 =	19	tonne/yr =	393	tonne CO_2e/yr
N_2O =	0.13	tonne/yr =	41	tonne CO_2e/yr
			Total tonne CO_2e/yr =	11,036

Syngas GHG Emission Factors		
CO_2 =	17.7	lb/MMBtu
CH_4 =	0.03	lb/MMBtu

Duct burner heat input rate is based Case 5, average ambient temperature and peak load.
Duct burner not operated during turbine startup and shutdown
Although N2O emissions are expected to be lower than from the combustion of natural gas, N2O emissions were conservatively estimated using the natural gas emission factor.

Duct burner - Burning PSA Offgas - released to HRSG and Feedstock Dryer Stacks

Operating Hours	8,000	hr/yr		
Heat Input (HHV)	149	MMBtu/hr		
CO_2 =	83,053	tonne/yr		
CH_4 =	146	tonne/yr =	3,073	tonne CO_2e/yr
N_2O =	0.12	tonne/yr =	37	tonne CO_2e/yr
			Total tonne CO_2e/yr =	86,163

Syngas GHG Emission Factors		
CO_2 =	153.6	lb/MMBtu
CH_4 =	0.3	lb/MMBtu

Duct burner heat input rate is based Case 5, average ambient temperature and peak load.
Duct burner not operated during turbine startup and shutdown
Although N2O emissions are expected to be lower than from the combustion of natural gas, N2O emissions were conservatively estimated using the natural gas emission factor.

Turbine - Burning Natural Gas - released to HRSG Stack

Operating Hours	351	hr/yr		
Heat Input (HHV)	2,401	MMBtu/hr		
CO_2 =	44,729	tonne/yr		
CH_4 =	0.84	tonne/yr =	18	tonne CO_2e/yr
N_2O =	0.08	tonne/yr =	26	tonne CO_2e/yr
			Total tonne CO_2e/yr =	44,772

HRSG heat input rate is assumed to be the maximum heat input rate firing natural gas. Hours of operation include startup and shutdown.

Auxiliary Boiler

Operating Hours		2,190	hr/yr			
Heat Input		213	MMBtu/hr			
CO_2 =	24,758	tonne/yr				
CH_4 =	0.47	tonne/yr =	10	tonne CO_2e/yr		
N_2O =	0.05	tonne/yr =	14	tonne CO_2e/yr	Total tonne CO_2e/yr =	24,782

Emergency Generators (2)

Operating Hours		50	hr/yr			
Heat Input		2,922	Bhp			
CO_2 =	3,341	lb/hr =	76	tonne CO_2/yr		
CH_4 =	0.13	lb/hr =	0.063	tonne CO_2e/yr		
N_2O =	0.03	lb/hr =	0.2315	tonne CO_2e/yr	Total tonne CO_2e/yr* =	152

The following conversions were used to convert from lb/gallon to lb/hp-hour; and then multiplying by the rated horsepower rating: 1 gallon/137,000 Btu; and 7,000 Btu/hp-hour.

* Total tonnes CO_2e per year represent the contributions from both generators.

Fire Water Pump

Operating Hours		100	hr/yr			
Heat Input		556	Bhp			
CO_2 =	636	lb/hr =	29	tonne CO_2/yr		
CH_4 =	0.03	lb/hr =	0.024	tonne CO_2e/yr		
N_2O =	0.01	lb/hr =	0.0881	tonne CO_2e/yr	Total tonne CO_2e/yr =	29

The following conversions were used to convert from lb/gallon to lb/hp-hour; and then multiplying by the rated horsepower rating: 1 gallon/137,000 Btu; and 7,000 Btu/hp-hour.

Gasification Flare

Pilot Operation						
Operating Hours		8,760	hr/yr			
Heat Input		0.5	MMBtu/hr			
CO_2 =	232	tonne/yr				
CH_4 =	0.00	tonne/yr =	0.1	tonne CO_2e/yr		
N_2O =	0.0004	tonne/yr =	0.1	tonne CO_2e/yr	Total tonne CO_2e/yr =	233
Flaring Events						
Total Operation		70,536	MMBtu/yr			
CO_2 =	3,744	tonne/yr				
CH_4 =	0.1	tonne/yr =	1	tonne CO_2e/yr		
N_2O =	0.01	tonne/yr =	2	tonne CO_2e/yr	Total tonne CO_2e/yr =	3,747

GHG emissions from flaring events are conservatively estimated using GHG emission factors for natural gas combustion.

Rectisol Flare

Pilot Operation						
Operating Hours		8,760	hr/yr			
Heat Input		0.3	MMBtu/hr			
CO_2 =	139	tonne/yr				
CH_4 =	0.00	tonne/yr =	0.1	tonne CO_2e/yr		
N_2O =	0.0003	tonne/yr =	0.08	tonne CO_2e/yr	Total tonne CO_2e/yr =	140
Flaring Events						
Operating Hours		40	hr/yr			
Vent gas flow		4542	lb-mole/hr			
CO_2 =	3,627	tonne/yr				
CH_4 =		tonne/yr =		tonne CO_2e/yr		
N_2O =		tonne/yr =		tonne CO_2e/yr	Total tonne CO_2e/yr =	3,627

GHG emissions from flaring event based on 100% carbon content of the gas during startup.

SRU Flare

Pilot Operation						
Operating Hours		8,760	hr/yr			
Heat Input		0.3	MMBtu/hr			
CO_2 =	139	tonne/yr				
CH_4 =	0.00	tonne/yr =	0.1	tonne CO_2e/yr		
N_2O =	0.0003	tonne/yr =	0.08	tonne CO_2e/yr	Total tonne CO_2e/yr =	140
Flaring Events - natural gas assist for acid gas venting during startup						
Operating Hours		40	hr/yr			
Heat Input		36	MMBtu/hr			
Throughput (inerts) - acid gas venting during startup						
CO_2 =		140000	scf/hr			
CO_2 =		16,240	lb/hr			
CO_2 =	371	tonne/yr				
CH_4 =	0.001	tonne/yr =	0.03	tonne CO_2e/yr		
N_2O =	0.00014	tonne/yr =	0.045	tonne CO_2e/yr	Total tonne CO_2e/yr =	371

Throughtput (inerts) provided from design engineers.

Tail Gas Thermal Oxidizer

Process Vent Disposal Emissions						
Operating Hours		8,314	hr/yr			
Heat Input		13	MMBtu/hr			
CO_2 =	5,736	tonne/yr				
CH_4 =	0.11	tonne/yr =	2.3	tonne CO_2e/yr		
N_2O =	0.0108	tonne/yr =	3.4	tonne CO_2e/yr	Total tonne CO_2e/yr =	5,742
SRU Startup & Shutdown						
Operating Hours		72	hr/yr			
Heat Input		80	MMBtu/hr			
CO_2 =	306	tonne/yr				
CH_4 =	0.006	tonne/yr =	0.12	tonne CO_2e/yr		
N_2O =	0.00058	tonne/yr =	0.179	tonne CO_2e/yr	Total tonne CO_2e/yr =	306

GHG emissions from thermal oxidizer are estimated using GHG emission factors for natural gas combustion for the assist gas.

Intermittent CO_2 Vent

Operating Hours	504	hr/yr		
CO_2 Emission Rate	767,435	lb/hr		
			Total tonne CO_2e/yr =	175,493

Assumes 504 hours per year venting at full rate.

Fugitives - Gasification Block

Operating Hours		8,760	hr/yr			
CO_2 =	32.0	tpy	31.12	tonne CO_2e/yr		
CH_4 =	0.27	tpy	5.55	tonne CO_2e/yr		
					Total tonne CO_2e/yr =	37

Detailed emission calculations are provided in Appendix M, Public Health.

Fugitives - Manufacturing Complex

Operating Hours		8,760	hr/yr			
CO_2 =	4.7	tpy	4.53	tonne CO_2e/yr		
CH_4 =	0.04	tpy	0.91	tonne CO_2e/yr		
					Total tonne CO_2e/yr =	5

Detailed emission calculations are provided in Appendix M, Public Health.

Ammonia Synthesis Plant Startup Heater

Operating Hours		140	hr/yr			
Heat Input		56	MMBtu/hr			
CO_2 =	416	tonne/yr				
CH_4 =	0	tonne/yr =	0	tonne CO_2e/yr		
N_2O =	0.00	tonne/yr =	0	tonne CO_2e/yr	Total tonne CO_2e/yr =	417

Urea Absorber Vents

Operating Hours		8,000	hr/yr			
CO_2		32	lb/hour			
CO_2 =	116	tonne/yr				
CH_4 =		tonne/yr =	0	tonne CO_2e/yr		
N_2O =		tonne/yr =	0	tonne CO_2e/yr	Total tonne CO_2e/yr =	116

Emission rate provided by project engineers.

Nitric Acid Unit

Operating Hours		8,000	hr/yr			
N_2O uncontrolled		10.78	lb/ton NHO3			
Production rate		501	ton/day			
N_2O uncontrolled		225	lb/hour			
destruction efficiency		95	%			
N_2O controlled		11.25	lb/hour			
N_2O controlled		0.54	lb/ton NHO3			
CO_2 =		tonne/yr				
CH_4 =		tonne/yr =	0	tonne CO_2e/yr		
N_2O =	41	tonne/yr =	12,659	tonne CO_2e/yr	Total tonne CO_2e/yr =	12,659

Emission factor and destruction efficiency provided by design engineer.

230 kV Circuit Breakers

Number of Circuit Breakers		6				
SF_6 capacity		240	lb/breaker			
Annual Leakage rate		0.5%				
SF_6 =	0.003	tonne/yr =	78	tonne CO_2e/yr	Total tonne CO_2e/yr =	78

SF6 GWP = 23,900 http://www.epa.gov/electricpower-sf6/faq.html)
Sources: SF6 inventory and maximum leakage rates from electrical equipment suppliers

18 kV Circuit Breakers

Number of Circuit Breakers		2				
SF_6 capacity		73	lb/breaker			
Annual Leakage rate		0.5%				
SF_6 =	0.000	tonne/yr =	8	tonne CO_2e/yr	Total tonne CO_2e/yr =	8

SF6 GWP = 23,900 http://www.epa.gov/electricpower-sf6/faq.html)
Sources: SF6 inventory and maximum leakage rates from electrical equipment suppliers

Total tonne CO_2e/yr for Stationary Sources=	**539,971**

Hydrogen Energy California LLC *5/1/2013*
HECA Project

		Greenhouse Gas Fuel Summary and Durations of Major Fuel Consumers											
		Syngas						PSA Off-Gas					
COMPONENTS	MW	mol%	mol*MW (lb/lbmole)	Wt%	MW C	% C	wt%Cmix	mol%	mol*MW (lb/lbmole)	Wt%	MW C	% C	wt%Cmix
CO (CARBON MONOXIDE)	28.01	1.92	0.54	8.48%	12	42.84%	3.63%	9.10	2.55	11.36%	12	42.84%	4.87%
H2 (HYDROGEN)	2.02	83.80	1.69	26.62%	-	0.00%	0.00%	23.78	0.48	2.14%	-	0.00%	0.00%
CO2 (CARBON DIOXIDE)	44.01	1.50	0.66	10.38%	12	27.27%	2.83%	7.09	3.12	13.92%	12	27.27%	3.79%
H2O (WATER)	18.02	-	-	0.00%	-	0.00%	0.00%	-	-	0.00%	-	0.00%	0.00%
CH4 (METHANE)	16.04	1.07	0.17	2.69%	12	74.81%	2.01%	5.03	0.81	3.60%	12	74.81%	2.69%
Ar (ARGON)	39.95	0.13	0.05	0.79%	-	0.00%	0.00%	0.59	0.23	1.04%	-	0.00%	0.00%
N2 (NITROGEN)	28.01	11.58	3.24	51.02%	-	0.00%	0.00%	54.38	15.23	67.90%	-	0.00%	0.00%
H2S (HYDROGEN SULFIDE)	34.08	0.00	0.00	0.00%	-	0.00%	0.00%	0.00	0.00	0.00%	-	0.00%	0.00%
COS (CARBONYL SULFIDE)	60.07	0.00	0.00	0.00%	12	19.98%	0.00%	0.00	0.00	0.00%	12	19.98%	0.00%
CH3OH (METHANOL)	32.03	0.01	0.00	0.03%	12	37.46%	0.01%	0.03	0.01	0.04%	12	37.46%	0.01%
C2H6 (ETHANE)	30.07	-	-	0.00%	24	79.81%	0.00%	-	-	0.00%	24	79.81%	0.00%
C3H8 (PROPANE)	44.10	-	-	0.00%	36	81.63%	0.00%	-	-	0.00%	36	81.63%	0.00%
C4H10 (N-BUTANE)	58.12	-	-	0.00%	48	82.59%	0.00%	-	-	0.00%	48	82.59%	0.00%
C4H10 (ISO-BUTANE)	58.12	-	-	0.00%	48	82.59%	0.00%	-	-	0.00%	48	82.59%	0.00%
C5H12 (N-PENTANE)	72.15	-	-	0.00%	60	83.16%	0.00%	-	-	0.00%	60	83.16%	0.00%
C5H12 (ISO-PENTANE)	72.15	-	-	0.00%	60	83.16%	0.00%	-	-	0.00%	60	83.16%	0.00%
C6+ (HEXANES, ETC)	86.18	-	-	0.00%	72	83.55%	0.00%	-	-	0.00%	72	83.55%	0.00%
NH3 (AMMONIA)	17.04	-	-	0.00%	-	0.00%	0.00%	-	-	0.00%	-	0.00%	0.00%
HCl (HYDROGEN CHLORIDE)	36.48	-	-	0.00%	-	0.00%	0.00%	-	-	0.00%	-	0.00%	0.00%
HCN (HYDROGEN CYANIDE)	27.03	-	-	0.00%	12	44.40%	0.00%	-	-	0.00%	12	44.40%	0.00%
Total		**100.00**	**6.36**	**100.00%**			**8.48%**	**100.00**	**22.43**	**100.00%**			**11.37%**

		Syngas Duration (hr)	Syngas Fuel input HHV (MMBtu/hr)	Syngas fuel consumption (MMscf/hr)	PSA Off-Gas Duration (hr)	PSA Off-Gas Fuel input HHV (MMBtu/hr)	PSA Off-Gas fuel consumption (MMscf/hr)
Gas Turbine	mmBTU/h	8,012	2,536.57	8.79	-	-	
Duct Burner	mmBTU/h	8,000	165.00	0.57	8,000	149.00	0.95
HHV (Btu/scf)		288.6			157.3		
Percentage of destruction of CH4		98.0%			98.0%		
CO2 lb/MMBtu HHV		17.704			153.56		
CH4 lb/MMBtu HHV		0.031			0.27		

		Syngas Hourly Emissions (lb/hr)	Syngas Annual Emissions (ton/yr)	Syngas Annual Emissions (tonnes/yr)	PSA Off-Gas Hourly Emissions (lb/hr)	PSA Off-Gas Annual Emissions (ton/yr)	PSA Off-Gas Annual Emissions (tonnes/yr)
CO2 emissions (lb/hr)	Gas Turbine	44,906	179,895	163,244	22,881	91,524	83,053
CH4 emissions (lb/hr)	Gas Turbine	79	317	288	40	161	146
CO2 emissions (lb/hr)	Duct Burner	2,921	11,684	10,603			
CH4 emissions (lb/hr)	Duct Burner	5	21	19			

Notes:

All Data based on Case 5 Performance Avg Ambient On-Peak

Includes startup and shutdown hours in the turbine operations. Assumed max heating value during SU/SD hours.

No startup or shutdown for duct burners

Hydrogen Energy California LLC *5/1/2013*
HECA Project

Greenhouse Gas Emissions Associated with the Mobile Sources During

Source	Annual CO2e Emissions (tonne/year)
Onsite Trucks	422
Onsite Trains	297
Offsite Workers Commuting	824
Offsite Trucks	12,372
Offsite Trains	50,075
Total CO2e Annual Emissions	**63,990**

Notes:

Onsite worker travel and associated emissions are negligible

GHG emissions are numerically depicted as metric tons (tonne) of carbon dioxide equivalents (CO_2e). CO_2e represents CO_2 plus the additional warming potential from CH_4 and N_2O. CH_4 and N_2O have 21 and 310 times the warming potential of CO_2, respectively.

Onsite LHD Gasoline Trucks

Number of Onsite Trucks		10	trucks		EF CO_2 =	1,175	g/mi
Total Annual VMT		10,000	miles/ truck		EF CH_4 =	0.0157	g/mi
					EF N_2O =	0.0101	g/mi
CO_2 =	118	tonne/yr					
CH_4 =	1.57E-03	tonne/yr =	3.E-02	tonne CO_2e/yr			
N_2O =	1.01E-03	tonne/yr =	3.E-01	tonne CO_2e/yr	Total tonne CO_2e/yr =	118	

CO2 emissions from EMFAC2007 for fleet year 2010 for light heavy-duty gasoline trucks travelling at 15 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for light gasoline trucks.

Onsite LHD Diesel Trucks

Number of Onsite Trucks		10	trucks		EF CO_2 =	519	g/mi
Total Annual VMT		10,000	miles/ truck		EF CH_4 =	0.001	g/mi
					EF N_2O =	0.0015	g/mi
CO_2 =	52	tonne/yr					
CH_4 =	1.00E-04	tonne/yr =	2.E-03	tonne CO_2e/yr			
N_2O =	1.50E-04	tonne/yr =	5.E-02	tonne CO_2e/yr	Total tonne CO_2e/yr =	52	

CO2 emissions from EMFAC2007 for fleet year 2010 for light heavy-duty diesel trucks travelling at 15 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for light diesel trucks.

Onsite Petcoke Trucks

Number of Truck loads		15,200	truck loads		EF CO_2 =	3,165	g/mi
Distrance Travelled Onsite		1.0	mi/ load		EF CH_4 =	0.0051	g/mi
Truck Idle Time		0.08	hr/load		EF N_2O =	0.0048	g/mi
					EF CO_2 =	6,542	g/ idle hr
					EF CH_4 =	0.011	g/ idle hr
					EF N_2O =	0.010	g/ idle hr
CO_2 =	54	tonne/yr					
CH_4 =	8.75E-05	tonne/yr =	2.E-03	tonne CO_2e/yr			
N_2O =	8.23E-05	tonne/yr =	3.E-02	tonne CO_2e/yr	Total tonne CO_2e/yr =	54	

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 10 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

Onsite Fluxant & Product Trucks

Number of Truck loads		21,620	truck loads		EF CO_2 =	3,165	g/mi
Distrance Travelled Onsite		2.49	mi/ load		EF CH_4 =	0.0051	g/mi
Truck Idle Time		0.08	hr/load		EF N_2O =	0.0048	g/mi
					EF CO_2 =	6,542	g/ idle hr
					EF CH_4 =	0.011	g/ idle hr
					EF N_2O =	0.010	g/ idle hr
CO_2 =	182	tonne/yr					
CH_4 =	2.93E-04	tonne/yr =	6.E-03	tonne CO_2e/yr			
N_2O =	2.76E-04	tonne/yr =	9.E-02	tonne CO_2e/yr	Total tonne CO_2e/yr =	182	

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 10 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

Onsite Miscellaneous Diesel Trucks

Number of Truck loads		2,330	truck loads		EF CO_2 =	3,165	g/mi
Distrance Travelled Onsite		2.2	mi/ load		EF CH_4 =	0.0051	g/mi
					EF N_2O =	0.0048	g/mi
CO_2 =	16	tonne/yr					
CH_4 =	2.61E-05	tonne/yr =	5.E-04	tonne CO_2e/yr			
N_2O =	2.46E-05	tonne/yr =	8.E-03	tonne CO_2e/yr	Total tonne CO_2e/yr =	16	

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 10 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles.

Onsite Switching Engines

Number of engines		1	per year		EF CO_2 =	672	g/bhp-hr
Avg power used onsite		260	hp		EF CH_4 =	0.053	g/bhp-hr
Annual operations		1248	hours/yr		EF N_2O =	0.0171	g/bhp-hr
CO_2 =	218	tonne/yr					
CH_4 =	1.71E-02	tonne/yr =	4.E-01	tonne CO_2e/yr			
N_2O =	5.55E-03	tonne/yr =	2.E+00	tonne CO_2e/yr		Total tonne CO_2e/yr =	220

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

Onsite Coal Trains

Number of Trains		119	per year		EF CO_2 =	491	g/bhp-hr
Number of engines		238	per year		EF CH_4 =	0.038	g/bhp-hr
Avg power used onsite		220	hp		EF N_2O =	0.0125	g/bhp-hr
Time to unload each train		2	hours				
CO_2 =	51	tonne/yr					
CH_4 =	4.03E-03	tonne/yr =	8.E-02	tonne CO_2e/yr			
N_2O =	1.31E-03	tonne/yr =	4.E-01	tonne CO_2e/yr		Total tonne CO_2e/yr =	52

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

Onsite Product Trains

Number of Trains		165	per year		EF CO_2 =	491	g/bhp-hr
Number of engines		330	per year		EF CH_4 =	0.038	g/bhp-hr
Avg power used onsite		150	hp		EF N_2O =	0.0125	g/bhp-hr
Time to unload each train		1	hours				
CO_2 =	24	tonne/yr					
CH_4 =	1.90E-03	tonne/yr =	4.E-02	tonne CO_2e/yr			
N_2O =	6.19E-04	tonne/yr =	2.E-01	tonne CO_2e/yr		Total tonne CO_2e/yr =	25

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

Offsite Coal Trains

Number of Trains cars per year		13,100	per year		EF CO_2 =	10,217	g/gal
Miles Traveled Per Train		794	Miles one way		EF CH_4 =	0.8	g/gal
Rail Freight Fuel Consumption		480	ton-mile/gallon		EF N_2O =	0.26	g/gal
Loaded train car weight		142	ton				
Unloaded train car weight		25	ton				
All Trains - Round Trip		1.74E+09	ton-miles/year				
Fuel Use for all Trains - Round Trip		3,618,693	gal/year				
CO_2 =	36,972	tonne/yr					
CH_4 =	2.89	tonne/yr =	60.79	tonne CO_2e/yr			
N_2O =	0.94	tonne/yr =	291.67	tonne CO_2e/yr		Total tonne CO_2e/yr =	37,325

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

Offsite Liquid Sulfur Product Trains

Number of Trains cars per year		85	per year		EF CO_2 =	10,217	g/gal
Miles Traveled Per Train		150	Miles one way		EF CH_4 =	0.8	g/gal
Rail Freight Fuel Consumption		480	ton-mile/gallon		EF N_2O =	0.26	g/gal
Loaded train car weight		125	ton				
Unloaded train car weight		25	ton				
All Trains - Round Trip		1.91E+06	ton-miles/year				
Fuel Use for all Trains - Round Trip		3,984	gal/year				
CO_2 =	40.71	tonne/yr					
CH_4 =	3.19E-03	tonne/yr =	7.E-02	tonne CO_2e/yr			
N_2O =	1.04E-03	tonne/yr =	3.E-01	tonne CO_2e/yr		Total tonne CO_2e/yr =	41

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

Offsite Gasification Solid Product Trains

Number of Trains cars per year		3,170	per year		EF CO_2 =	10,217	g/gal
Miles Traveled Per Train		198	Miles one way		EF CH_4 =	0.8	g/gal
Rail Freight Fuel Consumption		480	ton-mile/gallon		EF N_2O =	0.26	g/gal
Loaded train car weight		125	ton				
Unloaded train car weight		25	ton				
All Trains - Round Trip		9.41E+07	ton-miles/year				
Fuel Use for all Trains - Round Trip		196,137	gal/year				
CO_2 =	2,004	tonne/yr					
CH_4 =	1.57E-01	tonne/yr =	3.E+00	tonne CO_2e/yr			
N_2O =	5.10E-02	tonne/yr =	2.E+01	tonne CO_2e/yr		Total tonne CO_2e/yr =	2,023

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

Offsite Ammonia Product Trains

Number of Trains cars per year		0	per year		EF CO_2 =	10,217	g/gal
Miles Traveled Per Train		264	Miles one way		EF CH_4 =	0.8	g/gal
Rail Freight Fuel Consumption		480	ton-mile/gallon		EF N_2O =	0.26	g/gal
Loaded train car weight		142	ton				
Unloaded train car weight		25	ton				
All Trains - Round Trip		0.00E+00	ton-miles/year				
Fuel Use for all Trains - Round Trip		0	gal/year				
CO_2 =	0	tonne/yr					
CH_4 =	0.00E+00	tonne/yr =	0.E+00	tonne CO_2e/yr			
N_2O =	0.00E+00	tonne/yr =	0.E+00	tonne CO_2e/yr		Total tonne CO_2e/yr =	0

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

Offsite Urea Product Trains

Number of Trains cars per year		4,298	per year		EF CO_2 =	10,217	g/gal
Miles Traveled Per Train		628	Miles one way		EF CH_4 =	0.8	g/gal
Rail Freight Fuel Consumption		480	ton-mile/gallon		EF N_2O =	0.26	g/gal
Loaded train car weight		125	ton				
Unloaded train car weight		25	ton				
All Trains - Round Trip		4.05E+08	ton-miles/year				
Fuel Use for all Trains - Round Trip		843,453	gal/year				
CO_2 =	8,618	tonne/yr					
CH_4 =	6.75E-01	tonne/yr =	1.E+01	tonne CO_2e/yr			
N_2O =	2.19E-01	tonne/yr =	7.E+01	tonne CO_2e/yr		Total tonne CO_2e/yr =	8,700

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

Offsite UAN Product Trains

Number of Trains cars per year		2,335	per year		EF CO_2 =	10,217	g/gal
Miles Traveled Per Train		264	Miles one way		EF CH_4 =	0.8	g/gal
Rail Freight Fuel Consumption		480	ton-mile/gallon		EF N_2O =	0.26	g/gal
Loaded train car weight		125	ton				
Unloaded train car weight		25	ton				
All Trains - Round Trip		9.25E+07	ton-miles/year				
Fuel Use for all Trains - Round Trip		192,631	gal/year				
CO_2 =	1,968	tonne/yr					
CH_4 =	1.54E-01	tonne/yr =	3.E+00	tonne CO_2e/yr			
N_2O =	5.01E-02	tonne/yr =	2.E+01	tonne CO_2e/yr		Total tonne CO_2e/yr =	1,987

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

Hydrogen Energy California LLC *5/1/2013*

HECA Project

Offsite Petcoke Trucks

Number of Trucks	15,200	truck per year		EF CO_2 =	1,671	g/mi
Distance traveled per Truck (Round Trip)	280	miles/ truck		EF CH_4 =	0.0051	g/mi
Total Annual VMT	4,256,000	miles/ year		EF N_2O =	0.0048	g/mi
CO_2 =	7,110	tonne/yr				
CH_4 =	2.17E-02	tonne/yr =	5.E-01	tonne CO_2e/yr		
N_2O =	2.04E-02	tonne/yr =	6.E+00	tonne CO_2e/yr	Total tonne CO_2e/yr =	7,117

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

Offsite Fluxant Trucks

Number of Trucks	2,360	truck per year		EF CO_2 =	1,671	g/mi
Distance traveled per Truck (Round Trip)	404	miles/ truck		EF CH_4 =	0.0051	g/mi
Total Annual VMT	953,440	miles/ year		EF N_2O =	0.0048	g/mi
CO_2 =	1,593	tonne/yr				
CH_4 =	4.86E-03	tonne/yr =	1.E-01	tonne CO_2e/yr		
N_2O =	4.58E-03	tonne/yr =	1.E+00	tonne CO_2e/yr	Total tonne CO_2e/yr =	1,594

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

Offsite Liquid Sulfur Product Trucks

Number of Trucks	1,020	truck per year		EF CO_2 =	1,671	g/mi
Distance traveled per Truck (Round Trip)	284	miles/ truck		EF CH_4 =	0.0051	g/mi
Total Annual VMT	289,680	miles/ year		EF N_2O =	0.0048	g/mi
CO_2 =	484	tonne/yr				
CH_4 =	1.48E-03	tonne/yr =	3.E-02	tonne CO_2e/yr		
N_2O =	1.39E-03	tonne/yr =	4.E-01	tonne CO_2e/yr	Total tonne CO_2e/yr =	484

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

Offsite Gasification Solids Product Trucks

Number of Trucks	3,170	truck per year		EF CO_2 =	1,671	g/mi
Distance traveled per Truck (Round Trip)	160	miles/ truck		EF CH_4 =	0.0051	g/mi
Total Annual VMT	507,200	miles/ year		EF N_2O =	0.0048	g/mi
CO_2 =	847	tonne/yr				
CH_4 =	2.59E-03	tonne/yr =	5.E-02	tonne CO_2e/yr		
N_2O =	2.43E-03	tonne/yr =	8.E-01	tonne CO_2e/yr	Total tonne CO_2e/yr =	848

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

Offsite Ammonia Product Trucks

Number of Trucks	0	truck per year		EF CO_2 =	1,671	g/mi
Distance traveled per Truck (Round Trip)	80	miles/ truck		EF CH_4 =	0.0051	g/mi
Total Annual VMT	0	miles/ year		EF N_2O =	0.0048	g/mi
CO_2 =	0	tonne/yr				
CH_4 =	0.00E+00	tonne/yr =	0.E+00	tonne CO_2e/yr		
N_2O =	0.00E+00	tonne/yr =	0.E+00	tonne CO_2e/yr	Total tonne CO_2e/yr =	0

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

GHG Emissions Summary for Mobile Sources — Emissions Summary

Hydrogen Energy California LLC — *5/1/2013*

HECA Project

Offsite Urea Product Trucks

Number of Trucks		5,730	truck per year		EF CO_2 =	1,671	g/mi
Distance traveled per Truck (Round Trip)		80	miles/ truck		EF CH_4 =	0.0051	g/mi
Total Annual VMT		458,400	miles/ year		EF N_2O =	0.0048	g/mi
CO_2 =	766	tonne/yr					
CH_4 =	2.34E-03	tonne/yr =	5.E-02	tonne CO_2e/yr			
N_2O =	2.20E-03	tonne/yr =	7.E-01	tonne CO_2e/yr	Total tonne CO_2e/yr =		767

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

Offsite UAN Product Trucks

Number of Trucks		9,340	truck per year		EF CO_2 =	1,671	g/mi
Distance traveled per Truck (Round Trip)		80	miles/ truck		EF CH_4 =	0.0051	g/mi
Total Annual VMT		747,200	miles/ year		EF N_2O =	0.0048	g/mi
CO_2 =	1,248	tonne/yr					
CH_4 =	3.81E-03	tonne/yr =	8.E-02	tonne CO_2e/yr			
N_2O =	3.59E-03	tonne/yr =	1.E+00	tonne CO_2e/yr	Total tonne CO_2e/yr =		1,250

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

Offsite Equipment and Miscellaneous Trucks

Number of Trucks		2,330	truck per year		EF CO_2 =	1,671	g/mi
Distance traveled per Truck (Round Trip)		80	miles/ truck		EF CH_4 =	0.0051	g/mi
Total Annual VMT		186,400	miles/ year		EF N_2O =	0.0048	g/mi
CO_2 =	311	tonne/yr					
CH_4 =	9.51E-04	tonne/yr =	2.E-02	tonne CO_2e/yr			
N_2O =	8.95E-04	tonne/yr =	3.E-01	tonne CO_2e/yr	Total tonne CO_2e/yr =		312

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

Offsite Employee Commute Vehicles

Total Number of Employee		200	employees/day		EF CO_2 =	364	g/mi
Number of Worker per Commuter Vehicle		1.3			EF CH_4 =	0.0159	g/mi
Daily Vehicle Count		154	vehicles/day		EF N_2O =	0.0093	g/mi
Distance traveled per vehicle (Round Trip)		40	miles/ vehicle/ day				
Day of Commute per Month		365	days/yr				
Total Annual VMT		2,246,154	miles/year				
CO_2 =	817	tonne/yr					
CH_4 =	3.57E-02	tonne/yr =	7.E-01	tonne CO_2e/yr			
N_2O =	2.09E-02	tonne/yr =	6.E+00	tonne CO_2e/yr	Total tonne CO_2e/yr =		824

CO2 emission factor for CO2 is from EMFAC 2007 (average of light duty automobile and light duty truck) for the vehicle model year fro m1971 to 2015. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for average of gasoline passenger cars, gasoline light trucks, diesel passenger cars, and diesel light truck.

Total tonne CO_2e/yr for Mobile Sources=	**63,990**

APPENDIX F

REVISED FUMIGATION MODELING RESULTS

SCREEN3 Fumigation Modeling

Nocturnal Fumigation - Inversion Break-up Fumigation *04/01/2013 revision*

Max model scenario from crit pollutants modeling	Impact Selection	Stack height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	Max Conc x/Q (ug/m^3/g/s)	Distance to max (m)
NO2 1hr HRSG and coal dryer in startup 40% NG mode, TO startup, nitric acid plant on	HRSG max impact no fumigation simple terrain	64.92	7.32	10.93	366.48	0.9826	1,100
	HRSG inversion Break-up Fumigation max impact	64.92	7.32	10.93	366.48	0.9861	18,902
	Coal Dryer max impact no fumigation simple terrain	92.96	4.88	3.47	366.48	4.0270	900
	Coal Dryer Inversion Break-up Fumigation max impact	92.96	4.88	3.47	366.48	1.9960	10,850
	TAIL TO max impact no fumigation simple terrain	50.29	0.76	15.52	922.04	6.5420	700
	TAIL TO Inversion Break-up Fumigation max impact	50.29	0.76	15.52	922.04	6.2880	4,775
	Nitric Acid Plant max impact no fumigation simple terrain	36.58	2.44	5.09	403.71	6.2480	713
	Nitric Acid Plant Inversion Break-up Fumigation max impact	36.58	2.44	5.09	403.71	7.1900	4,400
SO2 1hr HRSG startup 80% natural gas mode, coal dryer normal emissions mix, TO startup	HRSG no fumigation simple terrain	64.92	7.32	11.42	366.48	0.9781	1,100
	HRSG inversion Break-up Fumigation max impact	64.92	7.32	11.42	366.48	0.9615	19,261
	Coal Dryer max impact no fumigation simple terrain	92.96	4.88	5.84	366.48	2.6210	1,000
	Coal Dryer Break-up Fumigation max impact	92.96	4.88	5.84	366.48	1.5420	13,225
	TAIL TO max impact no fumigation simple terrain	50.29	0.76	15.52	922.04	6.5420	700
	TAIL TO Inversion Break-up Fumigation max impact	50.29	0.76	15.52	922.04	6.2880	4,775
CO 1hr HRSG shutdown 20% load NG mode, no coal dryer, TO normal process vent	HRSG max impact no fumigation simple terrain	64.92	7.32	11.48	366.48	0.9776	1,100
	HRSG inversion Break-up Fumigation max impact	64.92	7.32	11.48	366.48	0.9586	19,304
	TAIL TO max impact no fumigation simple terrain	50.29	0.76	15.52	922.04	6.5420	700
	TAIL TO Inversion Break-up Fumigation max impact	50.29	0.76	15.52	922.04	6.2880	4,775

Since the peak impacts occur at different locations the peak concentrations predicted from fumigation of all together sources will be greatly overpredicted.

	Emission Rate (g/s)	Xf = 1 hour fumigation conc (ug/m3)	X1 = 1 hour no fumigation conc (ug/m3)	Predicted conc for averaging time (ug/m3)	Background conc (ug/m3)	Total model + background conc (ug/m3)	
NO2 1 hr							
HRSG startup	13.5065	**13.319**	13.271	13.32			
COAL DRYER startup	1.9064	3.805	7.677	7.68			
TAIL_TO startup	2.8123	17.684	18.398	18.40			**NO OLM**
NITRIC ACID PLANT	0.5260	**3.782**	3.287	3.78			
				43.18	140	183	
SO2 1 hr							
HRSG Startup natural gas mode	0.5984	0.575	0.585	0.59			
COAL DRYER normal operations mode	0.1180	0.182	0.309	0.31			
TAIL_TO startup	15.7497	99.034	103.035	103.03			
				103.93	42	146	
CO 1 hr							
HRSG Shutdown 20% CTG load on NG	285.9802	274.141	279.574	279.57			
TAIL_TO normal process vent	0.3276	2.060	2.143	2.14			
				281.72	4581	4863	

for **2** cases the Xf is more than X1, therefore fumigation must be considered

Scenarios match worst case criteria pollutant modeling

Assumptions and stack parameters

Average annual temp: 63.4 F (or 290.5944 K) daily average Buttonwillow, WRCC AFC Table 5.1-2
Flat terrain only
No downwash
Add max impacts from all sources regardless of location, conservative

	Distance to nearest fenceline (m)
HRSG	421.00
Coal Dryer	483.00
Thermal Oxidizer	595.00
Nitric Acid Plant	713.00

Closest receptor for each source are the distances above, plus receptors out to 10 km with receptor spacing every 100 m from fenceline receptor to 3 km, and every 500 m from 3 km to 10 km.

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
1516 NINTH STREET, SACRAMENTO, CA 95814
1-800-822-6228 – WWW.ENERGY.CA.GOV

AMENDED APPLICATION FOR CERTIFICATION FOR THE HYDROGEN ENERGY CALIFORNIA PROJECT

Docket No. 08-AFC-08A
PROOF OF SERVICE
(Revised 05/10/2013)

SERVICE LIST:

APPLICANT
SCS Energy, LLC
Marisa Mascaro
30 Monument Square, Suite 235
Concord, MA 01742
mmascaro@scsenergyllc.com

Tiffany Rau
2629 Manhattan Avenue, PMB# 187
Hermosa Beach, CA 90254
trau@heca.com

Hydrogen Energy California, LLC
George Landman
Director of Finance and
Regulatory Affairs
*1 Embarcadero Center, 29th Floor
San Francisco, CA 94111
glandman@heca.com

CONSULTANT FOR APPLICANT
URS Corporation
Dale Shileikis, Vice President
Energy Services Manager
Major Environmental Programs
One Montgomery Street, Suite 900
San Francisco, CA 94104-4538
dale_shileikis@urscorp.com

COUNSEL FOR APPLICANT
Michael J. Carroll
Marc T. Campopiano
Latham & Watkins, LLP
650 Town Center Drive, 20th Floor
Costa Mesa, CA 92626-1925
michael.carroll@lw.com
marc.campopiano@lw.com

INTERESTED AGENCIES
California ISO
e-recipient@caiso.com

Department of Conservation
Office of Governmental and
Environmental Relations
(Department of Oil, Gas &
Geothermal Resources)
Marni Weber
801 K Street, MS 2402
Sacramento, CA 95814-3530
marni.weber@conservation.ca.gov

INTERVENORS
California Unions for Reliable
Energy
Thomas A. Enslow
Marc D. Joseph
Adams Broadwell Joseph &
Cardozo
520 Capitol Mall, Suite 350
Sacramento, CA 95814
tenslow@adamsbroadwell.com

Association of Irritated Residents
Tom Frantz
30100 Orange Street
Shafter, CA 93263
tom.frantz49@gmail.com

Kern-Kaweah Chapter
of the Sierra Club
Andrea Issod
Matthew Vespa
85 Second Street, 2nd Floor
San Francisco, CA 94105
andrea.issod@sierraclub.org
matt.vespa@sierraclub.org

Environmental Defense Fund (EDF)
Timothy O'Connor, Esq.
123 Mission Street, 28th Floor
San Francisco, CA 94105
toconnor@edf.org

Natural Resources Defense Council
George Peridas
111 Sutter Street, 20th Floor
San Francisco, CA 94104
gperidas@nrdc.org

Kern County Farm Bureau, Inc.
Benjamin McFarland
801 South Mt. Vernon Avenue
Bakersfield, CA 93307
bmcfarland@kerncfb.com

HECA Neighbors
c/o Chris Romanini
P.O. Box 786
Buttonwillow, CA 93206
roman93311@aol.com

*Indicates Change

<u>ENERGY COMMISSION STAFF</u>
Robert Worl
Project Manager
robert.worl@energy.ca.gov

John Heiser
Associate Project Manager
john.heiser@energy.ca.gov

Lisa DeCarlo
Staff Counsel
lisa.decarlo@energy.ca.gov

<u>ENERGY COMMISSION – PUBLIC ADVISER</u>
Blake Roberts
Assistant Public Adviser
publicadviser@energy.ca.gov

<u>COMMISSION DOCKET UNIT</u>
CALIFORNIA ENERGY COMMISSION – DOCKET UNIT
Attn: Docket No. 08-AFC-08A
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
docket@energy.ca.gov

<u>OTHER ENERGY COMMISSION PARTICIPANTS (LISTED FOR CONVENIENCE ONLY):</u>

After docketing, the Docket Unit will provide a copy to the persons listed below. Do not send copies of documents to these persons unless specifically directed to do so.

KAREN DOUGLAS
Commissioner and Presiding Member

ANDREW McALLISTER
Commissioner and Associate Member

Raoul Renaud
Hearing Adviser

Galen Lemei
Adviser to Presiding Member

Jennifer Nelson
Adviser to Presiding Member

Hazel Miranda
Adviser to Associate Member

David Hungerford
Adviser to Associate Member

Patrick Saxton
Adviser to Associate Member

Eileen Allen
Commissioners' Technical Adviser for Facility Siting

DECLARATION OF SERVICE

I, Dale Shileikis, declare that on May 17, 2013, I served and filed copies of the attached Updated Emissions and Modeling Report dated May, 2013. This document is accompanied by the most recent Proof of Service, which I copied from the web page for this project at: http://www.energy.ca.gov/sitingcases/hydrogen_energy/.

The document has been sent to the other persons on the Service List above in the following manner:

(C*heck one*)

For service to all other parties and filing with the Docket Unit at the Energy Commission:

___ I e-mailed the document to all e-mail addresses on the Service List above and personally delivered it or deposited it in the U.S. mail with first class postage to those persons noted above as "hard copy required"; OR

_X_ Instead of e-mailing the document, I personally delivered it or deposited it in the U.S. mail with first class postage to all of the persons on the Service List for whom a mailing address is given.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that I am over the age of 18 years.

Dated: May 17, 2013 ______________________