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Table A-1
Plantwide GHG Emission Summary
Formosa Plastic Corporation, Texas
Olefins Expansion
March 2014

Name	EPN(s)	GHG Mass Emissions [1] ton/yr	CO_2e [1] ton/yr
Cracking Furnace Nos. 1 through 14	OL3-FUR1 through OL3-FUR14	1,543,060	1,544,785
Steam Boiler Nos. 1 through 4	OL3-BOIL1 through OL3-BOIL4	834,087	835,023
PDH Reactor Nos. 1 through 4	PDH-REAC1 through PDH-REAC4	236,503	236,943
Olefins 3 Fugitives [4]	OL3-FUG	4.83	114.8
PDH Fugitives [4]	PDH-FUG	1.17	23.17
Elevated Flare [2]	OL3-FLRA, OL3-FLRB	76,305	84,196
Low Pressure Flare 1 [2]	OL3-LPFLR1	9,184	9,857
Low Pressure Flare 2 [2]	OL3-LPFLR2	9,184	9,857
Decoking Drum 1 [3]	OL3-DK1	329	329
Decoking Drum 2 [3]	OL3-DK2		
MAPD Regenerator Vent [4]	OL3-MAPD	32.8	32.8
PDH Unit MSS Vessel Opening [4]	PDH-MSSVO	3.12	8.20
Olefins 3 Plant MSS Vessel Opening [4]	OL3-MSSVO	2.22	46.0
Olefins 3 Emergency Engine	OL3-GEN	447	449
PDH Emergency Engine	PDH-GEN	447	449
	total =	***2,709,591***	***2,722,113***

Note:
[1] Combustion unit emissions (furnace, boiler, reactors) include emissions from both fuel gas and natural gas combustion. CO2e emissions in units of short (English) tons per year.
[2] Flare emissions include emissions from flare pilot and waste gas combustion.
MSS emissions associated with flares streams are also included in the elevated flare value.
[3] Emissions from furnace decoking may occur from either decoking drum 1 or 2.
[4] FPC TX Requests that No Emission Limit be established for this source.
Compliance will be assured with the design/work practice standard as specified in the permit.

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Table A-2
GHG Emission Calculations - Natural Gas Combustion
Formosa Plastic Corporation, Texas
Olefins Expansion
March 2014

GHG Emissions Contribution From Natural Gas Fired Combustion:

Source Type	Average Heat Input/Unit (MMBtu/hr)	Annual Operation per Unit (hrs/yr)	Annual Avg Heat Input, Each Unit (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[1]	Emissions per Unit: GHG Mass Emissions[2] (metric ton/yr)	Emissions per Unit: Global Warming Potential[3]	Emissions per Unit: CO_2e (metric ton/yr)	Emissions per Unit: CO_2e (tpy)
Pyrolysis Furnaces	220	700	154,000	CO_2	53.02	8,165	1	8,165	9,002
				CH_4	1.0E-03	0.15	25	3.85	4.24
				N_2O	1.0E-04	0.02	298	4.59	5.06
					Totals	**8,165**		**8,174**	**9,011**
PDH Unit Reactors	191	970	185,000	CO_2	53.02	9,809	1	9,809	10,814
				CH_4	1.0E-03	0.19	25	4.63	5.10
				N_2O	1.0E-04	0.02	298	5.51	6.08
					Totals	**9,809**		**9,819**	**10,825**
Steam Boilers	431	405	175,000	CO_2	53.02	9,279	1	9,279	10,230
				CH_4	1.0E-03	0.18	25	4.38	4.82
				N_2O	1.0E-04	0.02	298	5.22	5.75
					Totals	**9,279**		**9,288**	**10,240**
Elevated Flare Pilots	0.50	8,760	4,000	CO_2	53.02	212	1	212	234
				CH_4	1.0E-03	4.00E-03	25	0.10	0.11
				N_2O	1.0E-04	4.00E-04	298	0.12	0.13
					Totals	**212.1**		**212**	**234**
Low Pressure Flare Pilots (each)	0.40	8,760	4,000	CO_2	53.02	212	1	212	234
				CH_4	1.0E-03	4.00E-03	25	0.10	0.11
				N_2O	1.0E-04	4.00E-04	298	0.12	0.13
					Totals	**212.1**		**212**	**234**
Total, All Natural Gas Combustion						***27,677***		***27,705***	***30,545***

Notes:

1. CO2 GHG factor from Table C-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting (GHG MRR).
CH4 and N2O GHG factors based on Table C-2 of GHG MRR.
2. CO_2 emissions based on 40 CFR Part 98, Subpart C, Equation C-1.
CH_4 and N_2O emissions based on 40 CFR Part 98, Subpart C, Equation C-8.
3. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Sample Calculation: Pyrolysis Furnaces - CO_2:

GHG Mass Emissions (metric ton/yr) = 0.001 x 154000 (MMBtu/yr) x 53.02 kg/MMBtu = 8165
CO2e (metric ton/yr) = 8165 (metric ton/yr) x 1 = 8165.1

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Table A-3
GHG Emission Calculations - Fuel Gas Combustion
Formosa Plastic Corporation, Texas
Olefins Expansion
March 2014

Fuel Gas Data:

Variable	Value		Units	Reference
	Olefins 3 Fuel Gas	PDH Unit Fuel Gas		
HHV	522	391	Btu/scf	design specification
Carbon Content (Annual Avg)	0.70	0.363	kg C/kg	design specification
Molecular Weight (Annual Avg)	8.23	6.49	kg/kg-mol	design specification

GHG Emissions Contribution From Fuel Gas Fired Combustion:

Source Type	Fuel Gas Type	Average Heat Input/Unit (MMBtu/hr)	Annual Average Fuel Gas Usage/Unit[1] (MMscf/hr)	Number of Units	Annual Operation (hrs/yr)	Annual Average Fuel Use, Each Unit (scf/yr)	Annual Average Heat Input, Each Unit (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[2]	Emissions per Unit: GHG Mass Emissions[3] (metric ton/yr)	Emissions per Unit: Global Warming Potential[4]	Emissions per Unit: CO_2e (metric ton/yr)	Emissions per Unit: CO_2e (tpy)
Pyrolysis Furnace	Olefins 3	220	0.421	14	8,760	3.69E+09	1.93E+06	CO_2		91,804	1	91,804	101,214
								CH_4	1.0E-03	1.93	25	48.18	53.12
								N_2O	1.0E-04	0.19	298	57.43	63.32
									Totals	**91,806**		**91,910**	**101,330**
Steam Boilers	Olefins 3	431	0.826	4	8,760	7.23E+09	3.78E+06	CO_2		179,853	1	179,853	198,288
								CH_4	1.0E-03	3.78	25	94.39	104.06
								N_2O	1.0E-04	0.38	298	112.51	124.04
									Totals	**179,857**		**180,060**	**198,516**
PDH Unit reactors	PDH	191	0.488	4	8,760	4.28E+09	1.67E+06	CO_2		43,513	1	43,513	47,973
								CH_4	1.0E-03	1.67	25	42	46
								N_2O	1.0E-04	0.17	298	50	55
									Totals	**43,515**		**43,605**	**48,074**
Total, All Fuel Gas Combustion										***315,178***		***315,574***	***347,920***

Notes:

1. Fuel use calculated as: MMscf/hr = Firing rate (MMBtu/hr) / HHV (Btu/scf)
2. CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.
CH_4 and N_2O emissions based on 40 CFR Part 98, Subpart C, Equation C-8.
3. CO_2 emissions based on 40 CFR Part 98, Subpart C, Equation C-5.
4. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Sample Calculation: Pyrolysis Furnaces - CO_2:

GHG Mass Emissions (metric ton/yr) = (44/12) x 3.69E+09 (scf/yr) x 0.7 kg C/kg x 8.23 kg/kg-mol / 849.5 scf/kg-mole @ std cond. x 0.001 = 9.18E+04
CO2e (metric ton/yr) = 9.18E+04 (metric ton/yr) x 1 = 9.18E+04

Table A-3A
GHG Emission Calculations - Fuel Gas Combustion
Formosa Plastic Corporation, Texas
Olefins Expansion
March 2014

Olefins 3 Plant Fuel Gas Properties

Worst-case composition for molecular weight and carbon fraction

Olefins 3 Blended Fuel Gas (FG) Compositions:

Component	Molecular Weight (lb/lbmol)	Molar Composition (mol %) [1]	Component Mass per Lbmol Fuel Gas (lb)	Number of carbons in component	Component Carbon Mass (lbC/lbmol)	Fuel Carbon Mass (lbC/lbmol)	Carbon Content (lbC/lb)
Hydrogen	2.016	57.50%	1.16	0	0	0.000	**0.70**
Nitrogen	28.013	0.10%	0.03	0	0	0.000	
Carbon Monoxide	28.01	0.19%	0.05	1	12	0.023	
Carbon Dioxide	44.009	0.35%	0.15	1	12	0.042	
Hydrogen Sulfide	34.08	0.00%	0.00	0	0	0.000	
Methane	16.04	41.14%	6.60	1	12	4.937	
Acetylene	26.038	0.00%	0.00	2	24	0.000	
Ethylene	28.05	0.14%	0.04	2	24	0.034	
Ethane	30.07	0.49%	0.15	2	24	0.118	
Propane	44.09	0.06%	0.03	3	36	0.021	
Propylene	42.08	0.00%	0.00	3	36	0.000	
Butanes	58.12	0.02%	0.01	4	48	0.010	
Pentanes	70.151	0.01%	0.01	5	60	0.005	
Hexanes	84.161	0.00%	0.00	6	72	0.003	

MW = 8.23 lb/lbmol

Worst case composition for Higher Heating Value

Olefins 3 Blended Fuel Gas (FG) Compositions:

Component	Molecular Weight (lb/lbmol)	Component Higher Heating Value, HHV (Btu/scf)	Molar Composition (mol %) [1]	Fuel Gas Higher Heating Value, HHV (Btu/scf)
Hydrogen	2.016	324.2	70.60%	229
Nitrogen	28.013	0.0	0.05%	0.00
Carbon Monoxide	28.01	321	0.18%	0.58
Carbon Dioxide	44.009	0	0.88%	0.00
Hydrogen Sulfide	34.08	625	0.00%	0.00
Methane	16.04	1,012	27.33%	277
Acetylene	26.038	1,447	0.00%	0.00
Ethylene	28.05	1,600	0.55%	8.79
Ethane	30.07	1,783	0.27%	4.83
Propane	44.09	2,557	0.00%	0.00
Propylene	42.08	2,185	0.06%	1.39
Butanes	58.12	3,369	0.01%	0.46
Pentanes	70.151	3,679	0.00%	0.17
Hexanes	84.161	4,315	0.00%	0.11

Gross heating value = 522 Btu/scf

Note: [1] Compositions are representative and may vary. Estimated compositions are used for emission calculation purposes only.

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Table A-3B
GHG Emission Calculations - Fuel Gas Combustion
Formosa Plastic Corporation, Texas
Olefins Expansion
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PDH Fuel Gas Properties

Worst case composition for molecular weight and carbon fraction

PDH Blended Fuel Gas Compositions:

Component	Molecular Weight (lb/lbmol)	Molar Composition (mol %) [1]	Component Mass per Lbmol Fuel Gas (lb)	Number of carbons	Component Carbon Mass (lbC/lbmol)	Fuel Carbon Mass (lbC/lbmol)	Carbon Content (lbC/lb)
Hydrogen	2.016	85.04%	1.71	0	0	0.000	**0.363**
Nitrogen	28.01	0.00%	0.0000	0	0	0.000	
Carbon Monoxide	28.01	0.00%	0.00	1	12	0.000	
Carbon Dioxide	44.009	6.41%	2.82	1	12	0.769	
Methane	16.04	4.50%	0.72	1	12	0.540	
Ethylene	28.05	3.39%	0.95	2	24	0.814	
Ethane	30.07	0.00%	0.00	2	24	0.000	
Propylene	42.08	0.342%	0.14	3	36	0.123	
Propane	44.09	0.286%	0.13	3	36	0.103	
Butanes	58.12	0.01600%	0.00930	4	48	0.008	
			MW = 6.49 lb/lbmol				

Worst case composition for Higher Heating Value

PDH Blended Fuel Gas Compositions:

Component	Molecular Weight (lb/lbmol)	Component Higher Heating Value, HHV (Btu/scf)	Molar Composition (mol %) [1]	Fuel Gas Higher Heating Value, HHV (Btu/scf)
Hydrogen	2.016	324.2	85.04%	276
Nitrogen	28.01	0.0	0.00%	0.00
Carbon Monoxide	28.01	321	0.00%	0.00
Carbon Dioxide	44.009	0	6.41%	0.00
Methane	16.04	1,012	4.50%	46
Ethylene	28.05	1,600	3.39%	54.23
Ethane	30.07	1,783	0.00%	0.00
Propylene	42.08	2,185	0.342%	7.47
Propane	44.09	2,557	0.286%	7.31
Butanes	58.12	3,369	0.01600%	0.539
				Gross heating value = 391 Btu/scf

Note: [1] Compositions are representative and may vary. Estimated compositions are used for emission calculation purposes only.

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Table A-4

GHG Emission Calculations - PDH Regeneration Gas Combustion

Formosa Plastic Corporation, Texas

Olefins Expansion

March 2014

PDH Regeneration Gas Data:

Variable	Value	Units	Reference
Carbon Content (Annual Avg)	0.0044	kg C/kg	design specification
Heating Value	0.2005	Btu/scf	design specification
Molecular Weight (Annual Avg)	28.21	kg/kg-mol	design specification

GHG Emissions Contribution From Regeneration Gas Combustion in PDH Reactors:

Source Type	Annual Average Fuel Gas Usage/Unit (scf/hr)	Number of Units	Annual Operation (hrs/yr)	Annual Average Fuel Use, Each Unit (scf/yr)	Pollutant	Emission Factor (kg/MMBtu)[1]	Emissions per Unit: GHG Mass Emissions[2] (metric ton/yr)	Emissions per Unit: Global Warming Potential[3]	Emissions per Unit: CO_2e (metric ton/yr)	Emissions per Unit: CO_2e (tpy)
PDH Unit reactors	64,983	4	8,760	5.69E+08	CO_2		305	1	305	336
					CH_4	1.0E-03	1.14E-04	25	0	3.15E-03
					N_2O	1.0E-04	1.14E-05	298	0	3.75E-03
						TOTAL =	***305***		***305***	***336***

Notes:

1. CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.
CH_4 and N_2O emissions based on 40 CFR Part 98, Subpart C, Equation C-8.
*CH_4 / N_2O = 1E-03 * Fuel * HHV * EF*

2. CO_2 emissions based on 40 CFR Part 98, Subpart C, Equation C-5.
*CO_2 = 44/12 * Fuel * CC* MW / MVC *0.001*

3. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Sample Calculation, CO_2:

GHG Mass Emissions (metric ton/yr) = (44/12) x 5.69E+08 (scf/yr) x 0.0044 kg C/kg x 28.21 kg/kg-mol / 849.5 scf/kg-mole @ std cond. x 0.001 = 3.05E+02
CO2e (metric ton/yr) = 3.05E+02 (metric ton/yr) x 1 = 3.05E+02

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Table A-4A
GHG Emission Calculations - PDH Regeneration Gas Combustion
Formosa Plastic Corporation, Texas
Olefins Expansion
March 2014

PDH Unit Regeneration Gas Properties

PDH Regeneration Gas Stream Compositions and Emission Calculations (via each PDH reactor):

Component	Molecular Weight (lb/lbmol)	Lower Heating Value, LHV (Btu/lb)	Lower Heating Value, LHV (Btu/scf)	Molar Composition (mol %) [1]	Component Mass per Lbmol Fuel Gas (lb)	Fuel Gas Lower Heating Value, LHV (Btu/scf)	Number of carbons	Component Carbon Mass (lbC/lbmol)	Fuel Carbon Mass (lbC/lbmol)	Carbon Content (lbC/lb)
CO	28.01	4,375	323	0.0010%	0.00	0.0032	1	12	0.000	**0.0044**
H_2O	18.015	0	0	7.00%	1.26	0.0000	0	0	0.000	
CO_2	44.009	0	0	1.00%	0.44	0.0000	1	12	0.120	
O_2	31.998	0	0	18.50%	5.92	0.0000	0	0	0.000	
Nitrogen	28.0134	0	0	73.5%	20.59	0.0000	0	0	0.000	
Hydrogen	2.016	51,571	274	0.0046%	0.00	0.0126	0	0	0.000	
Methane	16.04	21,504	909	0.0017%	0.00	0.0155	1	12	0.000	
Ethane	30.07	20,429	1,619	0.00010%	0.00	0.0016	2	24	0.000	
Ethylene	28.05	20,272	1,499	0.0006%	0.00	0.0090	2	24	0.000	
Propane	44.097	19,923	2,316	0.0044%	0.00	0.1019	3	36	0.002	
Propylene	42.08	19,678	2,182	0.0026%	0.00	0.0567	3	36	0.001	
					MW = 28.21 lb/lbmol	**Net heating value = 0.2005 Btu/scf**				

Note: [1] Compositions are representative and may vary. Estimated compositions are used for emission calculation purposes only.

Table A-5
GHG Emission Calculations - Flares
Formosa Plastic Corporation, Texas
Olefins Expansion
March 2014

Flare Gas Data:

Variable	Values			Units	Reference
	Elevated Flare 1st Stage	Elevated Flare 2nd Stage	Low Pressure Flares		
Carbon Content (Annual Avg)	0.81	0.73	0.34	kg C/kg	design specification
Molecular Weight (Annual Avg)	26.2	16.7	15.0	kg/kgmol	design specification

GHG Emissions from Flares:

Source Type	Annual Avg Flare Gas Flow Rate (scf/yr)	Pollutant	GHG Mass Emissions[2] (metric ton/yr)	Global Warming Potential[3]	CO_2e (metric ton/yr)	CO_2e (tpy)
Elevated Flare 1st Stage	1.84E+08	CO_2	16,581	1	16,581	18,281
		CH_4	50.05	25	1,251	1,379
		N_2O	0.17	298	49.41	54.48
			16,631		**17,882**	**19,715**
Elevated Flare 2ndStage	1.05E+07	CO_2	545	1	545	601
		CH_4	1.64	25	41.1	45.3
		N_2O	0.01	298	1.62	1.79
			547		**588**	**648**
Low Pressure Flare 1	3.68E+08	CO_2	8094	1	8094	8923
		CH_4	24.43	25	611	673
		N_2O	8.09E-02	298	24.12	26.59
			8118		**8728**	**9623**
Low Pressure Flare 2	3.68E+08	CO_2	8094	1	8094	8923
		CH_4	24.43	25	611	673
		N_2O	8.09E-02	298	24.12	26.59
			8118		**8728**	**9623**
Total, All Flare Gas Combustion		**Totals**	***33,414***		***35,926***	***39,609***

Notes:

1. *CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*
2. *CO_2 emissions based on 40 CFR Part 98, Subpart Y, Equation Y-1a.*
3. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

Sample Calculation: Elevated Flare - CO_2:

GHG Mass Emissions (metric ton/yr) = (44/12) x 1.84E+08 (scf/yr) x 0.813 kg C/kg x 26.21 kg/kgmol / 849.5 scf/kg-mole @ std cond. x 0.001 x 0.98 = 1.66
CO2e (metric ton/yr) = 1.66E+04 (metric ton/yr) x 1 = 1.66E+04

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Table A-5A
GHG Emission Calculations - Flares
Formosa Plastic Corporation, Texas
Olefins Expansion
March 2014

Elevated Flare 1st Stage Gas Properties

Waste Gas Composition	Molecular Weight (lb/lbmol)	Lower Heating Value, LHV (Btu/lb)	Lower Heating Value, LHV (Btu/scf)	Molar Composition (mol %) [1]	Component Mass per Lbmol Fuel Gas (lb)	Number of carbons	Component Carbon Mass (lbC/lbmol)	Fuel Carbon Mass (lbC/lbmol)	Carbon Content (lbC/lb)
Hydrogen	2.0158	51,571	274	0.45%	0.01	0	0	0.000	**0.81**
Nitrogen	28.00	0	0	0.15%	0.04	0	0	0.000	
Carbon Dioxide	44.01	0	0	0.54%	0.24	1	12	0.065	
Methane	16.0426	21,504	910	52.39%	8.40	1	12	6.287	
Ethylene	28.0536	20,272	1,501	14.00%	3.93	2	24	3.360	
Ethane	30.0694	20,429	1,621	0.75%	0.23	2	24	0.180	
Propylene	42.0804	19,678	2,185	31.53%	13.27	3	36	11.352	
Propane	44.0962	19,923	2,318	0.13%	0.06	3	36	0.048	
Butanes	58.123	19,680	3,018	0.032%	0.02	4	48	0.016	
Pentanes	70.134	19,340	3,579	0.01%	0.01	5	60	0.008	
Hexanes	84.1608	19,236	4,272	0.01%	0.01	6	72	0.007	
					MW = 26.2 lb/lbmol				

Note: [1] Compositions are representative and may vary. Estimated compositions are used for emission calculation purposes only.

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Table A-5B
GHG Emission Calculations - Flares
Formosa Plastic Corporation, Texas
Olefins Expansion
March 2014

Elevated Flare 2nd Stage Gas Properties

Waste Gas Composition	Molecular Weight (lb/lbmol)	Lower Heating Value, LHV (Btu/lb)	Lower Heating Value, LHV (Btu/scf)	Molar Composition (mol %) [1]	Component Mass per Lbmol Fuel Gas (lb)	Number of carbons	Component Carbon Mass (lbC/lbmol)	Fuel Carbon Mass (lbC/lbmol)	Carbon Content (lbC/lb)
Hydrogen	2.0158	51,571	274	0.04%	0.00	0	0	0.000	**0.73**
Nitrogen	28.00	0	0	0.33%	0.09	0	0	0.000	
Carbon Dioxide	44.01	0	0	1.16%	0.51	1	12	0.139	
Methane	16.0426	21,504	910	96.53%	15.49	1	12	11.584	
Ethylene	28.0536	20,272	1,501	0.00%	0.00	2	24	0.000	
Ethane	30.0694	20,429	1,621	1.62%	0.49	2	24	0.389	
Propylene	42.0804	19,678	2,185	0.00%	0.00	3	36	0.000	
Propane	44.0962	19,923	2,318	0.20%	0.09	3	36	0.072	
Butanes	58.123	19,680	3,018	0.070%	0.04	4	48	0.034	
Pentanes	70.134	19,340	3,579	0.03%	0.02	5	60	0.018	
Hexanes	84.1608	19,236	4,272	0.02%	0.02	6	72	0.014	
					MW = 16.7 lb/lbmol				

Note: [1] Compositions are representative and may vary. Estimated compositions are used for emission calculation purposes only.

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Table A-5C
GHG Emission Calculations - Flares
Formosa Plastic Corporation, Texas
Olefins Expansion
March 2014

Low Pressure Flares Gas Properties

Waste Gas Composition	Molecular Weight (lb/lbmol)	Lower Heating Value, LHV (Btu/lb)	Lower Heating Value, LHV (Btu/scf)	Molar Composition (mol %) [1]	Component Mass per Lbmol Fuel Gas (lb)	Number of carbons	Component Carbon Mass (lbC/lbmol)	Fuel Carbon Mass (lbC/lbmol)	Carbon Content (lbC/lb)
Nitrogen	14.01	0	0	57.60%	8.07	0	0	0.000	**0.34**
Methane	16.04	21,520	911	40.00%	6.42	1	12	4.800	
isopentane	72.15	19,312	3,676	0.24%	0.17	5	60	0.143	
Butane	58.12	19,661	3,015	0.02%	0.01	4	48	0.007	
Hydrogen	2.016	51,571	274	1.00%	0.02	0	0	0.000	
Oxygen	16.00	0	0	0.69%	0.11	0	0	0.000	
Methyl Acetylene	40.06	19,851	2,098	0.42%	0.17	3	36	0.150	
Butadiene	53.09	19,156	2,683	0.02%	0.01	4	48	0.008	
Benzene	78.11	17,480	3,603	0.02%	0.02	6	72	0.017	
					MW = 15 lb/lbmol				

Note: [1] Compositions are representative and may vary. Estimated compositions are used for emission calculation purposes only.

Table A-6
GHG Emission Calculations - Decoking
Formosa Plastic Corporation, Texas
Olefins Expansion
March 2014

Decoking Information:

Variable	Value	Units	Reference
Volumetric Flow Rate During Decoking	714,636	scf/hr	design specification
CO_2 Concentration	0.10	mol %	design specification
CH_4 Concentration	0	mol %	design specification
Decoking Duration (Per Event)	48	hours	design specification
Number of Furnaces	14	qty	Formosa design data
Decoking Frequency (Per Furnace)	12	events/yr/ furnace	design specification

Constants:

Field	Value	Units
CO_2 Molecular Weight	44	kg/kgmol
CH_4 Molecular Weight	16	kg/kg-mol
Molar Volume Conversion	849.50	scf/kg-mol
Conversion Factor	0.001	metric ton/kg

CO_2 Emissions from Furnace Decoking:

Source Type	Pollutant	GHG Mass Emissions[1] (metric ton/yr)	Global Warming Potential[2]	CO_2e (metric ton/yr)	CO_2e (tpy)
Furnace Decoke [3]	CO_2	298	1	**298**	**329**
	CH_4	0.00	25	**0.00**	**0.00**
Total, Decoking		***298***		***298***	***329***

Notes:

1. *CO_2 and CH_4 emissions based on 40 CFR Part 98, Subpart Y, Equation Y-19.*
2. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*
3. *Emissions from decoking may occur from either decoking drum 1 or 2.*

Sample Calculation: Furnace Decoking - CO_2:

GHG Mass Emissions (metric ton/yr) = 714636 scf/hr x 12 events/yr/ furnace x 14 qty x 48 hours x (0.1/100) x 44 kg/kgmol/ 849.5 scf/kg-mol x 0.001 metric ton/kg = 298.5

CO2e (metric ton/yr) = 298 (metric ton/yr) x 1 = 298

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Table A-7

GHG Emission Calculations - MAPD Regen Vent

Formosa Plastic Corporation, Texas

Olefins Expansion

March 2014

MAPD Regen Vent Data:

Variable	Value	Units	Reference
Volumetric Flow Rate (Annual Avg)	191,559	scf/hr	design specification
CO_2 Concentration	3.0	mol %	design specification
CH_4 Concentration	0	mol %	design specification
Maximum Vent Operating Schedule	100	hours/yr	design specification

Constants:

Field	Value	Units
CO_2 Molecular Weight	44	kg/kgmol
CH_4 Molecular Weight	16	kg/kg-mol
Molar Volume Conversion	849.50	scf/kg-mol
Conversion Factor	0.001	metric ton/kg

CO_2 Emissions from MAPD Regen Vent:

Source Type	Pollutant	GHG Mass Emissions[1] (metric ton/yr)	Global Warming Potential[2]	CO_2e (metric ton/yr)	CO_2e (tpy)
MAPD Regen Vent	CO_2	29.8	1	29.8	32.8
	CH_4	0.00	25	0.00	0.00
Total, Regen Vent		***29.8***		***29.8***	***32.8***

Notes:

1. CO_2 and CH_4 emissions based on 40 CFR Part 98, Subpart Y, Equation Y-19.

2. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Sample Calculation: MAPD Regen Vent - CO_2:

GHG Mass Emissions (metric tpy) = 191559 scf/hr x (3/100) x 100 hours/yr x

44 kg/kgmol / 849.5 scf/kg-mol x 0.001 metric ton/kg = 29.8

CO2e (metric ton/yr) = 30 (metric ton/yr) x 1 = 30

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Table A-8

GHG Emission Calculations - Emergency Engines

Formosa Plastic Corporation, Texas

Olefins Expansion

March 2014

Diesel Emergency Engine Specifications:

Variable	Value	Units	Reference
Annual Operating Schedule	100	hours/year	RICE MACT limitation
Power Rating	676	hp	design specification
Brake Specific Fuel Consumption	8,110	Btu/hp-hr	design specification

GHG Emissions Contribution From Diesel Combustion:

Source	Heat Input (MMBtu/hr)	Pollutant	Emission Factor (kg/MMBtu)[1]	GHG Mass Emissions (metric ton/yr)	Global Warming Potential[2]	CO_2e (metric ton/yr)	CO_2e (tpy)
Olefins 3 Emergency Engine	54.8	CO_2	73.96	405	1	405	447
		CH_4	3.0E-03	1.64E-02	25	0.41	0.45
		N_2O	6.0E-04	3.29E-03	298	0.98	1.08
PDH Emergency Engine	54.8	CO_2	73.96	405	1	405	447
		CH_4	3.0E-03	0.02	25	0.41	0.45
		N_2O	6.0E-04	0.00	298	0.98	1.08
Total, Emergency Engines			**Totals**	***811***		***814***	***897***

Notes:

1. GHG factors based on Tables C-1 and C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

2. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

3. Annual Emission Rate = Heat Input x Emission Factor x 0.001 metric ton/kg x hours/year x Global Warming Potential

Sample Calculation: Diesel Combustion - CO_2:

GHG Mass Emissions (metric ton/yr) = 54.8 (MMBtu/hr) x 73.96 kg/MMBtu x 2.2 x 100 hours/year / 2000 = 405
CO2e (metric ton/yr) = 405 (metric ton/yr) x 1 = 405

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Table A-9

GHG Emission Calculations - Piping Fugitives

Formosa Plastic Corporation, Texas

Olefins Expansion

March 2014

Olefins 3 Unit Fuel Gas and N.G. Piping Components:

EPN	Source Type	Fluid State	Count	Emission Factor[1] scf/hr/comp	CO_2 Content (vol %)	CH_4 Content (vol %)	CO_2 (tpy)	CH_4 (tpy)	Total (tpy)
OL3-FUG	Valves	Gas/Vapor	308	0.121	1.00%	50.0%	1.86E-01	3.396	
	Flanges	Gas/Vapor	765	0.017			6.50E-02	1.185	
	Compressors	Gas/Vapor	3	0.007			1.05E-04	1.91E-03	
GHG Mass-Based Emissions							0.25	4.58	***4.83***
Global Warming Potential[3]							1	25	
CO_2e Emissions							0.25	114.57	***114.82***

PDH Unit Fuel Gas and N.G. Piping Components:

EPN	Source Type	Fluid State	Count	Emission Factor[1] scf/hr/comp	CO_2 Content (vol %)	CH_4 Content (vol %)	CO_2 (tpy)	CH_4 (tpy)	Total (tpy)
PDH-FUG	Valves	Gas/Vapor	308	0.121	1.00%	10.0%	1.86E-01	0.679	
	Flanges	Gas/Vapor	765	0.017			6.50E-02	0.237	
	Compressors	Gas/Vapor	3	0.007			1.05E-04	3.83E-04	
GHG Mass-Based Emissions							0.25	0.92	***1.17***
Global Warming Potential[3]							1	25	
CO_2e Emissions							0.25	22.91	***23.17***

Notes:

1. Emission factors from Table W-1A of 40 CFR 98 Mandatory Greenhouse Gas Reporting published in the May 21, 2012 Technical Corrections

2. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Sample Calculation: OL3 Valve GHG Emissions - CO_2:

308 valves	*0.121 scf gas*	*0.01 scf CO2*	*lbmol*	*44.01 lb CO_2*	*8760 hr*	*ton =*	*0.1864*	*ton/yr*
	*hr * valve*	*scf gas*	*385.5 scf*	*lbmol*	*yr*	*2000 lb*		