TECHNICAL EVALUATION
&
PRELIMINARY DETERMINATION

APPLICANT

Florida Power and Light Company
700 Universe Boulevard.
Juno Beach, Florida 33408

Sanford Power Plant

PROJECT

Project No. 1270009-022-AC (PSD-FL-270E)
Application for Minor Source Air Construction Permit

Units 4 and 5 Combustion Turbine Improvements

Volusia County, Florida

PERMITTING AUTHORITY

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

October 12, 2011

1. GENERAL PROJECT INFORMATION

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 Chapters 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 in Rule 62-204.800, F.A.C.

Glossary of Common Terms

Because of the technical nature of the project, the permit contains numerous acronyms and abbreviations, which are defined in Appendix A of this permit.

Facility Description and Location

The Florida Power & Light Company (FPL) Sanford Power Plant is an existing stationary source, which is categorized under Standard Industrial Classification Code No. 4911. The existing Sanford Power Plant is located in Volusia County at 950 South Highway 17-92, DeBary, Florida in Florida. The UTM coordinates of the existing facility are Zone 17, 468.1 km East, and 3190.86 km North.

The facility consists of one conventional residual fuel oil-fired unit (Unit 3), two natural gas and distillate-fired-fired combined cycle units (Units 4 and 5) and ancillary equipment.

Figures 1 and 2 are photographs of the FPL Sanford Power Plant, which is located near the St. John's River where it discharges into Lake Monroe. Unit 3 is indicated by the red and white stack.
Units 4 and 5 are also indicated in the photograph. A large cooling pond indicated in Figure 2 is used in lieu of cooling towers.

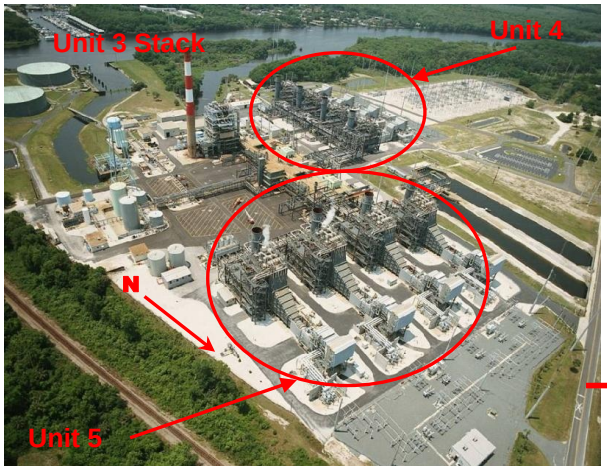


Figure 1. Aerial View of FPL Sanford Plant

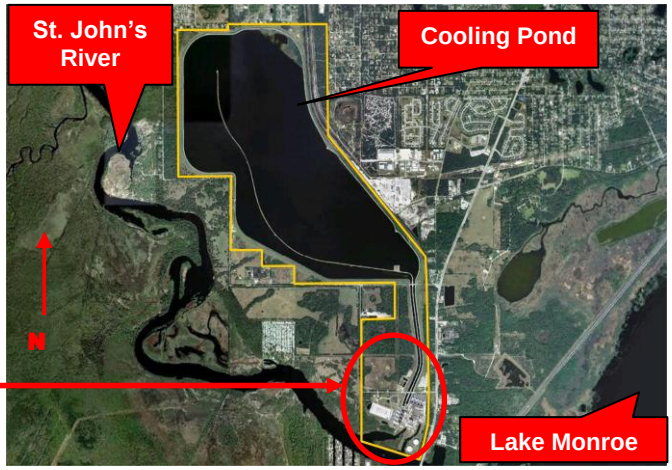


Figure 2. Satellite View of Sanford Plant Environs

This site is in an area that is in attainment (or designated as unclassifiable) for all air pollutants subject to state and federal Ambient Air Quality Standards (AAQS).

Facility (i.e. Entire Sanford Power Plant) Regulatory Categories

- Per the facility Title V operation permit, the facility is not 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 62-213, F.A.C.
- The facility is a major stationary source in accordance with Rule 62-212.400, F.A.C. for the Prevention of Significant Deterioration (PSD) of Air Quality.

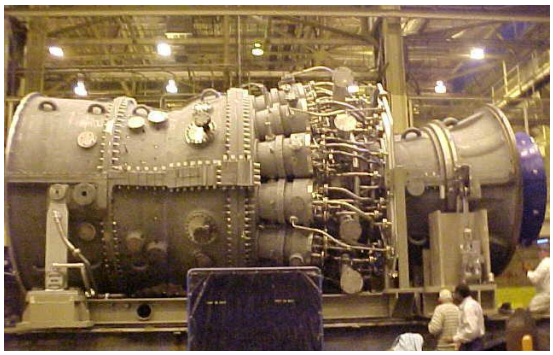
Description of Units 4 and 5

The project involves Units 4 and 5, each of which is a nominal 1,000 megawatts (MW) combined cycle unit consisting of: four nominal 170 MW General Electric (GE) Model 7FA.03[1] combustion turbine-electric generators (CT) turbines; four unfired heat recovery steam generators (HRSG); four 125-foot stacks; and a steam turbine-electric generator (STG). Units 4 and 5 also include automated control systems, inlet air filtration systems, evaporative inlet air cooling systems and associated support equipment. Units 4 and 5 were permitted as repowered combined cycle units in 1999 in accordance with the PSD rules and a best available control technology (BACT) determination was conducted for volatile organic compounds (VOC). Units 4 and 5 started up as repowered combined cycle units in 2003.

Emissions of carbon monoxide (CO), particulate matter (PM/PM_{10}), sulfur dioxide (SO_2), and VOC are minimized by efficient combustion of inherently clean fuels and Dry Low NO_X (DLN) technology (Units 4 and 5) when firing natural gas or wet injection when firing backup distillate fuel oil (Unit 5 only).

Project Description

The left hand side of Figure 3 is a factory picture of an earlier version of the GE CT similar to the prime movers located within Units 4 and 5. The right hand side of the figure is a cutaway diagram of a more recent version showing the 14-stage compressor, the 14 combustor cans oriented along the circumference of the mid-section and the three-stage rotor (expansion) section.



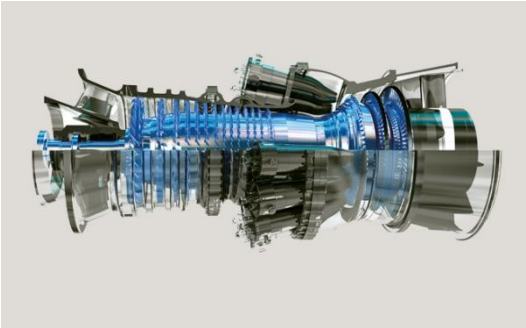


Figure 3. Factory Photo of an earlier GE 7FA and Internal View of a more recent GE 7FA.

FPL proposes to upgrade the eight CT during an otherwise routine maintenance outage. The changes will increase the efficiency and power output of each CT by replacing new hot gas path components with those characteristic of the more recent GE Model 7FA.04 CT to increase firing temperature. The components include combustion liners and flow sleeves. New control software will be installed.

[1] GE Model 7FA.03 was previously known as GE Model PG7241FA.

Below are photos from a similar project of a CT undergoing similar modifications. The left hand side of Figure 4 is a photo of the combustion section and the three-stage rotor (expansion) section with the upper casings removed and combustors removed.

Figure 4. Internal Photo of GE 7FA with Combustors Removed. Details of Rotor Section.

The photo on the right hand side of the figure shows further details of the hot gas path. The hot combustion gases pass from left to right through the 1st stage nozzle and then the 1st stage blades and buckets, 2nd stage nozzle and blades and finally the 3rd stage nozzle and blades. The blades, seen as the three vertical rings in the picture, are attached to the rotor and spin as the gas expands, thus providing thrust to drive the compressor section and an attached direct-drive electrical generator.

The nozzles, of which only one per stage is visible (others removed) are stationary and fixed to the casing. The proposed project will change the materials, internal cooling passages, and sealing of some of these these components.

The photo on the left hand side of Figure 5 shows 14 liners (per CT), each of which is installed immediately downstream of the six fuel nozzles located within each combustor. These channel the hot gas to the rotor section. The photo on the right hand side of the figure shows 14 flow sleeves (one per liner). These direct compressor discharge air around the liners to keep them cool. The liner and flow sleeve combination will be modified to reduce resistance to air flow and improve efficiency.

Figure 5. Replacement Combustor Liners and Flow Sleeves (14 Sets/CT) Planned for Units 4 and 5.

The project will result in theoretical fuel heat input increases of 32 and 35 million Btu per hour (mmBtu/hr) per CT when firing natural gas (Units 4 and 5) and distillate fuel oil (Unit 5 only), respectively. This will not require an increase in the permitted design fuel heat input rates of 1,776 and 1,930 mmBtu/hr/CT when firing natural gas and distillate fuel oil, respectively, referenced to the higher heating value (HHV) and a compressor air inlet temperature of 59 degrees Fahrenheit (°F).

As discussed further below, any increases in annual emissions will be less than the respective significant emission rates (SER) established in Rule 62-210.200(Definitions), Florida Administrative Code (F.A.C.). A review for the Prevention of Significant Deterioration (PSD) and a new Best Available Control Technology (BACT) determination were not required pursuant to Rule 62-212.400, F.A.C.

There will be no change in the previous BACT determination for VOC conducted for Units 4 and 5 in 1999 or in the emission limits for CO, PM/PM_{10}, SO_2 or NO_X that insured that the PSD rules were not triggered for the latter pollutants. The low emission levels are achieved through a combination of inherently clean fuels and good combustion processes; in particular Dry Low NO_X (DLN-2.6) combustion technology. Units 4 and 5 are subject to a NO_X concentration limits of 9 parts per million by volume, dry at 15 percent (%) oxygen (ppmvd) when firing natural gas. Unit 5 is also subject to a NO_X concentration limit of 42 ppmvd achieved by wet injection firing backup distillate fuel oil.

Processing Schedule

August 29, 2011 Received the application for a minor source air pollution construction permit.

October 12, 2011 Distributed Intent to Issue Air Permit

2. PSD APPLICABILITY

General PSD Applicability

For areas currently in attainment with the AAQS or areas otherwise designated as unclassifiable, the Department regulates major stationary sources of air pollution in accordance with Florida's PSD preconstruction review program as defined in Rule 62-212.400, F.A.C. Under preconstruction review, the Department first must determine if a project is subject to the PSD requirements ("PSD applicability review") and, if so, must conduct a PSD preconstruction review. A PSD applicability review is required for projects at new and existing major stationary sources. In addition, proposed projects at existing minor sources are subject to a PSD applicability review to determine whether potential emissions *from the proposed project itself* will equal or exceed the PSD major stationary source thresholds. A facility is considered a "major stationary source" with respect to PSD if it emits or has the potential to emit:

- 250 TPY or more of any regulated air pollutant; or
- 100 TPY or more of any regulated air pollutant and the facility belongs to one of 28 PSD-major facility categories listed at Rule 62-210.200 (Definitions), F.A.C., including fossil fuel-fired steam electric plants of more than 250 million British thermal units per hour heat input.

The rules cited are available at the following links: Link to 62-210, F.A.C. and Link to 62-212, F.A.C.

PSD pollutants include: CO; NO_X; SO_2; PM; PM_{10}; VOC; lead (Pb); Fluorides (F); sulfuric acid mist (SAM); total reduced sulfur (TRS), including hydrogen sulfide (H_2S); and mercury (Hg).

For major stationary sources, PSD applicability is based on the previously mentioned SER as defined in Rule 62-210.200 (Definitions), F.A.C. Emissions of PSD pollutants from the project exceeding these SER are considered "significant" and BACT must be employed to minimize emissions of each PSD pollutant.

Refer to Table 1. Although a facility may be "major" for only one PSD pollutant, a project must include BACT controls for any PSD, emissions of which pollutant equal or exceed the corresponding SER.

Table 1. List of SER by PSD-Pollutant. [1,4,5]

Pollutant	SER (TPY)	Pollutant	SER (TPY)
CO	100	NO_X	40
PM/PM_{10} [2]	25/15	Ozone (VOC) [3]	40
Ozone (NO_X) [3]	40	SAM	7
SO_2	40	F	3
Pb	0.6	TRS	10
H_2S	10	Hg	0.1

1. Excluding those defined exclusively for municipal waste combustors and municipal solid waste landfills.
2. PM with a diameter less than 2.5 micrometers ($PM_{2.5}$) is also a PSD pollutant, but an SER has not yet been defined in the Department's rules.
3. Ozone (O_3) is regulated by its precursors (VOC and NO_X).
4. There is a federal SER of 75,000 TPY for Greenhouse Gases (GHG) as carbon dioxide (CO_2) equivalent (CO_2e) that has not been incorporated into Department rules.
5. SER also means any emissions rate or any net emissions increase associated with a major stationary source or major modification which would construct within 10 kilometers of a Class I area and have an impact on such area equal to or greater than 1 $\mu g/m^3$, 24-hour average.

PSD Applicability for Project

The PSD requirements of Rule 62-212.400(4) through (12), F.A.C., apply to the construction of any new major stationary source or the major modification of any existing major stationary source. A significant emissions increase of a PSD pollutant (and thus a major modification) will occur if the difference (or the sum of the differences if more than one emissions unit is involved) between the **projected actual emissions** and the **baseline actual emissions** equals or exceeds the SER for that pollutant. [Rule 62-212.400(2)(a)1., F.A.C.]

For any existing electric utility steam generating unit, "baseline actual emissions" means the average rate, in TPY, at which the unit actually emitted the pollutant during any consecutive 24-month period selected by the owner or operator within the 5-year period immediately preceding the date a complete permit application is received by the Department. [Rule 62-210.200 (Definitions), F.A.C.]

"Projected actual emissions" means the maximum annual rate, in TPY, at which an existing emissions unit is projected to emit a PSD pollutant in any one of the 5 years following the date the unit resumes regular operation after the project, or in any one of the 10 years following that date, if the project involves increasing the emissions unit's design capacity or its potential to emit that PSD pollutant and full utilization of the unit would result in a significant emissions increase or a significant net emissions increase at the major stationary source. [Rule 62-210.200 (Definitions), F.A.C.]

There are a number of additional considerations within the cited rules when making the described comparison of projected actual emissions to baseline actual emissions. One of the key considerations is that in making the calculation of projected actual emissions, the Department shall exclude that portion of the unit's emissions following the project that an existing unit could have accommodated during the consecutive 24-month period used to establish the baseline actual emissions and that are also unrelated to the particular project including any increased utilization due to product demand growth.

The applicant conducted the described analysis, which is documented in the report attached to the application available at: Link to FPL Application .

Table 2 is a summary of the applicant's PSD applicability analysis. The full step-by-step procedure is shown in the application report in Tables 1 through 7 (Pages 74 through 82 of the pdf document).

Table 2. Summary of the Applicant's PSD Applicability Analysis.

Pollutant [1]	Baseline Actual Emissions (TPY)	Projected Actual Emissions (TPY)	Projected Emissions Increase (TPY)	SER (TPY)	Subject to PSD?
CO	159.9	167.5	7.6	100	No
NO_X	1,328.1	1,359.8	31.7	40	No
PM/PM_{10}	287.2	287.2	0.0	25/15	No
SO_2	26.5	27.2	0.7	40	No
VOC [2]	0.15	0.16	< 1	40	No
SAM	4.1	4.2	0.1	7	No
CO_2	5,214,241	5,248,293	34,052	75,000 (EPA SER)	No
N_2O (CO_2e)	2,973	3,932	959		
CH_4 (CO_2e)	2,014	2,014	0		
Total GHG (CO_2e)	5,219,227	5,254,238	35,011		

1. N_2O is nitrous oxide – a GHG. CH_4 is methane – a GHG.
2. The baseline and projected VOC emissions appear unrealistically low. However, any increase would be less than the increase in CO emissions and less than the VOC SER.

As shown in the above table, total project emissions will not exceed the PSD SER; therefore, the project is not subject to PSD preconstruction review. However, because the projected emissions increase for NO_X is approaching the PSD SER, future reporting comparing baseline actual emissions of NO_X to future actual emissions of NO_X will be required for 5 years following completion of the project, in accordance with the requirements of Rule 62-210.370, F.A.C.

To-date, Units 4 and 5 have used only natural gas. Assuming an increase of heat input rate for natural gas-firing and oil-firing of 32 mmBtu/hr/CT (1.8% of 1,776 mmBtu/hr/CT), NO_X emissions may increase at each compressor inlet temperature. At International Organization for Standardization (ISO) conditions, actual NO_X emissions are approximately 50 pounds per hour (lb/hr/CT). In that case, the additional emissions would be less than 1 lb/hr/CT or 32 TPY assuming the equivalent of 8,000 hours/year/CT at full load. At this emission increase (assuming there is any increase at all), the SER for NO_X would not be triggered. A similar analysis for CO, SO_2, VOC, PM/PM_{10} and SAM would yield the same conclusion; PSD is not triggered.

While there is a projected increase in GHG emissions, there is an overall reduction in heat rate (Btu/kilowatt-hour) that reduces the amount of emissions for each megawatt-hour (MWH) generated.

According to the applicant, there will be an approximate 1% percent decrease in heat rate as a result of the project, which will reduce CO_2e emissions by roughly 53,000 TPY compared with the projected future actual emissions given in the table. Because of the efficiency improvements, the proposed project will reduce the output based emissions on the basis of lb CO_2e/MWH as well as lb NO_X/MWH. Similar conclusions apply for the other PSD pollutants, including CO, SO_2, PM/PM_{10} and VOC.

3. NSPS APPLICABILITY

Sanford Units 4 and 5 are each an affected facility and an existing facility as defined in 40 CFR 60, Subpart A – General Provisions. [40 CFR 60.2 (Definitions) adopted as Rule 62-204.800(8)(a), F.A.C.] Link to 40 CFR 60.2 .

Sanford Units 4 and 5 were constructed pursuant to 40 CFR 60, Subpart GG - Standards of Performance for Stationary Gas Turbines. [40 CFR 60, Subpart GG adopted as Rule 62-204.800(8)(b)(40), F.A.C.] Link to Subpart GG . The key minimum requirements of Subpart GG applicable to Sanford Units 4 and 5 include standards for NO_X and SO_2. In summary these are:

- Limit of 75 ppmvd of NO_X plus an efficiency and fuel nitrogen correction that for the Sanford Units 4 and 5 CT would result in a limit of approximately 110 ppmvd as measured by an annual NO_X compliance test and continuous water or steam to fuel monitoring (with continuous emissions monitoring system (CEMS) alternatives); and
- Limit of 0.8% by weight of sulfur in the fuel burned in the CT using one of several standard methods (with alternatives for contracts and representative sampling indicating sulfur less than 20 grains per 100 standard cubic feet – gr/100 SCF).

The following table is the summary of the emission limits given in the original air construction permit (1270001-004-AC/PSD-FL-270) for repowered Units 4 and 5. The NO_X emissions are corrected to 15% oxygen and measured by continuous emission monitoring systems (CEMS).

Table 3. Emission Limits Applicable to Repowered Units 4 and 5.

Emission Unit	NO_X	CO	VOC	PM/Visibility (% Opacity)	Technology and Comments
Combustion Turbines (each)	9 ppmvd (30 day) - gas 42 ppmvd - oil 75/110 ppmvd (NSPS)	12 ppmvd - gas 20 ppmvd - oil	1.4 ppmvd 7 ppmvw	10 - gas 20 - oil	Dry Low NO_X Combustors Natural Gas or 0.05% S Fuel Oil Good Combustion Water Injection on Fuel Oil

Clearly the NO_X requirements of Subpart GG (indicated by NSPS in the table) are less stringent than those imposed by the permit that was issued for Units 4 and 5 in 1999. Also the fuel spec in the original permit of natural gas or 0.05% sulfur (S) fuel oil is more stringent than the 0.8% S specification in Subpart GG.

For the purposes of NSPS applicability, the term "modification" means any physical change in, or change in the method of operation of, an existing facility which increases the amount of any pollutant (to which a standard applies) emitted into the atmosphere by that facility or which results in the emission of any air pollutant (to which a standard applies) into the atmosphere not previously emitted.
[40 CFR 60.2 (Definitions) adopted as Department Rule 62-204.800(8)(a), F.A.C.] Link to 40 CFR 60.2 .

Modifications are further addressed in Section 40 CFR 60.14. Link to 40 CFR 60.14 . This section requires that emission rates be expressed on a short-term mass per hour basis i.e. kilograms/hour (kg/hr). It includes a key exemption from the definition of modification for "maintenance, repair, and replacement which the Administrator determines to be routine for a source category …."

The applicant presumed that replacement of the hot gas paths components with upgraded versions to improve efficiency does constitute "routine replacement".

Reconstruction, which would make an existing facility also an affected facility, is addressed in Section 40 CFR 60.15. Link to 40 CFR 60.15 . Reconstruction means "replacement of components of an existing facility to such an extent that the fixed capital cost of the new components exceeds 50% of the fixed capital cost that would be required to construct a comparable entirely new facility".

Sanford Units 4 and 5 were repowered at a cost on the order of $700,000,000.[2] The marginal cost of the improved hot path components compared with like-kind routine replacement of existing components is at most a few percent of the cost of constructing a comparable and entirely new facility. The Department concludes that the project does not constitute reconstruction.

There may or may not be a small increase in short-term mass emission rates of NO_X. According to the application, "since the hourly emission rates for these pollutants may potentially increase, the proposed

[2] Newspaper Article. Sun Sentinel. March 5, 2002. Link to Article

project is a potential modification according to the rules for NSPS. As a result, the improved Units 4 and 5 turbines may be subject to 40 CFR 60 Subpart KKKK …..".

40 CFR 60, Subpart KKKK - Standards of Performance for Stationary Combustion Turbines applies to stationary combustion turbines that commenced construction, modification or reconstruction after February 18, 2005. [40 CFR 60, Subpart KKKK adopted as Department Rule 62-204(8)(b)(81), F.A.C.]. Link to Subpart KKKK . Units subject to Subpart KKKK are not (i.e. no longer) subject to Subpart GG.

The key minimum requirements of Subpart KKKK applicable to Sanford Units 4 and 5 include standards for NO_X and SO_2. In summary these are:

- Limits of 15 and 42 ppmvd of NO_X, gas-fired or oil-fired respectively, on a 30-day basis when operating in combined cycle mode, and
- Limit of 0.90 lb SO_2/MWH or 0.060 lb SO_2/mmBtu using one of several standard sulfur fuel test methods (with alternatives for contracts and representative sampling indicating sulfur less than 20 gr/100 SCF of natural gas and less than 0.05%, by weight, in the fuel oil).

These requirements are more stringent than those of Subpart GG and approximately as stringent as the NO_X emission limitation and the sulfur fuel specifications already applicable to Units 4 and 5 per the original repowering permit. The key exception is that the Subpart KKKK simple cycle NO_X limit when firing natural gas would be applicable on a 4-hour basis rather than a 30-day basis. Simple cycle operation is rarely if ever practiced for Units 4 and 5.

Overall there would be no meaningful difference in the future operation of Units 4 and 5 or future emissions regardless of the applicability of Subpart KKKK. The Department will make a final determination based on future operation and will require the applicant to submit data comparing emissions before and after the project in accordance with 40 CFR 60, Appendix C – Determination of Emission Rate Change. Details of the methodology are provided in the following link:
Link to Appendix C .

According to the introduction in Appendix C, the "method shall be used to determine whether a physical or operational change to an existing facility *resulted* in an increase in the emission rate to the atmosphere. The method used is the Student's *t* test, commonly used to make inferences from small samples". Fortunately Units 4 and 5 have CEMS for NO_X and it will be easy to review data from before and after the change and make the inference from a relatively large number of runs (n = 20-29).

If short-term mass emission rate increases occur, then Units 4 and 5 will be subject to the requirements of Subpart KKKK. The primary changes would be in certain reporting requirements.

4. PERMIT CHANGES

The only permit conditions required are:

- A description and authorization of the improvement project – replacement of hot gas path components with upgraded parts;
- A requirement that the permittee report emissions of NO_X pursuant to Rule 62-212.300(1)(e), F.A.C. to determine in the future whether the project has triggered PSD; and
- A requirement that the permittee conduct tests in accordance with 40 CFR 60, Appendix C (using CEMS) and submit the data with a preliminary inference whether the emission rates after the change are greater than before the change with 95% confidence and whether Subpart KKKK applies.
- The present Title V Operation Permit (1270009-018-AV) already provides exclusion of several hours of emission data during tuning of the combustors such as would be performed at the completion of the turbine improvement project. The Department will, nevertheless, include a condition in the present

air construction permit to insure that similar tuning is allowed on a permanent basis rather than only during the lifetime of the present Title V Operation Permit, which expires on December 31, 2014.

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 a significant increase in emissions. Robert Wong is the project engineer responsible for reviewing the application and drafting the permit. Additional details of this analysis may be obtained by contacting the project engineer at the Department's Office of Permitting and Compliance at Mail Station #5505, 2600 Blair Stone Road, Tallahassee, Florida 32399.