Appendix M

Public Health and Safety

Hydrogen Energy California (HECA) Project
4/11/2012
Emissions Summary

Compound	CAS #	Annual Rate (TPY)	CTG/HRSG Stack (lb/yr)	Coal Dryer Stack (lb/yr)	Cooling Tower (Power Block) (lb/yr)	Cooling Tower (Process Area) (lb/yr)	Cooling Tower (ASU) (lb/yr)	Auxiliary Boiler (lb/yr)	Ammonia Plant Startup Heater (lb/yr)	Emergency Generators (lb/yr)	Fire Water Pump (lb/yr)	Gasification Flare (lb/yr)	SRU Flare (lb/yr)	Rectisol Flare (lb/yr)	TG Thermal Oxidizer (lb/yr)	CO_2 Vent (lb/yr)	Manufacturing Complex (lb/yr)	Onsite Truck (lb/yr)	Onsite Train (lb/yr)	Fugitives (lb/yr)
Acetaldehyde	75-07-0	2.15E-02	3.66E+01	6.46E+00																
Ammonia*	7664-41-7	1.57E+02	1.56E+05	2.75E+04				1.03E+03									1.18E+05			1.14E+04
Antimony	7440-36-0	1.32E-02	2.24E+01	3.95E+00																
Arsenic	7440-38-2	2.88E-02	4.88E+01	8.61E+00	5.33E-02	8.70E-02	2.40E-02	8.89E-02	1.47E-03			1.43E-02	7.75E-04	3.78E-03	2.13E-02					
Benzene	71-43-2	2.94E-02	4.88E+01	8.61E+00				9.33E-01	1.54E-02			1.50E-01	8.14E-03	3.97E-02	2.24E-01					
Beryllium	7440-41-7	3.11E-03	5.28E+00	9.33E-01				5.33E-03	8.80E-05			8.56E-04	4.65E-05	2.27E-04	1.28E-03					
Cadmium	7440-43-9	1.15E-01	1.95E+02	3.44E+01				4.89E-01	8.07E-03			7.85E-02	4.26E-03	2.08E-02	1.17E-01					
Carbon Disulfide	75-15-0	5.50E-01	9.35E+02	1.65E+02																
Carbonyl Sulfide	463-58-1	2.69E+00														5.32E+03				5.94E+01
Chromium	7440-47-3	6.55E-03	1.04E+01	1.83E+00				6.22E-01	1.03E-02			9.99E-02	5.42E-03	2.64E-02	1.49E-01					
Chromium (hexavalent)	18540-29-9	1.83E-03	3.11E+00	5.49E-01																
Cobalt	7440-48-4	3.14E-03	5.28E+00	9.33E-01				3.73E-02	6.16E-04			5.99E-03	3.25E-04	1.59E-03	8.95E-03					
Copper*	7440-50-8	2.93E-04			1.03E-02	1.69E-02	4.66E-03	3.78E-01	6.23E-03			6.06E-02	3.29E-03	1.61E-02	9.06E-02					
Cyanides	57-12-5	6.87E-02	1.16E+02	2.04E+01																1.15E+00
Fluoride*	1101	1.44E-03			9.31E-01	1.52E+00	4.20E-01													
Formaldehyde	50-00-0	2.28E-01	3.46E+02	6.10E+01				3.33E+01	5.50E-01			5.35E+00	2.91E-01	1.42E+00	7.99E+00					
Hexane	110-54-3	5.87E-01						8.00E+02	1.32E+01			1.28E+02	6.97E+00	3.40E+01	1.92E+02					
Hydrochloric Acid	7647-01-0	1.55E-01	2.64E+02	4.66E+01																
Hydrogen Fluoride (hydrofluoric acid)	7664-39-3	5.98E-01	1.02E+03	1.79E+02																
Hydrogen Sulfide	7783-06-4	2.64E+00														3.01E+03				2.28E+03
Lead	7439-92-1	6.70E-03	1.14E+01	2.01E+00																
Manganese	7439-96-5	1.67E-02	2.11E+01	3.73E+00	2.66E+00	4.35E+00	1.20E+00	1.69E-01	2.79E-03			2.71E-02	1.47E-03	7.18E-03	4.05E-02					
Mercury	7439-97-6	7.71E-03	1.03E+01	4.98E+00				1.16E-01	1.91E-03			1.85E-02	1.01E-03	4.91E-03	2.77E-02					
Methanol	67-56-1	7.09E+00																		1.42E+04
Methyl Bromide (Bromomethane)	74-83-9	5.70E-01	9.70E+02	1.71E+02																
Methylene Chloride (Dichloromethane)	75-09-2	2.63E-02	4.47E+01	7.89E+00																
Naphthalene	91-20-3	3.01E-02	5.08E+01	8.97E+00				2.71E-01	4.47E-03			4.35E-02	2.36E-03	1.15E-02	6.50E-02					
Nickel	7440-02-0	5.35E-03	7.93E+00	1.40E+00				9.33E-01	1.54E-02			1.50E-01	8.14E-03	3.97E-02	2.24E-01					
Nitric Acid*	7697-37-2	8.19E-01																		1.64E+03
Phenol	108-95-2	4.40E-01	7.48E+02	1.32E+02																
Propylene*	115-07-1	6.33E+00																		1.27E+04
Selenium	7782-49-2	6.77E-03	1.14E+01	2.01E+00	4.43E-02	7.23E-02	2.00E-02	1.07E-02	1.76E-04			1.71E-03	9.30E-05	4.53E-04	2.56E-03					
Sulfuric Acid and Sulfates*	7664-93-9	1.14E+00	1.93E+03	3.41E+02																
Toluene	108-88-3	1.50E-03	6.71E-01	1.18E-01				1.51E+00	2.49E-02			2.43E-01	1.32E-02	6.42E-02	3.62E-01					
Vanadium*	7440-62-2	7.50E-04						1.02E+00	1.69E-02			1.64E-01	8.91E-03	4.34E-02	2.45E-01					
Diesel Particulate Matter*	DPM	7.72E-02								4.51E+01	1.84E+00							1.48E+01	9.26E+01	
2-Methylnaphthalene	91-57-6	7.83E-06						1.07E-02	1.76E-04			1.71E-03	9.30E-05	4.53E-04	2.56E-03					
3-Methylchloranthrene	56-49-5	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
7,12-Dimethylbenz(a)anthracene	57-97-6	5.22E-06						7.11E-03	1.17E-04			1.14E-03	6.20E-05	3.02E-04	1.71E-03					
Acenaphthene	83-32-9	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Acenaphthylene	208-96-8	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Anthracene	120-12-7	7.83E-07						1.07E-03	1.76E-05			1.71E-04	9.30E-06	4.53E-05	2.56E-04					
Benz(a)anthracene	56-55-3	2.81E-05	4.68E-02	8.25E-03				8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Benzo(a)pyrene	50-32-8	3.91E-07						5.33E-04	8.80E-06			8.56E-05	4.65E-06	2.27E-05	1.28E-04					
Benzo(b)fluoranthene	205-99-2	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Benzo(g,h,i)perylene	191-24-2	3.91E-07						5.33E-04	8.80E-06			8.56E-05	4.65E-06	2.27E-05	1.28E-04					
Benzo(k)fluoranthene	207-08-9	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Chrysene	218-01-9	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Dibenzo(a,h)anthracene	53-70-3	3.91E-07						5.33E-04	8.80E-06			8.56E-05	4.65E-06	2.27E-05	1.28E-04					
Dichlorobenzene	106-46-7	3.91E-04						5.33E-01	8.80E-03			8.56E-02	4.65E-03	2.27E-02	1.28E-01					
Fluoranthene	206-44-0	9.78E-07						1.33E-03	2.20E-05			2.14E-04	1.16E-05	5.67E-05	3.20E-04					
Fluorene	86-73-7	9.13E-07						1.24E-03	2.05E-05			2.00E-04	1.08E-05	5.29E-05	2.98E-04					
Indeno(1,2,3-cd)pyrene	193-39-5	5.87E-07						8.00E-04	1.32E-05			1.28E-04	6.97E-06	3.40E-05	1.92E-04					
Phenanathrene	85-01-8	5.54E-06						7.55E-03	1.25E-04			1.21E-03	6.59E-05	3.21E-04	1.81E-03					
Pyrene	129-00-0	1.63E-06						2.22E-03	3.67E-05			3.57E-04	1.94E-05	9.44E-05	5.33E-04					
Total Combined HAPs and TACs (tpy)		**181.47**	**81.44**	**14.37**	**0.00**	**0.00**	**0.00**	**0.93**	**0.01**	**0.02**	**0.00**	**0.07**	**0.00**	**0.02**	**0.10**	**4.17**	**59.17**	**0.01**	**0.05**	**2.11E+01**
Total HAPs* (tpy)		**15.94**	**2.46**	**0.44**	**0.00**	**0.00**	**0.00**	**0.42**	**0.01**	**0.00**	**0.00**	**0.07**	**0.00**	**0.02**	**0.10**	**4.17**	**0.00**	**0.00**	**0.00**	**8.25E+00**

Note:
* Denotes pollutants that are not listed as Federal HAPs. These pollutants are not included in the HAP total provided. As shown, combined annual HAP emissions are less than 25 tons per year. Additionally, individual HAP emissions are below 10 tons per year.

Hydrogen Energy California LLC *4/11/2012*
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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 =	105	hr/yr
HRSG Shutdown Hours =	18	hr/yr
Total HRSG Operating Hours	**8,459**	**hr/yr**

Coal Dryer		
Coal Dryer Normal Operating Hours =	8000	hr/yr
Coal Dryer Startup Hours =	102	hr/yr
Coal Dryer Shutdown Hours =	8	hr/yr
Total Coal Dryer Operating Hours	**8,110**	**hr/yr**

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

			HRSG + Coal Dryer					
			Toal Hourly Combined Emission	**Total Annual Combined Emissions**	**CTG/HRSG Stack**		**Coal 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	4.30E+01	4.38E-03	3.66E+01	7.72E-04	6.46E+00
Ammonia	7664-41-7	5 ppm	2.17E+01	1.84E+05	1.85E+01	1.56E+05	3.20E+00	2.75E+04
Antimony	7440-36-0	1.1	3.15E-03	2.63E+01	2.68E-03	2.24E+01	4.72E-04	3.95E+00
Arsenic	7440-38-2	2.4	6.87E-03	5.74E+01	5.84E-03	4.88E+01	1.03E-03	8.61E+00
Benz(a)anthracene	56-55-3	0.0023	6.58E-06	5.50E-02	5.59E-06	4.68E-02	9.87E-07	8.25E-03
Benzene	71-43-2	2.4	6.87E-03	5.74E+01	5.84E-03	4.88E+01	1.03E-03	8.61E+00
Beryllium	7440-41-7	0.26	7.44E-04	6.22E+00	6.32E-04	5.28E+00	1.12E-04	9.33E-01
Cadmium	7440-43-9	9.6	2.75E-02	2.30E+02	2.33E-02	1.95E+02	4.12E-03	3.44E+01
Carbon disulfide	75-15-0	46	1.32E-01	1.10E+03	1.12E-01	9.35E+02	1.97E-02	1.65E+02
Chromium (hexavalent)	18540-29-9	0.15	4.38E-04	3.66E+00	3.72E-04	3.11E+00	6.57E-05	5.49E-01
Chromium	7440-47-3	0.51	1.46E-03	1.22E+01	1.24E-03	1.04E+01	2.19E-04	1.83E+00
Cobalt	7440-48-4	0.26	7.44E-04	6.22E+00	6.32E-04	5.28E+00	1.12E-04	9.33E-01
Cyanides	57-12-5	5.7	1.63E-02	1.36E+02	1.39E-02	1.16E+02	2.45E-03	2.04E+01
Formaldehyde	50-00-0	17	4.86E-02	4.07E+02	4.13E-02	3.46E+02	7.30E-03	6.10E+01
Hydrochloric acid	7647-01-0	13	3.72E-02	3.11E+02	3.16E-02	2.64E+02	5.58E-03	4.66E+01
Hydrogen fluoride (Hydrofluoric acid)	7664-39-3	50	1.43E-01	1.20E+03	1.22E-01	1.02E+03	2.15E-02	1.79E+02
Lead	7439-92-1	0.56	1.60E-03	1.34E+01	1.36E-03	1.14E+01	2.40E-04	2.01E+00
Manganese	7439-96-5	1.0	2.98E-03	2.49E+01	2.53E-03	2.11E+01	4.46E-04	3.73E+00
Mercury	7439-97-6	see notes	1.83E-03	1.53E+01	1.21E-03	1.03E+01	6.14E-04	4.98E+00
Methyl bromide (Bromomethane)	74-83-9	47.7	1.36E-01	1.14E+03	1.16E-01	9.70E+02	2.05E-02	1.71E+02
Methylene chloride (Dichloromethane)	75-09-2	2.2	6.29E-03	5.26E+01	5.35E-03	4.47E+01	9.44E-04	7.89E+00
Naphthalene	91-20-3	2.5	7.15E-03	5.98E+01	6.08E-03	5.08E+01	1.07E-03	8.97E+00
Nickel	7440-02-0	0.39	1.12E-03	9.33E+00	9.48E-04	7.93E+00	1.67E-04	1.40E+00
Phenol	108-95-2	36.8	1.05E-01	8.80E+02	8.95E-02	7.48E+02	1.58E-02	1.32E+02
Selenium	7782-49-2	0.56	1.60E-03	1.34E+01	1.36E-03	1.14E+01	2.40E-04	2.01E+00
Sulfuric acid and sulfates	7664-93-9	95	2.72E-01	2.27E+03	2.31E-01	1.93E+03	4.08E-02	3.41E+02
Toluene	108-88-3	0.033	9.44E-05	7.89E-01	8.03E-05	6.71E-01	1.42E-05	1.18E-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:

Total gasifier coal feed rate	4850	stpd	
Hg concentration in coal feed	0.09	ppmw	
Total Hg in coal feed	0.873	lb/day	= 0.09 lb Hg/10^6 lb coal x 2000 lb/ton
Uncontrolled coal dryer Hg emission (5.5% of feed) from volatilization	0.048	lb/day	
Coal dryer Hg emissions control efficiency	80%		
Controlled coal dryer Hg emission from volatilization	0.0096	lb/day	
Total Controlled coal dryer Hg emission from volatilization + HRSG flue gas	0.0147	lb/day	
Hg in syngas from gasifier	0.863	lb/day	
Control efficiency of the mercury cleanup in the syngas	96%		
Controlled HG emissions in HRSG flue gas	0.034	lb/day	
Controlled HG emissions from the HRSG stack	0.029	lb/day	

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 coal dryer where is passes over pulverized coal to dry it before it is injected into the gasifier. Therefore, it was assumed that HRSG/coal dryer exhaust is split based on 85%/15%. No exhaust will be directed to the coal dryer during natural gas operations or portions of startup and shutdown.
8) Annual emissions for both HRSG and coal dryer based on the higher hours of operation of the HRSG

Hydrogen Energy California LLC *4/11/2012*
Hydrogen Energy California (HECA) Project

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	12	13	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	5.12E-07	4.44E-03
Copper	7440-50-8	0.005	1.19E-06	1.03E-02	9.95E-08	8.62E-04
Fluoride	1101	0.45	1.07E-04	9.31E-01	8.95E-06	7.76E-02
Manganese	7439-96-5	1.29	3.07E-04	2.66E+00	2.56E-05	2.22E-01
Selenium	7784-49-2	0.02	5.11E-06	4.43E-02	4.26E-07	3.69E-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	8.05E-07	6.69E-03
Copper	7440-50-8	0.005	2.03E-06	1.69E-02	1.56E-07	1.30E-03
Fluoride	1101	0.45	1.83E-04	1.52E+00	1.41E-05	1.17E-01
Manganese	7439-96-5	1.29	5.23E-04	4.35E+00	4.02E-05	3.34E-01
Selenium	7784-49-2	0.02	8.70E-06	7.23E-02	6.69E-07	5.56E-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 — *4/11/2012*

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 — *4/11/2012*
Hydrogen Energy California (HECA) Project

Operating Parameters

Heat Input =	55	10^6 Btu/hr (HHV)
Natural gas heating value =	1,050	Btu/scf
Fuel usage =	0.052	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	1.05E-05	1.47E-03
Benzene	71-43-2	2.10E-03	1.10E-04	1.54E-02
Beryllium	7440-41-7	1.20E-05	6.29E-07	8.80E-05
Cadmium	7440-43-9	1.10E-03	5.76E-05	8.07E-03
Chromium	7440-47-3	1.40E-03	7.33E-05	1.03E-02
Cobalt	7440-48-4	8.40E-05	4.40E-06	6.16E-04
Copper	7440-50-8	8.50E-04	4.45E-05	6.23E-03
Formaldehyde	50-00-0	7.50E-02	3.93E-03	5.50E-01
Hexane	110-54-3	1.80E+00	9.43E-02	1.32E+01
Manganese	7439-96-5	3.80E-04	1.99E-05	2.79E-03
Mercury	7439-97-6	2.60E-04	1.36E-05	1.91E-03
Naphthalene	91-20-3	6.10E-04	3.20E-05	4.47E-03
Nickel	7440-02-0	2.10E-03	1.10E-04	1.54E-02
Selenium	7782-49-2	2.40E-05	1.26E-06	1.76E-04
Toluene	108-88-3	3.40E-03	1.78E-04	2.49E-02
Vanadium	7440-62-2	2.30E-03	1.20E-04	1.69E-02
Benzo(a)pyrene	50-32-8	1.20E-06	6.29E-08	8.80E-06
Benz(a)anthracene	56-55-3	1.80E-06	9.43E-08	1.32E-05
Benzo(b)fluoranthene	205-99-2	1.80E-06	9.43E-08	1.32E-05
Chrysene	218-01-9	1.80E-06	9.43E-08	1.32E-05
Dibenzo(a,h)anthracene	53-70-3	1.20E-06	6.29E-08	8.80E-06
Dichlorobenzene	106-46-7	1.20E-03	6.29E-05	8.80E-03
Indeno(1,2,3-cd)pyrene	193-39-5	1.80E-06	9.43E-08	1.32E-05
2-Methylnaphthalene	91-57-6	2.40E-05	1.26E-06	1.76E-04
3-Methylchloranthrene	56-49-5	1.80E-06	9.43E-08	1.32E-05
7,12-Dimethylbenz(a)anthracene	57-97-6	1.60E-05	8.38E-07	1.17E-04
Acenaphthene	83-32-9	1.80E-06	9.43E-08	1.32E-05
Acenaphthylene	208-96-8	1.80E-06	9.43E-08	1.32E-05
Anthracene	120-12-7	2.40E-06	1.26E-07	1.76E-05
Benzo(g,h,i)perylene	191-24-2	1.20E-06	6.29E-08	8.80E-06
Benzo(k)fluoranthene	207-08-9	1.80E-06	9.43E-08	1.32E-05
Fluoranthene	206-44-0	3.00E-06	1.57E-07	2.20E-05
Fluorene	86-73-7	2.80E-06	1.47E-07	2.05E-05
Phenanathrene	85-01-8	1.70E-05	8.90E-07	1.25E-04
Pyrene	129-00-0	5.00E-06	2.62E-07	3.67E-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 — *4/11/2012*
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.

Hydrogen Energy California LLC *4/11/2012*
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 *4/11/2012*
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 — *4/11/2012*
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 Operations		
Heat Input =	80	10^6 Btu/hr (HHV)
Fuel usage =	0.076	10^6 scf/hr
Startup Hours per year =	48	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	2.13E-02
Benzene	71-43-2	2.10E-03	1.86E-04	2.24E-01
Beryllium	7440-41-7	1.20E-05	1.06E-06	1.28E-03
Cadmium	7440-43-9	1.10E-03	9.74E-05	1.17E-01
Chromium	7440-47-3	1.40E-03	1.24E-04	1.49E-01
Cobalt	7440-48-4	8.40E-05	7.44E-06	8.95E-03
Copper	7440-50-8	8.50E-04	7.53E-05	9.06E-02
Formaldehyde	50-00-0	7.50E-02	6.64E-03	7.99E+00
Hexane	110-54-3	1.80E+00	1.59E-01	1.92E+02
Manganese	7439-96-5	3.80E-04	3.37E-05	4.05E-02
Mercury	7439-97-6	2.60E-04	2.30E-05	2.77E-02
Naphthalene	91-20-3	6.10E-04	5.40E-05	6.50E-02
Nickel	7440-02-0	2.10E-03	1.86E-04	2.24E-01
Selenium	7782-49-2	2.40E-05	2.13E-06	2.56E-03
Toluene	108-88-3	3.40E-03	3.01E-04	3.62E-01
Vanadium	7440-62-2	2.30E-03	2.04E-04	2.45E-01
Benzo(a)pyrene	50-32-8	1.20E-06	1.06E-07	1.28E-04
Benz(a)anthracene	56-55-3	1.80E-06	1.59E-07	1.92E-04
Benzo(b)fluoranthene	205-99-2	1.80E-06	1.59E-07	1.92E-04
Chrysene	218-01-9	1.80E-06	1.59E-07	1.92E-04
Dibenzo(a,h)anthracene	53-70-3	1.20E-06	1.06E-07	1.28E-04
Dichlorobenzene	106-46-7	1.20E-03	1.06E-04	1.28E-01
Indeno(1,2,3-cd)pyrene	193-39-5	1.80E-06	1.59E-07	1.92E-04
2-Methylnaphthalene	91-57-6	2.40E-05	2.13E-06	2.56E-03
3-Methylchloranthrene	56-49-5	1.80E-06	1.59E-07	1.92E-04
7,12-Dimethylbenz(a)anthracene	57-97-6	1.60E-05	1.42E-06	1.71E-03
Acenaphthene	83-32-9	1.80E-06	1.59E-07	1.92E-04
Acenaphthylene	208-96-8	1.80E-06	1.59E-07	1.92E-04
Anthracene	120-12-7	2.40E-06	2.13E-07	2.56E-04
Benzo(g,h,i)perylene	191-24-2	1.20E-06	1.06E-07	1.28E-04
Benzo(k)fluoranthene	207-08-9	1.80E-06	1.59E-07	1.92E-04
Fluoranthene	206-44-0	3.00E-06	2.66E-07	3.20E-04
Fluorene	86-73-7	2.80E-06	2.48E-07	2.98E-04
Phenanathrene	85-01-8	1.70E-05	1.51E-06	1.81E-03
Pyrene	129-00-0	5.00E-06	4.43E-07	5.33E-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.

Intermittent CO_2 Vent — HAP Emissions Summary

Hydrogen Energy California LLC — *4/11/2012*
Hydrogen Energy California (HECA) Project

Operating Parameters

Total Hours of Operation =	504	hr/yr
Total Flow =	761,400	lb/hr
Total Flow =	17,584	lbmol/hr
Molecular weight		
COS	60	lb/lbmol
H_2S	34	lb/lbmol

Compound	CAS #	Emission Factor (ppm)	Hourly (lb/hr)	Annual (lb/yr)
Carbonyl Sulfide	463-58-1	10	1.06E+01	5.32E+03
Hydrogen Sulfide	7783-06-4	10	5.98E+00	3.01E+03

Notes:

1) Emission rates based on plant design and 504 hours per year of full venting.

Emergency Diesel Generator — HAP Emissions Summary

Hydrogen Energy California LLC — *4/11/2012*

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 — *4/11/2012*

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 HP Absorber

Urea HP Absorber Operating Hours = 8,052 hr/yr

Compound	CAS #	Hourly (lb/hr)	Annual (lb/yr)
Ammonia (NH3)	8013-59-0	11.14	89,675

Note:

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

Urea LP Absorber

Urea LP Absorber Operating Hours = 8,052 hr/yr

Compound	CAS #	Hourly (lb/hr)	Annual (lb/yr)
Ammonia (NH3)	8013-59-0	2.02	16,305

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	1.02	8,224

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	0.51	4,141

Note:

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

Data Supplied By Client						
	Onsite Petcoke and Coal Trucks(@ 10 mph)		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	34	2	73	7	5	10
Maximum number of trucks or loads						
1-hour	6	6	13	13	5	10
Annual average	15,200	15,200	20,880	20,880	1,818	10000
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

	Onsite Petcoke and Coal Trucks (@ 10 mph)		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)	1.0E-03	1.2E-04	6.2E-03	2.7E-04	2.3E-03	5.3E-04
Annual PM_{10} (pounds per year)	2.8E+00	3.2E-01	1.0E+01	4.4E-01	7.7E-01	5.3E-01

HARP Inputs - Annual and Hourly Emission Rates per Volume Source

	Onsite Petcoke and Coal Trucks (@ 10 mph)		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	3.0E-05	5.8E-05	8.5E-05	3.9E-05	4.6E-04	5.3E-05
PM_{10} pounds per year per volume source	8.2E-02	1.6E-01	1.4E-01	6.2E-02	1.5E-01	5.3E-02

Hydrogen Energy California LLC *4/11/2012*
Hydrogen Energy California (HECA) Project

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	109	153	262

	Switching Engine	Line-haul Engine for Coal Train	Line-haul Engine for Product Train
PM10 Emission Factor (g/bhp-hr)	0.10	0.10	0.10
Conversion Factor (bhp-hr/gal)	15.2	20.8	20.8
PM10 Emissions (lbs/hr /engine)	0.057	0.048	0.033
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 Vome Sources in AERMOD/HARP	104		

Notes:

Switching Engine EPA Tier 3 - 40 CFR Part 1033

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)	0.06	0.10	0.00
Annual PM_{10} (pounds per year)	71.47	21.13	10.11

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	1.5E-03
PM_{10} pounds per year per volume source	9.9E-01

Hydrogen Energy California LLC *4/11/2012*
Hydrogen Energy California (HECA) Project

		Total Uncontrolled Emissions		Total Controlled Emissions	
Compound	**Name**	**Emissions (lb/hr)**	**Emissions (tpy)**	**Emissions (lb/hr)**	**Emissions (tpy)**
CO_2	Carbon dioxide	20.30	88.93	7.37	32.28
CH_4	Methane	0.04	0.19	0.04	0.19
CO	Carbon monoxide	1.07	4.70	1.05	4.62
H_2S	Hydrogen Sulfide	2.10	9.22	0.26	1.14
NH_3	Ammonia	15.12	66.22	1.30	5.70
COS	Carbonyl Sulfide	0.03	0.12	0.01	0.03
CH_3OH	Methanol	17.44	76.39	1.62	7.09
C_3H_6	Proylene	11.44	50.13	1.44	6.33
HCN	Hydrogen Cyanide = Cyanide Compounds	0.002	0.008	0.000	0.001
HNO_3	Nitric acid	2.12	9.29	0.19	0.82
Total VOC	Volatile organic compounds	28.91	126.64	3.07	13.45

Hydrogen Energy California LLC *4/11/2012*
Hydrogen Energy California (HECA) Project

	Total Uncontrolled Emissions		Total Controlled Emissions	
Compound	**Emissions (lb/hr)**	**Emissions (tpy)**	**Emissions (lb/hr)**	**Emissions (tpy)**
CO_2	17.09	74.86	7.12	31.19
CH_4	4.36E-02	1.91E-01	4.31E-02	1.89E-01
CO	1.07	4.70	1.05	4.62
H_2S	2.10	9.22	0.26	1.14
NH_3	0.29	1.26	0.04	0.16
COS	2.76E-02	1.21E-01	6.78E-03	0.03
CH_3OH	17.44	76.39	1.62	7.09
C_3H_6	11.44	50.13	1.44	6.33
HCN	1.73E-03	7.58E-03	1.31E-04	5.73E-04
Total VOC	**28.91**	**126.64**	**3.07**	**13.45**

EPA Table 2-1SOCMI Average Fugitive Emission Factors

Component Type	Service Type	Emission Factor (1) (kg/hr/source)	Control Efficiency (%) (3)
Valves	Gas	5.97E-03	92%
	Light Liquid	4.03E-03	88%
	Heavy Liquid	2.30E-04	
Pump Seals	Light Liquid	1.99E-02	75%
	Heavy Liquid	8.62E-03	
Compressor Seals	Gas	2.28E-01	
Pressure Relief Valves	Gas	1.04E-01	
Connectors	All	1.83E-03	93%
Open-Ended Lines	All	1.70E-03	
Sampling Connections	All	1.50E-02	
Agitator Seals (2)	All	1.99E-02	

Note:
Source: EPA 1995, Protocol for Equipment Leak Emission Estimates
(1) Factors are for total organic compound emission rates. Emission factors assumed to be same for other constituents emitted from the stream.
(2) Factors for light liquid pump seals can be used to estimate the leak rate from agitator seals
(3) Control efficiencies for an LDAR program at a SOCMI process unit using HON reg neg
(control effectiveness attributable to requirements of the hazardous NESHAPS equipment leak regulations)
Emission are conservative since many of these streams are not as volatile as the streams that the SOCMI factors were developed for.

Area #1: Methanol

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	50	8760	0.66	2.88	0.05	0.23
Valves	Light Liquid	416	8760	3.70	16.19	0.44	1.94
Valves	Heavy Liquid	0	8760	-	-	-	-
Pump Seals	Light Liquid	7	8760	0.31	1.35	0.08	0.34
Pump Seals	Heavy Liquid	0	8760	-	-	-	-
Compressor Seals	Gas	0	8760	-	-	-	-
Connectors	All	1225	8760	4.94	21.65	0.35	1.52
			Total	**9.60**	**42.06**	**0.92**	**4.02**
			CH_3OH	9.60	42.06	0.92	4.02

Area #2: Syn Gas

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy
Valves	Gas	108	8760	0.56	2.44
Valves	Light Liquid	0	8760	-	-
Valves	Heavy Liquid	0	8760	-	-
Pump Seals	Light Liquid	0	8760	-	-
Pump Seals	Heavy Liquid	0	8760	-	-
Compressor Seals	Gas	0	8760	-	-
Connectors	All	372	8760	0.59	2.58
			Total	**1.15**	**5.02**
			CO_2	1.69E-01	0.74
			CH_4	1.14E-02	4.99E-02
			CO	0.95	4.16
			H_2S	1.26E-02	5.50E-02
			NH_3	2.92E-05	1.28E-04
			COS	4.38E-03	1.92E-02

Area #4: Shifted Syn Gas

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy
Valves	Gas	198	8760	2.19	9.60
Valves	Light Liquid	0	8760	-	-
Valves	Heavy Liquid	0	8760	-	-
Pump Seals	Light Liquid	0	8760	-	-
Pump Seals	Heavy Liquid	0	8760	-	-
Compressor Seals	Gas	1	8760	0.42	1.85
Connectors	All	632	8760	2.14	9.39
			Total	**4.76**	**20.84**
			CO_2	4.58	20.08
			CH_4	3.17E-02	1.39E-01
			CO	9.68E-02	4.24E-01
			H_2S	4.47E-02	1.96E-01

Area #5: Propylene

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	188	8760	2.47	10.84	0.20	0.87
Valves	Light Liquid	288	8760	2.56	11.21	0.31	1.34
Valves	Heavy Liquid	0	8760	-	-	-	-
Pump Seals	Light Liquid	3	8760	0.13	0.58	0.03	0.14
Pump Seals	Heavy Liquid	0	8760	-	-	-	-
Compressor Seals	Gas	1	8760	0.50	2.20	0.50	2.20
Connectors	All	1432	8760	5.78	25.30	0.40	1.77
			Total	**11.44**	**50.13**	**1.44**	**6.33**
			C_3H_6	11.44	50.13	1.44	6.33

Area #6: Sour Water

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy
Valves	Gas	0	8760	-	-
Valves	Light Liquid	0	8760	-	-
Valves	Heavy Liquid	508	8760	0.01	0.03
Pump Seals	Light Liquid	0	8760	-	-
Pump Seals	Heavy Liquid	17	8760	0.01	0.04
Compressor Seals	Gas	0	8760	-	-
Connectors	All	1410	8760	0.17	0.73
			Total	**0.18**	**0.81**
			CO_2	0.16	0.69
			CO	8.79E-05	3.85E-04
			H_2S	0.01	0.05
			NH_3	0.02	0.07

Hydrogen Energy California LLC *4/11/2012*
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Area #7: H_2S Laden Methanol

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	94	8760	1.24	5.42	0.10	0.43
Valves	Light Liquid	358	8760	3.18	13.93	0.38	1.67
Valves	Heavy Liquid	0	8760	-	-	-	-
Pump Seals	Light Liquid	7	8760	0.31	1.34	0.08	0.34
Pump Seals	Heavy Liquid	0	8760	-	-	-	-
Compressor Seals	Gas	0	8760	-	-	-	-
Connectors	All	1323	8760	5.34	23.37	0.37	1.64
			Total	**10.06**	**44.06**	**0.93**	**4.08**
			CO_2	4.50	19.69	0.42	1.82
			CH_4	2.94E-04	1.29E-03	2.72E-05	1.19E-04
			CO	3.47E-03	0.02	3.21E-04	1.41E-03
			H_2S	0.17	0.76	0.02	0.07
			COS	7.50E-04	3.28E-03	6.94E-05	3.04E-04
			CH_3OH	5.38	23.58	0.50	2.18

Area #8: CO_2 Laden Methanol

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	79	8760	1.04	4.55	0.08	0.36
Valves	Light Liquid	79	8760	0.70	3.07	0.08	0.37
Valves	Heavy Liquid	0	8760	-	-	-	-
Pump Seals	Light Liquid	0	8760	-	-	-	-
Pump Seals	Heavy Liquid	0	8760	-	-	-	-
Compressor Seals	Gas	0	8760	-	-	-	-
Connectors	All	516	8760	2.08	9.11	0.15	0.64
			Total	**3.82**	**16.74**	**0.31**	**1.37**
			CO_2	1.37	6.00	0.11	0.49
			CH_4	1.17E-04	5.11E-04	9.55E-06	4.18E-05
			CO	1.37E-03	0.01	1.12E-04	4.90E-04
			H_2S	3.70E-06	1.62E-05	3.03E-07	1.33E-06
			CH_3OH	2.45	10.73	0.20	0.88

Area #9: Acid Gas

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	161	8760	2.12	9.28	0.17	0.74
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Pump Seals	Light Liquid	0	8760	-	-	-	-
Pump Seals	Heavy Liquid	0	8760	-	-	-	-
Compressor Seals	Gas	0	8760	-	-	-	-
Connectors	All	492	8760	1.98	8.69	0.14	0.61
			Total	**4.10**	**17.97**	**0.31**	**1.35**
			CO_2	2.48	10.84	0.19	0.81
			CH_4	7.19E-05	3.15E-04	5.40E-06	2.37E-05
			CO	2.65E-03	0.01	1.99E-04	8.72E-04
			H_2S	1.60	7.02	0.12	0.53
			COS	0.02	0.09	1.57E-03	0.01
			CH_3OH	1.39E-03	0.01	1.04E-04	4.57E-04

Area #10: Ammonia-Laden Gas

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	157	8760	1.70	7.43	0.14	0.59
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Pump Seals	Light Liquid	0	8760	-	-	-	-
Pump Seals	Heavy Liquid	0	8760	-	-	-	-
Compressor Seals	Gas	0	8760	-	-	-	-
Connectors	All	407	8760	1.35	5.90	0.09	0.41
			Total	**3.04**	**13.34**	**0.23**	**1.01**
			CO_2	2.53	11.10	0.19	0.84
			CH_4	7.67E-05	3.36E-04	5.79E-06	2.54E-05
			CO	0.01	0.06	1.02E-03	4.47E-03
			H_2S	0.22	0.97	0.02	0.07
			NH_3	0.27	1.20	0.02	0.09
			COS	8.03E-04	3.52E-03	6.07E-05	2.66E-04
			HCN	1.73E-03	0.01	1.31E-04	5.73E-04

Area #11: Sulfur

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy
Valves	Gas	0	8760	-	-
Valves	Light Liquid	0	8760	-	-
Valves	Heavy Liquid	37	8760	5.56E-06	2.44E-05
Pump Seals	Light Liquid	0	8760	-	-
Pump Seals	Heavy Liquid	2	8760	1.13E-05	4.94E-05
Compressor Seals	Gas	0	8760	-	-
Connectors	All	159	8760	1.90E-04	8.33E-04
			Total	**2.07E-04**	**9.07E-04**
			H_2S	2.07E-04	9.07E-04

Area #12: TGTU Process Gas

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy
Valves	Gas	53	8760	0.47	2.04
Valves	Light Liquid	0	8760	-	-
Valves	Heavy Liquid	0	8760	-	-
Pump Seals	Light Liquid	0	8760	-	-
Pump Seals	Heavy Liquid	0	8760	-	-
Compressor Seals	Gas	1	8760	0.34	1.47
Connectors	All	203	8760	0.55	2.40
			Total	**1.35**	**5.91**
			CO_2	1.31	5.72
			CO	0.01	0.03
			H_2S	0.04	0.16
			COS	6.94E-04	3.04E-03

Note:
Please note that component counts listed in the tables above are only estimates, and do not represent exact component counts

E_{TOC} = $F_A * WF_{TOC} * N$

Where:
F_A = Applicable average emisison factor for equipment type
WF_{TOC} = Average weight fraction of TOC in the stream
N = Number of pieces of equipment of the applicable equipment type

The SOCMI emission factor does not need to be corrected for methane in the stream, because the emission factor is for total organic compounds.

Hydrogen Energy California LLC *4/11/2012*
Hydrogen Energy California (HECA) Project

Area Speciation

Comound	Wt % ($WF_{Constituents}$)										
	Stream 1 Methanol	Stream 2 Syn Gas	Stream 4 Shifted Syn Gas	Stream 5 Propylene	Stream 6 Sour Water	Stream 7 H_2S Laden Methanol	Stream 8 CO_2 Laden Methanol	Stream 9 Acid Gas	Stream 10 Ammonia-Laden Gas	Stream 11 Sulfur	Stream 12 TGTU Process Gas
CO_2	0.0000%	5.7900%	81.0200%	0.0000%	2.5007%	44.6797%	35.8142%	60.3215%	68.3203%	0.0000%	64.6507%
CH_4	0.0000%	0.3900%	0.5600%	0.0000%	0.0000%	0.0029%	0.0030%	0.0018%	0.0021%	0.0000%	0.0000%
CO	0.0000%	32.4900%	1.7100%	0.0000%	0.0014%	0.0345%	0.0358%	0.0645%	0.3642%	0.0000%	0.3054%
H_2S	0.0000%	0.4300%	0.7900%	0.0000%	0.1819%	1.7268%	0.0001%	39.0430%	5.9832%	0.0296%	1.8596%
NH_3	0.0000%	0.0010%	0.0000%	0.0000%	0.2497%	0.0000%	0.0000%	0.0000%	7.3602%	0.0000%	0.0000%
COS	0.0000%	0.1500%	0.0000%	0.0000%	0.0000%	0.0075%	0.0000%	0.5105%	0.0216%	0.0000%	0.0344%
CH_3OH	100.0000%	0.0000%	0.0000%	0.0000%	0.0000%	53.5058%	64.1012%	0.0339%	0.0000%	0.0000%	0.0000%
C_3H_6	0.0000%	0.0000%	0.0000%	100.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%
HCN	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0467%	0.0000%	0.0000%
$WF_{Constituents}$ [1]	**100.00%**	**39.25%**	**84.08%**	**100.00%**	**2.93%**	**99.96%**	**99.95%**	**99.98%**	**82.10%**	**0.03%**	**66.85%**

Conversion Note:
1 kg = 2.20 pound

Note:
(1) $WF_{Constituents}$ does not always equal 100% due to the presence of inerts in the area not listed in table above.

Component Count	Process Area										
	1	2	4	5	6	7	8	9	10	11	12
	Methanol	Syn Gas	Shifted Syn Gas	Propylene	Sour Water	H_2S Laden Methanol	CO_2 Laden Methanol	Acid Gas	Ammonia-Laden Gas	Sulfur	TGTU Process Gas
Valves - Gas	50	108	198	188	0	94	79	161	157	0	53
Valves - Light Liquid	416	0	0	288	0	358	79	0	0	0	0
Valves - Heavy Liquid	0	0	0	0	508	0	0	0	0	37	0
Pumps - Light Liquid	7	0	0	3	0	7	0	0	0	0	0
Pumps - Heavy Liquid	0	0	0	0	17	0	0	0	0	2	0
Compressors	0	0	1	1	0	0	0	0	0	0	1
Connectors	1225	372	632	1432	1410	1323	516	492	407	159	203
	1698	**480**	**831**	**1912**	**1935**	**1782**	**674**	**653**	**564**	**198**	**257**

	Process Area											
	1	2	4	5	6	7	8	9	10	11	12	
	Methanol	Syn Gas	Shifted Syn Gas	Propylene	Sour Water	H_2S Laden Methanol	CO_2 Laden Methanol	Acid Gas	Ammonia-Laden Gas	Sulfur	TGTU Process Gas	Total
Compound	Annual Fugitive Emissions with LDAR Application (ton/yr)											
CO_2		0.74	20.08		0.69	1.82	0.49	0.81	0.84		5.72	31.19
CH_4		0.05	0.14			0.00	0.00	0.00	0.00			0.19
CO		4.16	0.42		0.00	0.00	0.00	0.00	0.00		0.03	4.62
H_2S		0.06	0.20		0.05	0.07	0.00	0.53	0.07	0.00	0.16	1.14
NH_3		0.00			0.07				0.09			0.16
COS		0.02				0.00		0.01	0.00		0.00	0.03
CH_3OH	4.02					2.18	0.88	0.00				7.09
C_3H_6				6.33								6.33
HCN									0.00			0.00
Total VOC	**4.02**	**0.02**	**0.00**	**6.33**	**0.00**	**2.18**	**0.88**	**0.01**	**0.00**	**0.00**	**0.00**	**13.45**
Total percentage of VOC content of gas in each process area	100.00%	0.15%	0.00%	100.00%	0.00%	53.51%	64.10%	0.54%	0.07%	0.00%	0.03%	

Note: The following compounds are included as VOCs, although not all compounds are found in the gas in each process area.
CH_3OH, C_3H_6, COS, and HCN

Summary by Volume Source for Modeling - Emissions are divided by number of Volume Sources

"GASIFICATION" (Area #2)

	lb/hr	lb/yr		
CO	0.316	2,772.38	3	number of Volume Sources
H_2S	4.19E-03	36.69	28	horizontal dimension (m)
NH_3	9.74E-06	8.53E-02	46.48	release ht (m)
CH_3OH			13.02	horizontal dimension (m)
C_3H_6			43.24	vertical dimension (m)
HCN			305	vertical dimension used for calcs (ft)

"SHIFT" (Area #4, 6)

	lb/hr	lb/yr		
CO	4.84E-02	424.19	2	number of Volume Sources
H_2S	2.81E-02	245.74	35	horizontal dimension (m)
NH_3	7.83E-03	68.56	6.10	release ht (m)
CH_3OH			16.28	horizontal dimension (m)
C_3H_6			5.67	vertical dimension (m)
HCN			40	vertical dimension used for calcs (ft)

"AGR" (Area #1, #5, #7, #8, #9)

	lb/hr	lb/yr		
CO	6.32E-04	5.54	1	number of Volume Sources
H_2S	1.37E-01	1195.86	48	horizontal dimension (m)
NH_3			6.10	release ht (m)
CH_3OH	1.62E+00	14172.79	22.33	horizontal dimension (m)
C_3H_6	1.44E+00	12657.98	5.67	vertical dimension (m)
HCN			40	vertical dimension used for calcs (ft)

"Sour Water Stripper" (Area #10)

	lb/hr	lb/yr		
CO	1.02E-03	8.94	1	number of Volume Sources
H_2S	1.68E-02	146.89	16	horizontal dimension (m)
NH_3	2.06E-02	180.69	6.10	release ht (m)
CH_3OH			7.44	horizontal dimension (m)
C_3H_6			5.67	vertical dimension (m)
HCN	1.31E-04	1.15	40	vertical dimension used for calcs (ft)

"SRU" (Area #11, #12)
2 number of Volume Sources

	lb/hr	lb/yr		
CO	3.08E-03	27.01	2	number of Volume Sources
H_2S	1.89E-02	165.37	16	horizontal dimension (m)
NH_3			6.10	release ht (m)
CH_3OH			7.44	horizontal dimension (m)
C_3H_6			5.67	vertical dimension (m)
HCN			40	vertical dimension used for calcs (ft)

Note: Selective LDAR program was applied to Areas # 1#5, #7, #8, #9, #10 due to high uncontrolled emissions for the VOCs (methanol and propylene) and hydrogen sulfide

Fugitive Emissions - UAN Unit

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	Total Uncontrolled Emissions		Total Controlled Emissions	
Compound	**Emissions (lb/hr)**	**Emissions (tpy)**	**Emissions (lb/hr)**	**Emissions (tpy)**
NH_3	2.31	10.14	0.23	0.99
CO_2	0.28	1.23	0.02	0.09
HNO_3	2.12	9.29	0.19	0.82

Summary by Volume Source - Emissions are divided by number of Volume Sources

"Unit 84" Three Volume Sources

	lb/hr	lb/yr
NH_3	0.08	660.02
CO_2	0.01	62.96
HNO_3	0.06	546.25

EPA Table 2-1SOCMI Average Fugitive Emission Factors

Component Type	Service Type	Emission Factor (1) (kg/hr/source)	Control Efficiency (%) (3)
Valves	Gas	5.97E-03	92%
	Light Liquid	4.03E-03	88%
	Heavy Liquid	2.30E-04	
Pump Seals	Light Liquid	1.99E-02	75%
	Heavy Liquid	8.62E-03	
Compressor Seals	Gas	2.28E-01	
Pressure Relief Valves	Gas	1.04E-01	
Connectors	All	1.83E-03	93%
Open-Ended Lines	All	1.70E-03	
Sampling Connections	All	1.50E-02	
Agitator Seals (2)	All	1.99E-02	

Note:
Source: EPA 1995, Protocol for Equipment Leak Emission Estimates
(1) Factors are for total organic compound emission rates. Emission factors assumed to be same for other constituents emitted from the stream.
(2) Factors for light liquid pump seals can be used to estimate the leak rate from agitator seals
(3) Control efficiencies for an LDAR program at a SOCMI process unit using HON reg neg
(control effectiveness attributable to requirements of the hazardous NESHAPS equipment leak regulations)
It was assumed that factors for connectors can be used to estimate the leak rate from flanges.
Emission are conservative since these streams are not as volatile as the streams that the SOCMI factors were developed for.

Unit # 84: 100 wt% Liquid NH3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	0	8760	-	-	-	-
Valves	Light Liquid	140	8760	1.24	5.45	0.15	0.65
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	All	195	8760	0.79	3.45	0.06	0.24
			Total	**2.03**	**8.89**	**0.20**	**0.89**
			NH_3	2.03	8.89	0.20	0.89

Unit # 84: 62 wt% Vapor NH3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	17	8760	0.14	0.61	0.01	0.05
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	33	8760	0.08	0.36	0.01	0.03
			Total	**0.22**	**0.97**	**0.02**	**0.07**
			NH_3	0.22	0.97	0.02	0.07

Unit # 84: 6.3 wt% Vapor NH3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	33	8760	0.03	0.12	2.19E-03	9.59E-03
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	66	8760	0.02	0.07	1.17E-03	5.14E-03
			Total	**0.04**	**0.19**	**3.36E-03**	**1.47E-02**
			NH_3	0.04	0.19	3.36E-03	1.47E-02

Unit # 84: 2.3 wt% Vapor NH3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	33	8760	0.01	0.04	7.99E-04	3.50E-03
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	66	8760	0.01	0.03	4.29E-04	1.88E-03
			Total	**0.02**	**0.07**	**1.23E-03**	**5.38E-03**
			NH_3	0.02	0.07	1.23E-03	5.38E-03

Unit # 84: 1 wt% Liquid NH3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	0	8760	-	-	-	-
Valves	Light Liquid	15	8760	1.33E-03	5.84E-03	1.60E-04	7.00E-04
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	27	8760	1.09E-03	4.77E-03	7.63E-05	3.34E-04
			Total	**2.42E-03**	**1.06E-02**	**2.36E-04**	**1.03E-03**
			NH_3	2.42E-03	1.06E-02	2.36E-04	1.03E-03

Unit # 84: 38 wt% Vapor CO_2

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	17	8760	0.09	0.37	6.80E-03	0.03
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	33	8760	0.05	0.22	3.54E-03	0.02
			Total	**0.14**	**0.59**	**1.03E-02**	**0.05**
			CO_2	0.14	0.59	1.03E-02	0.05

Fugitive Emissions - UAN Unit

Hydrogen Energy California LLC 4/11/2012
Hydrogen Energy California (HECA) Project

Unit # 84: 6.4 wt% Vapor CO_2

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	60	8760	0.05	0.22	4.04E-03	0.02
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	45	8760	0.01	0.05	8.13E-04	0.00
			Total	**0.06**	**0.27**	**4.86E-03**	**0.02**
			CO_2	0.06	0.27	4.86E-03	0.02

Unit # 84: 3.6 wt% Vapor CO_2

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	83	8760	0.04	0.17	0.00	0.01
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	156	8760	0.02	0.10	0.00	0.01
			Total	**0.06**	**0.27**	**0.00**	**0.02**
			CO_2	0.06	0.27	0.00	0.02

Unit # 84: 1.8 wt% Vapor CO_2

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	69	8760	0.02	0.07	1.31E-03	5.73E-03
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	63	8760	4.58E-03	0.02	3.20E-04	1.40E-03
			Total	**0.02**	**0.09**	**1.63E-03**	**7.13E-03**
			CO_2	0.02	0.09	1.63E-03	7.13E-03

Unit # 84: 60 wt% Liquid HNO_3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	99	8760	0.78	3.42	0.06	0.27
Valves	Light Liquid	96	8760	0.51	2.24	0.06	0.27
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	264	8760	0.64	2.80	0.04	0.20
			Total	**1.93**	**8.46**	**0.17**	**0.74**
			HNO_3	1.93	8.46	0.17	0.74

Unit # 84: 48 wt% Liquid HNO_3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	0	8760	-	-	-	-
Valves	Light Liquid	24	8760	0.10	0.45	0.01	0.05
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	45	8760	0.09	0.38	0.01	0.03
			Total	**0.19**	**0.83**	**0.02**	**0.08**
			HNO_3	0.19	0.83	0.02	0.08

Note:
Please note that component counts listed in the tables above are only estimates, and do not represent exact component counts

E_{TOC} = $F_A * WF_{TOC} * N$

Where:
F_A = Applicable average emisison factor for equipment type
WF_{TOC} = Average weight fraction of TOC in the stream
N = Number of pieces of equipment of the applicable equipment type

The SOCMI emission factor does not need to be corrected for methane in the stream, because the emission factor is for total organic compounds.

Stream Speciation

Comound	Wt % ($WF_{Constituent}$) 100 wt% Liquid NH3	62 wt% Vapor NH3	6.3 wt% Vapor NH3	2.3 wt% Vapor NH3	1 wt% Liquid NH3	38 wt% Vapor CO2	6.4 wt% Vapor CO2	3.6 wt% Vapor CO2	1.8 wt% Vapor CO2	60 wt% Liquid Nitric Acid	48 wt% Liquid Nitric Acid
NH_3	100.0%	62.0%	6.3%	2.3%	1.0%						
CO_2						38.0%	6.4%	3.6%	1.8%		
Nitric Acid (HNO_3)										60.0%	48.0%
$WF_{Constituents}$ [1]	**100.0%**	**62.0%**	**6.3%**	**2.3%**	**1.0%**	**38.0%**	**6.4%**	**3.6%**	**1.8%**	**60.0%**	**48.0%**

Conversion Note:
1 kg = 2.20 pound

Note:
(1) $WF_{Constituent}$ only shows the constituants that are of concern for air quality permitting, such as VOCs, TACs, criteria pollutants and GHGs

	Stream 100 wt% Liquid NH3	62 wt% Vapor NH3	6.3 wt% Vapor NH3	2.3 wt% Vapor NH3	1 wt% Liquid NH3	38 wt% Vapor CO2	6.4 wt% Vapor CO2	3.6 wt% Vapor CO2	1.8 wt% Vapor CO2	60 wt% Liquid Nitric Acid	48 wt% Liquid Nitric Acid
Valves - Gas	0	17	33	33	0	17	60	83	69	99	0
Valves - Light Liquid	140	0	0	0	15	0	0	0	0	96	24
Valves - Heavy Liquid	0	0	0	0	0	0	0	0	0	0	0
Connectors	195	33	66	66	27	33	45	156	63	264	45
	335	**50**	**99**	**99**	**42**	**50**	**105**	**239**	**132**	**459**	**69**

Compound	Stream 100 wt% Liquid NH3	62 wt% Vapor NH3	6.3 wt% Vapor NH3	2.3 wt% Vapor NH3	1 wt% Liquid NH3	38 wt% Vapor CO2	6.4 wt% Vapor CO2	3.6 wt% Vapor CO2	1.8 wt% Vapor CO2	60 wt% Liquid Nitric Acid	48 wt% Liquid Nitric Acid
	Annual Fugitive Emissions with LDAR Application (ton/yr)										
NH_3	0.89	0.07	0.01	0.01	1.03E-03						
CO_2						0.59	0.27	0.27	0.09		
HNO_3										0.74	0.08

Summary by Volume Source for Modeling - Emissions are divided by number of Volume Sources
UAN Unit

	lb/hr	lb/yr
NH_3	0.226	1,980.07
HNO_3	0.187	1,638.74

1 number of Volume Sources
24 horizontal dimension (m)
6.10 release ht (m)
11.16 horizontal dimension (m)
5.67 vertical dimension (m)
40 vertical dimension used for calcs (ft)

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	Total Uncontrolled Emissions		Total Controlled Emissions	
Compound	**Emissions (lb/hr)**	**Emissions (tpy)**	**Emissions (lb/hr)**	**Emissions (tpy)**
NH_3	4.19	18.34	0.40	1.76
CO_2	2.93	12.84	0.23	0.99

Summary by Volume Source - Emissions are divided by number of Volume Sources

"Unit 82" Three Volume Sources

	lb/hr	lb/yr
NH_3	0.13	1,171.95
CO_2	0.08	660.60

EPA Table 2-1SOCMI Average Fugitive Emission Factors

Component Type	Service Type	Emission Factor(1) (kg/hr/source)	Control Efficiency (%) (3)
Valves	Gas	5.97E-03	92%
	Light Liquid	4.03E-03	88%
	Heavy Liquid	2.30E-04	
Pump Seals	Light Liquid	1.99E-02	75%
	Heavy Liquid	8.62E-03	
Compressor Seals	Gas	2.28E-01	
Pressure Relief Valves	Gas	1.04E-01	
Connectors	All	1.83E-03	93%
Open-Ended Lines	All	1.70E-03	
Sampling Connections	All	1.50E-02	
Agitator Seals(2)	All	1.99E-02	

Note:
Source: EPA 1995, Protocol for Equipment Leak Emission Estimates
(1) Factors are for total organic compound emission rates. Emission factors assumed to be same for other constituents emitted from the stream.
(2) Factors for light liquid pump seals can be used to estimate the leak rate from agitator seals
(3) Control efficiencies for an LDAR program at a SOCMI process unit using HON reg neg
(control effectiveness attributable to requirements of the hazardous NESHAPS equipment leak regulations)
It was assumed that factors for connectors can be used to estimate the leak rate from flanges.
Emission are conservative since these streams are not as volatile as the streams that the SOCMI factors were developed for.

Unit # 82: 100 wt% Liquid NH3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	0	8760	-	-	-	-
Valves	Light Liquid	77	8760	0.68	3.00	0.08	0.36
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	All	141	8760	0.57	2.49	0.04	0.17
			Total	**1.25**	**5.49**	**0.12**	**0.53**
			NH_3	1.25	5.49	0.12	0.53

Unit # 82: 50-70 wt% Liquid NH3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	0	8760	-	-	-	-
Valves	Light Liquid	47	8760	0.29	1.28	0.04	0.15
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	63	8760	0.18	0.78	0.01	0.05
			Total	**0.47**	**2.06**	**0.05**	**0.21**
			NH_3	0.47	2.06	0.05	0.21

Unit # 82: 25-40 wt% Liquid NH3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	0	8760	-	-	0.00E+00	0.00E+00
Valves	Light Liquid	117	8760	0.42	1.82	0.05	0.22
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	225	8760	0.36	1.59	2.54E-02	1.11E-01
			Total	**0.78**	**3.41**	**7.53E-02**	**3.30E-01**
			NH_3	0.78	3.41	7.53E-02	3.30E-01

Unit # 82: 0.5-25 wt% Liquid NH3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	0	8760	-	-	0.00E+00	0.00E+00
Valves	Light Liquid	254	8760	0.56	2.47	0.07	0.30
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	456	8760	0.46	2.01	3.22E-02	1.41E-01
			Total	**1.02**	**4.49**	**9.99E-02**	**4.38E-01**
			NH_3	1.02	4.49	9.99E-02	4.38E-01

Unit # 82: 3-30 wt% Vapor NH3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	60	8760	0.24	1.04	0.02	0.08
Valves	Light Liquid	60	8760	1.60E-01	7.00E-01	1.92E-02	8.41E-02
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	219	8760	2.65E-01	1.16E+00	1.86E-02	8.13E-02
			Total	**6.62E-01**	**2.90E+00**	**5.67E-02**	**2.48E-01**
			NH_3	6.62E-01	2.90E+00	5.67E-02	2.48E-01

Unit # 82: 30-60 wt% Vapor NH3

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	23	8760	0.18	0.80	1.45E-02	0.06
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	45	8760	0.11	0.48	7.63E-03	0.03
			Total	**0.29**	**1.27**	**2.22E-02**	**0.10**
			NH_3	0.29	1.27	0.02	0.10

Unit # 82: 100 wt% Vapor CO_2

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	60	8760	0.79	3.46	6.32E-02	0.28
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	45	8760	0.18	0.80	1.27E-02	0.06
			Total	**0.97**	**4.25**	**7.59E-02**	**0.33**
			CO_2	0.97	4.25	7.59E-02	0.33

Unit # 82: 50-70 wt% Liquid CO_2

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	83	8760	0.76	3.35	0.06	0.27
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	156	8760	0.44	1.93	0.03	0.14
			Total	**1.21**	**5.28**	**0.09**	**0.40**
			CO_2	1.21	5.28	0.09	0.40

Fugitive Emissions - Urea Unit

Hydrogen Energy California LLC 4/11/2012
Hydrogen Energy California (HECA) Project

Unit # 82: 25-40 wt% Liquid CO_2

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	69	8760	0.36	1.59	2.91E-02	1.27E-01
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	63	8760	1.02E-01	0.45	7.12E-03	3.12E-02
			Total	**0.46**	**2.04**	**3.62E-02**	**1.58E-01**
			CO_2	0.46	2.04	3.62E-02	1.58E-01

Unit # 82: 0.5-25 wt% Liquid CO_2

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	26	8760	0.09	0.37	6.84E-03	0.03
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	51	8760	0.05	0.23	3.60E-03	0.02
			Total	**0.14**	**0.60**	**1.04E-02**	**0.05**
			CO_2	0.14	0.60	0.01	0.05

Unit # 82: 2-30 wt% Vapor CO_2

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	26	8760	0.10	0.45	8.21E-03	0.04
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	51	8760	0.06	0.27	4.32E-03	0.02
			Total	**0.16**	**0.72**	**1.25E-02**	**0.05**
			CO_2	0.16	0.72	0.01	0.05

Unit # 82: 20-65 wt% Vapor CO_2

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	57	8760	0.49	2.14	3.90E-02	0.17
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	81	8760	0.21	0.93	1.49E-02	0.07
			Total	**0.70**	**3.07**	**5.39E-02**	**0.24**
			CO_2	0.70	3.07	0.05	0.24

Note:
Please note that component counts listed in the tables above are only estimates, and do not represent exact component counts

E_{TOC} = $F_A * WF_{TOC} * N$

Where:
F_A = Applicable average emisison factor for equipment type
WF_{TOC} = Average weight fraction of TOC in the stream
N = Number of pieces of equipment of the applicable equipment type

The SOCMI emission factor does not need to be corrected for methane in the stream, because the emission factor is for total organic compounds.

Stream Speciation

Comound	Wt % ($WF_{Constituent}$) 100 wt% Liquid NH3	50-70 wt% Liquid NH3	25-40 wt% Liquid NH3	0.5-25 wt% Liquid NH3	3-30 wt% Vapor NH3	30-60 wt% Vapor NH3	100 wt% Vapor CO2	50-70 wt% Liquid CO2	25-40 wt% Liquid CO2	0.5-25 wt% Liquid CO2	2-30 wt% Vapor CO2	30-65 wt% Vapor CO2
NH_3	100.0%	70.0%	40.0%	25.0%	30.0%	60.0%						
CO_2							100.0%	70.0%	40.0%	25.0%	30.0%	65.0%
$WF_{Constituents}$ [1]	**100.0%**	**70.0%**	**40.0%**	**25.0%**	**30.0%**	**60.0%**	**100.0%**	**70.0%**	**40.0%**	**25.0%**	**30.0%**	**65.0%**

Conversion Note:
1 kg = 2.20 pound

Note:
(1) $WF_{Constituent}$ only shows the constituants that are of concern for air quality permitting, such as VOCs, TACs, criteria pollutants and GHGs

	Stream 100 wt% Liquid NH3	50-70 wt% Liquid NH3	25-40 wt% Liquid NH3	0.5-25 wt% Liquid NH3	3-30 wt% Vapor NH3	30-60 wt% Vapor NH3	100 wt% Vapor CO2	50-70 wt% Liquid CO2	25-40 wt% Liquid CO2	0.5-25 wt% Liquid CO2	2-30 wt% Vapor CO2	30-65 wt% Vapor CO2
Valves - Gas	0	0	0	0	60	23	60	83	69	26	26	57
Valves - Light Liquid	77	47	117	254	60	0	0	0	0	0	0	0
Valves - Heavy Liquid	0	0	0	0	0	0	0	0	0	0	0	0
Connectors	141	63	225	456	219	45	45	156	63	51	51	81
	218	**110**	**342**	**710**	**339**	**68**	**105**	**239**	**132**	**77**	**77**	**138**

	Stream 100 wt% Liquid NH3	50-70 wt% Liquid NH3	25-40 wt% Liquid NH3	0.5-25 wt% Liquid NH3	3-30 wt% Vapor NH3	30-60 wt% Vapor NH3	100 wt% Vapor CO2	50-70 wt% Liquid CO2	25-40 wt% Liquid CO2	0.5-25 wt% Liquid CO2	2-30 wt% Vapor CO2	30-65 wt% Vapor CO2
Compound	**Annual Fugitive Emissions with LDAR Application (ton/yr)**											
NH_3	0.53	0.21	0.33	0.44	2.48E-01	0.10						
CO_2							0.33	0.40	1.58E-01	0.05	0.05	0.24

Summary by Volume Source for Modeling - Emissions are divided by number of Volume Sources
Urea Unit

	lb/hr	lb/yr
NH_3	0.201	1,758

2 number of Volume Sources
12 horizontal dimension (m)
6.10 release ht (m)
5.58 horizontal dimension (m)
5.67 vertical dimension (m)
40 vertical dimension used for calcs (ft)

Fugitive Emissions - Ammonia Unit

Hydrogen Energy California LLC
Hydrogen Energy California (HECA) Project

4/11/2012

	Total Uncontrolled Emissions		Total Controlled Emissions	
Compound	**Emissions (lb/hr)**	**Emissions (tpy)**	**Emissions (lb/hr)**	**Emissions (tpy)**
NH_3	8.33	36.48	0.64	2.79

Summary by Volume Source - Emissions are divided by number of Volume Sources

"Unit 81" Three Volume Sources

	lb/hr	lb/yr
NH_3	0.21	1,861.32

EPA Table 2-1SOCMI Average Fugitive Emission Factors

Component Type	Service Type	Emission Factor (1) (kg/hr/source)	Control Efficiency (%) (3)
Valves	Gas	5.97E-03	92%
	Light Liquid	4.03E-03	88%
	Heavy Liquid	2.30E-04	
Pump Seals	Light Liquid	1.99E-02	75%
	Heavy Liquid	8.62E-03	
Compressor Seals	Gas	2.28E-01	
Pressure Relief Valves	Gas	1.04E-01	
Connectors	All	1.83E-03	93%
Open-Ended Lines	All	1.70E-03	
Sampling Connections	All	1.50E-02	
Agitator Seals (2)	All	1.99E-02	

Note:
Source: EPA 1995, Protocol for Equipment Leak Emission Estimates
(1) Factors are for total organic compound emission rates. Emission factors assumed to be same for other constituents emitted from the stream.
(2) Factors for light liquid pump seals can be used to estimate the leak rate from agitator seals
(3) Control efficiencies for an LDAR program at a SOCMI process unit using HON reg neg
(control effectiveness attributable to requirements of the hazardous NESHAPS equipment leak regulations)
It was assumed that factors for connectors can be used to estimate the leak rate from flanges.
Emission are conservative since these streams are not as volatile as the streams that the SOCMI factors were developed for.

Unit # 81: 0.14 wt% (or 0.07 mol %) NH3 in Gas

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	177	8760	2.33	10.20	0.19	0.82
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	All	327	8760	1.32	5.78	0.09	0.40
			Total	**3.65**	**15.98**	**0.28**	**1.22**
			NH_3	3.65	15.98	0.28	1.22

Unit # 81: 5.8 wt % (or 3.1 mol %) NH3 in Gas

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	227	8760	2.09	9.16	0.17	0.73
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	378	8760	1.07	4.68	0.07	0.33
			Total	**3.16**	**13.84**	**0.24**	**1.06**
			NH_3	3.16	13.84	0.24	1.06

Unit # 81: 7.8 wt % (or 4.3 mol %) NH3 in Gas

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	84	8760	0.44	1.94	3.54E-02	1.55E-01
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	93	8760	0.15	0.66	1.05E-02	4.60E-02
			Total	**0.59**	**2.59**	**4.59E-02**	**2.01E-01**
			NH_3	0.59	2.59	4.59E-02	2.01E-01

Unit # 81: 32.9 wt % (or 20.7 mol %) NH3 in Gas

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	131	8760	0.43	1.89	3.45E-02	1.51E-01
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	258	8760	0.26	1.14	1.82E-02	7.98E-02
			Total	**0.69**	**3.03**	**5.27E-02**	**2.31E-01**
			NH_3	0.69	3.03	5.27E-02	2.31E-01

Unit # 81: 35.7 wt % (or 31.6 mol %) NH3 in Gas

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	38	8760	0.15	0.66	0.01	0.05
Valves	Light Liquid	0	8760	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	72	8760	8.71E-02	3.82E-01	6.10E-03	2.67E-02
			Total	**2.37E-01**	**1.04E+00**	**1.81E-02**	**7.93E-02**
			NH_3	2.37E-01	1.04E+00	1.81E-02	7.93E-02

Unit # 81: 99.99 wt % (or 99.9 mol %) NH3 in Gas

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC}) lb/hr	Uncontrolled Emissions (E_{TOC}) tpy	Controlled Emissions (E_{TOC}) lb/hr	Controlled Emissions (E_{TOC}) tpy
Valves	Gas	414	8760	3.27	14.32	2.62E-01	1.15
Valves	Light Liquid	0	8760	-	-	-	-
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	438	8760	1.06	4.64	7.42E-02	0.33
			Total	**4.33**	**18.96**	**3.36E-01**	**1.47**
			NH_3	4.33	18.96	0.34	1.47

Fugitive Emissions - Ammonia Unit

Hydrogen Energy California LLC 4/11/2012
Hydrogen Energy California (HECA) Project

Unit # 81: 099.99 wt % (or 99.9 mol %) NH3 in Liquid

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC})		Controlled Emissions (E_{TOC})	
				lb/hr	tpy	lb/hr	tpy
Valves	Gas	0	8760	-	-	0.00E+00	-
Valves	Light Liquid	575	8760	5.11	22.38	0.61	2.69
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	732	8760	2.95	12.94	2.07E-01	0.91
			Total	**8.06**	**35.31**	**8.20E-01**	**3.59**
			NH_3	8.06	35.31	8.20E-01	3.59

Unit # 81: 5.61 wt % NH_3 in liquid water

Component	Service	Equipment Count (N)	Annual Hours of Operation	Uncontrolled Emissions (E_{TOC})		Controlled Emissions (E_{TOC})	
				lb/hr	tpy	lb/hr	tpy
Valves	Gas	0	8760	-	-	-	-
Valves	Light Liquid	101	8760	0.90	3.93	0.11	0.47
Valves	Heavy Liquid	0	8760	-	-	-	-
Flanges	Light Liquid	186	8760	0.53	2.30	0.04	0.16
			Total	**1.42**	**6.23**	**0.14**	**0.63**
			NH_3	1.42	6.23	0.14	0.63

Note:
Please note that component counts listed in the tables above are only estimates, and do not represent exact component counts

E_{TOC} = $F_A * WF_{TOC} * N$

Where:
F_A = Applicable average emisison factor for equipment type
WF_{TOC} = Average weight fraction of TOC in the stream
N = Number of pieces of equipment of the applicable equipment type

The SOCMI emission factor does not need to be corrected for methane in the stream, because the emission factor is for total organic compounds.

Stream Speciation

Comound	Wt % ($WF_{Constituent}$)							
	0.14 wt % (or 0. 07 mol %) NH3 in gas	5.8 wt % (or 3.1 mol %) NH3 in gas	7.8 wt % (or 4.3 mol %) NH3 in gas	32.9 wt % (or 20.7 mol %) NH3 in gas	35.7 wt % (or 31.6 mol %) NH3 in gas	99.99 wt % (or 99.9 mol %) NH3 in gas	99.99 wt % (or 99.9 mol %) NH3 in liq	5.61 wt % NH3 in liq water
NH_3	100.0%	70.0%	40.0%	25.0%	30.0%	60.0%	100.0%	70.0%
$WF_{Constituents}$ [1]	**100.0%**	**70.0%**	**40.0%**	**25.0%**	**30.0%**	**60.0%**	**100.0%**	**70.0%**

Conversion Note:
1 kg = 2.20 pound

Note:
(1) $WF_{Constituent}$ only shows the constituants that are of concern for air quality permitting, such as VOCs, TACs, criteria pollutants and GHGs

	Stream							
	0.14 wt % (or 0. 07 mol %) NH3 in gas	5.8 wt % (or 3.1 mol %) NH3 in gas	7.8 wt % (or 4.3 mol %) NH3 in gas	32.9 wt % (or 20.7 mol %) NH3 in gas	35.7 wt % (or 31.6 mol %) NH3 in gas	99.99 wt % (or 99.9 mol %) NH3 in gas	99.99 wt % (or 99.9 mol %) NH3 in liq	5.61 wt % NH3 in liq water
Valves - Gas	177	227	84	131	38	414	0	0
Valves - Light Liquid	0	0	0	0	0	0	575	101
Valves - Heavy Liquid	0	0	0	0	0	0	0	0
Connectors	327	378	93	258	72	438	732	186
	504	**605**	**177**	**389**	**110**	**852**	**1307**	**287**

	Stream							
	0.14 wt % (or 0. 07 mol %) NH3 in gas	5.8 wt % (or 3.1 mol %) NH3 in gas	7.8 wt % (or 4.3 mol %) NH3 in gas	32.9 wt % (or 20.7 mol %) NH3 in gas	35.7 wt % (or 31.6 mol %) NH3 in gas	99.99 wt % (or 99.9 mol %) NH3 in gas	99.99 wt % (or 99.9 mol %) NH3 in liq	5.61 wt % NH3 in liq water
Compound	**Annual Fugitive Emissions with LDAR Application (ton/yr)**							
NH_3	1.22	1.06	0.20	0.23	7.93E-02	1.47	3.59	0.63

Summary by Volume Source for Modeling - Emissions are divided by number of Volume Sources
Ammonia Unit

	lb/hr	lb/yr
NH_3	0.319	2,792

2 number of Volume Sources
24 horizontal dimension (m)
6.10 release ht (m)
11.16 horizontal dimension (m)
5.67 vertical dimension (m)
40 vertical dimension used for calcs (ft)

Total Reduced Sulfur

Pollutant	Annual Rate (tons per year)	TRS as H2S (tons/yr)	Molecular Wt	Source of emissions		
Hydrogen Sulfide	2.64	2.64	34	CO_2 vent and fugitives		
Carbonyl Sulfide	2.69	1.53	60	CO_2 vent and fugitives	**Significance Threshold (tons/yr)**	**Significant?**
	Total	**4.17**			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		
Hydrogen Sulfide	2.64	2.64	34	CO_2 vent and fugitives		
Carbon Disulfide	0.55	0.25	76	CTG/HRSG and coal dryer		
Carbonyl Sulfide	2.69	1.53	60	CO_2 vent and fugitives	**Significance Threshold (tons/yr)**	**Significant?**
	Total	**4.42**			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	1.14	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	2.64	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)