TECHNICAL EVALUATION
AND
PRELIMINARY DETERMINATION

APPLICANT

Duke Energy Florida, Inc. (DEF)
299 First Avenue, North, Mail Code CN77
St. Petersburg, Florida 33701

Crystal River Power Plant
Facility ID No. 0170004

PROJECT

Permit Revision No. 0170004-048-AC

Revised CAM Plan

COUNTY

Citrus County, Florida

PERMITTING AUTHORITY

Florida Department of Environmental Protection
Division of Air Resource Management
Office of Permitting and Compliance
2600 Blair Stone Road, MS #5505
Tallahassee, Florida 32399-2400

September 23, 2014

1. GENERAL PROJECT INFORMATION

1.1. Air Pollution Regulations

Projects at stationary sources with the potential to emit air pollution are subject to the applicable environmental laws specified in Section 403 of the Florida Statutes (F.S.). The statutes authorize the Department of Environmental Protection (Department) to establish regulations regarding air quality as part of the Florida Administrative Code (F.A.C.), which includes the following applicable chapters: 62-4 (Permits); 62-204 (Air Pollution Control – General Provisions); 62-210 (Stationary Sources – General Requirements); 62-212 (Stationary Sources – Preconstruction Review); 62-213 (Operation Permits for Major Sources of Air Pollution); 62-296 (Stationary Sources - Emission Standards); and 62-297 (Stationary Sources – Emissions Monitoring). Specifically, air construction permits are required pursuant to Rules 62-4, 62-210 and 62-212, F.A.C.

In addition, the U. S. Environmental Protection Agency (EPA) establishes air quality regulations in Title 40 of the Code of Federal Regulations (CFR). Part 60 specifies New Source Performance Standards (NSPS) for numerous industrial categories. Part 61 specifies National Emission Standards for Hazardous Air Pollutants (NESHAP) based on specific pollutants. Part 63 specifies NESHAP based on the Maximum Achievable Control Technology (MACT) for numerous industrial categories. The Department adopts these federal regulations on a quarterly basis in Rule 62-204.800, F.A.C.

1.2. Facility Description and Location

The Duke Energy of Florida, Inc. (DEF) Crystal River Power Plant is an existing power plant, which is categorized under Standard Industrial Classification Code No. 4911. Refer to **Figure 1** and **Figure 2**. The existing Crystal River Power Plant is located in Citrus County at 15760 West Power Line Street in Crystal River, Florida.

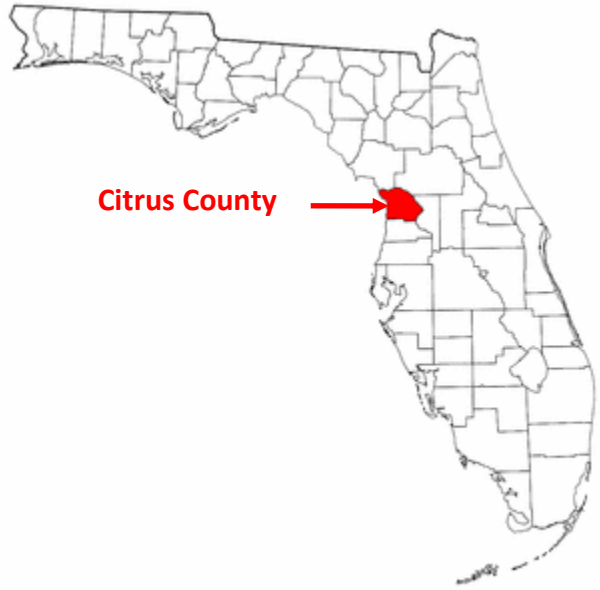

Figure 1. Citrus County, Florida.

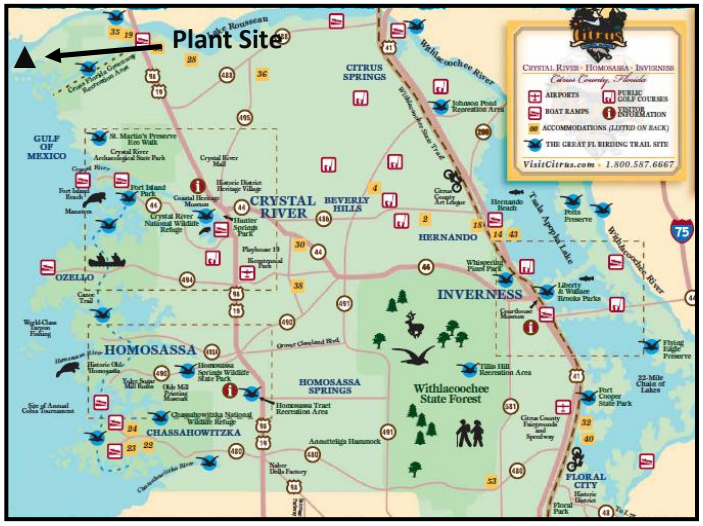

Figure 2. Location of Crystal River Power Plant.

The UTM coordinates of the existing facility are Zone 17, 334.3 kilometers (km) East and 3204.5 km North. This site is in an area that is in attainment (or designated as unclassifiable) for all air pollutants subject to Ambient Air Quality Standards (AAQS).

This facility consists of: four coal-fired fossil fuel steam generating (FFSG) units with electrostatic precipitators; two natural draft cooling towers for FFSG Units 4 and 5; helper mechanical cooling towers for FFSG Units 1, 2; coal, fly ash, and bottom ash handling facilities; limestone and gypsum material handling activities; hydrate lime storage and transfer system for Units 4 and 5; and, various fire pumps and generators. The facility continuously operates low-NO_X burners, selective catalytic reduction systems (SCR), flue gas desulfurization systems (FGD) which includes limestone and gypsum material handling activities and acid mist mitigation (AMM) systems for

existing Units 4 and 5, as authorized by permits No. 0170004-023-AC (PSD-FL-383C) and 0170004-037-AC (PSD-FL-383E). In conjunction with the new control equipment, Units 4 and 5 are now also authorized to burn a blend of bituminous/sub-bituminous coal.

A list of the emission units (EU) at the facility is given in **Table 1** below.

TABLE 1 – LIST OF EMISSION UNITS AT THE CRYSTAL RIVER POWER PLANT.

E.U. No.	Brief Description
Regulated Emission Units	
001	Fossil Fuel Steam Generator, Unit 1
002	Fossil Fuel Steam Generator, Unit 2
004	Fossil Fuel Steam Generator, Unit 4
003	Fossil Fuel Steam Generator, Unit 5
006	Fly ash transfer (Source 1) from Unit 1
008	Fly ash storage silo (Source 3) for Units 1 and 2
009	Fly ash transfer (Source 4) from Unit 2
010	Fly ash transfer (Source 5) from Unit 2
014	Bottom ash storage silo for Units 1 and 2
012	Relocatable diesel generators
013	Cooling towers for Units 1, 2, and 3
015	Cooling towers for Units 4 and 5
016	Material handling activities for coal-fired steam units
020	Portable Cooling Towers for Units 1 and 2
028	3500 kW diesel generator associated with Unit 3
023	Limestone and Gypsum Material Handling Activities
029	Diesel fire pump, south yard
030	Emergency generator (meteorological weather station)
Unregulated Emissions Units and/or Activities	
017	Fuel and lube oil tanks and vents
018	Sewage treatment, water treatment, lime storage
019	Two 3500 kW diesel generators associated with Unit 3

1.3. Facility Regulatory Categories

- The facility is a major source of hazardous air pollutants (HAP).
- The facility is a Title V major source of air pollution in accordance with Chapter 213, F.A.C.
- The facility is major stationary source in accordance with Rule 62-212.400, F.A.C., for the Prevention of Significant Deterioration (PSD) of Air Quality.

1.4. Project Description

1.4.1. Background

The Department issued the current Title V air operation permit for the Crystal River Power Plant (0170004-043-AV) on June 17, 2014. On September 5, 2014, Duke Energy Florida, Inc. (DEF) submitted an air construction permit application for requested changes to the facility's current sulfuric acid mist (SAM, H_2SO_4) compliance assurance monitoring (CAM) plan contained in the Title V permit. DEF requested this update to the SAM CAM plan to reflect the permissible upgrades made to the hydrated lime system.

In July 2013, DEF completed the installation of a temporary hydrated lime based acid mist mitigation (AMM) system at the Crystal River Power Plant to reduce SAM emissions on Unit 4 (EU 004) and Unit 5 (EU 003) as permitted in air construction permit 0170004-037-AC. This system replaced the ammonia based acid mist mitigation system, which has been retained as a back-up AMM system. The SAM CAM injection curves developed in November 2013 and SAM CAM Plan subsequently permitted in Title V operation permit (0170004-042-AV) on March 25, 2014, were based on functionalities and parameters associated with the temporary system.

In March 2014, DEF upgraded the hydrated lime system to improve system performance and subsequently conducted additional testing in April 2014 and July 2014 on the updated, permanent system. These system upgrades and the high reactive hydrated lime injection option resulted in necessary updates to the SAM CAM injection curves. DEF has requested the Department incorporate these changes into the current SAM CAM plan and Title V permit (No. 0170004-043-AV). The permit revision application presented the modifications made to the AMM system and the proposed revisions to the SAM CAM Plan.

The requested updates to the SAM CAM Plan follow the same structure and format as the current CAM plan which ensures compliance with the SAM emission limit of 0.009 lb/MMBtu for Boilers 4 and 5. The proposed changes reflect the additional testing completed in 2014 on the AMM system that is representative of current operation after the AMM system changes as detailed below.

In addition to these system changes, DEF also requested that the SAM CAM Plan reflect the option of injecting high reactive hydrated lime or the standard hydrated lime. Currently, the Title V permit specifies that the AMM system is designed to use hydrated lime which includes both standard and high reactive varieties. Tests show that high reactive hydrated lime is a more efficient means of acid mist removal since it achieves the same level of control at lower injection rates. Therefore, DEF requested that a separate SAM CAM curve be incorporated into the SAM CAM Plan to accommodate the high reactive hydrated lime's injection rates that demonstrate compliance.

1.4.2. Acid Mist Mitigation (AMM) Systems to Reduce Sulfuric Acid Mist (SAM) Emissions

SAM emissions from combustion in Units 4 and 5 are controlled through either hydrated lime injection (primary) or alkali/ammonia injection (backup). The design for the AMM systems associated with each unit are to use either hydrated lime or ammonia. The hydrated lime or ammonia reacts with sulfur trioxide (SO_3) to form salts (e.g., bisulfates), which are removed by the electrostatic precipitator (ESP) and/or the FGD (flue gas desulfurization) system. The design for either system (hydrated lime or ammonia) is for an 85% reduction of SAM emissions.

In the primary AMM system, hydrated lime is injected into the flue gas through a combination of locations downstream of the SCR. The hydrated lime injection rates vary based on emission control levels and operational parameters at each of the hydrated lime injection locations. The hydrated lime reacts with the acidic compounds in the flue gas stream to form particulate matter that is removed in the ESP and/or in the wet scrubber.

Since development of the most recent SAM CAM in November 2013, DEF has installed a total of forty eight (48) COBRA lances for sorbent delivery in the flue gas stream of Units 4 and 5 (24 lances per unit). The COBRA lances were installed at the ESP outlet location on Units 4 and 5 and at the SCR outlet on Unit 5. In addition, after the April 2014 testing but prior to the July 2014 testing, COBRA lances were also installed after the SCR on Unit 4. The COBRA lances contain a dispersion plate, which produces a low pressure zone in the duct, enhancing particle dispersion. The scattered sorbent particles come into more frequent contact with acid mist in the flue gas, and thus, increase efficiency of the lime reacting with SO_3 to promote equivalent acid mist removal at lower injection rates. Installation of the COBRA lances helps normalize the effectiveness of the already-permitted AMM system, minimizing malfunctions during operation, and does not result in an increase in emissions. The air pollution control package still continues to maintain the same design parameters.

Furthermore, since July 2013, DEF has gained a year of experience in working with the permanent hydrated lime based AMM system. This operational experience has provided DEF expertise on better minimizing line blockages with tailored preventative maintenance and ensuring the AMM system is operating in a consistent manner. The injection curves developed in the November 2013 SAM CAM plan were based on functionalities

and parameters associated with the temporary system and were developed prior to the March 2014 permanent system and operational changes. Since the permanent system provides more effective control, the temporary system has since been removed.

1.4.3. SAM CAM Curve Development

This section of the Technical Evaluation and Proposed Determination presents a discussion of the development of the SAM curves for standard hydrated lime and for high reactive lime by DEF. DEF completed performance testing on both boilers (Units 4 and 5) on April 21-30, 2014. There were twenty-four (24) standard hydrated lime tests performed on Unit 4, fifteen (15) standard lime tests performed on Unit 5, and ten (10) high reactive hydrated lime tests performed on Unit 5. Additional performance testing was performed on July 8-10, 2014. There were eleven (11) high reactive hydrated lime tests performed on Unit 4 and eleven (11) high reactive hydrated lime tests performed on Unit 5 in July 2014.

The purpose of the tests was to determine the sorbent injection rate at varying loads and operating conditions that would be required for DEF to demonstrate compliance with the permit limit of 0.009 lb/MMBtu H_2SO_4 (Title V Permit 0170004-043-AV, Specific Condition **B.11.**). Operating conditions, such as sorbent injection location, sulfur content in coal, and temperature, were varied and analyzed. However, based on an analysis of the test results, and for simplicity of compliance management while ensuring conservative control throughout the range of operating conditions, DEF determined that load was the appropriate parameter for determining the minimum injection rates necessary to maintain compliance.

The operating conditions for both units were stabilized for at least four (4) hours prior to testing. Stack testing was performed under normal operating conditions at varying loads with an adequate supply of normal or routine coal. Because there is an inherent variability in coal sources and their associated sulfur content, the sulfur content in the coal was specifically analyzed by comparing its impact on compliance at varying injection rates. Since the test results indicated some variability, this was taken into account when developing the SAM CAM curves. DEF defined injection rates at tested loads that conservatively exceeded the demonstrated minimum injection rates during testing therefore providing an adequate buffer for the variability due to other operating parameters. All testing was performed by a third party contractor using independent testing equipment installed on both units at the stack. Detailed information about the operating conditions during each stack test can be found in Appendix A of the application. The April and July 2014 tests were used in the development of the updated curves.

1.4.4. Specific Changes Requested

- DEF requested that Figure 1 and the associated tables in Appendix CAM for Emission Units 003 and 004 (SAM emissions controlled by AMM system) in the facility's current title V air operation permit be modified to the following to accommodate for the April 2014 and July 2014 test results as described above. These test results modify the current injection curve for both boilers.
- In addition to these system changes, DEF also requested that the SAM CAM Plan reflect the option of injecting high reactive hydrated lime or the standard hydrated lime. Currently, the Title V permit specifies that the AMM system is designed to use hydrated lime which includes both standard and high reactive varieties. Tests performed by DEF show that high reactive hydrated lime is a more efficient means of acid mist removal since it achieves the same level of control at lower injection rates. Therefore, DEF requested that a separate SAM CAM curve be incorporated into the SAM CAM Plan to accommodate the high reactive hydrated lime's injection rates that demonstrate compliance.
- Based on the recent testing, DEF also requested that the permit condition language associated with the required operating protocols for the AMM systems be modified to remove the specificity in operating scenarios. The express purpose of the recent testing was to determine the sorbent injection rate at varying loads and operating conditions that would be required for DEF to remain in compliance with the permit limit of 0.009 lb/MMBtu H_2SO_4. Operating conditions, such as sorbent injection location, sulfur content in coal, and temperature, were varied and analyzed. The applicant believed that the operating conditions detailed in the current Title V air operation permit Specific Condition **B.23.** do not provide a full representation of the variance in SAM emission rates. Therefore, DEF requested that this specificity be removed from the permit. Implementing this change requires a revision to an underlying air construction permit (0170004-037-AC).

1.5. Application Processing Schedule

Application for an Air Construction Permit Revision received on September 5, 2014. Application was deemed complete.

2. PSD APPLICABILITY

2.1. 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. Commonly addressed PSD pollutants in the power industry include: carbon monoxide (CO), NO_X, particulate matter (PM), PM with a mean diameter of 10 microns or less (PM_{10}), PM with a mean diameter of 2.5 microns or less ($PM_{2.5}$), sulfur dioxide (SO_2), volatile organic compounds (VOC), lead (Pb), fluorides (F), sulfuric acid mist (SAM), and mercury (Hg). According to state and federal rules, six greenhouse gases (GHG), are also subject to PSD review.

Additional PSD pollutants that are more common to certain other industries include: hydrogen sulfide (H_2S), TRS including H_2S, reduced sulfur compounds (RSC) including H_2S, municipal waste combustor (MWC) organics measured as total tetra- through octa-chlorinated dibenzo-p-dioxins and dibenzofurans (dioxin/furan), MWC metals measured as PM; MWC acid gases measured as SO_2 and HCl, and MSW landfill emissions as non-methane organic compounds (NMOC).

As defined in Rule 62-210.200(189)(a)1, F.A.C., a stationary source is a "major stationary source" (major PSD source) if it emits or has the potential to emit (PTE):

- 250 tons per year (TPY) or more of any PSD pollutant; <u>or</u>
- 100 TPY or more of any PSD pollutant <u>and</u> the facility belongs to one of the 28 listed PSD major facility categories.
- For the special case of greenhouse gases (GHGs), the facility must first be shown to emit or have a PTE of 100,000 tons/year of GHGs as carbon dioxide equivalent (CO_2e) to (possibly) be subject to regulation.[1]

The list given in the citation includes the category of "fossil fuel-fired steam electric plants of more than 250 million British thermal units per hour heat input". This category applies to the Crystal River Power Plant before and after the proposed project. The Crystal River Power Plant is a major stationary source based on actual emissions of and potential to emit 100 TPY or more of several individual PSD pollutants.

If emissions of GHGs expressed as CO_2e emissions are greater than 100,000 tons/year, then the total (unweighted) GHGs mass emissions are compared with the 100 and 250 tons/year thresholds to determine whether the source is a major stationary source.[2]

For major stationary sources such as the Crystal River Power Plant, PSD applicability for modification projects is based on thresholds known as the significant emission rates (SER) as defined in Rule 62-210.200(274), F.A.C. Any "net emissions increase" as defined in Rule 62-210.200(204), F.A.C. of a PSD pollutant from the project that equals or exceeds the respective SER is considered "significant". SER also means any emissions rate or any net emissions increase of a PSD pollutant associated with a major stationary source or major modification which would construct within 10 km of a Class I area and have an impact on such area equal to or greater than 1 gram per cubic meter, 24-hour average.

Although a facility may be "major" (i.e. emits or has the potential to emit 100 or 250 TPY as applicable) for only one PSD pollutant, a project must include BACT controls for any PSD pollutant that exceeds the corresponding

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[1] In making this calculation, the values listed in 40 CFR 98, Subpart A, Table A-1 are used to weight emissions by their respective Global Warming Potential (GWP). For example, the current GWP factors for four of the GHGs are: $CO_2 = 1$; $CH_4 = 25$; $N_2O = 298$ and $SF_6 = 22{,}800$.

[2] This procedure was held to be invalid at the federal level due to a U.S. Supreme Court opinion dated June 23, 2014. Link to Supreme Court Opinion The Department is reviewing the effects of the decision on its own rules. EPA issued guidance regarding implementation of the decision on July 24, 2014. Link to EPA Guidance

SER given in **Table 2**.

TABLE 2 – LIST OF SER BY PSD-POLLUTANT. [1]

Pollutant	SER (TPY)	Pollutant	SER (TPY)
CO	100	NO_X	40
$PM/PM_{10}/PM_{2.5}$	25/15/10	Ozone (VOC) [2]	40
$PM_{2.5}$ (NO_X)	40	$PM_{2.5}$ (SO_2)	40
Ozone (NO_X) [2]	40	SAM	7
SO_2	40	Pb	0.6
Hg	0.1	GHGs	0 [3]

1. Excluding fluoride and pollutants specific to the Pulp and Paper industry, MWCs, MSW landfills.
2. Ozone (O_3) is regulated by its precursors (VOC and NO_X). PSD for $PM_{2.5}$ can be triggered by its precursors (NO_X and SO_2).
3. Pursuant to 40 CFR 52.21(b)(23)(ii), pollutants with no SER listed at 40 CFR 52.21(b)(23)(i) have a SER of zero tons/year.

2.2. PSD Applicability for Project

The project will add and revise air construction permit specific conditions to change the compliance assurance monitoring (CAM) plan for SAM emissions in the facility's Title V air operation permit. There will be no emissions increases and the project is not subject to PSD preconstruction review.

3. DEPARTMENT REVIEW

The revised sorbent injection curves for Crystal River Units 003 and 004 are given in **Figure *3*** below. This figure will be incorporated into current air construction permit revision (Permit No. 0170004-048-AC) as Figure 1 to correspond to the figure number used in SAM CAM Plan the current Title V air operation permit (Permit No. 0170004-043-AV).

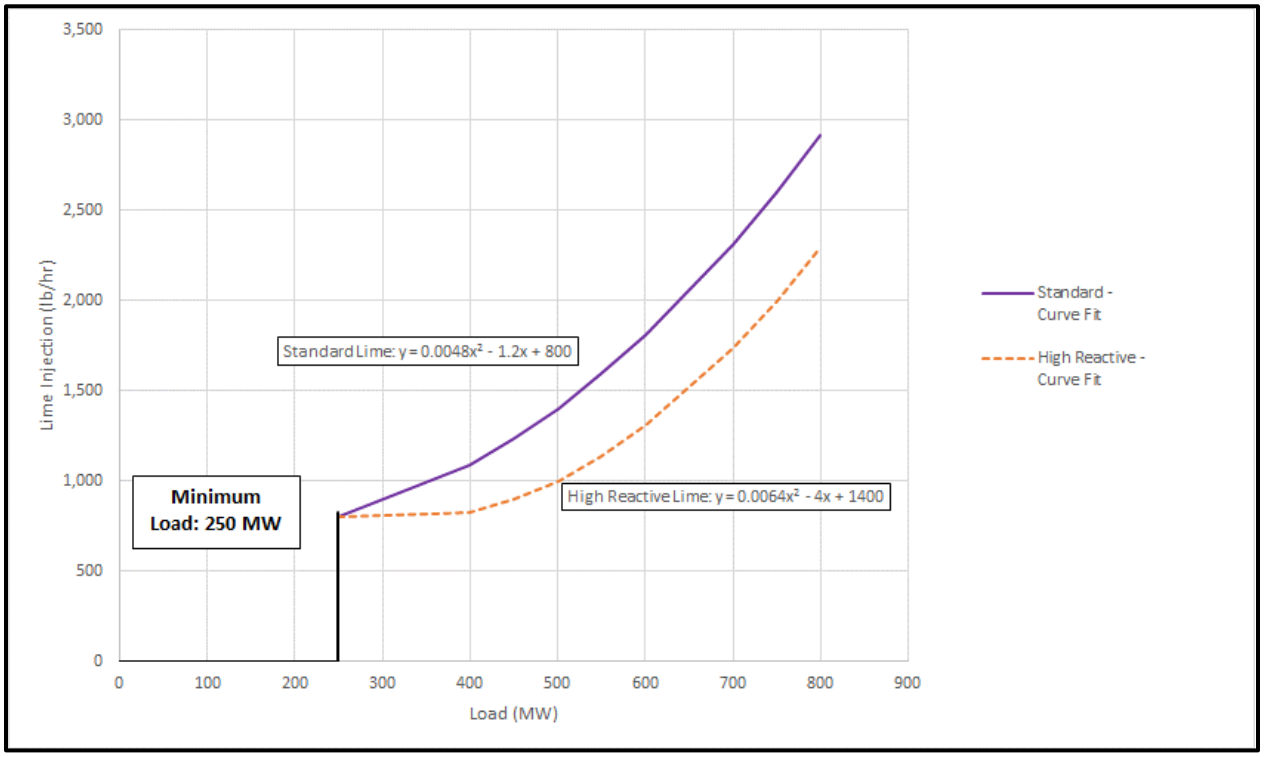

Figure 3. Continued – Quadratic Fit for Standard Lime

3.1. Response to Requested Revisions

The proposed revisions to the facility's Title V air operation permit CAM plan as requested by the applicant were reviewed and approved by the Department. Details of these changes are noted below:

3.1.1. Sulfuric Acid Mist Compliance Assurance Plan

- **Specific Condition 2.** of new air construction permit No. 0170004-048-AC is added as follows:

Appendix CAM for Emission Units 003 and 004: The permittee shall operate the facility in accordance with the following change to the compliance assurance monitoring (CAM) plan in the current Title V air operation permit:

Figure 3 (see above) and **Table 3** and **Table 4** below will replace their equivalents in Appendix CAM for Emission Units 003 and 004 (SAM emissions controlled by AMM system).

TABLE 3 – STANDARD LIME QUADRATIC FIT INJECTION RATES.

Lime	Load	Hydrated Lime Injection Rate
	(MW)	(lb/hr)
Standard	250	800
Standard	400	1,088
Standard	450	1,232
Standard	500	1,400
Standard	550	1,592
Standard	600	1,808
Standard	700	2,312
Standard	725	2,453
Standard	750	2,600

TABLE 4 – HIGH REACTIVE LIME QUADRATIC FIT INJECTION RATES.

Lime	Load	Hydrated Lime Injection Rate
	(MW)	(lb/hr)
High Reactive	250	800
High Reactive	400	824
High Reactive	450	896
High Reactive	500	1,000
High Reactive	550	1,136
High Reactive	600	1.304
High Reactive	700	1,736
High Reactive	725	1,864
High Reactive	750	2,000

3.1.2. Operations Under the Title V Air Operation Permit Revision

- **Specific Condition 3.** of new air construction permit No. 0170004-048-AC is added as follows:

Title V Air Operation Permit Revision: The permittee shall be allowed to operate in accordance with the changes specified in this air construction permit revision (i.e., revised **Figure 3**, Figure 1 in the permit) in lieu of the SAM CAM Plan protocol (current Figure 1) contained in the facility's current Title V air operation permit, until the time that the SAM CAM Plan appendix of the Title V permit is formally revised.

3.1.3. SAM Performance Tests

- **Specific Condition 16.** of existing air construction permit 0170004-037 is revised as follows:

16. Preliminary SAM Performance Tests: Within 60 days after completing construction on the pollution control systems, the permittee shall conduct a series of preliminary performance tests on either unit to determine the SAM emissions rate under a variety of operating scenarios. The purpose of the tests is to document the impact of the AMM systems on reducing SAM emissions and results in the development of correlation/curves between injection rates, operating conditions and emissions. When collecting data during the SAM performance tests, the permittee is exempt from the SAM emissions standards of this permit.

a. For each set of operating conditions being evaluated, the permittee shall conduct at least a 1-hour test run

to determine SAM emissions. At least nine test runs shall be conducted to evaluate ~~the effect of~~ SAM emissions ~~on parameters such as: the SO_2 emissions rate prior to the SCR catalyst, the unit load, the flue gas flow rate, the ammonia injection rate, the current catalyst oxidation rate, and the operating level of the FGD system~~.

b. Tests shall be conducted with the fuel blends and load rates that are representative of the actual operating ranges intended for Units 4 and 5. Sufficient tests shall be conducted to establish the SAM emissions rates under varying operating conditions and levels of ammonia injection ~~(e.g., bypass of the SCR reactor, SCR reactor in service without ammonia injection, SCR reactor in service, etc.)~~.

c. At least 15 days prior to initiating the performance tests, the permittee shall submit a test notification, preliminary test schedule and test protocol to the Bureau of Air Regulation and the Compliance Authority.

d. Within 45 days following the last test run conducted, the permittee shall provide a report summarizing the emissions tests and results. All SAM emissions test data shall be provided with this report.

e. Within 45 days following the submittal of the performance test report and no later than 90 days following the last test run conducted, the permittee shall submit an operating protocol summarizing the following: identify each set of operating conditions evaluated; identify each operating parameter evaluated; identify the relative influence of each operating parameter; describe how the automated control system will adjust the ammonia and/or hydrated lime injection rate based on the selected parameters; identify the frequency with which operational parameters will be reevaluated and adjusted within the automated control system; provide a description of the algorithm used for the automated control system or a series of related performance curves; and provide details for calculating and estimating the SAM emissions rate based on the level of ammonia and/or hydrated lime injection and operating conditions. The performance tests shall be used to set the AMM control systems and estimate SAM emissions.

f. The permittee shall operate the AMM systems in accordance with the operating protocol determined by the performance tests.

Using these procedures, the permittee may later conduct additional SAM performance tests to establish a new operating protocol for the AMM system due to changes with the fuel blends, control equipment, operating methods or other circumstances.

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. No air quality modeling analysis is required because the project does not result in any increase in emissions.

Tom Cascio is the project engineer responsible for reviewing the application and drafting the permit revision. Additional details of this analysis may be obtained by contacting him by telephone at 850/717-9077 or by e-mail at tom.cascio@dep.state.fl.us in the Department's Office of Permitting and Compliance at Mail Station #5505, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.