**TECHNICAL EVALUATION**

**&**

**PRELIMINARY DETERMINATION**

**APPLICANT**

Geoplasma St. Lucie, LLC
171 17th Street NW, Suite 1550
Atlanta, Georgia 30363

St. Lucie Plasma Gasification Project
ARMS Facility ID No. 1110138

**PROJECT**

Project No. 1110138-001-AC
24 Megawatt (gross) Waste-to-Energy (WTE) Facility
(686 Tons per Day Resource Recovery Facility)

**COUNTY**

St. Lucie County, Florida

**PERMITTING AUTHORITY**

Florida Department of Environmental Protection
Division of Air Resource Management
Bureau of Air Regulation
Special Projects Section
2600 Blair Stone Road, MS#5505
Tallahassee, Florida 32399-2400

May 25, 2010

## 1. APPLICATION INFORMATION

### 1.1. Applicant Name and Address

Geoplasma-St. Lucie, LLC (Geoplasma)
171 17th Street NW, Suite 1550
Atlanta, Georgia 30363

***Authorized Representative***: Dr. Hilburn O. Hillestad

### 1.2. Key Dates

- December 17, 2009 Received air construction permit application from Geoplasma.
- January 16, 2010 Department issued request for additional information (RAI).
- February 23, 2010 Received response to RAI from Geoplasma.
- May 25, 2010 Department distributed Draft Permit package and posted documents.

### 1.3. Facility Location

The proposed Geoplasma Waste-to-Energy (WTE) facility will be located in St. Lucie County on a parcel of land approximately 9 acres in size within the boundary of the existing St. Lucie County Baling & Recycling Facility (SLCBRF). The location of St Lucie County (shown in red) and the proposed site within the County are shown below in Figures 1 and 2, respectively.

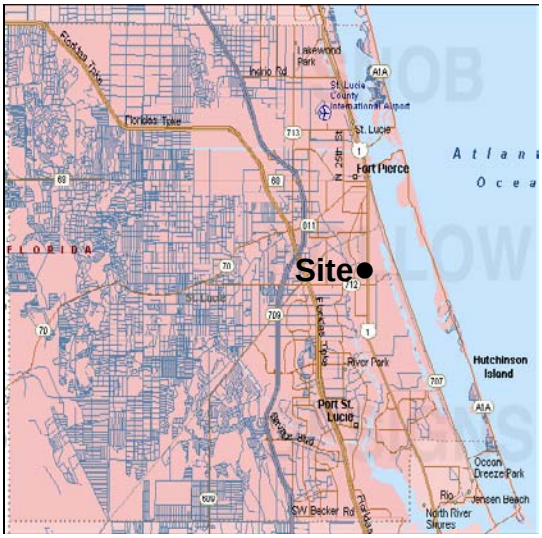



**Figure 1 – St. Lucie County, Florida** **Figure 2 – Map of St. Lucie County, Location of Facility**

A satellite view and map of the site and the immediate environs are visible at the following link:

Satellite View of St. Lucie County Sanitary Landfill, Site of Future Geoplasma WTE Site

The site is located off Glades Cut-Off Road south of the intersection of Interstate 95 and the Florida Turnpike and approximately 8 miles southwest of the City of Fort Pierce.

## 2. EXISTING LANDFILL OPERATION

To fully understand the proposed project, it is useful to first understand the existing operation at the SLCBRF. The following description is based on information available at the solid waste link of the St. Lucie County Board of County Commissioners website at: www.stlucieco.gov/solid_waste/index.htm .

The SLCBRF receives and processes solid waste products from residents and commercial properties in the County and processes roughly 600 tons per operating day (TPD) of Class I waste, 100 TPD of construction and demolition (C&D) debris and 140 TPD of yard waste.

Refer to Figures 3 and 4. Arriving garbage trucks containing Class I municipal solid waste (MSW) are weighed and sent to the tipping floor of the baling facility and unloaded of all its collected refuse. Material is sorted by categories of recyclable items such as wood, metal, electronics, tires, cardboard, propane tanks, chemicals, drums, etc. Remaining refuse is pushed to a set of floor conveyers and moved to the baling room where it is compressed, baled, loaded onto trucks, and transported to the landfill.

**Figure 3. Scale House, Tipping Floor, Baling Room, Outdoor Bale Stacking at "Balefill"**

C&D waste is kept separate from the Class I waste and is sent to the separate C&D recycling facility. Pieces of debris such as wood, concrete and metal are removed after which the sorted pile is placed onto a conveyor and sent through the recycling equipment. The recycling steps consist of picking lines to manually remove recyclable items, a star screen to remove concrete, rocks and dirt, two magnetic conveyors and additional picking lines.

**Figure 4. C&D Waste Handling, Grinder, Landfill Leachate Collection Pond, LFG Flare**

All of the items removed from the Class I and C&D streams are collected and recycled. Metal is stored for processing. Wood is shredded, piled, and shipped to a cogeneration power plant and used as boiler fuel. Electronics are palletized and placed onto a semitrailer for subsequent transportation.

Yard waste is collected at a designated area and is composted.

The existing facility has a Title V Operation Permit that includes the requirements of 40 Code of Federal Regulations (CFR) Part 60, Subparts Cc and WWW. As required by Subparts Cc and WWW, the landfill gas (LFG) generated by decomposing waste is collected through an active collection system consisting of 90 wells. The LFG is piped to a local juice maker for use as boiler fuel.

## 3. PROPOSED PROJECT

### 3.1. Project Description

The applicant proposes to construct a 24 megawatts (MW, gross) WTE facility at the SLCBRF. From a regulatory point of view it will be a nominal 686 tons per day (TPD) municipal waste combustor or resource recovery facility.

Basically, Geoplasma will take over responsibility of the operation beyond the scale house and will gasify solid waste (such as Class I waste, C&D waste, tires and yard trash) in a plasma arc gasification vessel equipped with plasma torches as described below. The total maximum feedstock throughput will be 686 tons per day of the described waste and metallurgical coke. The resulting synthetic gas (syngas) gas will be combusted in a multi-stage thermal oxidizer (TO). The heat generated will be transferred to a heat

recovery steam generator (HRSG). The resulting high pressure, high temperature (HPHT) steam will be expanded in a steam turbine generator (STG) to generate electrical power, some of which will be used on-site and some of which will be sold to the grid.

The facility will be comprised of seven process areas:

- Material handing: consisting of feedstock (MSW, tires with steel belts and other permitted materials), metallurgical coke (coke), limestone, ammonia and powered activate carbon (PAC) delivery, conveying and storage;
- Process byproduct handing: consisting of fly ash, spent PAC, gypsum and vitrified material conveying and storage;
- Plasma arc gasifier (PAG): where feedstock is gasified into syngas, the energetic components of which are primarily hydrogen ($H_2$) and carbon monoxide (CO);
- Power island (steam generating unit): consisting of a multi-stage TO to combust the syngas, a HRSG and a STG;
- Air pollution control equipment: including an electrostatic precipitator (ESP), a selective catalytic reduction (SCR) unit, powdered activated carbon injection (PACI) system with a fabric filter baghouse, and a flue gas desulfurization (FGD) scrubber;
- Emergency flare system: for temporary and infrequent disposal of bypasses syngas; and
- Emergency support equipment: consisting of a generator, fire pump engine and an auxiliary boiler.

The location of the proposed Geoplasma facility within the SLCBRF property is shown in Figure 5 below. The figure includes a preliminary layout of key components that has since been updated as shown in Figure 6.

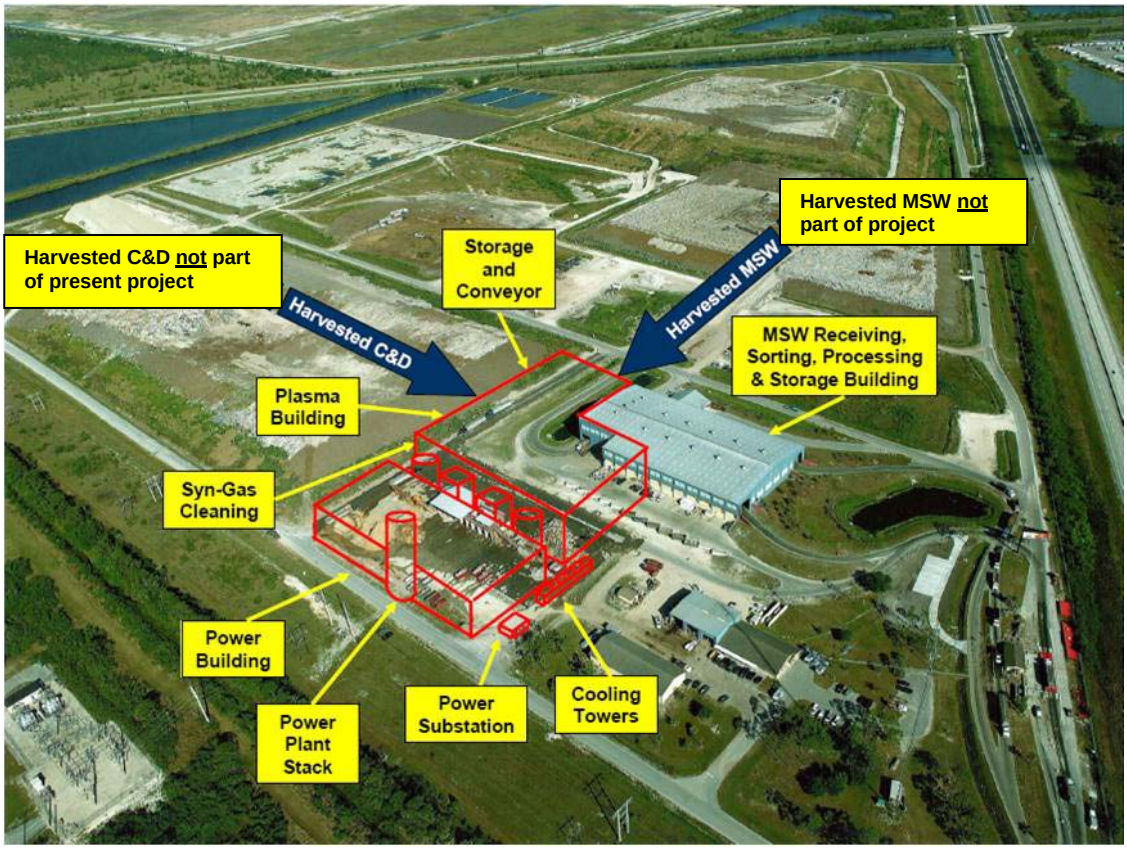



**Figure 5 – Proposed Geoplasma WTE Facility at St Lucie County Sanitary Landfill**

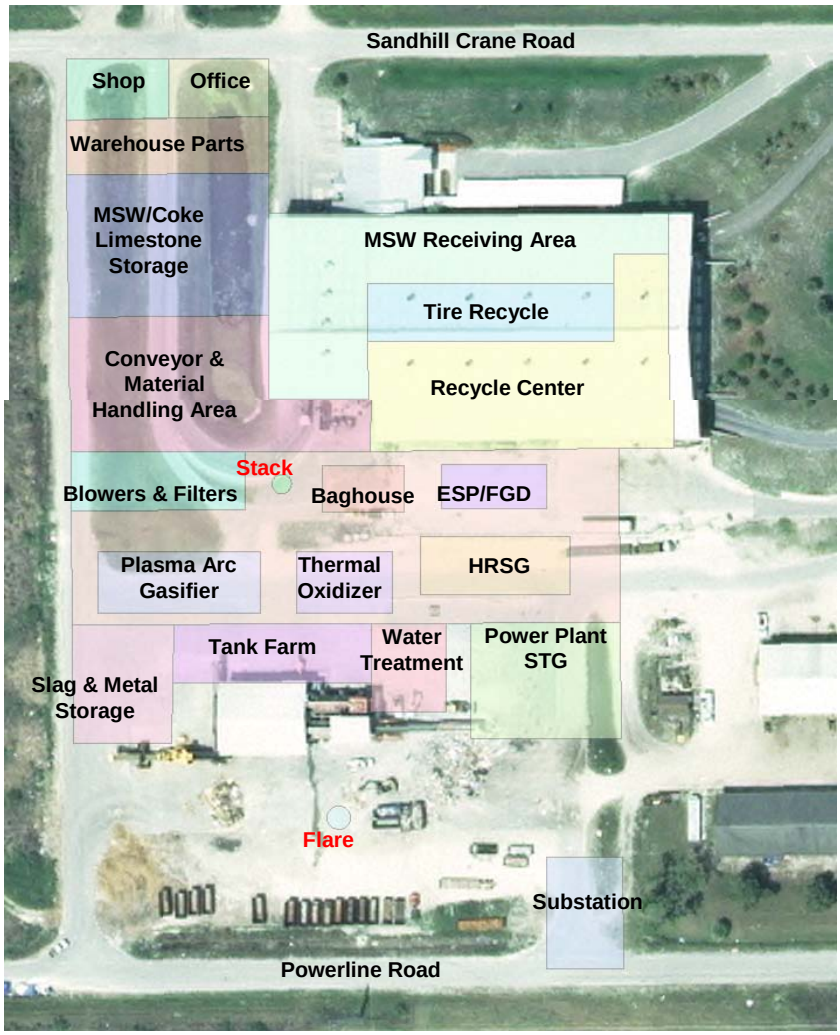



**Figure 6 – Proposed Layout of the Geoplasma WTE Facility**

### 3.2. Fuel Feedstock

The bulk of the solid waste is best described as MSW. The affected source is called a municipal waste combustor (MWC) in the key rule applicable to the project which is 40 CFR 60, Subpart Eb - Standards of Performance for Large Municipal Waste Combustors.

MSW includes the items and materials that fit within the definition of MSW contained in either Section 403.706(5), Florida Statutes (F.S.) or 40 CFR 60.51b. The two definitions are as follows:

*[Section 403.706(5), F.S.] As used in this section, "municipal solid waste" includes any solid waste, except for sludge, resulting from the operation of residential, commercial, governmental, or institutional establishments that would normally be collected, processed, and disposed of through a public or private solid waste management service. The term includes yard trash but does not include solid waste from industrial, mining, or agricultural operations.*

*[40 CFR 60.51b, Definitions] Municipal solid waste or municipal-type solid waste or MSW means household, commercial/retail, and/or institutional waste. Household waste includes material discarded by single and multiple residential dwellings, hotels, motels, and other similar permanent or temporary housing establishments or facilities. Commercial/retail waste includes material discarded by stores, offices, restaurants, warehouses, nonmanufacturing activities at industrial facilities, and other similar*

*establishments or facilities. Institutional waste includes material discarded by schools, nonmedical waste discarded by hospitals, material discarded by nonmanufacturing activities at prisons and government facilities, and material discarded by other similar establishments or facilities. Household, commercial/retail, and institutional waste does not include used oil; sewage sludge; wood pallets; construction, renovation, and demolition wastes (which includes but is not limited to railroad ties and telephone poles); clean wood; industrial process or manufacturing wastes; medical waste; or motor vehicles (including motor vehicle parts or vehicle fluff). Household, commercial/retail, and institutional wastes include: (1) Yard waste; (2) Refuse-derived fuel; and (3) Motor vehicle maintenance materials limited to vehicle batteries and tires except as specified in §60.50b(g).*

The Subpart Eb MSW definition relates more to the wastes that, if combusted, would make the source subject to the given rule rather than a strict delineation of what can and cannot be processed in a MWC. The Department clarifies in its MWC permits the fuel slates on a project-by-project basis.

Following is an <u>example</u> of a typical fuel slate for a WTE facility in Florida. The actual fuel slate for the Geoplasma facility will be stated in the permit.

1. The facility shall <u>not</u> burn any of the following materials:
   a) those materials that are prohibited by state or federal law;
   b) those materials that are prohibited by this permit;
   c) lead acid batteries;
   d) hazardous waste;
   e) nuclear waste;
   f) radioactive waste;
   g) sewage sludge;
   h) explosives; and
   i) beryllium-containing waste, as defined in 40 CFR 61, Subpart C.
2. Further, the facility <u>shall not knowingly burn</u>:
   a) nickel-cadmium batteries pursuant to Section 403.7192 (3);
   b) mercury containing devices and lamps pursuant to Sections 403.7186(2) & (3);
   c) untreated biomedical waste from biomedical waste generators regulated pursuant to Chapter 64E-16, F.A.C., and from similar generators (or sources);
   d) segregated loads of biological waste; and
   e) CCA treated wood.
3. The following other solid waste may be used as fuel at the facility:
   a) confidential, proprietary or special documents (including but not limited to business records, lottery tickets, event tickets, coupons and microfilm);
   b) contraband which is being destroyed at the request of appropriately authorized local, state or federal governmental agencies, provided that such material is not an explosive, a propellant, a hazardous waste, or otherwise prohibited at the facility. For the purposes of this determination, contraband includes but is not limited to drugs, narcotics, fruits, vegetables, plants, counterfeit money, and counterfeit consumer goods;
   c) wood pallets, clean wood, and land clearing debris;
   d) packaging materials and containers;
   e) clothing, natural and synthetic fibers, fabric remnants, and similar debris, including but not limited to aprons and gloves;

f) rugs, carpets, and floor coverings, but not asbestos-containing materials or polyethylene or polyurethane vinyl floor coverings;

g) construction and demolition debris.

h) oil spill debris from aquatic, coastal, estuarine or river environments. Such items or materials include but are not limited to rags, wipes, and absorbents.

i) items suitable for human, plant or domesticated animal use, consumption or application where the item's shelf-life has expired or the generator wishes to remove the items from the market. Such items or materials include but are not limited to off-specification or expired consumer products, pharmaceuticals, medications, health and personal care products, cosmetics, foodstuffs, nutritional supplements, returned goods, and controlled substances.

j) consumer-packaged products intended for human or domesticated animal use or application but not consumption. Such items or materials include but are not limited to carpet cleaners, household or bathroom cleaners, polishes, waxes and detergents.

k) waste materials that:

   i. are generated in the manufacture of items in categories (c) or (d), above and are functionally or commercially useless (expired, rejected or spent); or

   ii. are not yet formed or packaged for commercial distribution. Such items or materials must be substantially similar to other items or materials routinely found in MSW.

l) waste materials that contain oil from:

   i. the routine cleanup of industrial or commercial establishments and machinery; or

   ii. spills of virgin or used petroleum products. Such items or materials include but are not limited to rags, wipes, and absorbents.

m) used oil and used oil filters. Used oil containing a PCB concentration equal or greater than 50 ppm shall not be burned, pursuant to the limitations of 40 CFR 761.20(e).

n) waste materials generated by manufacturing, industrial or agricultural activities, provided that these items or materials are substantially similar to items or materials that are found routinely in MSW, subject to prior approval of the Department

### 3.3. Material Handling, Storage and Processing

Figure 7 provides a process flow diagram for the non-feedstock material handling operations at the Geoplasma facility. Particulate matter (PM) emission points are shown by the dashed arrows in the diagram. Handling of the MSW, tires and other permitted feedstocks are not expected to result in additional fugitive emissions and are not included in Figure 7. Key material handling operations, including feedstocks are briefly described below.

- *Feedstocks*: The project will utilize the existing SLCBRF building for initial processing of the MSW and the separation of recyclable materials. An enclosed conveyor system will be utilized to transport the MSW, tires and other feedstock materials from the existing processing area to the gasifier. Air for the gasifier and thermal oxidizer will be drawn through the waste processing area and conveyor to minimize the potential for odors and fugitive emissions from feedstock processing and recycling operations.

- *Coke*: Coke is required in the process as described below. Coke will be delivered to the project site via trucks and stored in a silo. The delivery trucks will each have an average net load of 25 tons of material. The storage silo will be pneumatically loaded and will be equipped with a bin vent fabric filter to minimize PM emissions during the unloading process. The coke will then be released into the gasifier feed system. Coke is projected to be consumed at a rate of approximately 2,000 pounds per hour (lb/hr) and 8,758 tons per year (TPY), which equates to approximately 350 truck deliveries per year.

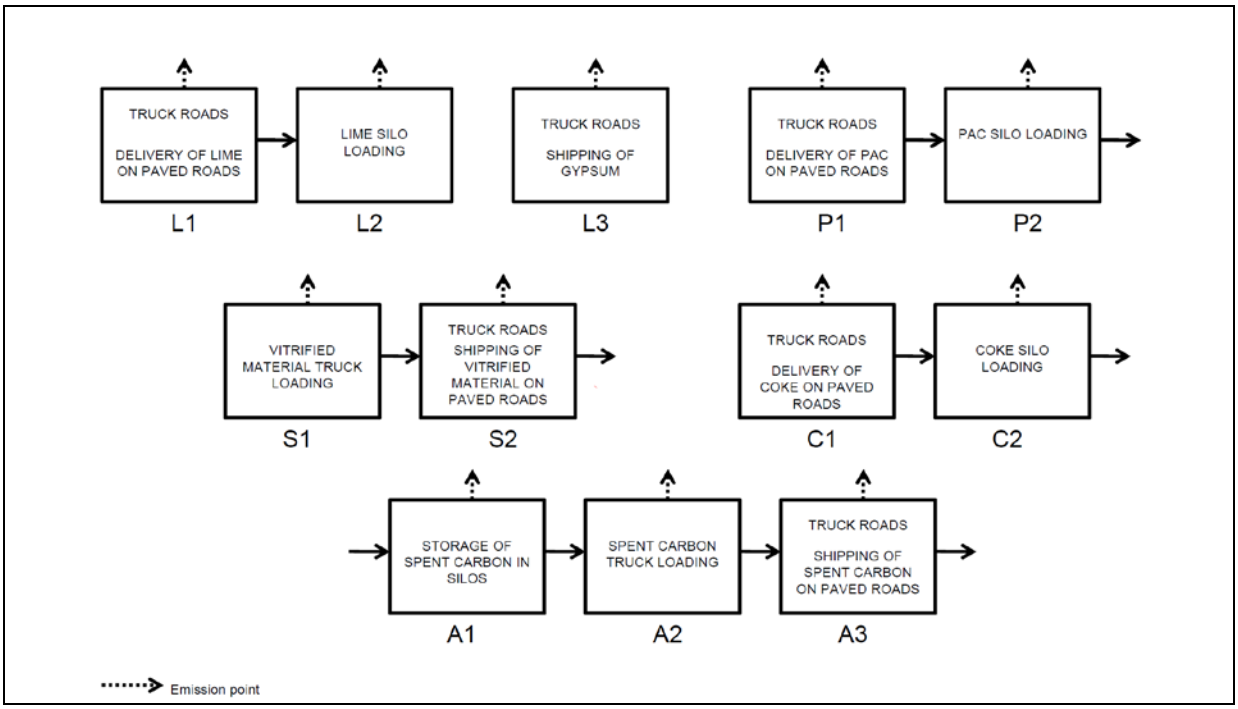



**Figure 7 - Material Handling, Processing, and Storage Process Flow Schematic Diagram**

- *Limestone*: Limestone is required in the process as a flux and in the FGD scrubber. Limestone will be delivered to the project site via trucks and stored in a silo. The delivery trucks will each have an average net load of 25 tons of material. The storage silo will be pneumatically loaded and will be equipped with a bin vent fabric filter to minimize PM emissions during the unloading process. The limestone will then be injected to the gasifier feed system and FGD system. Limestone is projected to be consumed at a rate of approximately 3,480 lb/hr in the gasifier (15,234 TPY) and 764 lb/hr (3,346 TPY) in the FGD system. A total of approximately 18,580 TPY will require approximately 743 truck deliveries per year.
- *Powdered activated carbon (PAC)*: PAC is required in the PACI system to control mercury (Hg), trace metals and complex organic compounds. A fabric filter bag house will be used to capture the spent carbon. PAC will be delivered to the project site via trucks and stored in a silo. The delivery trucks will each have an average net load of 25 tons of material. The storage silo will be pneumatically loaded and will be equipped with a bin vent fabric filter to minimize PM emissions during the unloading process. The PAC will then be injected into the flue gas stream ahead of the bag house. PAC is projected to be consumed at a rate of approximately 38 lb/hr and 167 TPY, which equates to approximately 7 truck deliveries per year.
- *Ammonia ($NH_3$)*: Aqueous ammonia is used in the SCR system. It will be delivered to the site by tank truck and stored in onsite tanks.

### 3.4. Gasification Process Description

The gasification process proposed by Geoplasma for the St. Lucie facility is based on technology developed by Westinghouse Plasma Corporation, a division of Alter, NRG. In the plasma gasification process developed by Westinghouse Plasma, MSW and other wastes such as tires are mixed with metallurgical coke and limestone and introduced into the top of a vertical cylindrical gasifier vessel similar to a cupola used in the metallurgical industry. The gasifier is heated by energy input devices called plasma torches located near the bottom of the vessel.

Figure 8 is a schematic of a Westinghouse Plasma torch. These have no moving parts. Incoming process gas such as air or oxygen is partially ionized whereby individual atoms are stripped of one or more electrons by an electrical discharge between the electrodes. The ionized process gas is further heated by passage through a magnetic field and exits in the plasma state reaching temperatures on the order of 10,000°F or greater.

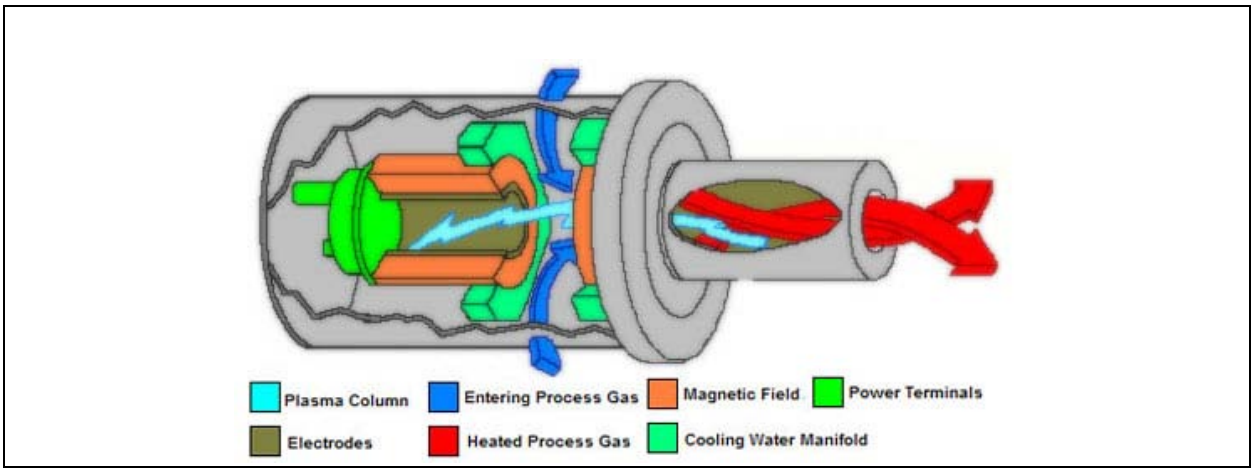



**Figure 8. Schematic of Westinghouse Plasma Torch**

The plasma torches do not directly contact the waste. The torches provide the high temperatures required in the cupola. For reference, the torches are available in sizes that can accommodate electrical power input up to 2.4 MW (Marc-11 at highest load). Their operation would constitute part of the parasitic load subtracted from the gross electrical output if used at a WTE plant.

Figure 9 is a schematic of one variation of the Alter NRG Plasma Gasification System based on the Westinghouse Plasma torch technology and pre-combustion syngas cleanup. The proposed project will incorporate post-combustion cleanup as described below.

As the waste moves downward through the gasifier, most of the carbon in the waste reacts with water and oxygen to primarily produce CO and lesser amounts of $H_2$, various hydrocarbons, reduced compounds such as $NH_3$, hydrogen sulfide ($H_2S$), etc. A large volume is required to provide the residence time needed to further crack difficult gasification products such as tars. The syngas is withdrawn from the top of the gasifier vessel and cleaned prior to beneficial use.

The inorganic (inert) components of the feedstock move downward to a porous bed formed by the coke introduced with the waste and are heated to very high temperature by the plasma torches. The inert materials are melted by the intense heat of the plasma torches, flow downward through the porous coke bed and are discharged as glass aggregate and metal nodules. The limestone added to the gasifier feedstock acts as flux to decrease the viscosity of the molten stream and facilitate flow through the porous coke bed.

A generalized explanation of how waste can be converted using plasma arc technology is available at:

http://science.howstuffworks.com/plasma-converter.htm

### 3.5. Syngas Combustion/Primary Pollution Control

Syngas such as from MSW, coal and biomass is combusted in a variety of equipment such as conventional boilers, engines and combustion turbines. Most modern applications familiar to the Department involve syngas cleanup prior to combustion. Thermal oxidizers (TO) such as proposed by Geoplasma are typically used to combust waste streams or to destroy air pollutants present in process exhaust gases at relatively low levels, such as CO and volatile organic compounds (VOC). Usually such applications require the use of supplementary fuel.

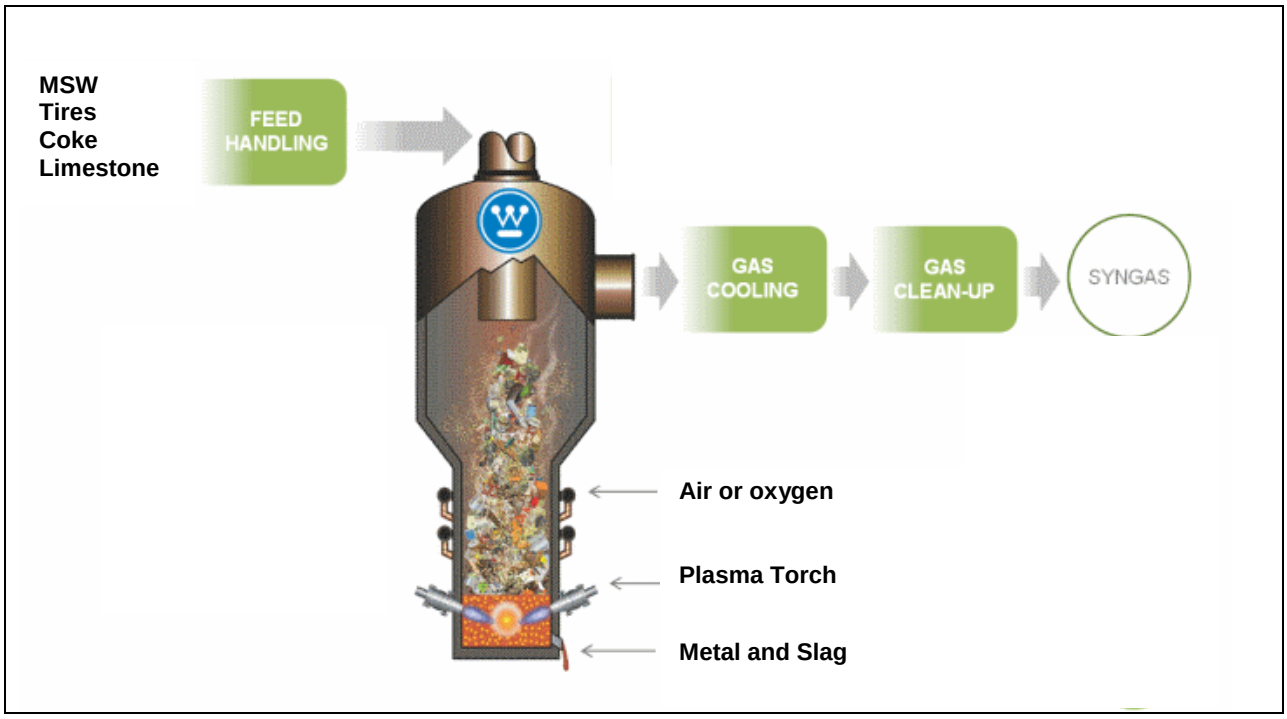



**Figure 9 – Key Components of the Alter NRG Plasma Gasification System**

In a typical TO application, the waste streams/pollutants react with oxygen in a temperature controlled environment, typically requiring additional fuel, to create an oxidation reaction. A waste heat boiler (such as a HRSG) may be located after the TO to extract the heat from the products of combustion to generate process (utility) steam.

A typical configuration for a fully integrated multi-stage TO system for the purpose of handling waste streams and destroying combustible air pollutants is shown in Figure 10 below. The application shown can accommodate liquid and gaseous waste streams as well as several supplementary fuels. A scrubber is provided downstream for subsequent acid gas control.

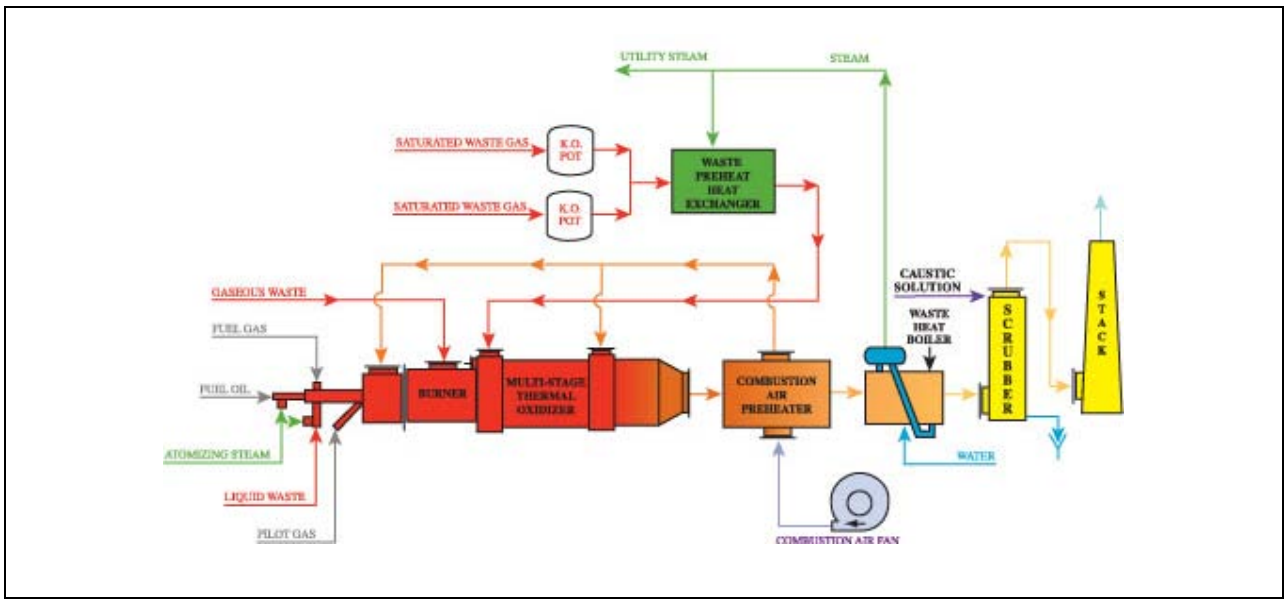



**Figure 10 – Integrated TO for Waste Gas and Air Pollution Control (Process Combustion Corporation)**

In the present application, a TO will be used wherein the waste stream and the supplementary fuel are one and the same (i.e. the syngas). Figure 11 is a general process flow diagram of the proposed St. Lucie Geoplasma facility. The syngas is combusted (prior to cleanup) in a multi-stage TO. Most of the heat from combustion is recovered in a HRSG to generate high pressure, high temperature (HPHT) steam to drive the STG (rather than as plant utility steam).

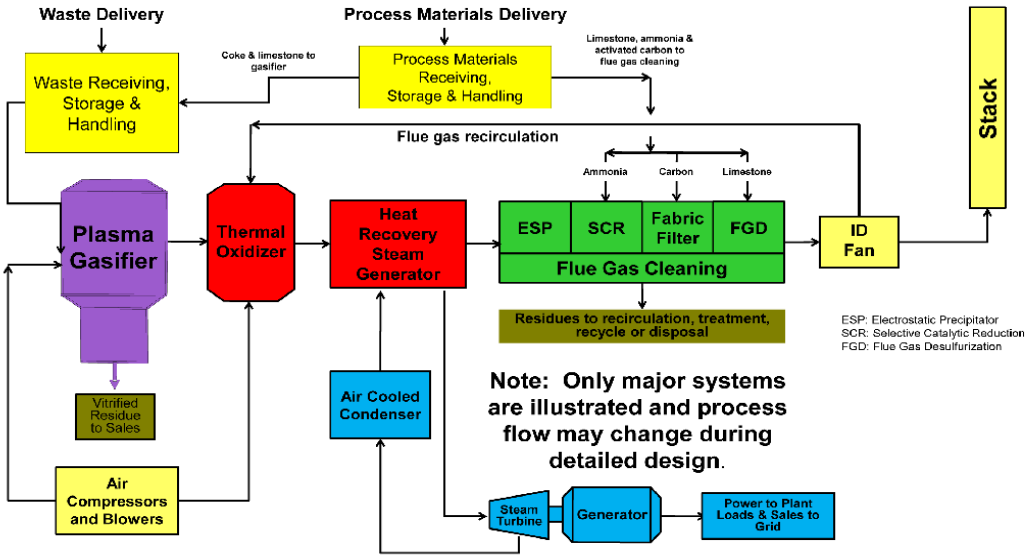



**Figure 11 – Process Flow Diagram of St. Lucie Geoplasma WTE Facility**

Geoplasma will use a type of multi-stage TO with reducing, conditioning and oxidizing sections. Flue gas recirculation (FGR) will be incorporated into the design and will help reduce nitrogen oxides ($NO_X$) formation. Overall, the combustion of the syngas in the described multi-stage TO provides the initial air pollution control for PM, $NO_X$, CO and VOC prior to the add-on control equipment described below.

### 3.6. Emergency Flaring System

According to the applicant, in the event of a sudden increase in the production of syngas in the gasifier that cannot be accommodated by the TO or the sudden unavailability of the TO, HRSG, emission control system or induced draft (ID) fans, it will be necessary to vent bypassed syngas to the emergency flare system. This will be accomplished by means of a flare stack designed to assure combustion of the syngas. The applicant does not anticipate that use of the flare system will be required during either normal start up or shutdown of the gasification system or during unplanned shutdowns, as the exhaust gas would continue to be directed through the thermal oxidizer and be subjected to all of the downstream pollution control systems. The applicant has requested that the emergency flaring system be allowed to operate for 10 hours per year consisting of 20 half-hour flaring events.

### 3.7. Electrostatic Precipitator (ESP)

Flue gas from the TO/HRSG will be further treated to remove: particulate matter ($PM/PM_{10}$); acid gases including sulfur dioxide ($SO_2$) and hydrogen chloride (HCl); $NO_X$; mercury (Hg) and other trace elements before being discharged to the atmosphere via a 125 foot (ft) stack.

A high temperature ESP will be located immediately downstream of the TO/HRSG to control $PM/PM_{10}$ and to remove certain ash components such as sodium (Na), potassium (K), magnesium (Mg) and calcium (Ca), that can otherwise affect the additional downstream pollution control equipment, such as the SCR system.

### 3.8. SCR System

A SCR system will be located immediately downstream of the ESP and utilized to reduce and further control $NO_X$ emissions. SCR reduces $NO_X$ emissions by injecting liquid $NH_3$ solution into the flue gas in the presence of a catalyst.

$NH_3$ reacts with $NO_X$ in the presence of a catalyst and excess oxygen yielding molecular nitrogen and water according to the following simplified reaction:.

$$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$$

### 3.9. PACI System/Fabric Filter Baghouse

A PACI system will be located immediately downstream of the SCR system to control Hg, trace metals and complex organic compounds. The PACI will function in conjunction with a fabric filter (FF) baghouse located immediately downstream that will capture the spent carbon and pollutants absorbed therein. The FF baghouse will also provide additional removal of $PM/PM_{10}$ and trace elements and ash not captured by the upstream ESP system.

### 3.10. FGD System

A wet FGD system, utilizing limestone will be installed to control emissions of acid gases, including sulfur dioxide ($SO_2$), hydrochloric acid (HCl) and hydrogen fluoride (HF). The limestone will be stored in a silo with a bin vent for loading. The limestone will be withdrawn from the bin and pneumatically conveyed to the flue duct downstream of the fabric filters. The $SO_2$ removal reactions are as follows:

$SO_2$ and water react to form sulfurous acid.

$$2SO_2 + H_2O \rightarrow H_2SO_4$$

Sulfurous acid reacts with limestone to form calcium sulfite, carbon dioxide and water.

$$H_2SO_3 + CaCO_3 \rightarrow CaSO_3 + CO_2 + H_2O$$

Calcium sulfite may be further oxidized to form gypsum.

$$2CaCO_3 + O_2 + 2H_2O \rightarrow CaSO_4 \bullet 2H_2O)$$

HCl and HF are water soluble and their removal is further enhanced by the limestone reagent.

### 3.11. Process By-Products

Process by-products will be generated at the Geoplasma facility. These process by-products are discussed below.

- *Vitrified Residue Material*: The gasification of feedstock, coke and limestone will result in the formation of vitrified (glass like) material that will be discharged from the bottom of the gasifier into water to produce a coarse sand-like aggregate that will be sold for use in construction. The wet vitrified material produced by the gasifier system will be loaded on to trucks for removal off-site. Vitrified material is expected to be produced at a rate of 13,200 lb/hr and 57,900 TPY which equates to approximately 2,300 truck shipments offsite per year.
- *Spent Carbon*: Spent carbon collected in the fabric filter baghouse will be transported via an enclosed conveyor or similar configuration to the spent carbon storage silo. The storage silo will be equipped with bin vent fabric filters to minimize PM emissions during the transfer operation. Spent carbon from the storage silo will be transported offsite for recycling and recovery.

- *Gypsum*: The FGD system will produce gypsum as a byproduct. Gypsum is typically used in production of wallboard and similar materials and will be shipped offsite for beneficial use in the wallboard industry. Gypsum is expected to be generated at a rate of approximately 900 lb/hr and 4,000 TPY, resulting in 160 truck shipments per year.

### 3.12. Additional Support Equipment

The proposed Geoplasma facility will also require:

- Up to four 1,000 gallon capacity above ground storage tanks for biodiesel and ultra low sulfur distillate (ULSD) fuel oil to support the emergency generator and emergency fire water pump engines;
- One 500 kilowatt (kW) emergency electrical generator (or smaller);
- One 335 horsepower (hp) emergency fire water pump engine (or smaller); and
- One natural gas fueled auxiliary boiler with a maximum heat input rate of 216 million British thermal units per hour (mmBtu/hr).

### 3.13. Emissions Units

Table 1 is a list of the Emissions Units (EU) that constitute this project.

**Table 1 – List of Emissions Units for the Geoplasma WTE Facility**

| Facility ID 1110138 | |
|---|---|
| **EU No.** | **Emission Unit Description** |
| 001 | Material handling consisting of: fuel feedstock (MSW, tires and other permitted materials); coke; limestone; PAC; and, process byproducts (vitrified residue, spent carbon and gypsum) |
| 002 | Plasma arc gasifier to generate syngas |
| 003 | Emergency syngas flaring system |
| 004 | Multi-staged thermal oxidizer fueled by syngas, a HRSG and a STG |
| 005 | Emergency generator fueled by biodiesel or ultra low sulfur distillate (ULSD) fuel oil |
| 006 | Emergency fire water pump engine fueled by biodiesel or ULSD fuel oil |
| 007 | Auxiliary boiler fueled by natural gas |

## 4. ANNUAL EMISSIONS AND APPLICABLE REGULATIONS

The project will result in emissions of PM and $PM_{10}$, $NO_X$, $SO_2$, CO, VOC, fluoride (F), lead (Pb) and hazardous air pollutants (HAP) including dioxin/furan (D/F) and hydrogen chloride (HCl), cadmium (Cd) and mercury (Hg). Table 2 summarizes the applicant's estimates of the potential-to-emit (PTE) in TPY of key regulated air pollutants from the Geoplasma facility.

**Table 2 - Estimated PTE of Key Air Pollutants (in TPY)**

| Source Operation | PM | $PM_{10}$ | $NO_X$ | $SO_2$ | CO | VOC | Pb | HAP |
|---|---|---|---|---|---|---|---|---|
| Thermal Oxidizer | 25 | 25 | 33 | 16 | 33 | 33 | 0.32 | 16.4 |
| Flare System | 11 | 11 | <1 | 1.1 | 0.3 | 0.1 | 0 | 2 |
| Support Equipment[1] | <0.5 | <0.5 | 16 | <0.5 | 13 | 1 | 0.03 | 0.5 |
| Material Handling | 1.5 | 1.1 | 0 | 0 | 0 | 0 | | 0 |
| Total | 38.0 | 37.6 | 50.0 | 17.6 | 46.3 | 34.1 | 0.35 | 18.9[2] |

1 Support equipment consists of the emergency generator, emergency fire water pump engine and auxiliary boiler.
2 Largest single HAP is hydrogen chloride (HCl) at a total of 18.9 TPY.

The applicant estimates Hg emissions at approximately 10.2 lb/yr. Because more than 10.0 TPY of HCl will be emitted, the facility is a major source of HAP.

### 4.1. State Regulations

The project is subject to the applicable environmental laws specified in Section 403 of the Florida Statutes (F.S.) and to the following rules in the Florida Administrative Code (F.A.C.).

**Table 3 – Key State Regulations Potentially Applicable to the Geoplasma Project**

| F.A.C. Chapter | Description |
|---|---|
| 62-4 | Permits |
| 62-204 | Air Pollution Control – General Provisions |
| 62-210 | Stationary Sources of Air Pollution – General Requirements |
| 62-212 | Stationary Sources - Preconstruction Review |
| 62-213 | Operation Permits for Major Sources of Air Pollution |
| 62-214 | Requirements for Sources Subject To the Federal Acid Rain Program |
| 62-296 | Stationary Sources - Emission Standards |
| 62-297 | Stationary Sources - Emissions Monitoring |

### 4.2. Regulatory Classification

Following is a summary of the applicability of key regulations to the Geoplasma project.

**Chapter 62-4, F.A.C.** www.dep.state.fl.us/air/rules/fac/62-4.pdf

Rule 62-4.070(1), F.A.C., Standards for Issuing or Denying Permits; Issuance; Denial.

This rule applies to all permitting decisions:

- A permit shall be issued to the applicant upon such conditions as the Department may direct, only if the applicant affirmatively provides the Department with reasonable assurance based on plans, test results, installation of pollution control equipment, or other information, that the construction, expansion, modification, operation, or activity of the installation will not discharge, emit, or cause pollution in contravention of Department standards or rules.

**Chapter 62-204, F.A.C.** www.dep.state.fl.us/air/rules/fac/62-204.pdf

Rule 62-204.220(1), F.A.C., Ambient Air Quality Protection.

This rule applies to all air permitting decisions.

- The Department shall not issue an air permit authorizing a person to build, erect, construct, or implant any new emissions unit; operate, modify, or rebuild any existing emissions unit; or by any other means release or take action which would result in the release of an air pollutant into the atmosphere which would cause or contribute to a violation of an ambient air quality standard established under Rule 62-204.240, F.A.C.

Rule 62-204.240, F.A.C., Ambient Air Quality Standards.

This rule applies to all air permitting decisions.

- Refer to list of pollutants and ambient air quality standards provided therein and discussed in the Ambient Air Quality Section of this evaluation.

Rule 62-204.800(8), F.A.C., Title 40, Code of Federal Regulations (CFR), Part 60, Standards of Performance for New Stationary Sources (NSPS).

The following provisions incorporated into Rule 62-204.800(8), F.A.C. adopted from federal regulations and incorporated into this rule apply to this project:

- 40 CFR 60, Subpart A – General Provisions;
- 40 CFR 60, Subpart Eb - Standards of Performance for Large Municipal Waste Combustors;
- 40 CFR 60, Subpart Db – Industrial, Commercial, Institutional Steam Generating Units; and
- 40 CFR 60, Subpart IIII – Stationary Compression Ignition Internal Combustion Engines (ICE).

Rule 62-204.800(11), F.A.C., 40 CFR 63, National Emission Standards for HAP (NESHAP).

The following provision incorporated into Rule 62-204.800(11), F.A.C. adopted from federal regulations and incorporated into this rule applies to this project:

- 40 CFR 63, Subpart A – General Provisions; and
- 40 CFR 63, Subpart ZZZZ – Stationary Reciprocating Internal Combustion Engines (RICE).

**Chapter 62-210, F.A.C.** www.dep.state.fl.us/air/rules/fac/62-210.pdf

62-210.200, F.A.C., Definitions.

- The Geoplasma project is a major source of HAP because it has the PTE 10 TPY or more of any one HAP.
- The Geoplasma project is a Title V or "Major Source" of air pollution because it is a major source of HAP.
- The existing SLCBRF is not classified as a "Major Stationary Source" (PSD-source) because it does not emit and does not have a PTE 250 TPY or more of a PSD pollutant and is not one of the 28 facility categories listed in the definition with the PSD applicability threshold of 100 TPY.
- The proposed Geoplasma project is not a PSD-source because it will occur at a stationary source that is not a PSD-source and the project would not constitute a major stationary source by itself.

Rule 62-210.300, F.A.C., Permits Required.

- Unless exempted, the owner or operator of any facility or emissions unit which emits or can reasonably be expected to emit any air pollutant shall obtain appropriate authorization (i.e. a permit) from the Department prior to undertaking any activity at the facility or emissions unit for which such authorization is required.

Rule 62-210.350, F.A.C., Public Notice and Comment.

- A notice of proposed agency action on a permit application, where the proposed agency action is to issue the permit, shall be published by any applicant.
- The notice of intent to issue an air construction permit for this project shall provide a 14-day period for submittal of public comments.
- Additional public notice requirements for projects subject to PSD or Nonattainment-Area Preconstruction Review do not apply to this project.

Rule 62-210.700, F.A.C., Excess Emissions.

This rule applies to all air permitting decisions. Only the key provisions potentially affecting this project are listed.

- Excess emissions resulting from startup, shutdown or malfunction of any emissions unit shall be permitted providing (1) best operational practices to minimize emissions are adhered to and (2) the duration of excess emissions shall be minimized but in no case exceed two hours in any 24 hour period unless specifically authorized by the Department for longer duration.
- Excess emissions which are caused entirely or in part by poor maintenance, poor operation, or any other equipment or process failure which may reasonably be prevented during startup, shutdown, or malfunction shall be prohibited.

- Considering operational variations in types of industrial equipment operations affected by this rule, the Department may adjust maximum and minimum factors to provide reasonable and practical regulatory controls consistent with the public interest.

**Chapter 62-212, F.A.C.** www.dep.state.fl.us/air/rules/fac/62-212.pdf

Rule 62-212.300, F.A.C., General Preconstruction Review Requirements.

- This rule generally applies to the construction or modification of air pollutant emitting facilities in those parts of the state in which the state ambient air quality standards are being met.

**Chapter 62-213, F.A.C.** www.dep.state.fl.us/air/rules/fac/62-213.pdf

- Because the facility is a Title V source, the applicant will be required to apply for and obtain a Title V operation permit in the future.

**Chapter 62-296, F.A.C.** www.dep.state.fl.us/air/rules/fac/62-296.pdf

Rule 62-296.320, F.A.C., General Pollutant Emission Limitation Standards.

- This rule prohibits the discharge of air pollutants which cause or contribute to an objectionable odor;
- This rule specifies a visible emissions standard of 20 percent (%) opacity; and
- The rule prohibits emissions of unconfined PM provisions without taking reasonable precautions to prevent such emissions.

Rules 62-296.401, F.A.C., Incinerators and Rule 62-296.416, F.A.C., Waste-to-Energy Facilities.

- Incinerators and waste to energy facilities combust waste. The fuel slate authorized by this permit does constitute a waste or MSW according to the Department's rules. Therefore, these two rules do apply to this project.

Rule 62-296.406, F.A.C., Fossil Fuel Steam Generators with Less than 250 mmBtu Heat Input

- The fossil fuel capability of the auxiliary boiler will be less than 250 mmBtu/hr heat input. This rule applies only to the extent that fossil fuel is burned in the auxiliary boiler. This provision includes: a visible emissions standard of 20% opacity and a requirement to conduct a determination of best available control technology (BACT) for PM and $SO_2$ for fossil fuel combustion.

**403.061, F.S.** 403.061, F.S.

- According to this particular statute, the department shall have the power and the duty to control and prohibit pollution of air and water in accordance with the law and rules adopted and promulgated by it and, for this purpose, to: (18) encourage and conduct studies, investigations, and research relating to pollution and its causes, effects, prevention, abatement, and control.
- This particular project presents a novel approach and configuration for the processing of MSW, recovery of energy there from, and control of air pollutants including plasma arc gasification, combustion in a TO and use of SCR.

## 5. DEPARTMENT EVALUATION

The syngas-fueled TO and associated equipment constitutes the MWC regulated pursuant to 40 CFR 60, Subpart Eb. The concentration-based emission limits pursuant to Subpart Eb are provided in Table 4 for comparison with those proposed by the applicant. Additional details are provided in the subsequent sections.

**Table 4 - Comparison of Concentration-based Emission Limits from Geoplasma Project with Requirements for MWC's per Subpart Eb**

| Pollutant | Subpart Eb | Geoplasma |
|---|---|---|
| $NO_X$ | 180 ppmvd [1] (1st year)<br>150 (thereafter)<br>(24 hr mean) | 150 ppmvd<br>(24 hr mean)<br>7.6 lb/hr (12-month mean)<br>~13.9 ppmvd (12-month mean) [2] |
| CO | No specific limit for MWC burning gasified waste | 50 ppmvd<br>(24-hr block mean)<br>7.6 lb/hr (12-month mean)<br>~22.8 ppmvd (12-month mean) |
| $SO_2$ | 30 ppmvd or<br>80% control [3]<br>(24-hr geometric mean) | 30 ppmvd or<br>80% control<br>(24-hr geometric mean)<br>3.7 lb/hr (12-month mean)<br>~4.9 ppmvd (12-month mean) |
| VOC | N/A [4] | 7.6 lb/hour |
| HCl | 25 ppmvd or<br>95% control [3] | 25 ppmvd or<br>95% control<br>3.7 lb/hr (12-month mean)<br>~8.6 ppmvd (12-month mean) |
| PM | 20 mg/dscm [5] | 20 mg/dscm<br>5.7 lb/hr |
| Pb | 140 µg/dscm [6] | 140 µg/dscm |
| Hg | 50 µg/dscm or<br>85% control [3] | 3.9 µg/dscm (12 month mean) or<br>85% control |
| Cd | 10 µg/dscm | 10 µg/dscm |
| D/F | 13 ng/dscm [7] | 13 ng/dscm |
| VE | 10 % - 6 minute average | N/A |
| $NH_3$ Slip | N/A [4] | 2 ppmvd |

1. ppmvd means parts per million by volume, dry corrected to 7% oxygen (@7% $O_2$).
2. the '~' symbol means approximate concentration equivalent to corresponding 12-month lb/hr limit.
3. least stringent of the values.
4. VOC and $NH_3$ emission limit not required by Subpart Eb.
5. mg/dscm means milligrams per dry standard cubic meter (dscm) @7% $O_2$.
6. µg/dscm means micrograms/dscm @7% $O_2$.
7. ng/dscm means total nanograms/dscm @7% $O_2$.

## 5.1. Emissions and Controls for the TO

***$NO_X$ Emissions***

$NO_X$ formation: $NO_X$ formation may occur by three different mechanisms: fuel $NO_X$ is formed from nitrogen compounds contained in fuel (fuel nitrogen); thermal $NO_X$ is formed from molecular or atomic nitrogen ($N_2$) and oxygen ($O_2$) present in combustion air; and prompt $NO_X$ is formed in the proximity of the flame front as intermediate combustion products.

$NO_X$ control strategy: $NO_X$ will be controlled by the following measures:

- A type of multi-stage TO with reducing, conditioning and oxidizing sections will be used to combust the syngas. Flue gas recirculation (FGR) will be employed in two of the sections to reduce $NO_X$ formation; and
- Combustion exhaust gases will be treated in a SCR system that will convert $NO_X$ and injected $NH_3$ to molecular nitrogen ($N_2$) and water vapor ($H_2O$).

$NO_X$ emission limits: Following are the $NO_X$ emission limits proposed for this project:

- 150 ppmvd on a 24 hour arithmetic average to comply with 40 CFR 60 Subpart Eb; and
- 7.6 lb/hr on a 12-month rolling average, rolled monthly (applicant's request).

For reference, the proposed mass emission rate equates to a long-term value of 13.9 ppmvd @7% $O_2$. This would be the lowest known emission rate for any MWC in the U.S.

$NO_X$ monitoring: Compliance with the $NO_X$ limits will be monitored through the continuous emission monitoring system (CEMS) specifications for units subject to 40 CFR 60, Appendices A and F.

***$SO_2$ and HCl Emissions***

$SO_2$ and HCl formation: $SO_2$ and HCl are formed from sulfur and chloride (Cl) compounds contained in MSW, coke and tires.

$SO_2$ and HCl control strategy:

- Use of limestone in a FGD system to control $SO_2$ and acid gases including HCl.

A by-product of the FGD system will be gypsum which will be sold to wallboard manufacturers.

$SO_2$ emission limits: Following are the $SO_2$ emission limits proposed for this project:

- 30 ppmvd on a 24 hour geometric average or 80% reduction whichever is less stringent to comply with 40 CFR 60 Subpart Eb; and
- 3.7 lb $SO_2$/hr on a 12-month average, rolled monthly (applicant's request).

For reference, the proposed mass emission rate equates to a long-term value of 4.9 ppmvd @7% $O_2$.

$SO_2$ monitoring:

- Compliance with the $SO_2$ limits will be monitored using the $SO_2$-CEMS specifications equal to those of units subject to 40 CFR 60, Appendices A and F.

HCl emission limits:

- 25 ppmvd HCl or 95% reduction whichever is less stringent to comply with 40 CFR 60 Subpart Eb; and
- 3.7 lb HCl/hr on a 12-month average, rolled monthly (applicant's request).

For reference, the proposed mass emission rate equates to a long-term value of 8.6 ppmvd HCl.

$SO_2$ and HCl monitoring:

- Compliance with the HCl limits will be monitored using initial and annual stack tests using EPA Test Methods 26 or 26A.

***PM/PM$_{10}$, Metals and Visible Emissions (VE)***

Particulate formation. PM/PM$_{10}$ are formed from ash contained in the MSW, coke, tires and other permitted feedstocks, products of incomplete combustion and from chemical reactions between products of combustion that form alkali and ammoniated chlorides, sulfates, nitrates and other such species. These emissions are also reflected as VE from stacks or contribute to regional haze due to further reactions in the atmosphere. Metals refer to Pb and Cd that are constituents of PM/PM$_{10}$ and are specifically limited by 40 CFR 60, Subpart Eb.

Particulate control strategy:

- Low $NO_X$ and $SO_2$ emissions to minimize formation of fine particulate species;
- Use of an ESP;
- SCR to minimize the amount of $NH_3$ injection (needed to reduce $NO_X$) and $NH_3$ slip that would otherwise participate in fine particle formation; and
- Use of a fabric filter baghouse.

Particulate and VE limits: Following are the particulate emissions limit proposed for this project:

- 20 mg/dscm of PM/PM$_{10}$ to comply with 40 CFR 60 Subpart Eb;
- 10 and 140 µg/dscm respectively of Cd and Pb to comply with 40 CFR 60 Subpart Eb;
- 5.7 lb/hr of PM/PM$_{10}$ (applicant's request);
- A baghouse design of 0.01 grains per dry standard cubic foot (gr/dscf) or better;
- $NH_3$ limit of 2 ppmvd at 7% $O_2$; and
- A VE limit of 10% (6-minute average) that will satisfy the minimum VE standard of 20% opacity per Rules 62-296.320 and 62-296.406, F.A.C.

Particulate and VE monitoring:

- Initial and annual particulate testing using EPA Methods 5 and 202;
- Initial and annual tests for Cd and Pb by EPA Method 29;
- Initial and annual VE tests by EPA Method 9 and measurements by a continuous opacity monitoring system (COMS); and
- Initial and annual $NH_3$ testing using EPA Method 320.

***Hg Emissions***

Hg sources and release: Hg is volatilized and released during combustion. The primary sources of mercury in MSW include batteries, thermostats, thermometers, switches and lamps.

Hg control strategy: A key component of the Hg control strategy is to continue present programs practiced at the SLCBRF. The main process strategy is the PACI system in conjunction with the fabric filter baghouse.

Hg limit: Following are the proposed Hg limits:

- 50 µg/dscm to comply with 40 CFR 60 Subpart Eb; and either
- 3.9 µg/dscm (applicant's request); or
- 85% removal whichever is less stringent.

The Department will apply a 12-month averaging time to the lower concentration limit.

Hg monitoring:

- Initial and annual test for Hg by EPA Method 29 to demonstrate compliance with the higher Subpart Eb limit; and
- Compliance with the lower 12-month Hg concentration limit will be monitored using a Hg-CEMS as described in 40 CFR 60, Subpart Eb (Section 60.58(n).

***Dioxin/furan (D/F) emissions***

D/F formation: The gasification of MSW provides the opportunity to form ringed hydrocarbon compounds. In the presence of chlorides, the opportunity for D/F formation exists.

D/F control strategy:

- Sufficient residence time in the gasifier;
- Thorough destruction of VOC in the TO;
- PACI system in conjunction with the fabric filter baghouse; and
- Further destruction by the SCR system.

D/F limit:

- 13 ng/dscm of D/F.

D/F Monitoring:

- Initial and annual test for D/F by EPA Method 23 to demonstrate compliance with the Subpart Eb limit.

***Sulfuric Acid Mist (SAM) Emissions***

SAM formation: SAM is formed by further oxidation of $SO_2$ to sulfur trioxide ($SO_3$) prior to exiting the process. $SO_3$ readily combines with water vapor ($H_2O$) available in flue gas to form SAM ($H_2SO_4$). SAM condenses on the cool surfaces in the exhaust duct, air pollution control equipment or on fly ash particles.

SAM control strategy: The SAM control strategy relies on the $SO_2$, HCl, $PM/PM_{10}$ and VE control strategies.

SAM limits: No limits on SAM are proposed or required.

SAM monitoring: The monitoring of $SO_2$, condensable PM and visible emissions is sufficient for the purposes of insuring that SAM emissions are actually low. The Department will require an initial stack test to determine the SAM emission characteristics of the TO and control system.

***CO and VOC Emissions***

CO and VOC formation: CO and VOC are products of incomplete combustion.

CO and VOC control strategy: Following is the CO and VOC emissions control strategy for this project:

- High temperature gasification followed by combustion in a multistage TO; and
- Incorporation of SCR for $NO_X$ control will help to reduce VOC emissions including organic HAP emissions such as dioxin and furan (D/F).

CO emission limits: Following are the CO emission limits proposed for this project:

- 50 ppmvd on a 24 hour block arithmetic average; and
- 7.6 lb/hr on a 12-month rolling average (applicant's request).

For reference there is no stated CO limit in 40 CFR 60 Subpart Eb for a gasification/TO configuration. CO limits for other categories range from 50 to 150 ppmvd and averaging times between 4 and 24 hours. For reference, the proposed mass emission rate equates to a long-term value of 22.8 ppmvd for CO.

VOC emission limits: Following are the VOC emission limits proposed for this project:

- 7.6 lb/hr on a 12-month rolling average (applicant's request).

CO and VOC monitoring:

Compliance with the long-term hourly CO limit will be monitored by CEMS in accordance with Performance Specification 4A of 40 CFR 60, Appendix B. The Department will require an initial stack test to determine the VOC emission characteristics of the unit using total hydrocarbons (THC) as a surrogate.

### 5.2. *Startup, Shutdown and Malfunctions – Proposed TO*

The standards under 40 CFR 60, Subpart Eb apply at all times except during periods of startup, shutdown or malfunction pursuant to 40 CFR 60.56b. Duration of startup or shutdown periods are limited to 3 hours per occurrence, except as provided in 40 CFR 60.58b(a)(1)(iii). During periods of startup, shutdown, or malfunction, monitoring data shall be dismissed or excluded from compliance calculations, but shall be recorded and reported in accordance with the provisions of 40 CFR 60.59b(d)(7).

The startup period commences when the affected facility begins the continuous gasification of municipal solid waste and does not include any warm-up period when the affected facility is combusting fossil fuel or other non-municipal solid waste fuel, and no municipal solid waste is being fed to the combustor.

Continuous gasification is the continuous, semi-continuous, or batch feeding of municipal solid waste for purposes of waste disposal, energy production, or providing heat to the combustion system in preparation for waste disposal or energy production.

Because of the long-term nature of all of the $NO_X$, $SO_2$, CO and Hg CEMS based mass emission rate limits and to avoid triggering PSD, all emissions data for these pollutants, including periods of startup, shutdown and malfunction, shall be included in any compliance determinations based on CEMS data.

### 5.3. Emissions and Controls for the Support Equipment

***Emergency Generator***

The emergency generator will be used 500 hours or less per year. Table 5 provides the emission limits pursuant to 40 CFR 60, Subpart IIII. Compliance with this standard also satisfies the requirements of 40 CFR 63, Subpart ZZZZ.

**Table 5 - NSPS Subpart IIII – Standards Applicable to Emergency Generator**

| **Capacity Category** (2007 and later) | **CO** (g/kW-hr)[1] | **PM** (g/kW-hr) | **$SO_2$**[2] **(% S)** | **NMHC**[3]**+$NO_X$** (g/kW-hr) |
|---|---|---|---|---|
| (130 ≤ kW ≤ 560 kW) | 2.6 | 0.15 | 0.0015 | 3.0 |

1. g/kW-hr means grams per kilowatt-hour.
2. $SO_2$ emission standard will be met by using ULSD fuel oil in the emergency generator and the wood chipper with fuel sulfur (S) content of 0.0015% by weight.
3. NMHC means Non-Methane Hydrocarbons.

***Emergency Fire Pump Engine***

The emergency fire pump engine will be used 500 hours or less per year. Table 6 is a summary of the emission limits pursuant to 40 CFR 60, Subpart IIII for the category that covers the fire pump engine.

**Table 6 - NSPS Subpart IIII – Emission Standards Applicable to the Emergency Pumps**

| **Emergency Pumps** (2009 and later) | **CO** (g/hp-hr)[1] | **PM** (g/hp-hr) | **$SO_2$**[2] **(% S)** | **NMHC+$NO_X$** (g/hp-hr) |
|---|---|---|---|---|
| (300 ≤ HP < 600) | 2.6 | 0.15 | 0.0015 | 3.0 |

1. g/hp-hr means grams per horsepower-hour.
2. $SO_2$ emission standard will be met by using ULSD FO in the emergency pumps with a fuel sulfur content of 0.0015% by weight.

***Auxiliary Boiler***

One natural gas fired auxiliary boiler is required to provide steam in the event the plasma arc gasifier is not in operation. The specifications of the auxiliary boiler are:

- The maximum heat input rate to the auxiliary boiler is restricted to no more than 216 mmBtu/hr on a 4-hour average basis;
- The auxiliary boiler shall fire only natural gas with a maximum fuel sulfur content of 20 grains per 100 standard cubic foot;
- The hours of operation of the auxiliary boiler are restricted to no more than 1,314 hours in any consecutive 12 month period at its maximum firing rate; and
- If the auxiliary boiler is fired at less than the permitted capacity, the operational hours shall be prorated based on the firing rate, e.g., at 50% capacity every hour of "actual" operation equals 30 minutes of permitted operation.

The auxiliary boiler is subject to the small boiler BACT requirements of Rule 62-296.406, F.A.C., which includes a determination of the Best Available Control Technology (BACT) for PM and $SO_2$ emissions. For this project, BACT for PM and $SO_2$ emissions is determined to be the firing of clean natural gas as the only authorized fuel. In addition, the auxiliary boiler is subject to all applicable requirements of 40 CFR 60, Subpart Db which applies to Small Industrial, Commercial or Institutional Boilers.

<u>$NO_X$ and Opacity emission limits</u>: The auxiliary boiler shall meet the following emissions limits:

- <u>$NO_X$ Emissions</u>: $NO_X$ emissions shall not exceed 0.20 pounds per mmBtu; and
- <u>Opacity</u>: VE shall not exceed 20% opacity except for one 6-minute period per hour that shall not exceed 27% opacity.

<u>$NO_X$ and Opacity monitoring</u>:

In accordance with EPA Method 7E, the auxiliary boiler stack shall be tested to demonstrate initial compliance with the $NO_X$ emissions standard. Subsequently, compliance on a thirty day rolling average basis shall be shown utilizing a $NO_X$ CEMS. In accordance with EPA Method 9, the auxiliary boiler stack shall be tested initially and annual to demonstrate compliance with the VE standard.

## 6. AMBIENT AIR QUALITY

### 6.1. <u>Introduction</u>

The proposed project maximum emission rates are well below PSD threshold levels, therefore an ambient air quality modeling analysis was not required for this project. However, the applicant provided an ambient air quality analysis to show compliance with the Ambient Air Quality Standards (AAQS). The following sections include the AAQS analysis, a review of current air quality in the vicinity of the project and information regarding this project and how it relates to other nearby sources of pollution.

## 6.2. Major Stationary Sources Near the Proposed Geoplasma Site

The proposed project is in St. Lucie County. Tables 7 to 11 below are lists of the largest stationary sources, by pollutant, in St. Lucie County and includes some larger sources in neighboring Martin County. The information is from annual operating reports submitted by the operators to the Department for 2009. Some data is from 2008 (noted below) due to incomplete data from 2009.

**Table 7 - Largest Sources of $NO_X$ (2009)**

| Owner | Site Name, County | TPY |
|---|---|---|
| Florida Power & Light (FPL) | FPL Martin Power Plant (2008), Martin County | 4,688 |
| Indiantown Cogeneration | Indiantown Cogeneration, Martin County | 1,301 |
| Florida Gas Transmission (FGT) Co. | FGT Station 20, St. Lucie County (SLC) | 289 |
| **St. Lucie Plasma Gasification** | **Plasma Gasification Facility (Proposed), SLC** | **50** |
| Tropicana Manufacturing | Tropicana Ft. Pierce, SLC | 34 |
| Florida Municipal Power Agency (FMPA) | Treasure Coast Energy Center, SLC | 33 |
| Florida Power and Light | St. Lucie Nuclear Power Plant, SLC | 32 |
| Ft. Pierce HD King Power Plant | HD King Power Plant (2008), SLC | 28 |

**Table 8 - Largest Sources of $SO_2$ (2009)**

| Owner | Site Name, County | TPY |
|---|---|---|
| FPL | FPL Martin Power Plant (2008), Martin County | 7,734 |
| Indiantown Cogeneration | Indiantown Cogeneration, Martin County | 1,767 |
| **St. Lucie Plasma Gasification** | **Plasma Gasification Facility (Proposed), SLC** | **18** |
| Ranger Construction Industries | Ranger Ft. Pierce, SLC | 7 |
| Dickerson Florida | Dickerson Asphalt Plant 14, SLC | 6 |
| FMPA | Treasure Coast Energy Center, SLC | 4 |

**Table 9 - Largest Sources of $PM/PM_{10}$ (2009)**

| Owner | Site Name, County | TPY |
|---|---|---|
| FPL | FPL Martin Power Plant (2008), Martin County | 844 |
| FMPA | Treasure Coast Energy Center, SLC | 40 |
| **St. Lucie Plasma Gasification** | **Plasma Gasification Facility (Proposed), SLC** | **38** |
| Tropicana Manufacturing | Tropicana Ft. Pierce, SLC | 12 |
| FGT | FGT Station 20, SLC | 5 |
| Dickerson Florida | Dickerson Asphalt Plant 14, SLC | 5 |

**Table 10 - Largest Sources of CO (2009)**

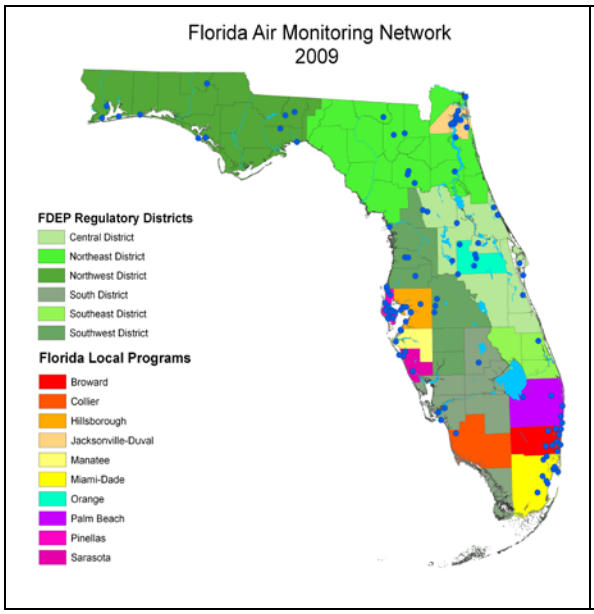
| Owner | Site Name, County | TPY |
|---|---|---|
| FPL | FPL Martin Power Plant (2008), Martin County | 1,451 |
| Louis Dreyfus Citrus | Indiantown Plant, Martin County | 776 |
| Tropicana Manufacturing | Tropicana Ft. Pierce, SLC | 144 |
| Indiantown Cogeneration | Indiantown Cogeneration, Martin County | 123 |
| FGT | FGT Station 20, SLC | 73 |
| **St. Lucie Plasma Gasification** | **Plasma Gasification Facility (Proposed), SLC** | **46** |
| Ranger Construction Industries | Ranger Ft. Pierce, SLC | 15 |
| Dickerson Florida | Dickerson Asphalt Plant 14, SLC | 13 |

**Table 11 - Largest Sources of VOC (2009)**

| Owner | Site Name | TPY |
|---|---|---|
| Louis Dreyfus Citrus | Indiantown Plant, SLC | 768 |
| Tropicana Manufacturing | Tropicana Ft. Pierce, SLC | 582 |
| FPL | FPL Martin Power Plant (2008), Martin County | 196 |
| FGT | FGT Station 20, SLC | 50 |
| S2 Yachts | S2 Yachts, SLC | 38 |
| **St. Lucie Plasma Gasification** | **Plasma Gasification Facility (Proposed), SLC** | **34** |
| Maverick Boat Company | Maverick Boat Company, SLC | 14 |

## 6.3. Ambient Air Monitoring Network

The State ambient air monitoring network operated by the Department and its partners (local air pollution control programs) includes monitors in counties containing over 90% of the population. As Figure 12 indicates, the ambient air monitoring sites are concentrated in areas of high population density, along the coasts and near major highways in the interior portion of the state.



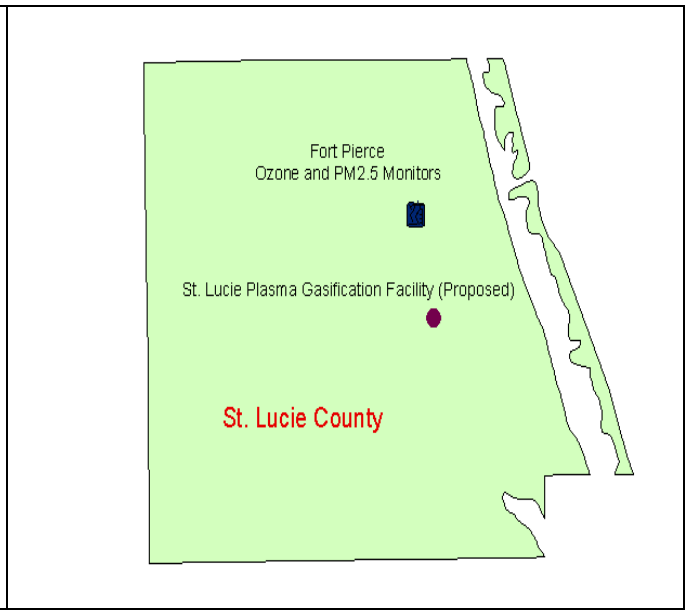




**Figure 12 – Florida Air Monitoring Network 2009** **Figure 13. Monitors in St. Lucie County**

The Department operates a monitoring site in Ft. Pierce, St. Lucie County for the measurement of ozone and $PM_{2.5}$ as shown in Figure 13 above and Table 12.

**Table 12 – Description of Ambient Monitoring Site in Fort Pierce, St. Lucie County**

| Station | Parameter | Frequency | Designation | Status |
|---|---|---|---|---|
| Ft. Pierce, 101 North Rock Road | Ozone | Continuous | SLAMS | Regulatory |
| | $PM_{2.5}$ | Every 3 days | SLAMS | Primary Regulatory |
| | $PM_{2.5}$ | Every 12 days | Collocated | Backup to regulatory |
| | $PM_{2.5}$ | Continuous | SPM | Non-regulatory |

1. SLAMS means State and Local Air Monitoring Stations used for regulatory AAQS attainment determinations
2. Data from a collocated sampler, if available, can be substituted for the primary sampler if the primary sampler was not operating or did not produce a valid measurement for that same day
3. SPM means Special Purpose Monitors and are not used for regulatory determinations

## 6.4. Existing Ambient Air Quality – $PM_{2.5}$ and Ozone

Ozone is a key indicator of the overall state of regional air quality. It is not emitted directly from combustion processes. Rather it is formed from VOC and $NO_X$ emitted primarily from regional industrial and transportation sources. VOC is also emitted from fires and vegetation (e.g. isoprene). These two precursors participate in photochemical reactions that occur on an area-wide basis and are highly dependent on meteorological factors.

Ozone limits and measurements are summarized on three year blocks, rolled annually. The reported ozone value was calculated by taking the maximum 8-hour readings recorded each day during the three years. The fourth highest of the recorded maxima were identified for each year and then the average of those three values was reported as the compliance value.

The St. Lucie County ozone compliance value is 63 parts per billion (ppb). It is shown in Figure 14 below, which shows the highest compliance values measured in each county where at least one ozone station is located.

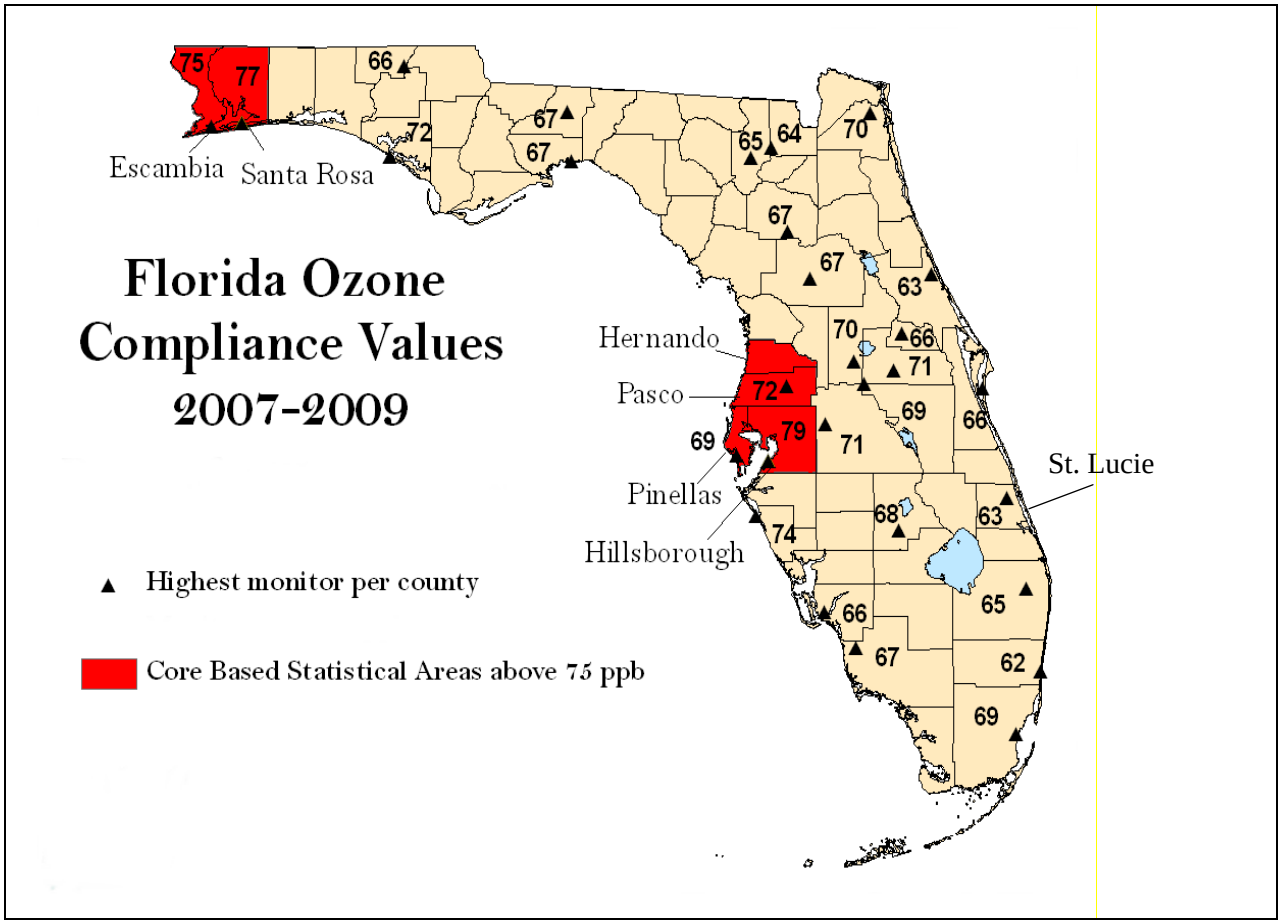



**Figure 14 – Florida Ozone Compliance Values**

$PM_{2.5}$ (also known as $PM_{fine}$) is another key indicator of the overall state of regional air quality. Some $PM_{2.5}$ is directly emitted as a product of combustion from transportation and industrial sources as well as fires. Much of it consists of particulate nitrates and sulfates formed through chemical reactions between gaseous precursors such as $SO_2$ and $NO_X$ from combustion sources and ammonia ($NH_3$) naturally present in the air or added by other industrial sources.

$PM_{2.5}$ limits and measurements are summarized on three year blocks, rolled annually. The reported 24-hour compliance value for $PM_{2.5}$ of 18 μg/m$^3$ shown in Figure 15 for the Ft. Pierce site was calculated by taking the average 24-hour readings recorded each day during the three years (2007-2009). The value for each year that exceeds 98% of all daily measurements within each given year was identified and then the average of those three numbers was reported as the 24-hour compliance value and compared with the standard of 35 μg/m$^3$.

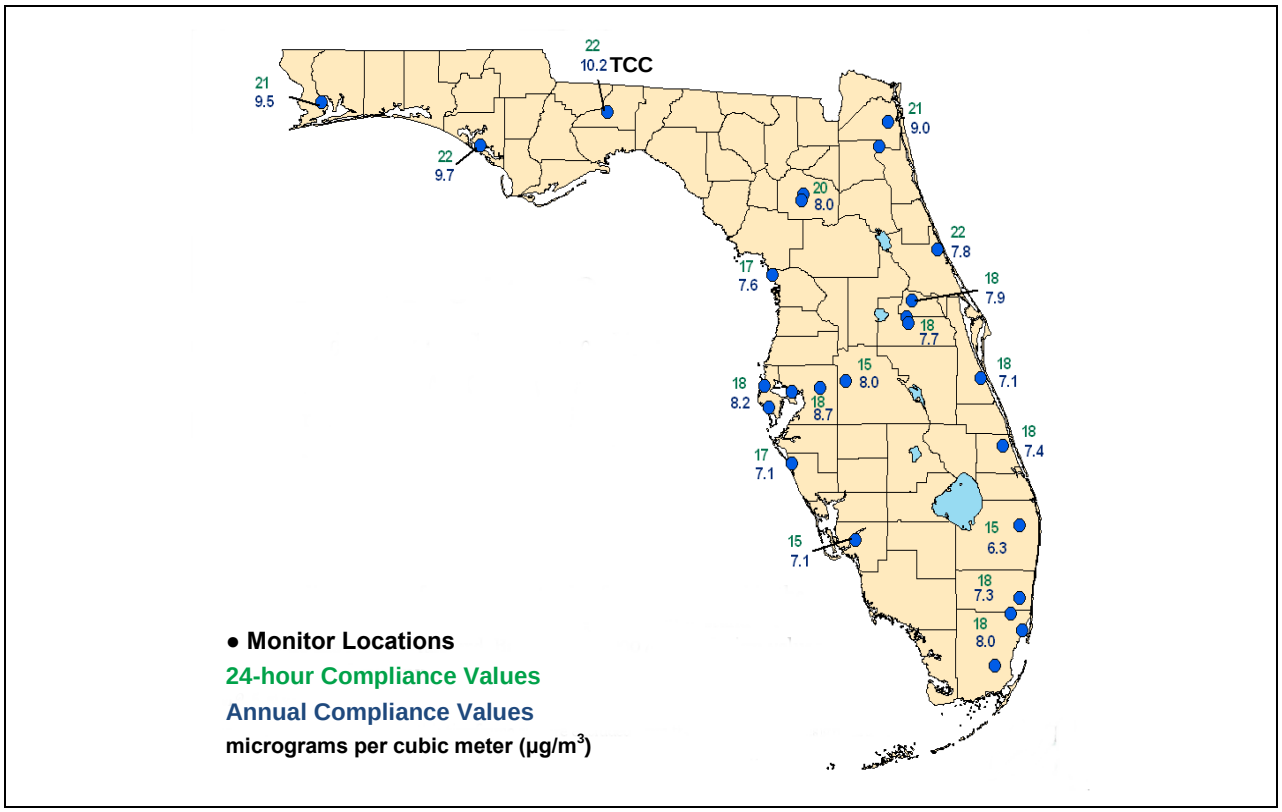



**Figure 15 – Florida $PM_{2.5}$ Compliance Values**

The simple average of all $PM_{2.5}$ measurements within each three years (2007-2009) was also calculated and then the mean of the three averages (7.4 μg/m$^3$) was reported as the annual compliance value and compared with the standard of 15 μg/m$^3$.

The results indicate that St. Lucie County is in attainment with the applicable ozone and $PM_{2.5}$ AAQS.

## 6.5. Ambient Air Monitoring – $NO_2$, $SO_2$, $PM_{10}$ and CO

Nitrogen dioxide ($NO_2$), $SO_2$, CO and $PM_{10}$ are directly emitted or quickly formed from combustion sources. $PM_{10}$ is also generated from material processing operations and entrained by wind, traffic, farming and other human activities. These criteria pollutants are monitored near areas of large stationary sources, large population centers or high traffic areas where both emissions and monitored concentrations of pollutants would generally be highest.

There are no active monitors for these four pollutants in St. Lucie County. None are required by federal and state procedures for siting National Ambient Monitoring Stations (NAMS) or SLAMS. Table 13 includes concentrations from key ozone and $PM_{2.5}$ monitors in St. Lucie County as well as values from $PM_{10}$, CO, $NO_2$ and $SO_2$ monitors located in counties where there is an expectation of equal or greater concentrations compared with what would be likely in St. Lucie County.

The measurements of $SO_2$, $NO_2$ and CO are one or more orders of magnitude less than the respective AAQS. There are greater transportation and industrial emissions in the areas where the stations are located (e.g. residual oil fueled power plant in Riviera Beach and the sugar industry in Palm Beach County). Values of the same pollutants should be lower in St. Lucie County, and certainly within the respective standards.

**Table 13 - Ambient Air Quality Measurements Nearest to the Project Site (2009)**

| Pollutant | Location | Averaging Period | Ambient Concentration | | | |
|---|---|---|---|---|---|---|
| | | | Compliance Period | Value | Standard | Units [g] |
| Ozone | Ft. Pierce | 8-hour | 2007-2009 | 63 [a] | 75 [a] | ppb |
| $PM_{2.5}$ | Ft. Pierce | 24-hour | 2007-2009 | 18 [b] | 35 [b] | $\mu g/m^3$ |
| | | Annual | 2007-2009 | 7.4 [c] | 15 [c] | $\mu g/m^3$ |
| $PM_{10}$ | Delray Beach, Palm Beach County | 24-hour | 2007-2009 | 59 [d] | 150 [d] | $\mu g/m^3$ |
| | | Annual | 2009 | 17 [e] | 50 [e] | $\mu g/m^3$ |
| $SO_2$ | Riviera Beach, Palm Beach County | 3-hour | 2009 | 13 | 1300 [f] | $\mu g/m^3$ |
| | | 24-hour | 2009 | 8 | 260 [f] | $\mu g/m^3$ |
| | | Annual | 2009 | 4 | 60 [f] | $\mu g/m^3$ |
| $NO_2$ | Lantana, Palm Beach County | Annual | 2009 | 10 | 100 [f] | $\mu g/m^3$ |
| CO | Ft. Lauderdale | 1-hour | 2009 | 3,565 | 40,000 [f] | $\mu g/m^3$ |
| | | 8-hour | 2009 | 2,300 | 10,000 [f] | $\mu g/m^3$ |

a. Three year average of the 4th highest daily maximum.
b. Three year average of the 98th percentile of 24-hour concentrations.
c. Three year average of the weighted annual mean.
d. Not to be exceeded on more than an average of one day per year over a three-year period.
e. Arithmetic mean.
f. Not to be exceeded more than once per year.
g. Units are in: micrograms per cubic meter (ug/m3) or parts per billion (ppb).

## 6.6. Air Quality Impact Analysis

Models and Meteorological Data Used in the Air Quality Analysis

The AERMOD modeling system was used to evaluate the pollutant emissions from the proposed project. AERMOD was approved by the EPA in November 2005. The AERMOD modeling system incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including the treatment of both surface and elevated sources, and both simple and complex terrain. AERMOD contains two input data processors, AERMET and AERMAP. AERMAP is the terrain processor and AERMET is the meteorological data processor. The applicant uses the proposed project's emissions at worst load conditions as inputs to AERMOD.

A series of specific model features, recommended by the EPA, are referred to as the regulatory options. The applicant used the EPA recommended regulatory options. Direction specific downwash parameters were used for all sources for which downwash was considered. The stacks associated with this project all satisfied the good engineering practice (GEP) stack height criteria.

The AERMET meteorological data used for this analysis consisted of a concurrent 5-year period of hourly surface weather observations and twice-daily upper air soundings from the National Weather Service at West Palm Beach International Airport and Florida International University (FIU) in Miami, respectively. The 5-year period of meteorological data was from 2001 through 2005.

In reviewing this permit application, the Department has determined that the application complies with the applicable provisions of the stack height regulations as revised by EPA on July 8, 1985 (50 FR 27892). Portions of the regulations have been remanded by a panel of the U.S. Court of Appeals for the D.C. Circuit in NRDC v. Thomas, 838 F. 2d 1224 (D.C. Cir. 1988). Consequently, this permit may be subject to modification should EPA revise the regulation in response to the court decision. This may result in revised emission limitations or may affect other actions taken by the source owners or operators.

For the NAAQS analysis, a combination of fence line receptors and receptors beyond the fence line were chosen for predicting maximum concentrations in the vicinity of the project out to 4 kilometers (km). The receptor grid consisted of receptors spaced at 50-meter (m) intervals around the facility fence line. Beyond the fence line, receptors were spaced at 100 m out to 2km and 200m spacing from 2 to 4 km.

The applicant provided a modeling analysis to ensure compliance with the national AAQS. The applicant also prepared a Significant Impact Analysis for the proposed project. If the proposed project has modeled concentrations above the Significant Impact Levels, then a multi-source modeling analysis must be done to ensure compliance with the national AAQS. The maximum predicted annual and maximum predicted high, second high short term average for the Significant Impact Analysis are summarized in Table 14 below. As shown in this table, emissions from the proposed facility are below the Significant Impact Levels and therefore, are not expected to significantly cause or contribute to a violation of an AAQS.

**Table 14 - Maximum Predicted Air Quality Impacts from Geoplasma Project**

| Pollutant | Averaging Time | Max Predicted Impact ($\mu g/m^3$) | Significant Impact Level ($\mu g/m^3$) | 2009 Baseline Concentrations ($\mu g/m^3$) | Total Impact ($\mu g/m^3$) | Ambient Air Standards ($\mu g/m^3$) |
|---|---|---|---|---|---|---|
| $PM_{10}$ | Annual | 0.2 | 1 | 17 | 17 | 50 |
| | 24-Hour | 2 | 5 | 59 | 61 | 150 |
| $SO_2$ | Annual | 0.2 | 1 | 4 | 4 | 80 |
| | 24-Hour | 1.3 | 5 | 8 | 9 | 365 |
| | 3-hour | 2.6 | 25 | 13 | 16 | 1300 |
| $NO_2$ | Annual | 0.2 | 1 | 10 | 10 | 100 |
| CO | 1-hour | 6.5 | 2,000 | 3,265 | 3,272 | 40,000 |
| | 8-hour | 3.9 | 500 | 2,300 | 2,304 | 10,000 |

The applicant also evaluated maximum predicted $PM_{2.5}$ impacts. All $PM_{10}$ emissions were assumed to be $PM_{2.5}$ emissions, which is a conservative assumption. The maximum predicted $PM_{10}$ impacts shown in the previous table were added to the measured $PM_{2.5}$ background concentrations from St. Lucie County. The total impacts are shown in the Table 15 below. The table shows these impacts are less than the national AAQS.

**Table 15 – Maximum Predicted $PM_{2.5}$ Impacts from the Geoplasma Project**

| Pollutant | Averaging Time | Max Predicted Impact ($\mu g/m^3$) | 2009 Baseline Concentrations ($\mu g/m^3$) | Total Impact ($\mu g/m^3$) | Ambient Air Standards ($\mu g/m^3$) |
|---|---|---|---|---|---|
| $PM_{2.5}$ | Annual | 0.2 | 7.4 | 7.6 | 15 |
| | 24-Hour | 2 | 18 | 20 | 35 |

The EPA established a new one hour standard for $NO_2$. The new standard of 189 $\mu g/m^3$ calculated as the 3-year average of the 98th percentile of the daily maximum one-hour average concentrations became effective on April 12, 2010. The applicant did not model $NO_2$ on an hourly basis. However, the applicant modeled CO on an hourly basis as shown above and calculated an impact of 6.5 $\mu g/m^3$ of CO.

Because the CO and $NO_X$ emission rates for the project are approximately equal, it is reasonable to assume that the project $NO_2$ impact will also be 6.5 $\mu g/m^3$. If short-term $NO_X$ emissions were actually an order of magnitude greater than CO emission, then the impact on ambient $NO_2$ would be on the order of 65 $\mu g/m^3$.

The Department reviewed the most recent $NO_2$ data measured at the most representative site. The data are summarized in the Table 16 below.

**Table 16 – Ambient $NO_2$ Air Quality Measurements at West Palm Beach Lantana Station**

| Pollutant | Location | Averaging Period | Ambient Concentration ($\mu g/m^3$) | |
|---|---|---|---|---|
| | | | Year | 2nd Highest Value |
| $NO_2$ | West Palm Beach, Lantana | 1-hour | 2009 | 83 |
| | | | 2008 | 87 |
| | Average of two years | 1-hour | 2008-2009 | 85 |

By adding the estimated project impact of 6.5 $\mu g\ NO_2/m^3$ to the background value of 85 $\mu g\ NO_2/m^3$, the total is approximately 92 and is less than the value of the new standard. If the $NO_2$ impact is actually 65 $\mu g\ NO_2/m^3$ then the total including background would be approximately 150 $\mu g/m^3$ and also still less than the value of the new standard.

The applicant also provided a conservative modeling analysis which compared maximum predicted $PM_{10}$, $SO_2$ and $NO_2$ values with the Significant Impact Levels for the Class I areas (e.g. Everglades National Park). The applicant used the same modeling methods for this analysis but placed receptors 50 km away from the facility since all Class I areas in Florida are beyond 50 km from the facility. The results of the analysis are shown in Table 17 below. At 50 km away from the facility, the modeled impacts are well below the Class I Significant Impact Levels.

**Table 17 - Maximum Predicted Air Quality Impacts from the Geoplasma Project at 50 km Distance**

| Pollutant | Averaging Time | Max Predicted Impact ($\mu g/m^3$) | Class I Significant Impact Level ($\mu g/m^3$) |
|---|---|---|---|
| $PM_{10}$ | Annual | 0.0002 | 0.2 |
| | 24-Hour | 0.007 | 0.3 |
| $SO_2$ | Annual | 0.0002 | 0.1 |
| | 24-Hour | 0.004 | 0.2 |
| | 3-hour | 0.02 | 1 |
| $NO_2$ | Annual | 0.0002 | 0.1 |

## 7. CONCLUSION

The Department makes a preliminary determination that the proposed project will comply with all applicable state and federal air pollution control regulations as conditioned by the Draft Permit. The project contacts are:

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