

TABLES

Table 3-1
Ultimate and Proximate Analysis of Feedstocks and Feedstock Usage
Project: St. Lucie Plasma Gasification

	Units	Municipal Solid Waste (Feedstock A)	Tires with Steel Belt (Feedstock B)	Metallurgical Coke (Feedstock C)	Blend of Feedstocks A, B, and C
<u>Ultimate Analysis</u>					
Carbon	%	26.7	72.2	91.0	33.1
Sulfur	%	0.1	1.1	0.8	0.2
Oxygen	%	18.8	1.9	0.0	16.7
Hydrogen	%	3.7	6.1	0.0	3.7
Nitrogen	%	1.1	0.2	0.0	1.0
Chlorine	%	0.7	0.0	0.0	0.6
Ash (from proximate analysis)	%	22.6	18.0	7.0	21.6
Moisture (from proximate analysis)	%	26.2	0.5	1.2	23.0
Total	%	100	100	100	100
<u>Proximate Analysis</u>					
Moisture	%	26.2	0.5	1.2	23.0
Volatile Matter + Fixed Carbon	%	51.2	81.4	91.8	55.4
Ash	%	22.6	18.0	7.0	21.6
Total	%	100	100	100	100
Gross (Higher) Heating Value (dry basis)	Btu/lb	7,084	14,346	12,979	7,939
Gross (Higher) Heating Value (as rc'd.)	Btu/lb	5,227	14,270	12,826	6,302
<u>Feedstocks Usage (Single Unit):</u>					
Gasifier Feed Rate	lb/hr	45,499	4,500	2,000	51,998
Gasifier Feed Rate	Tons/hr	22.7	2.2	1.0	26.0
Gasifier Feed Rate	Tons/24-hrs	546.0	54.0	24.0	624.0
Gasifier Feed Rate	Tons/yr	199,284	19,708	8,758	227,750
Gasifier Feed Rate Contribution	%	88%	9%	4%	100%
Gasifier Heat Input	MMBtu/hr	238	64	26	328
Gasifier Heat Input Contribution	%	73%	20%	8%	100%

**Table 3-2
Summary of Total Project Emissions
Project: St. Lucie Plasma Gasification**

Pollutant	Thermal Oxidizer (TPY)	Gasifier Emergency Flare (TPY)	Emergency Generator (TPY)	Fire Water Pump (TPY)	Aux. Boiler (TPY)	Material Handling Operations (TPY)	PROJECT TOTAL (TPY)	St. Lucie Landfill (TPY)	SITE TOTAL (TPY)	PSD Treshold (TPY)	PSD Review (Y/N)
SO ₂	16	8.9	0.002	0.001	0.03	NA	25	6.5	32	250	N
PM	25	24	0.06	0.03	0.18	1.5	51	1.3	52	250	N
PM ₁₀	25	24	0.06	0.03	0.18	1.1	50	1.3	52	250	N
NO _x	33	0.11	0.99	0.49	9.3	NA	44	6.8	51	250	N
CO	33	0.59	0.96	0.48	7.8	NA	43	37.2	80	250	N
VOC	33	0.30	0.12	0.06	0.5	NA	34	7.7	42	250	N
HCl	16	13	-	-	-	NA	30	NA	30	NA	N

Note: "--" = negligible.

Table 3-3
Air Pollutant Emissions From Plasma Gasification and Thermal Oxidizer
Project: St. Lucie Plasma Gasification

Parameter	Units	Thermal Oxidizer Unit
		Main Stack
<u>Performance</u>		
Net Power Output	kW	24,276
Net Heat Rate	Btu/kWhr	13,498
Heat Input (HHV)	MMBtu/hr	327.7
Capacity Factor		100%
<u>Stack Data</u>		
Height	feet	125
Diameter	feet	5
Temperature	°F	140
Velocity	ft/sec	60
<u>Emissions</u>		
SO ₂	lb/MMBtu	0.01
	lb/hr	3.74
	lb/MW-hr	0.2
	tons/year	16
Filterable PM/PM ₁₀	lb/MMBtu	0.02
	lb/hr	5.74
	lb/MW-hr	0.2
	tons/year	25
NO _x	lb/MMBtu	0.02
	lb/hr	7.60
	lb/MW-hr	0.3
	tons/year	33
CO	lb/MMBtu	0.02
	lb/hr	7.60
	lb/MW-hr	0.3
	tons/year	33
VOC	lb/MMBtu	0.02
	lb/hr	7.60
	lb/MW-hr	0.3
	tons/year	33
HCl	lb/MMBtu	0.01
	lb/hr	3.74
	lb/MW-hr	0.2
	tons/year	16

Note: Based on blend of feedstocks: municipal solid waste, tires, and coke. See Table 3-1.

Sources: Geoplasma 2009, AlterNRG 2009, Golder 2009, 40 CFR 60 Subpart Eb

Table 3-4
Air Pollutant Emissions from Gasifier Emergency Flare Stack
Project: St. Lucie Plasma Gasification

Parameter	Units	Gasifier
		Emergency Flare
<u>Performance</u>		
Hours of Operation		22
<u>Stack Data</u>		
Height	feet	TBD
Diameter	feet	TBD
Temperature	°F	140
Velocity	ft/sec	TBD
<u>Emissions</u>		
SO ₂	lb/hr	809.4
	tons/year	8.9
Filterable PM/PM ₁₀	lb/hr	2,181
	tons/year	24
NO _x	lb/hr	9.96
	tons/year	0.1
CO	lb/hr	54.2
	tons/year	0.6
VOC	lb/hr	27.2
	tons/year	0.3
HCl	lb/hr	1,224
	tons/year	13

Note: Based on blend of feedstocks: municipal solid waste, tires, and coke. See Table 3-1.

Sources: Geoplasma 2009, AlterNRG 2009, PCC 2009, Golder 2009, AP-42 Section 13.5 1991

Table 3-6
Performance and Emission Data
For Fire Water Pump
Project: St. Lucie Plasma Gasification

Parameter	Value
<u>Performance</u>	
Number of Units	1
Rating (kW)	250
Rating (hp)	335
Fuel	Diesel
Fuel Heat content (Btu/lb) (HHV)	19,300
Fuel density (lb/gal)	7.1
Heat input (MMBtu/hr) (HHV)	2.7
Fuel usage (gallons/hr)	19.4
Maximum operation (hours/yr)	500
Maximum fuel usage (gallons/yr)	9,700
<u>Emissions</u>	
SO ₂ - Basis (%S)	0.0015%
Conversion of S to SO ₂	100
Molecular weight SO ₂ / S (64/32)	2
Emission rate (lb/hr)	0.004
(TPY)	0.001
NO _x - Basis (g/hp-hr)	2.68
Emission rate (lb/hr)	2.0
(TPY)	0.49
CO - Basis (g/hp-hr)	2.6
Emission rate (lb/hr)	1.9
(TPY)	0.48
VOC - Basis (g/hp-hr)	0.32
Emission rate (lb/hr)	0.24
(TPY)	0.06
PM/PM ₁₀ /PM _{2.5} - Basis (g/hp-hr)	0.15
Emission rate (lb/hr)	0.11
(TPY)	0.03

Source: Golder, 2009; 40 CFR Part 60, Subpart IIII, AP-42

Table 3-7
Performance and Emission Data
For Auxiliary Boiler
Project: St. Lucie Plasma Gasification

Parameter	Value
<u>Performance</u>	
Fuel type	Natural Gas
Fuel Usage (scf/hr)	211,765
Heat Input (mmBtu/hr-HHV)	216
Hours per Year	876
Maximum Fuel Usage (mmscf/yr)	186
<u>Stack Parameters</u>	
Diameter (ft)	2.75
Height (ft)	50
Temperature (°F)	296
Velocity (ft/sec)	81
Flow (acfm)	29,000
<u>Emissions</u>	
SO ₂ -Basis (2,000 grains S/10 ⁶ scf)	0.002
(lb/hr)	0.06
(tpy)	0.03
NO _x - (lb/mmBtu)	0.098
(lb/hr)	21.18
(tpy)	9.28
CO - (lb/mmBtu)	0.08
(lb/hr)	17.79
(tpy)	7.79
VOC - (lb/mmBtu)	0.005
(lb/hr)	1.16
(tpy)	0.51
PM/PM10 - (lb/10 ⁶ ft ³)	1.90
(lb/hr)	0.40
(tpy)	0.18

Source: Golder, 2009, EPA AP-42 Chapter 1.4

Table 3-8
Summary of PM Emissions From The Material Handling Operations
Project: St Lucie Plasma Gasification

Operation Scenario	PM Emission Rate		PM ₁₀ Emission Rate		PM _{2.5} Emission Rate	
	Hourly ^a (lb/hr)	Annual (TPY)	Hourly ^a (lb/hr)	Annual (TPY)	Hourly ^a (lb/hr)	Annual (TPY)
<u>Truck Traffic on Paved Roads</u>						
Lime Delivery	1.0E-02	9.3E-02	2.0E-03	1.8E-02	3.0E-04	2.7E-03
Gypsum Delivery	1.0E-02	2.0E-02	2.0E-03	3.9E-03	3.0E-04	5.8E-04
Coke Delivery	1.0E-02	4.4E-02	2.0E-03	8.6E-03	3.0E-04	1.3E-03
PAC Delivery	1.0E-02	8.4E-04	2.0E-03	1.6E-04	3.0E-04	2.4E-05
Spent Carbon Shipping	1.0E-02	8.4E-04	2.0E-03	1.6E-04	3.0E-04	2.4E-05
Vitrified Material Shipping	6.6E-02	2.9E-01	1.3E-02	5.7E-02	1.9E-03	8.4E-03
Subtotal	0.12	0.45	0.02	0.09	0.003	0.01
<u>Material Storage Silos (Vent)</u>						
Limestone	0.009	0.0569	0.009	0.0569	0.001	0.0086
Coke	0.009	0.0188	0.009	0.0188	0.001	0.0028
PAC	0.009	0.0007	0.009	0.0007	0.001	0.0001
Spent Carbon	0.21	0.94	0.21	0.94	0.03	0.14
Subtotal	0.241	1.015	0.241	1.015	0.037	0.154
<u>Truck Loading</u>						
Spent Carbon Loading	7.3E-07	1.3E-06	1.4E-07	2.5E-07	2.1E-08	3.8E-08
Vitrified Material Loading	9.1E-04	1.6E-03	1.8E-04	3.2E-04	2.7E-05	4.7E-05
Subtotal	9.1E-04	1.6E-03	1.8E-04	3.2E-04	2.7E-05	4.7E-05
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Total Emissions	0.4	1.5	0.3	1.1	0.04	0.2

Source: Golder, 2009

^a Based on maximum daily throughputs.

Table 3-9
Summary of Total Hazardous Air Pollutants Emissions
for the Thermal Oxidizer, the Aux Boiler, the Emergency Generator, and the Fire Water Pump
Project: St. Lucie Plasma Gasification

Parameter	Emissions (TPY)				Total
	Thermal Oxidizer	Aux Boiler	Emergency Generator	Fire Water Pump	
Organics					
1,1,1-Trichloroethane	--	7.33E-04	--	--	7.33E-04
1,2-Dibromoethane	--	1.30E-03	--	--	1.30E-03
1,2-Dichloroethane	--	6.86E-04	--	--	6.86E-04
1,2-Dichloropropane	--	7.81E-04	--	--	7.81E-04
2,3,7,8-Tetrachlorodibenzo-p-dioxins	--	2.03E-10	--	--	2.03E-10
2,3,7,8-Tetrachlorodibenzo-p-furans	--	2.13E-09	--	--	2.13E-09
2,4,6-Trichlorophenol	--	5.20E-07	--	--	5.20E-07
2,4-Dinitrophenol	--	4.26E-06	--	--	4.26E-06
2-Nitrophenol	--	5.68E-06	--	--	5.68E-06
4-Nitrophenol	--	2.60E-06	--	--	2.60E-06
Acenaphthene	--	--	5.82E-06	3.09E-06	8.91E-06
Acenaphthylene	--	--	1.15E-05	6.09E-06	1.76E-05
Acetaldehyde	--	1.96E-02	3.14E-05	1.66E-05	1.97E-02
Acetophenone	--	7.57E-08	--	--	7.57E-08
Acrolein	--	9.46E-02	9.81E-06	5.20E-06	9.46E-02
Anthracene	--	--	1.53E-06	8.11E-07	2.34E-06
Benzene	--	9.93E-02	9.66E-04	5.12E-04	1.01E-01
Benzo(a)anthracene	--	--	7.74E-07	4.10E-07	1.18E-06
Benzo(a)pyrene	--	--	3.20E-07	1.70E-07	4.89E-07
Benzo(b)fluoranthene	--	--	1.38E-06	7.32E-07	2.11E-06
Benzo(g,h,i)perylene	--	--	6.92E-07	3.67E-07	1.06E-06
Benzo(k)fluoranthene	--	--	2.71E-07	1.44E-07	4.15E-07
bis(2-Ethylhexyl)phthalate	--	--	--	--	0.00E+00
Bromomethane	--	3.55E-04	--	--	3.55E-04
Carbazole	--	4.26E-05	--	--	4.26E-05
Carbon tetrachloride	--	1.06E-03	--	--	1.06E-03
Chlorine	--	1.87E-02	--	--	1.87E-02
Chlorobenzene	--	7.81E-04	--	--	7.81E-04
Chloroform	--	6.62E-04	--	--	6.62E-04
Chloromethane	--	5.44E-04	--	--	5.44E-04
Chrysene	--	--	1.90E-06	1.01E-06	2.91E-06
Dibenzo(a,h)anthracene	--	--	4.31E-07	2.28E-07	6.59E-07
Dichloromethane	--	6.86E-03	--	--	6.86E-03
Ethylbenzene	--	7.33E-04	--	--	7.33E-04
Fluoranthene	--	--	5.01E-06	2.66E-06	7.67E-06
Fluorene	--	--	5.56E-06	2.95E-06	8.51E-06
Formaldehyde	--	1.04E-01	9.82E-05	5.20E-05	1.04E-01
Indo(1,2,3-cd)pyrene	--	--	5.15E-07	2.73E-07	7.88E-07
Naphthalene	--	2.29E-03	1.62E-04	8.57E-05	2.54E-03
Pentachlorophenol	--	1.21E-06	--	--	1.21E-06
Phenanthrene	--	--	1.31E-06	6.93E-07	2.00E-06
Phenol	--	1.21E-03	--	--	1.21E-03
Propionaldehyde	--	1.44E-03	--	--	1.44E-03
Propylene	--	--	3.47E-03	1.84E-03	5.31E-03
Pyrene	--	--	4.62E-06	2.45E-06	7.06E-06
Styrene	--	4.49E-02	--	--	4.49E-02
Tetrachlorodibenzo-p-dioxins	--	1.11E-08	--	--	1.11E-08
Tetrachlorodibenzo-p-furans	--	1.77E-08	--	--	1.77E-08
Toluene	--	2.18E-02	3.50E-04	1.85E-04	2.23E-02
Trichloroethene	--	7.10E-04	--	--	7.10E-04
Xylene	--	--	2.40E-04	1.27E-04	3.67E-04
Metals					
Antimony	3.04E-02	1.49E-05	--	--	3.04E-02
Arsenic	1.26E-02	4.16E-05	4.98E-06	2.64E-06	1.27E-02
Beryllium	--	2.08E-06	3.73E-06	1.98E-06	7.79E-06
Cadmium	2.29E-02	7.76E-06	3.73E-06	1.98E-06	2.29E-02
Chromium	--	3.97E-05	3.73E-06	1.98E-06	4.54E-05
Cobalt	--	1.23E-05	--	--	1.23E-05
Copper	--	--	7.47E-06	3.96E-06	1.14E-05
Lead	3.20E-01	4.54E-03	1.12E-05	5.94E-06	3.25E-01
Manganese	--	3.03E-03	7.47E-06	3.96E-06	3.04E-03
Mercury	4.76E-03	3.31E-04	3.73E-06	1.98E-06	5.10E-03
Nickel	2.57E-03	6.24E-05	3.73E-06	1.98E-06	2.64E-03
Selenium	--	5.30E-06	1.87E-05	9.89E-06	3.39E-05
Zinc	6.15E-02	--	4.98E-06	2.64E-06	6.15E-02
Acid Gas					
Halogens	15.98	--	--	--	1.60E+01
Dioxin Furan					
PCDD/PCDF (total mass) 40 CFR 60 Subpart Eb	1.59E-05	--	--	--	1.59E-05
HAPs (Total)	16.4	0.4	0.005	0.003	16.9
Maximum Individual HAP	16.0	0.1	0.003	0.002	16.0

Source: Golder, 2009.

Boiler Emission Factors from EPA AP-42, Table 1.6-3 and 1.6-4. See also Table 3-7 of the St. Lucie Plasma Gasification Application Report.

Emergency Generator and Water Pump Emission Factors from EPA AP-42, Table 3.4, and Table 1.3. See also Tables 3-5 and 3-6 of the St. Lucie Plasma Gasification Application Report.

Table 5-1 National and State AAQS, and Significant Impact Levels

Pollutant	Averaging Time	AAQS ($\mu\text{g}/\text{m}^3$)		Significant Impact Levels ($\mu\text{g}/\text{m}^3$) ^e
		Primary Standard	Secondary Standard	
Particulate Matter ^a (PM _{2.5})	Annual Arithmetic Mean	15	15	NA
	24-Hour Maximum	35	35	NA
Particulate Matter (PM ₁₀)	Annual Arithmetic Mean	50	50	1
	24-Hour Maximum ^b	150	150	5
Sulfur Dioxide	Annual Arithmetic Mean	80	NA	1
	24-Hour Maximum ^c	365	NA	5
	3-Hour Maximum	NA	1,300	25
Carbon Monoxide ^c	8-Hour Maximum	10,000	10,000	500
	1-Hour Maximum	40,000	40,000	2,000
Nitrogen Dioxide	Annual Arithmetic Mean	100	100	1
Ozone ^d	8-Hour Maximum	147	147	NA
Lead	Calendar Quarter Arithmetic Mean	1.5	1.5	NA

Note: Particulate matter (PM_{2.5}) = particulate matter with aerodynamic diameter less than or equal to 2.5 micrometers.
 Particulate matter (PM₁₀) = particulate matter with aerodynamic diameter less than or equal to 10 micrometers.
 NA = Not applicable, i.e., no standard exists.

^(a) The 3-year average of the weighted annual mean PM_{2.5} concentrations from single or multiple community-oriented monitors must not exceed 15.0 $\mu\text{g}/\text{m}^3$. The 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu\text{g}/\text{m}^3$ (effective December 17, 2006).

^(b) Not to be exceeded more than once per year on average over 3 years.

^(c) Not to be exceeded more than once per year.

^(d) The 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective 60 days after publication in the Federal Register).

^(e) Maximum concentrations are not to be exceeded.

Sources: Federal Register, Vol. 43, No. 118, June 19, 1978.; 40 CFR 50; 40 CFR 52.21.; COMAR 26.11.04.

Table 5-2
Major features of the AERMOD Model, Version 09292

AERMOD Model Features
· Plume dispersion/growth rates are determined by the profile of vertical and horizontal turbulence, vary with height, and use a continuous growth function.
· In a convective atmosphere, uses three separate algorithms to describe plume behavior as it comes in contact with the mixed layer lid; in a stable atmosphere, uses a mechanically mixed layer near the surface.
· Polar or Cartesian coordinate systems for receptor locations can be included directly or by an external file reference.
· Urban model dispersion is input as a function of city size and population density; sources can also be modeled individually as urban sources.
· Stable plume rise: uses Briggs equations with winds and temperature gradients at stack top up to half-way up to plume rise. Convective plume rise: plume superimposed on random convective velocities.
· Procedures suggested by Briggs (1974) for evaluating stack-tip downwash.
· Has capability of simulating point, volume, area, and multi-sized area sources.
· Accounts for the effects of vertical variations in wind and turbulence (Brower et al., 1998).
· Uses measured and computed boundary layer parameters and similarity relationships to develop vertical profiles of wind, temperature, and turbulence (Brower et al., 1998).
· Concentration estimates for 1-hour to annual average times.
· Creates vertical profiles of wind, temperature, and turbulence using all available measurement levels.
· Terrain features are depicted by use of a controlling hill elevation and a receptor point elevation.
· Modeling domain surface characteristics are determined by selected direction and month/season values of surface roughness length, albedo, and Bowen ratio.
· Contains both a mechanical and convective mixed layer height, the latter based on the hourly accumulation of sensible heat flux.
· The method of Pasquill (1976) to account for buoyancy-induced dispersion.
· A default regulatory option to set various model options and parameters to EPA-recommended values.
· Contains procedures for calm-wind and missing data for the processing of short term averages.

Note: AERMOD = The American Meteorological Society and EPA Regulatory Model.

Source: Paine et al., 2007.

**Table 5-3
Source Stack Parameters
Project: St. Lucie Plasma Gasification**

SOURCE DESCRIPTION Point Source	MODEL ID	UTM Coordinates ^a		Physical				Operating			
		East	North	Height		Diameter		Temperature		Velocity	
		(m)	(m)	(ft)	(m)	(ft)	(m)	(°F)	(K)	(ft/s)	(m/s)
Gasifier/Thermal Oxidizer	STCK1	560,145	3,029,056	125	38.1	5	1.5	140	333	60	18.3

^a UTM Zone 16, North American Datum 83

Table 5-4
Source Emissions
Project: St. Lucie Plasma Gasification

MODEL ID	PM ₁₀		SO ₂		NO _x		CO	
	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(lb/hr)	(g/s)
STCK1	5.7	0.7	3.7	0.5	7.6	0.96	7.6	0.96

Table 5-5
Solid Structures Dimenaions
Project: St. Lucie Plasma Gasification

Structure Description ^a	Model ID	Height		Length		Width	
		(ft)	(m)	(ft)	(m)	(ft)	(m)
Existing Building	BLD1	50	15	341	104	210	64
Proposed Plant	BLD2	50	15	472	144	600	183

^a The structures are polygonal buildings. Dimensions shown for length and width represent the maximum lengths of the buildings.

Table 5-6
Summary of Maximum Concentrations Predicted for Proposed Project
Compared to EPA Class II Significant Impact Levels
Project: St. Lucie Plasma Gasification

Pollutant	Averaging Time	Maximum Concentration ($\mu\text{g}/\text{m}^3$) ^a	EPA Class II Significant Impact Levels ($\mu\text{g}/\text{m}^3$)
SO ₂	Annual	0.2	1
	24-Hour	1.3	5
	3-Hour	2.6	25
PM ₁₀	Annual	0.2	1
	24-Hour	2.0	5
NO _x ^b	Annual	0.2	1
CO	8-Hour	3.9	500
	1-Hour	6.5	2,000

^a Concentrations are based on highest predicted concentrations from AERMOD using five years of meteorological data for 2001 to 2005 consisting of surface and upper air data from the National Weather Service station at West Palm Beach/Miami International Airport (PBIMIA).

^b NO_x to NO₂ conversion factor of 0.75 applied to modeled NO_x impacts based on EPA Modeling Guidelines.

TABLE 5-7
Summary of Maximum Concentrations Predicted for Proposed Project
Within 50 KM in the Direction of Everglades NP
Compared to EPA Class I Significant Impact Levels
Project: St. Lucie Plasma Gasification

Pollutant	Averaging Time	Maximum Concentration ($\mu\text{g}/\text{m}^3$) ^{a, b}	EPA Class I Significant Impact Levels ($\mu\text{g}/\text{m}^3$)
SO ₂	Annual	0.0002	0.1
	24-Hour	0.004	0.2
	3-Hour	0.02	1.0
PM ₁₀	Annual	0.0002	0.2
	24-Hour	0.007	0.3
NO _x ^b	Annual	0.0002	0.1

^a Concentrations are based on highest predicted concentrations from AERMOD using five years of meteorological data for 2001 to 2005 consisting of surface and upper air data from the National Weather Service station at West Palm Beach/Miami International Airport (PBIMIA).

^b NO_x to NO₂ conversion factor of 0.75 applied to modeled NO_x impacts based on EPA Modeling Guidelines.