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Comments on November 2013 Greenhouse Gas Workshop

Amended Application for Certification for HYDROGEN ENERGY CALIFORNIA (08-AFC-8A) Kern County, California

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Submitted to:

California Energy Commission

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URS

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COMMENTS ON NOVEMBER 2013 GREENHOUSE GAS WORKSHOP

During the Greenhouse Gas (GHG) Workshop in Sacramento on November 13, 2013, California Energy Commission (CEC) GHG staff presented calculations for a possible technique to estimate the State Bill (SB) 1368 emission performance standard for the HECA project. The following describes HECA's suggested modifications to the CEC spreadsheet calculations (Docket Number 201226).

Although HECA does not agree with all of the calculation techniques that CEC has used in estimating the EPS, the following are clarifications on the calculations presented by CEC during the November 13 GHG workshop. Attachment 1 provides the tables that correspond to the sections below. HECA proposes the following edits to these calculations:

Average Power Allocation

- The ASU Power apportionment was corrected to properly weight the value according to 16 hours of maximum power production and 8 hours of maximum fertilizer production per day. Resulting value is 69.7 percent instead of 64.1 percent.
- EOR CO_2 Compression should be allocated (A or Apportioned) between power and fertilizer, not assigned entirely to power (P). This changes the "percent" column to 64.9 percent, the syngas power apportionment.
- The PSA and Ammonia Units allocation should be based on the amount of hydrogen in the PSA off-gas, as recommended by CEC Staff at the Workshop; the calculation was modified accordingly, resulting in 3.9 percent of the energy usage allocated to power production. The calculation technique is shown in the column to the right of the table.
- The Net Power Export (not including OEHI) should not include ASU power usage, thus it would be approximately 227 MW for this average power allocation. Although for the purposes of this table for CEC, Net Power Export (not including OEHI) should be calculated based on Gross Power Generation, not Power Generation Less Fertilizer Contribution.
  - "Fertilizer power consumption (MW) included in Net Power" was changed to subtract the power generated by the fertilizer unit.
- URS added a row for possible additional compression required to sequester the CO_2 at OEHI.

Average Emissions Allocation and EP

- The CO_2 vent emissions should be allocated (A) not assigned entirely to power (P), since these emissions come from producing syngas, which is split in usage between power and fertilizer.
- All OEHI Emissions should be excluded from the calculation, as this is a separate industrial process, regulated in its own right under Assembly Bill 32. A portion of the Fugitive GHG Emissions may be included (as allocated emissions) since these may occur in the transfer of CO_2 from HECA to the OEHI process.
  - It is especially overreaching to include indirect emissions from EOR Component Power Consumption. These emissions will already be included in the SB1368 calculation at their generation source and should not also be included in HECA's SB1368 calculation, thus double counting the same emissions. Additionally, it is

impossible to know where these emissions came from – they could easily have come from a solar or wind source in the central valley which would not have any GHG emissions.

Max Power Allocation

- Changes to this scenario are the same as in the Average Power Allocation described above, with the following addition:
  - The allocation of Water Treatment and Process Cooling Tower were corrected to account for the different Syngas Power apportionment under Max Power versus Average Power.

Max Power Emissions and EP

- All changes made to this tab are the same as in the Average Emissions Allocation and EP tab.

ATTACHMENT 1
CALCULATIONS

Average Power Allocation

Net Power Allocation when Firing Syngas

Power Balance	Units	Allocation	Daily Average	Percent	Allocated to Power	
Ambient Temperature	*Fahrenheit		65			
Gross Power Generation (CT/ST)	MW		382.4			
Power Generation Fertilizer Contribution	MW		6.1			
Power Generation Less Fertilizer Contribution	MW	P	376.3	100.0%	376.3	Common Apportionment: Avg Daily
Total Auxiliary Load	MW		155.0			Syngas Power: 64.9%
Gasification	MW	A	12.1	64.9%	7.9	
Shift and LTGC	MW	A	0.9	64.9%	0.6	
AGR	MW	A	19.3	64.9%	12.5	ASU Power: 69.7%
SRU	MW	A	2.0	64.9%	1.3	
EOR CO_2 Compression	MW	A	36.1	64.9%	23.4	
PSA and Ammonia Units	MW	A	37.8	3.9%	1.5	Power value from the PSA unit is 3.9% = (1183 lb/hr of H2 * 16 + 1972 lb/hr of H2 * 8)/24 from PSA to CTG/HRSG for power production (stream 15) /(41440 lb/hr of H2 * 16 + 29084 lb/hr total H2 * 8)/24 for power production (stream 20)
CO_2 Purification	MW	F	6.1	0.0%	0.0	
Urea/UAN	MW	F	6.0	0.0%	0.0	
Power Block	MW	P	5.6	100.0%	5.6	
Water Treatment	MW	A	6.4	67.2%	4.3	Note allocation is mixed (common 2.0 MW * 64.9% (syngas power allocation) + 3.0 MW * 100% all power allocation + 1.4 MW * 0% fertilizer no power allocation)/total water treatment load 6.4 MW = 67.2% overall power allocation (directly from applicant source data)
Power Cooling Tower	MW	P	4.0	100.0%	4.0	
Process Cooling Tower	MW	A	9.7	33.5%	3.2	Note allocation is mixed (common 5.0 MW * 64.9% (syngas power allocation) + 4.6 MW * 0% fertilizer no power allocation)/total process cooling tower load 9.7 MW = 33.5% overall power allocation (directly from applicant source data)
Fertilizer Storage/Handling	MW	F	0.6	0.0%	0.0	
Other Supporting Systems	MW	A	8.4	64.9%	5.5	
ASU	MW	A	106.9	69.7%	74.5	Note allocation is based on average daily common (77 MW*16+76.7 MW*8)/24*64.9% (syngas power allocation) + (27.6 MW*16+18.6 MW*8)/24 * 100% nitrogen for power allocation divided by total average ASU consumption of (109 MW*16+102.6 MW*8)/24 = 106.87, so total allocation = 69.7%
Net Power Export (not incl. OEHI)	MW		120.5		111.5	Fertilizer power consumption (MW) included in Net Power
Possible additional compression for CCS at OEHI	MW	A	2.0	64.9%	1.3	
SB 1368 Net Power	MW				230.7	

Source: Power Generation and Consumption data from HECA 2013 TN200144 Figure CS-7-3; allocation to power percentage data from same source Attachment CS-7-1 for syngas allocation and same source derived from Table CS-7-4, Attachment CS-7-1, and Table CS-7-2 for ASU daily average MW consumption and allocation to power.

P = Power
F = Fertilizer
A = Apportioned

Notes:
AGR = acid gas removal
CO_2 = carbon dioxide
CT = combustion turbine
EOR = enhanced oil recovery
LTGC = low-temperature gas cooling
PSA = Pressure Swing Adsorption
SRU = sulfur recovery unit
ST = steam turbine
UAN = urea ammonium nitrate

	MW/hr	Hrs/Year	Total
Net Generation Totals for Syngas	230.7	8000	1845961.23
Net Generation for Natural Gas	300	336	100800
		Total	1946761.23
		Total Steady State	1845961.23

Sources for Hrs/Year and MW/hr for natural gas are HECA 2013 TN201026 Table 3.

Items that may the potential for compromise are shown with yellow highlight -	
Items with orange highlight show modifications HECA made to CEC calculations	

Average Emissions Allocation and Emission Performance

HECA Annual CO2 Emissions for SB 1368 Emission Performance Standard (Avg. Case)

Sources of CO_2	Annual CO2 (MT)	Allocation	Percent	Allocated
CTG/HRSG burning syngas/PSA off-gas	256,900	P	100.0%	256,900
CTG/HRSG burning natural gas	44,729	P	100.0%	44,729
CO_2 Vent	175,493	A	64.9%	113,895
Flares pilot	510	A	64.9%	331
Flares SU/SD	7,742	A	64.9%	5,025
Thermal Oxidizer standby	5,736	A	64.9%	3,723
Thermal Oxidizer SU/SD, maintenance	306	A	64.9%	199
Emergency Engines	105	exempt	0.0%	0
Auxiliary Boiler	24,758	A	64.9%	16,068
Ammonia Start-Up Heater	416	F	0.0%	0
Urea Absorber Vents	116	F	0.0%	0
Fugitives	36	A	64.9%	23
Total Early Operations	516,847			440,892
Total Mature Operations	383,138			354,115
Total Steady State Operations	263,403			260,977
OEHI CO_2 EOR Emission Sources	**Annual CO2 (MT)**	**Allocation**	**Percent**	**Allocated**
CO_2 Injection Heaters	34,483	EOR	0.0%	0
Regeneration Gas Heater	5,747	EOR	0.0%	0
TEG Reboiler	2,874	EOR	0.0%	0
Amine Unit	575	EOR	0.0%	0
Fire Pump Engines	3	EOR	0.0%	0
CTB – Flare	6,921	EOR	0.0%	0
RCF – Flare	6,533	EOR	0.0%	0
Fugitive GHG Emissions	43	A	64.9%	28
Maintenance GHG	50	EOR	0.0%	0
Pressure Relief GHG	1	EOR	0.0%	0
Miscellaneous Small Tanks	2	EOR	0.0%	0
EOR Component Power Consumption	281,049	EOR	0.0%	0
Workers Commuting	205	EOR	0.0%	0
Well Maintenance Activities	215	EOR	0.0%	0
Total EOR CO2 Emissions	**338,700**			**28**

Allocation for Apportioned Power: 64.9%

note that not all of the fugitives at OEHI would be attributible to CCS activities, most would be attributed to EOR

Sources: HECA emissions data from HECA 2013 TN 201026. Allocation to power value from HECA 2013 TN 200144; OEHI emissions information from AFC Appendix A, Oxy 2013 TN 69314, and Oxy 2013 TN 69487

Average Daily Basis	Early Ops	Mature Ops	Steady State
Total Emissions	440,920	354,143	261,005
Total Generation	1,946,761	1,946,761	1,845,961
Emissions Performance MT CO2/MWh	0.226	0.182	0.141

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Maximum Power Allocation

Max Power Allocation when Firing Syngas

Power Balance	Units	Allocation	Maximum Power Production On-Peak	Percent	Allocated to Power	
Ambient Temperature	*Fahrenheit		65			
Gross Power Generation (CT/ST)	MW		416.0			
Power Generation Fertilizer Contribution	MW		3.5			
Power Generation Less Fertilizer Contribution	MW	P	412.5	100.0%	412.5	Common Apportionment: Max Power
Total Auxiliary Load	MW		150.5			Syngas Power: 71.3%
Gasification	MW	A	12.1	71.3%	8.6	
Shift and LTGC	MW	A	0.9	71.3%	0.6	
AGR	MW	A	19.3	71.3%	13.8	ASU Power: 75.7%
SRU	MW	A	2.0	71.3%	1.4	
EOR CO_2 Compression	MW	A	36.1	71.3%	25.7	
PSA and Ammonia Units	MW	A	33.3	2.9%	1.0	Power value from the PSA unit is 2.8% = 1183 lb/hr of H2 from PSA to CTG/HRSG for power production (stream 15) /41440 lb/hr total H2 for power production (stream 20)
CO_2 Purification	MW	F	6.1	0.0%	0.0	
Urea/UAN	MW	F	6.0	0.0%	0.0	
Power Block	MW	P	5.7	100.0%	5.7	
Water Treatment	MW	A	6.4	69.2%	4.4	Note allocation is mixed (common 2.0 MW * 71.3% (syngas power allocation) + 3.0 MW * 100% all power allocation + 1.4 MW * 0% fertilizer no power allocation)/total water treatment load 6.4 MW = 69.2% overall power allocation (directly from applicant source data)
Power Cooling Tower	MW	P	4.0	100.0%	4.0	
Process Cooling Tower	MW	A	9.7	36.8%	3.6	Note allocation is mixed (common 5.0 MW * 71.3% (syngas power allocation) + 4.6 MW * 0% fertilizer no power allocation)/total process cooling tower load 9.7 MW = 30.9% overall power allocation (directly from applicant source data)
Fertilizer Storage/Handling	MW	F	0.6	0.0%	0.0	
Other Supporting Systems	MW	A	8.3	71.3%	5.9	
ASU	MW	A	109.0	75.7%	82.5	Note allocation is based on max power common 77 MW*71.3% (syngas power allocation) + 27.6 MW *100% nitrogen for power allocation divided by total ASU consumption of 109.0 MW = 75.7%
Net Power Export (not incl. OEHI)	MW		157		98.7	Fertilizer power consumption (MW) included in Net Power
Possible additional compression for CCS at OEHI	MW	A	2.0	71.3%	1.4	
SB 1368 Net Power	MW				253.8	

Source: Power Generation and Consumption data from HECA 2013 TN200144 Figure CS-7-3; allocation to power percentage data from same source Attachment CS-7-1 for syngas allocation and same source derived from Table CS-7-4, Attachment CS-7-1, and Table CS-7-2 for ASU daily average MW consumption and allocation to power.

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Notes:
AGR = acid gas removal
CO_2 = carbon dioxide
CT = combustion turbine
EOR = enhanced oil recovery
LTGC = low-temperature gas cooling
PSA = Pressure Swing Adsorption
SRU = sulfur recovery unit
ST = steam turbine
UAN = urea ammonium nitrate

	MW/hr	Hrs/Year	Total
Net Generation Totals for Syngas	253.8	8000	2030546.2
Net Generation for Natural Gas	300	336	100800
		Total	2131346.2
		Total Steady State	2030546.2

Sources for Hrs/Year and MW/hr for natural gas are HECA 2013 TN201026 Table 3.

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Maximum Power Emisions and Emission Performance

HECA Annual CO2 Emissions for SB 1368 Emission Performance Standard (max power case)

Sources of CO_2	Annual CO2 (MT)	Allocation	Percent	Allocated
CTG/HRSG burning syngas/PSA off-gas	256,900	P	100.0%	256,900
CTG/HRSG burning natural gas	44,729	P	100.0%	44,729
CO_2 Vent	175,493	A	71.3%	125,127
Flares pilot	510	A	71.3%	364
Flares SU/SD	7,742	A	71.3%	5,520
Thermal Oxidizer standby	5,736	A	71.3%	4,090
Thermal Oxidizer SU/SD, maintenance	306	A	71.3%	218
Emergency Engines	105	exempt	0.0%	0
Auxiliary Boiler	24,758	A	71.3%	17,652
Ammonia Start-Up Heater	416	F	0.0%	0
Urea Absorber Vents	116	F	0.0%	0
Fugitives	36	A	71.3%	26
Total Early Operations	516,847			454,625
Total Mature Operations	383,138			359,291
Total Steady State Operations	263,403			261,379
OEHI CO_2 EOR Emission Sources	**Annual CO2 (MT)**	**Allocation**	**Percent**	**Allocated**
CO_2 Injection Heaters	34,483	EOR	0.0%	0
Regeneration Gas Heater	5,747	EOR	0.0%	0
TEG Reboiler	2,874	EOR	0.0%	0
Amine Unit	575	EOR	0.0%	0
Fire Pump Engines	3	EOR	0.0%	0
CTB – Flare	6,921	EOR	0.0%	0
RCF – Flare	6,533	EOR	0.0%	0
Fugitive GHG Emissions	43	A	71.3%	31
Maintenance GHG	50	EOR	0.0%	0
Pressure Relief GHG	1	EOR	0.0%	0
Miscellaneous Small Tanks	2	EOR	0.0%	0
EOR Component Power Consumption	281,049	EOR	0.0%	0
Workers Commuting	205	EOR	0.0%	0
Well Maintenance Activities	215	EOR	0.0%	0
Total EOR CO2 Emissions	**338,700**			**31**

Allocation for Apportioned

Power	71.3%

note that not all of the fugitives at OEHI would be attributible to CCS activities, most would be attributed to EOR

Sources: HECA emissions data from HECA 2013 TN 201026. Allocation to power value from HECA 2013 TN 200144; OEHI emissions information from AFC Appendix A, Oxy 2013 TN 69314, and Oxy 2013 TN 69487

Max Power Basis	Early Ops	Mature Ops	Steady State
Total Emissions	454,656	359,322	261,410
Total Generation	2,131,346	2,131,346	2,030,546
Emissions Performance MT CO2/MWh	0.213	0.169	0.129

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