TECHNICAL EVALUATION

&

PRELIMINARY DETERMINATION

APPLICANT

Progress Energy Florida, Inc.
299 First Avenue North, CN77
St. Petersburg, FL 33701

Crystal River Power Plant
ARMS Facility ID No. 0170004

PROJECT

Draft Permit No. 0170004-026-AC / PSD-FL-383D
Alternative Sorbent Demonstration Project

COUNTY

Citrus County, Florida

PERMITTING AUTHORITY

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

April 26, 2011

1. GENERAL PROJECT INFORMATION

State Regulations

This project is subject to the applicable environmental laws specified in Section 403 of the Florida Statutes (F.S.). The Florida Statutes authorize the Department of Environmental Protection to establish rules and regulations regarding air quality as part of the Florida Administrative Code (F.A.C.). This project is subject to the applicable rules and regulations defined in the following Chapters of the F.A.C.: 62-4 (Permitting Requirements); 62-204 (Ambient Air Quality Requirements, PSD Increments, and Federal Regulations Adopted by Reference); 62-210 (Permits Required, Public Notice, Reports, Stack Height Policy, Circumvention, Excess Emissions, and Forms); 62-212 (General Preconstruction Review, Preconstruction Review for the Prevention of Significant Deterioration (PSD) of Air Quality Review and Best Available Control Technology (BACT); 62-213 (Title V Air Operation Permits for Major Sources of Air Pollution); 62-296 (Emission Limiting Standards); and 62-297 (Test Methods and Procedures, Continuous Monitoring Specifications, and Alternate Sampling Procedures). PSD applicability and the preconstruction review requirements of Rule 62-212.400, F.A.C. are discussed in Section 3 of this Technical Evaluation and Preliminary Determination (TEPD).

Federal Regulations

The Environmental Protection Agency (EPA) establishes air quality regulations in Title 40 of the Code of Federal Regulations (CFR). Part 60 identifies New Source Performance Standards (NSPS) for a variety of industrial activities. Part 61 specifies National Emissions Standards for Hazardous Air Pollutant (NESHAP) based on specific pollutants. Part 63 specifies NESHAP provisions based on the Maximum Achievable Control Technology (MACT) for given source categories. Federal regulations are adopted in Rule 62-204.800, F.A.C. Additional details of the applicable federal regulations are provided in Section 3 of this report.

The applicable requirements of specific state and federal regulations are specified under the Department's review in Section 4 of this TEPD.

Facility Description and Location

The Crystal River Power Plant is an electrical generating plant categorized under Standard Industrial Classification Code No. 4911 for electrical services. The existing power plant is located at the Crystal River Energy Complex in Citrus County, north of Crystal River and west of U.S. Highway 19. The Crystal River Power Plant consists of the following units: four coal-fired steam generating units with electrostatic precipitators; two natural draft cooling towers; two sets of mechanical draft cooling towers; coal and ash material handling facilities; and relocatable diesel-fired generators. The Crystal River Energy Complex also includes a nuclear unit and associated facilities permitted under the same Title V air operation permit. The UTM coordinates are Zone17, 334.3 kilometers East and 3204.5 kilometers North.

Primary Regulatory Categories

- The facility is a major source of hazardous air pollutants (HAP).
- The facility operates units subject to the acid rain provisions of the Clean Air Act.
- The facility is a Title V major source of air pollution in accordance with Chapter 213, F.A.C.
- The facility is an existing PSD major stationary source in accordance with Rule 62-212.400, F.A.C.
- The existing facility is subject to Power Plant Site Certification No. PA 77-09.

PSD Permit History

- In March of 2007, the Department issued Permit No. 0170004-013-AC authorizing the installation of new selective catalytic reduction (SCR) systems on Units 4 and 5 to reduce nitrogen oxides (NO_X). The purpose of the project was to implement the Clean Air Interstate Rule (CAIR) and the Clean Air Mercury Rule (CAMR). It did not trigger PSD preconstruction review.

- In May of 2007, the Department issued Permit No. PSD-FL-383, which superseded Permit No. 0170004-013-AC and authorized the following new equipment in addition to SCR systems: new low-NO_X burners for Units 4 and 5; new wet flue gas desulfurization (FGD) systems for Units 4 and 5 to reduce sulfur dioxide (SO_2) and other acid gas emissions; a new acid mist mitigation (AMM) system for Units 4 and 5 to reduce sulfuric acid mist (SAM) emissions; upgraded electrostatic precipitators (ESP) for Units 4 and 5 to reduce emissions of particulate matter (PM) and particulate matter with a mean aerodynamic diameter of 10 microns or less (PM_{10}); new stack configurations for Units 4 and 5; and a new carbon burn out unit. The project also allowed a higher sulfur coal to take advantage of the new wet flue gas desulfurization systems. As a result, the project was subject to PSD preconstruction review for carbon monoxide (CO), PM/PM_{10}, SAM and volatile organic compounds (VOC).
- In February of 2009, Permit No. PSD-FL-383A (Project No. 0170004-019-AC) revised the original permit to require operation of the wet FGD and SCR systems in response to the Environmental Protection Agency's revised 8-hour ozone standard.
- In May of 2009, Permit No. PSD-FL-383B (Project No. 0170004-022-AC) revised the original permit to: include a temporary alternate compliance demonstration for carbon monoxide emissions for Unit 5 until the continuous emissions monitoring system is installed during the outage to tie in the new wet FGD system and stack; correct as-built equipment descriptions for the gypsum storage and handling systems; acknowledge that the limestone crushing operations will be subject to the federal provisions in New Source Performance Standards (NSPS) Subpart OOO of 40 Code of Federal Regulations (CFR) 60; and clarify the timeframes for compliance monitoring following completion of construction, startup and shakedown of the air pollution control systems.
- In October of 2010, Permit No. PSD-FL-383C (Project No. 0170004-023-AC) revised the original permit to: authorize limited periods of shutdown of the acid mist mitigation system for maintenance and repair; and clarify that the deadline for submitting an application to revise the Title V air operation permit is after completing the work for both units.

Project Description

Only the following existing emissions units will be affected by the proposed project.

EU No.	Description
003	Unit 5 Fossil Fuel Steam Generator
004	Unit 4 Fossil Fuel Steam Generator

The applicant proposes to install and operate a temporary demonstration system to evaluate sulfuric acid mist reduction methods for several alternative sorbents; conduct fuel additive trials to assess reductions in slag formation, which may reduce the formation of sulfur trioxide (SO_3) and thereby SAM. Ammonia is used in the current AMM system as well as the SCR system. Fly ash removed by the ESP contains substantial amounts of ammonia, which causes worker issues as well as limits the beneficial re-use at other plants (e.g., cement plants).

The application also requests the following revisions to existing permit conditions in air construction permit 0170004-023-AC: decrease the final BACT standard for CO emissions from 0.17 pound per million British thermal units (lb/MMBtu) to 0.11 lb/MMBtu; increase the stack opacity limit from 10% to 15%; and remove or modify the current maximum sulfur content of 3.13% by weight to an equivalent standard of 5.5 lb SO_2/MMBtu.

Processing Schedule

01/03/2011 Received the application for a minor source air pollution construction permit.

02/01/2011 Requested additional information.

02/01/2011 Received revised application for a concurrent air construction permit revision (CO BACT); and

03/15/2011 Received additional information; application complete.

2. PSD APPLICABILITY REVIEW

General PSD Applicability

The Department regulates major stationary sources in accordance with Florida's PSD program pursuant to Rule 62-212.400, F.A.C. PSD preconstruction review is required in areas that are currently in attainment with the state and federal Ambient Air Quality Standards (AAQS) or areas designated as "unclassifiable" for these regulated pollutants. As defined in Rule 62-210.200, F.A.C., a facility is considered a "major stationary source" if it emits or has the potential to emit 5 tons per year of lead, 250 tons per year or more of any PSD pollutant, or 100 tons per year or more of any PSD pollutant and the facility belongs to one of the 28 listed PSD major facility categories. PSD pollutants include: carbon monoxide (CO); nitrogen oxides (NO_X); sulfur dioxide (SO_2); particulate matter (PM); particulate matter with a mean particle diameter of 10 microns or less (PM_{10}); particulate matter with a mean particle diameter of 2.5 microns or less ($PM_{2.5}$); volatile organic compounds (VOC); lead (Pb); fluorides (F); sulfuric acid mist (SAM); hydrogen sulfide (H_2S); total reduced sulfur (TRS), including H_2S; reduced sulfur compounds, including H_2S; and mercury (Hg).

For major stationary sources, PSD applicability is based on emissions thresholds known as the "significant emission rates" as defined in Rule 62-210.200, F.A.C. Emissions of PSD pollutants from the project exceeding these rates are considered "significant" and the Best Available Control Technology (BACT) must be employed to minimize emissions of each PSD pollutant. Although a facility may be "major" for only one PSD pollutant, a project must include BACT controls for any PSD pollutant that exceeds the corresponding significant emission rate. Rule 62-210.200, F.A.C. defines "BACT" as:

> *An emission limitation, including a visible emissions standard, based on the maximum degree of reduction of each pollutant emitted which the Department, on a case by case basis, taking into account:*
>
> 1. *Energy, environmental and economic impacts, and other costs;*
> 2. *All scientific, engineering, and technical material and other information available to the Department; and*
> 3. *The emission limiting standards or BACT determinations of Florida and any other state;*
>
> *determines is achievable through application of production processes and available methods, systems and techniques (including fuel cleaning or treatment or innovative fuel combustion techniques) for control of each such pollutant.*
>
> *If the Department determines that technological or economic limitations on the application of measurement methodology to a particular part of an emissions unit or facility would make the imposition of an emission standard infeasible, a design, equipment, work practice, operational standard or combination thereof, may be prescribed instead to satisfy the requirement for the application of BACT. Such standard shall, to the degree possible, set forth the emissions reductions achievable by implementation of such design, equipment, work practice or operation.*
>
> *Each BACT determination shall include applicable test methods or shall provide for determining compliance with the standard(s) by means which achieve equivalent results.*
>
> *In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR Parts 60, 61, and 63.*

In addition, applicants must provide an Air Quality Analysis that evaluates the predicted air quality impacts resulting from the project for each PSD pollutant.

PSD Applicability for the Project

The project is located in Citrus County, which is in an area that is currently in attainment with (or designated as unclassifiable for) the state and federal Ambient Air Quality Standards (AAQS). According to the application the proposed project will not result in an increase in any emissions except for the temporary alternative sorbent

injection system, which will result in a slight increase in additional particulate matter emissions related to sorbent handling and storage (estimated to be approximately 0.6 tons per year. Although there may be additional short-term SAM emissions during the alternative sorbent trials, the overall purpose of the project is to improve SAM emissions reductions, mitigate potential plume issues and reduce the ammonia concentration in fly ash removed by the ESP. Based on the available information, this temporary project is not subject to any additional PSD preconstruction review.

3. DEPARTMENT REVIEW

Permit No. 0170004-023-AC (PSD-FL-383C)

The applicant requested the following revisions to Permit No. 0170004-023-AC (PSD-FL-383C), which affects Unit 4 (EU 004) and Unit 5 (EU 003) fossil fuel steam generators.

Subsection 3.A, Condition 6.a, Maximum Sulfur Content of Coal

Request: The applicant requests removal of the maximum sulfur (S) specification for coal (3.1% by weight) or a revision to an equivalent SO_2 specification (5.5 lb SO_2/MMBtu). The applicant states that certain coal specifications are slightly higher than the required 3.13% by weight, but would still meet the proposed equivalent SO_2 specification because of a higher heating value. Based on a heating value of 11,375 Btu/lb, the maximum sulfur content can vary up to 3.15%. The design of the existing acid mist mitigation (AMM) and wet FGD systems are very effective in reducing SO_2 and SAM emissions.

Response: Based on the information provided, the equivalent SO specification would be:

$$\text{Equivalent } SO_2 \text{ Specification} = (0.0313 \text{ lb S/lb coal})(2 \text{ lb } SO_2\text{/lb S})(\text{lb coal/11,375 Btu})(10^{+06} \text{ Btu/MMBtu})$$

$$= 5.5 \text{ lb } SO_2\text{/MMBtu}$$

Therefore, the Department agrees to revise the maximum sulfur specification for coal from 3.13% by weight to an equivalent SO_2 specification of 5.5 lb SO_2/MMBtu.

New Subsection 3.G, Temporary Trial Period to Evaluate Alternative Sorbents

Request: The applicant requests authorization to install, test and operate new temporary equipment on Units 4 and 5 to inject alternative sorbents in order to evaluate additional SAM reduction and impacts on fly ash. The demonstration project includes temporary trials and evaluation for the following alternative sorbents (or similar materials): sodium bicarbonate, calcium hydroxide (hydrated lime), Trona, dry magnesium oxide, sodium bisulfate (SBS), calcium carbonate, micronized limestone and ammonia.

With the current AMM system, the use of higher sulfur coals will require additional ammonia injection, which could cause a visible plume of ammonia byproducts as well as further increase the ammonia concentration in the collected fly ash. The current ammonia levels in the fly ash have affected the storage, handling and the beneficial re-use of the fly ash. The purpose of the demonstration project is to ensure the proper control of SAM emissions while reducing the ammonia concentration in collected fly ash. The applicant proposes the trial of alternate sorbents with and without ammonia injection by the current AMM system. The applicant indicates approximately 168 hours to conduct the alternative sorbent trials, during which time SAM control could vary, but is expected to be substantial for each proposed sorbent.

During the trial period, the applicant requests flexibility from the requirement to comply with the SAM emissions standards while evaluating the alternative sorbents. In addition, the application requests authorization to operate the final selected option with the temporary equipment based on successful stack test performance data until permanent equipment is installed under a subsequent permit authorizing the new option and equipment. The demonstration period is expected to last six months, with another month on each end for mobilization and demobilization. The permanent system is expected to take approximately 18 months to design and install. At that time, an application for a concurrent air construction permit and a Title V revision will be submitted.

There are two new air emissions sources associate with the dry sorbent storage and injection system. These potential emissions occur when displaced air entrains dust particles as the sorbent storage vessels are filled. To minimize emissions, the exhaust from the storage vessels and the pneumatic conveyor are routed through a portable dust collector prior to exhausting to the ambient air. The dust collector is designed to meet an outlet dust loading of 0.015 grains per actual cubic feet (acf) and the equipment vendor guarantees a filtration efficiency of 99.9% plus for particles down to two microns in diameter. The applicant estimates particulate matter emissions of approximately 0.6 tons/year based on: a flow rate of 7000 acfm; an outlet dust loading of 0.015 grains/acf; and six hours of operation per day. Therefore, this project did not trigger PSD preconstruction review for PM, PM_{10} or $PM_{2.5}$.

Units 4 and 5 have multiple anti-fouling probes manufactured by Breen Energy Solutions that measure conduction across the probe surface resulting from condensed hydrated bisulfate (ammonia bisulfate and sulfuric acid). These measurements give a direct indication of ammonia bisulfate and sulfuric acid fouling. The probes detect the formation of ammonia slip levels as low as 1 part per million (ppm) assuming sufficient free localized SO_3. The probes have a dry detection system that is immune to heavy particulate loading and provides immediate electronic response to excursions in ammonium bisulfate levels. The applicant proposes to utilize the probes to measure the ammonia and SAM levels during the temporary trials.

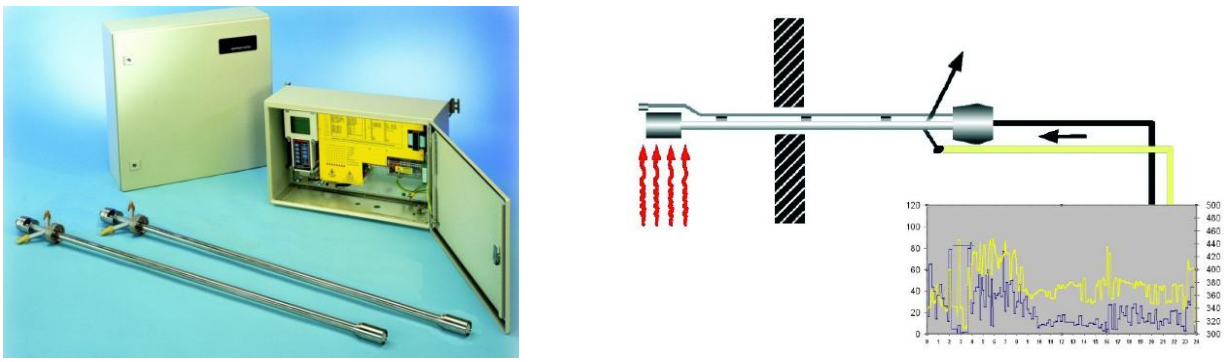

Figure 1. AbSensor Anti-Fouling Probe (AFP) from Breen Energy Solutions.

Response: The draft permit authorizes the installation of the temporary equipment necessary to conduct the demonstration project. The dust collectors on the bin vents will be subject to a 5% opacity work practice standard. Opacity in excess of 5% requires an investigation and corrective action. The Department recognizes the need to evaluate additional alternative sorbents to reduce ammonia levels in the collected fly ash as well as mitigate a potential visible plume from ammonia byproducts. Therefore, the draft permit will require compliance with all terms and conditions in the current Title V air operation permit during the trial period, with the exception of:

- The AMM system may be operated as necessary to conduct the evaluation. Short-term SAM excursions may occur while evaluating given sorbent injection modes (sorbent type, rate and/or injection location) during the demonstration period. If a demonstration results in operation that is not in accordance with the conditions of the Title V permit, the demonstration shall cease as soon as possible. The permittee shall immediately notify the Compliance Authority (by phone, fax, or email) of any non-compliance issue. The demonstration shall not resume until appropriate actions have been taken to correct the problem.
- As determined by EPA Method 9 during the trial period, the stack exhaust of Units 4 and 5 may exceed 10% opacity provided the following additional conditions are met:
  - As determined by the in-duct COMS for the given unit, the in-duct opacity after the ESP and before the wet FGD system does not exceed 10%, based on a 6-minute block average.
  - As determined by EPA Method 9 observations, the stack exhaust shall not exceed 15% opacity based on a 6-minute average, except for one 6-minute period per hour of not more than 20% opacity.

Ammonia slip and SAM data collected from the anti-fouling probes will be used to evaluate the alternative sorbents. The permittee may elect to conduct preliminary engineering stack tests to correlate SAM emissions with data collected from the anti-fouling probes or just to establish SAM emissions. For each alternative sorbent that the permittee intends to request continued temporary authorization beyond the initial demonstration period, the permittee shall conduct SAM emissions performance tests to develop the required operating protocol for the alternative sorbent that demonstrates compliance with the BACT standard for SAM emissions. Such performance tests shall be conducted in accordance with the current conditions in the permit.

The draft permit allows the permittee to request written authorization to continue operation of the temporary system with an alternative sorbent while designing and obtaining a permit for a permanent system. Such a request must include the operating protocol for the alternative sorbent based successful SAM emissions stack test data. If approved, the permittee shall operate the temporary alternative sorbent injection systems in accordance with the operating protocol to ensure compliance with the BACT standard for SAM emissions. For permanent authorization of an alternative sorbent, the permittee is required to submit an application for an air construction permit that also identifies the design features, additional permanent equipment and new construction activities.

New Subsection 3.G, Temporary Trial Period to Evaluate Fuel Additives

Request: The applicant proposes trials of the following fuel additives (or similar materials): Coaltreat 500, Coaltreat 700, magnesium oxide and magnesium hydroxide. Applied directly to the coal prior to combustion, the additives are expected to reduce slag formation, which in turn may reduce the formation of SO_3 and, ultimately, the amount of SAM generated. An estimated 60% reduction in furnace SO_3 has been indicated by the vendor of the additives. Fuel additive trials may be conducted separately from the alternative sorbent trials or in conjunction with the alternative sorbent trials.

Response: The fuel additives are expected to improve boiler performance and potentially reduce SAM emissions or result in no change. Data collected by the anti-fouling probes may be used to determine relative effectiveness with regard to SAM emissions. The draft permit authorizes trials of the fuel additives with or without the alternative sorbent trials; however, if fuel additives are used during the SAM performance stack tests to determine the operating protocol for a successful alternative sorbent, then that fuel additive rate may become an operating condition for satisfactory compliance.

Subsection 3.A, Condition 8.e: Increase opacity Standard

Request: The applicant requests revising the opacity standard from 10% to 15%, except for one 6-minute period per hour of not more than 20%. Under the new control equipment configuration, the particulate matter emissions were less than 0.007 lb/MMBtu from Units 4 and 5, which is approximately 75% below the BACT standard of 0.03 lb/MMBtu. Corresponding stack opacity levels during the particulate matter stack tests were less than 8%, which was higher than expected based on the emissions test results, but within the vendor guarantee. There are several factors that may have contributed to these opacity levels. Units 4 and 5 do have a common stack based on EPA terminology, but the configuration is actually a single stack with two exhaust liners. There is no visible distinct difference between the two plumes, which are combined at the stack exit points, which may cause a higher observed opacity level.

Response: The Department notes that the in-duct COMS indicated opacity levels of 8% or less prior to the wet FGD system during the particulate matter tests. Therefore, a visible plume after the wet FGD system could partly be water vapor (which must be discounted in accordance with EPA Method 9) or the formation of ammonia byproducts. To date, there have not been any opacity observations in excess of the current standard with the modified ESP in operation. Since one of the reasons for conducting the alternative sorbent trials is to resolve potential plume issues, the opacity standard during the entire trial period will be 15% based on a 6-minute block average, except for one 6-minute period per hour of not more than 20% as long as the in-duct opacity measured by COMS is 10% or less. The temporary opacity standard shall become effective beginning

with the first trial of an alternative sorbent and shall end upon issuance of the Department's written approval or disapproval to continue operation of the temporary sorbent injection system.

Subsection 3.A, Condition 9.c and d: Reduce the Carbon Monoxide (CO) Emissions Limit

Request: As required in Permit No. PSD-FL-383C, the applicant requests final revision of the CO BACT standard based on actual CO emissions data collected for initial operation after completing installation of the new low-NO_X burners. Specifically, the applicant requests a reduction in the CO BACT standard from 0.17 to 0.11 lb/MMBtu.

Response: Since this involves the revision of a BACT standard, a 30-day public comment period is required. To accommodate the applicant's accelerated schedule for the alternative sorbent injection demonstration project, this request will be processed as a separate project.

4. PRELIMINARY DETERMINATION

The Department makes a preliminary determination that the proposed project will comply with all applicable state and federal air pollution regulations as conditioned by the Draft Permit. This determination is based on a technical review of the complete application, reasonable assurances provided by the applicant, and the conditions specified in the Draft Permit. Tammy McWade is the project engineer responsible for reviewing the application and drafting the permit changes. Jeff Koerner edited the draft permit documents. Additional details of this analysis may be obtained by contacting the project engineer at the Department's Bureau of Air Regulation at Mail Station #5505, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.