TECHNICAL EVALUATION

Florida Power & Light Company

Martin Plant Unit B

Units 3,4, and 8

Martin County

PSD-FL-146, and 327, 085001-016-AC

DRAFT Permit Revision No. 0850001-017-AV
Revision to FINAL Title V Permit No. 0850001-013-AV

Florida Department of Environmental Protection
Division of Air Resource Management
Bureau of Air Regulation
Permitting South

August 21, 2006

TECHNICAL EVALUATION FOR AIR CONSTRUCTION PERMITTING ACTIONS

Cold Start-up of Combined Cycle Unit 8 STG.

The Department conducted a full determination of best available control technology (BACT) during the original permitting of Unit 8 in 2003 and required use of inherently clean fuels, installation of DLN combustors and a selective catalytic reduction (SCR) system.

A cold startup of a STG that is part of a four-on-one combined cycle unit is an uncommon event and indicates that there has been a prolonged shutdown of about 1,000 MW of typically baseloaded capacity. A cold STG startup might occur at intervals between one and ten years.

A longer period of excess emissions for the cold startup of the STG provides greater flexibility to the operator in the manner by which different CT/HRSG sets are blended in and out within the allowable excess emissions period. According to the applicant, the longer period allows for use of only two CTs to start up the STG (and HRSGs). This is a lower emitting scenario because less CTs operate in the higher emitting (non DLN) modes.

A two CT start-up with 8-hours of excess emissions versus a three CT start-up with 6-hours of excess emissions allows:

- Offers a modest net reduction in NO_X mass emissions over the duration of the start-up.
- Greater operational flexibility;
- Simplifies the start-up process;
- Has less risk from unintended CT trips associated with blending/unblending operations, and

The FP&L analysis is included as Attachment I to this Statement of Basis. The rationale provided is acceptable to the Department.

Annual Testing of Units 3 and 4 at 90-100 percent of capacity.

The original AC/PSD Permit issued in 1991 did not specify the rate at which Units 3 and 4 must be tested during annual compliance tests. The applicable regulation required that testing be conducted at 90 to 100 percent of capacity. In 1996, the Department, at the request of FP&L, added a condition to the AC/PSD Permit to reflect Department's December 1995 Guidance DARM-EM-05, "Rate of Operation during Compliance Testing for Combustion Turbines" which identified a rate of 95 to 100 percent of capacity 95-100 percent of the manufacturer's rated heat input to the combustion turbine achievable for the average ambient (or conditioned) air temperature during the test..

The mentioned Guidance was subsequently rescinded. The applicable rule provision is Paragraph 62-297.310(2), F.A.C. provides testing between 90 to 100 percent of capacity.

The Department will issue an AC/PSD Permit Modification that reflects the 90 to 100 percent test requirement in accordance with the rule, but will keep the additional wording that marks capacity to ambient or conditioned air. The additional wording accounts for the fact that capacity varies throughout the year with respect to temperature. For example the "Winter Rating" of such units could easily be 15 percent greater than the "Summer Rating". The change will also be reflected by revision of Condition B.3 of the Title V Operation Permit as discussed below.

Recognition of Power (Steam) Augmentation on Units 3 and 4.

Combined Cycle Units 3 and 4 were permitted in 1991 with enforceable limitations on heat input, NO_X and CO. The concept of power augmentation was not specifically addressed in the original AC/PSD Permit.

Power augmentation involves the routing of some steam from the HRSG back to the expansion portion of the CT for purpose of additional power production from the electrical generator directly associated with the CT. Normally such steam is routed to the STG. In certain applications, some steam is actually routed back to the CT combustors for NO_X control. In the present case, the CTs have DLN combustors and, except for rare use of fuel oil, do not require steam injection for NO_X control.

By letter dated February 1993 (during the construction of Units 3 and 4) FP&L advised the Department:

"With the completion of detailed engineering and shop testing, refinement of the information previously provided to DER as part of the certification process has occurred in two general areas. The first is the development of the peak mode of operation (i.e. power augmentation)."

The details submitted by FP&L in 1993 and 1994 are included as Attachment II to this Statement of Basis. During the same time, the Department was in the process of modifying the relevant AC/PSD Permit. Apparently both FP&L and the Department did not at the time consider it necessary to revise the open AC/PSD Permit to recognize power augmentation as a distinct mode of operation.

By letter dated August 2, 1994, FP&L submitted a description of the goals for the Unit 3 and 4 testing program. The manner by which testing would be conducted while practicing power augmentation was described and is given in the previously referenced Attachment II.

It is clear that the unit must comply with the same emission limits during power augmentation as required under the normal mode for natural gas operation. It is also clear that power augmentation is practiced sparingly.

For clarification purposes, the Department will add a provision in the Draft AC/PSD Permit Modification to recognize this mode of operation. For reference, this mode is already recognized in the current Title V Operation Permit and no changes are required within the present Title V Operation Permit Revision.

Excess Emissions during Operational Switching from Natural Gas to Fuel Oil on Combined Cycle Units 8

The Department previously recognized the need for excess emissions considerations for switching from fuel oil to natural gas during operation of the combustion turbines. The Air Construction/PSD Permit for Combined Cycle Unit 8 provides that:

Fuel Switching: For oil-to-gas fuel switching, excess emissions shall not exceed one (1) hour in any 24-hour period.

The excess emissions are at least partially caused by the need to reduce load to less than 50 percent of capacity at which level the dry low NO_X/CO features of the GE 7FA combustion turbines are not fully employed.

The reverse situation does not require the same consideration of excess emissions. Operational switching from natural gas to fuel oil firing can be accomplished without a significant load reduction. Additionally, the fuel oil firing mode is characterized by greater allowable and actual emissions. The Department believes that any excess emissions from natural gas to fuel oil switching can be accommodated by the permitted limits for fuel oil firing.

Additional Approved Test Methods for Combined Cycle Units 3 and 4

Method 7E is an approved test method for determination of NO_X concentrations. The Department will allow its use in conjunction with other approved EPA Methods to determine both NO_X concentrations and mass emissions.

Methods 25 and 25A are approved test Methods for Total Hydrocarbons. The applicant may use these methods in lieu of the previously approved Method 18 to determine VOC emissions and may, as needed, use certain provisions of Method 18 to subtract non-VOC fractions (e.g. methane) from the values obtained by Methods 25 or 25A.

NO_X emissions data collected during the annual NO_X continuous monitor RATA required pursuant to 40 CFR 75 may be substituted for the required annual performance test.

Testing Conditions Related to Power Augmentation and Fuel Oil use

Clarification that testing is required for the power augmentation mode. The unit has CEMS for NO_X emissions. FP&L has requested and the Department concurs that separate compliance tests are not necessary for power augmentation and fuel oil firing modes if employed less than 200 hrs/yr, each.

Attachment I

Cold Start-up of the Steam Turbine/Generator on a Four-on-One Combined Cycle

The following scenario is specific to Manatee Unit 3, but also applies to Martin Unit 8 and Turkey Point Unit 5. All three units have "four-on-one" combined cycles that consist of: 4 General Electric 7FA combustion turbine-electrical generators (CTs); four duct-fired heat recovery steam generators (HRSGs); and a single steam turbine-electrical generator (STG).

Although a cold steam start-up is a complex procedure done infrequently, actual operating experience now shows that the six hours originally permitted by the PSD and AC permits is inadequate to successfully, and smoothly, execute a cold Steam Turbine start. The Steam Turbine Start Up process has CTs sequentially started so that the respective HRSG is able to provide a sufficient quantity of steam at the appropriate temperature, pressure, and flow to maintain accurate Steam Turbine speed control and warm the STG slowly. This requires that the CT's be run at low loads, during which time the full Dry Low NO_X (DLN) features are not fully enabled.

Typically, one CT is started ahead of the others, and a second CT is started somewhat later. When the steam conditions from the second CT/HRSG match the pressure and temperature of the first HRSG, it is "blended" by means of valving operations with the first CT/HRSG steam and the start-up progresses. Later, a third CT/HRSG combination is started, warmed up, and "blended". This is done in order to "unblend" the first CT/HRSG as it approaches the 6-hour excess emissions window. That is, the steam from the first CT's HRSG is routed by means of valving operations from the Main Steam Turbine Header to the condenser. The first CT's load is then ramped up to a point where the SCR can be placed into service and render the CT in compliance with its normally permitted emissions. Afterward, it is "re-blended" with the other two starting units.

This process of "unblending" one CT while ensuring the other CT's have been sequentially started up, and in the right configuration to provide steam of adequate temperature, pressure, and quantity to be "blended" to the steam turbine has proven to be challenging. During the "unblending" and "blending" valving operations, CT HRSG's temperatures, pressure and drum levels become very difficult to control.

Any HRSG instability can trip the CT's which would require a new restart and potentially more excess emissions, either from a restart of the CTs, or more typically, the start-up must postponed until the next calendar day as insufficient start-up time remains in the current 24-hour period. Postponing the start-up until the next day necessitates that the needed generation is supplied from elsewhere. In the case of Manatee Unit 3 (or Martin Unit 8 or Turkey Point Unit 5), alternate residual fuel oil-fired units are greater emitters.

Extending the 6 hour emission limit to 8 hours would significantly reduce the number of "unblending/blending" operations, and provide more certainty of a successful timely start using as few as two CTs. It also will allow more operational flexibility in cases where the load from 3 or 4 CT's is not needed, or when 2 CT's are out of service for routine maintenance.

Manatee Unit 3, for example, conducted a cold start-up of the STG on June 12, 2005. Three CTs were used during the start-up. To remain within the 6-hour excess emissions window, CT-A was unblended at the end of its 6-hour period, ramped up in firing rate, and the SCR placed into service. The CEM emissions data in Table 1 below is from that start-up. The "Additional 2 hours" of emissions data is projected from the actual emissions of the last 2 hours (hours 5 and 6) of CT-A and CT-C operation.

A two CT start-up with 8-hours of excess emissions versus a three CT start-up with 6-hours of excess emissions allows: greater operational flexibility; a simplified start-up process; less risk from unintended CT trips associated with blending/unblending operations; and a modest net reduction in NOx mass emissions over the duration of the start-up.

Table 1. PMT UNIT 3 COLD TURBINE S/U JUNE 12, 2005. NOx emissions in pounds from CEM data

	CT-A	CT-B	CT-C	A+C	A+B+C
First 6 hours	554	509	574		
Additional 2 hours *Projected from hours 5 and 6 actual emissions	209*		230*		
Projected total for 2 CTs @ 8 hours each (CTs A & C)	763		804	1,567	
Total for 3 CTs @ 6 hours each	554	509	574		1,637

Attachment II

Power Augmentation on Combined Cycle Units 3 and 4 (2/1993 and 8/1994)

Power Augmentation

Units 3 & 4 at Martin utilize advanced combustion turbines (CT's). The term "advanced" refers to a very high firing temperature design. The higher firing temperature requires use of exotic materials coupled with very sophisticated internal cooling techniques. This design approach results in a machine which operates very close to its true maximum capability in normal operation (e.g., base load).

Conventional power generation combustion turbines have two ratings, base and peak loads. Conventional units operate at a base load firing temperature of 1900° F to 2100° F and have reasonable design margins. Peak load is a temporary operating mode which is accomplished by simply raising the firing temperature by 50° F to 100° F in the conventional combustion turbine.

Peak load operation for Units 3 & 4 cannot be accomplished by simply raising the firing temperature since these units operate at 2350° F. To obtain a peak load rating for these units, steam is injected into the combustion turbine at temperatures lower than the combustion gases.

The lower temperature steam allows overfiring of the CT without exceeding 2350° F. Furthermore, the additional mass flow contributed by the steam produces more power from the turbine. GE refers to this peaking mode of operation as "power augmentation". When operating in this mode, emission limits will remain within the already permitted levels.

Operating in this mode has economic and environmental benefits. Economically, the additional power supply is at a very desirable incremental heat rate, thus lowering fuel costs. Environmentally, the use of this peaking mode displaces other higher emission units in the FPL system. Therefore, the benefits accrue to both the environment and FPL customers.

Martin Units 3 & 4 are designed to use the power augmentation mode sparingly. The auxiliary equipment necessary to support power augmentation in limited in capacity. For example, the water treatment plant and demineralizer can support continuous power augmentation for only 48 hours at a time. On a consistent daily use basis, Units 3 & 4 would only be able to run two hours per day in the power augmentation mode. FPL expects to use this peak mode of operation approximately 228 hours per year. This estimate is based on several assumptions that cannot be verified without actual plant operational data and yearly weather patterns.

III. Steam Power Augmentation Testing of CT operation for both physical performance and compliance with permitted emission limits for NOx, CO and VOC will be conducted with steam augmentation occurring from zero up to maximum steam injection levels. Based on these operation tests, adjustments will be made to the control constants and fuel split schedules as discussed above to maintain emissions at permitted levels and to control combustor stability and dynamics.