The Case Against Plasma Arc Waste Incineration

What is Plasma Arc Gasification?

Gasification exposes waste to temperatures above 1400°F in the absence of oxygen. Waste is converted to hydrogen and carbon monoxide gas, carbon char, inert materials and heavy metals. The synthetic gas is burned in a second chamber. Plasma Arc or plasma torch units utilize an electric arc to heat waste, creating the synthetic gas. Conventional mass burn incinerators are *excess air* combustion units; that is, waste is burned in the presence of more air than is necessary to oxidize or burn the materials in the firebox. Gasification and plasma arc incinerators utilize *starved air* combustion to create a fuel gas. Contrary to some vendor's claims, every plasma arc proposal for waste processing includes combustion and a smokestack (See Figure A).

The St. Lucie Plasma Arc Incinerator

Plasma Gasification Project
Waste to Energy Facility
St. Lucie County, Florida

Applicant: Geoplasma-St. Lucie, LLC
DEP File No. 1110138-001-AC

The Florida Department of Environmental Protection is presently considering a proposal to construct and operate a municipal waste incineration facility in St. Lucie County, Florida. If permitted, the proposed plant would incinerate 686 tons per day of municipal solid waste and tires to power a 24 megawatt plasma arc gasification waste-to-energy unit. The St. Lucie Plasma Gasification Project would operate on the existing landfill site on Florida's Atlantic Coast, about eight miles southwest of Fort Pierce. If built, this would be the first large-scale plasma arc facility in the United States to use municipal solid waste to generate electrical power.[a] According to Florida DEP, the project is an incinerator:[b]

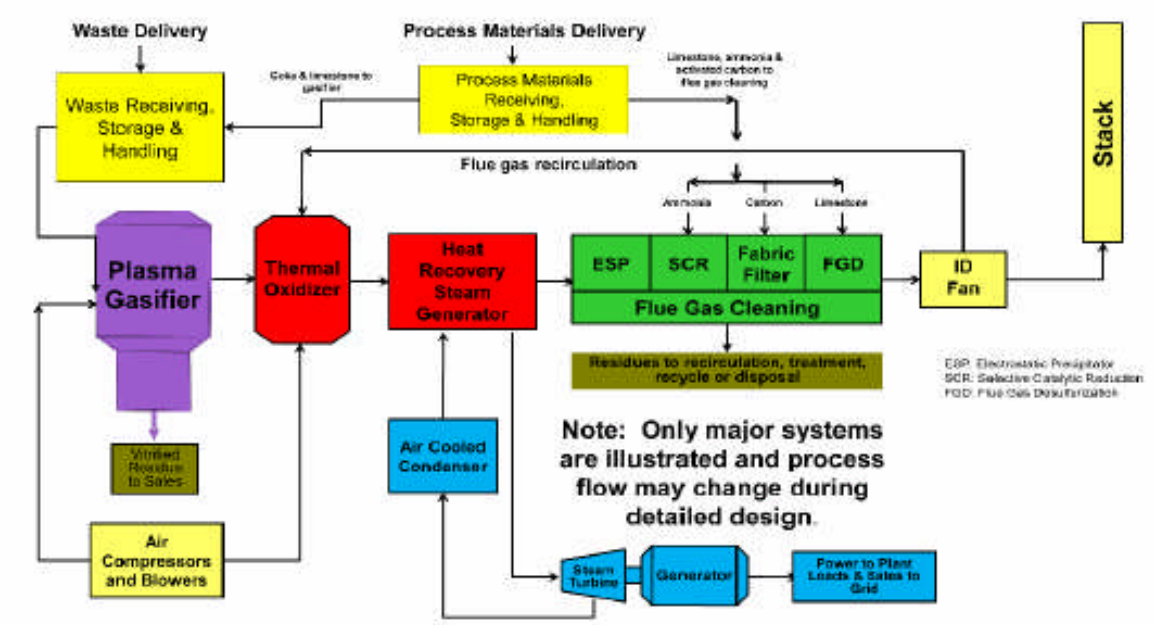
> The proposed Geoplasma facility is a new Large Municipal Waste Combustor (Large MWC) because it is a waste combustion unit that is capable of combusting more than 250 tons per day (TPD) of municipal solid waste (MSW).

The St. Lucie facility would use a Westinghouse-developed gasification process with a plasma torch, a heat source reaching temperatures of 10,000°F. Under the Florida DEP permit, up to 250,000 tons of municipal solid waste per year would be processed to produce a low energy synthetic gas. Florida DEP's analysis states:[c]

> 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 H2, various hydrocarbons, reduced compounds such as NH3, hydrogen sulfide (H2S), etc.

The synthetic gas produced is withdrawn from the gasification unit and then burned to produce steam for turbines which drive the electric generator. Figure A is a schematic diagram of the process.[d]

Figure A. St. Lucie Geoplasma Facility Process



Air Pollution from Plasma Arc Incineration

The applicable federal regulation which the State of Florida stipulates for operation of the facility is 40 CFR Part 60 Subpart Eb, which is the standard of performance for municipal waste combustor steam generating units (Sections 60.50b through 60.59b). Plasma arc gasifiers and multi-stage thermal oxidizers utilized in the St. Lucie incinerator are subject to the New Source Performance Standards under 40 CFR 60. With this standard in place, the annual air pollution as determined by Florida DEP is listed in Table 1.[e]

Table 1. Annual Air Pollution from St. Lucie Geoplasma

Pollutant	**Pounds per year**
Carbon monoxide	92,600
Nitrogen oxides	100,000
Particulates	76,000
PM-10	75,200
Sulfur dioxide	35,200
Volatile organic compounds	68,200
Hydrochloric acid	37,800
Lead	700
Mercury	10.2
Total	**410,510**

The St. Lucie Geoplasma facility would be a Title V Major Source of air pollution. The facility would emit high levels of hazardous air pollutants including hydrochloric acid and mercury. Nitrogen oxides and volatile organic compounds are precursors of ground-level ozone, a secondary pollutant.

Similar to most incinerators, the St. Lucie Geoplasma facility will have a bypass stack which will be used during emergencies; that is, in case of a failure of the thermal oxidizers or a sudden increase in synthetic gas production. Dioxins and furans, common toxic byproducts of older mass-burn incinerators, are also a problem for plasma acre gasification systems.[f]

> Even if there is less oxygen in the plasma chamber than in conventional mass-burn incinerators, this does not prevent the formation of harmful pollutants. As one study that examined the formation of dioxins and furans under pyrolysis conditions concludes, even at oxygen concentrations lower than 2 percent, considerable amounts of highly toxic polychlorinated dioxins and furans were formed.

A waste byproduct of the plasma arc gasification process is a dense, solid material which is collected at the bottom of the unit. However, some metals do pass through the system, contaminating the synthetic gas. An industry site describes this as follows:[g]

> Ash and other inorganic material present in the fuel or waste is melted down to a complex liquid silicate that flows to the bottom of the reaction vessel. Metals that are present also melt and flow to the bottom of the reactor vessel, where they can either mix with the silicate, or if present in a large enough quantity, float on the bottom of it as a separate layer. The liquid melt is allowed to flow continuously from the vessel to a water quench where the liquid silicate melt is cooled to a non leachable, non toxic, obsidian like solid silicate. Some metals are not melted. Instead, they vapourise and pass out of the reactor vessel with the gases formed by the organic material.

Pollution from mass burn incinerators and starved air gasification units differ by the amount of pollution emitted, not by the type. In other words, both emit the same pollutants into the atmosphere, but in different amounts. The levels of oxygen and nitrogen in the combustion process affect the levels of some air pollutants. For example, EPA data show that gasification units emit more nitrogen oxides and dioxins than conventional incinerators, and equal amounts of mercury. Emissions of some pollutants are largely unchanged; in both types of combustion heavy metals are atomized and released into the atmosphere in elemental form. Dioxin emissions from gasification units are 83% higher than mass burn incinerators.[h]

Waste to Energy is Energy Wasted

The fuel for the St. Lucie incinerator would include municipal solid waste, tires with steel belts and other permitted feedstocks. The federal definition of MSW is:[i]

> 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, non-manufacturing activities at industrial facilities, and other similar establishments or facilities. Institutional waste includes material discarded by schools, non-medical waste discarded by hospitals, material discarded by non-manufacturing activities at prisons

and government facilities, and material discarded by other similar establishments or facilities.

Sewage sludge is not included in the above definition and is prohibited for use as fuel by Florida DEP at the St. Lucie facility. However, oil spill debris from coastal, estuary or river environments is permitted to be burned.

Energy is wasted by burying or burning municipal solid waste. Energy recovery from waste burners of all types pales in comparison to the energy needed to manufacture new products. Paper made from trees requires double the energy of recycled paper. Each ton of recycled paper saves about two dozen trees and 410 gallons of fuel needed to produce new paper. And beverage cans made from aluminum ore require 20 times as much energy to produce compared with cans made of recycled aluminum.[j]

Plasma Arc Incineration Global Warming Impacts

Using municipal solid waste for fuel releases into the atmosphere the carbon in paper, cardboard and yard wastes as well as the carbon in plastic products and containers made from petroleum. Burning petroleum-based plastics adds to greenhouse gases in the same way as burning fossil fuels such as coal, oil or natural gas. It is the release of carbon that has been locked up in fossil deposits for millions of years that is driving global warming. Carbon released into the atmosphere from the burning of waste products adds to greenhouse gas levels in the atmosphere. Over time some of this carbon is taken up again by new growth in forests, but in the short-term the damage is done. Recycling and composting far exceed all other waste management options in reducing greenhouse gas emissions.[k]

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Blue Ridge Environmental Defense League

End notes

[a] Written Notice of Intent to Issue Air Permit, St. Lucie Plasma Gasification Project, Florida DEP File No. 1110138-001-AC, May 25, 2010
[b] Draft Permit, Section 4, Appendix Eb, St. Lucie Plasma Gasification Project, Florida DEP File No. 1110138-001-AC
[c] Technical Evaluation and Preliminary Determination, Section 3.4 Gasification Process Description, Page 9, St. Lucie Plasma Gasification Project, Florida DEP File No. 1110138-001-AC, May 25, 2010
[d] *Ibid*, Figure 11, page 11
[e] *Ibid*, Table 2, page 13
[f] *Plasma Arc Technology for Municipal Solid Waste: A Proven Technology or Incinerator in Disguise?* Global Alliance for Incinerator Alternatives, March 10, 2008, Referencing Weber, R., Sakurai, T., *Formation characteristics of PCDD and PCDF during pyrolysis processes*. Chemosphere 45: 1111-1117) 2001
[g] "Safe Waste and Power," page 2, http://www.safewasteandpower.com/process_plasma-gasification.html, Downloaded June 2, 2010
[h] US Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, Volume 1, Fifth Edition, AP-42
[i] 40 CFR 60.51b, Definitions
[j] *The Solid Waste Handbook: A Practical Guide*, William D. Robinson, Editor, ISBN: 978-0-471-87711-0, March 1986
[k] Tellus Institute study for the Massachusetts Department of Environmental Protection, December 2008, http://www.mass.gov/dep/recycle/priorities/tellusmmr.pdf