



SULFURIC ACID MIST PERFORMANCE TEST PROTOCOL

Duke Energy Florida, Inc.
Crystal River Power Plant
Units 4 & 5
Crystal River, Citrus County, Florida

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1.0 INTRODUCTION

As of mid-July 2013, the Duke Energy Florida, Inc. (DEF) Crystal River Power Plant (Crystal River Plant) has completed construction of a permanent hydrated lime injection system to control the formation of acid mist. This permanent system replaces the temporary system that has been operating in place since 2011. As part of this project, and in accordance with Air Permit No PSD-FL-383F, Project No. 0170004-037-AC, Emissions Unit Specific Condition No. 3.A.16, as issued by the Florida Department of Environmental Protection (FL DEP), Duke Energy will conduct a series of preliminary performance tests on Unit 4 and Unit 5 to determine sulfuric acid mist (SAM) emissions rates under a variety of unit operating conditions in order to refine the injection rates when operating with the permanent system.

The purpose of this test program is to document the impact of the hydrated lime injection rate from the permanently installed system on reducing the SAM emissions and to revise, as necessary, the hydrated lime injection rate correlation curves developed for use with the temporary system at varying unit operating conditions/loads and injection locations. This protocol outlines the procedures to be followed, the test methods to be used, and any requested deviations from either the specific conditions and limitations as listed in the above referenced air permit, or from the test methods themselves.

In addition to the SAM performance testing, a revised SAM Operating Protocol (SAMOP) will be submitted to FL DEP after the test data are evaluated and implemented in the form of a correlation curve. The purpose of the SAMOP is to outline how the AMM system will be operated at various load levels and operating conditions, based upon the results of the SAM performance tests. Once the SAMOP is implemented, follow-up compliance testing for SAM will be performed.

C.E.M. Solutions of Hernando, Florida has been contracted to perform the stack testing for this particular project.

2.0 BACKGROUND AND TEST PLAN OVERVIEW

Air Permit No. PSD-FL-383F, Emissions Unit Specific Condition No.3.A.16 outlines the general SAM performance testing requirements. More specifically, DEF is to conduct a minimum 1-hour test run to determine the SAM emissions for at least nine (9) different operating conditions. In addition, the SAM performance 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.

The air permit also provides several “examples” of the types of parameters that can be evaluated to determine how they are affected by the SAM emissions. These examples include the SO₂ emissions rate prior to the SCR catalyst, the unit load, the flue gas flow rate, the alkali injection rate, the current catalyst oxidation rate, and the operating level of the FGD system.

In 2011, DEF conducted the necessary testing to demonstrate compliance with the above requirements in conjunction with the installation and operation of the temporary hydrated lime injection system. The purpose of this additional test program is to refine the previously demonstrated conditions and calibrate the permanently installed system. DEF proposes to clarify and satisfy meeting the above requirements and suggestions as follows:

- A 1-hour test run will be performed on each unit under ten (10) different operating conditions, involving varying levels of hydrated lime injection, various injection locations and a range of load levels.
- An additional eight (8) 1-hour test runs will be conducted on one of the two units using an “enhanced” hydrated lime product in order to evaluate its effectiveness versus the standard hydrated lime product.
- All test runs will be performed while combusting the normal fuel supply of approximately 5 lb/MMBtu coal.

- The following parameters will be evaluated and recorded during testing:
 - Unit load
 - Heat input (based upon CEMS flow and %CO₂)
 - SO₂ process monitor concentration at the FGD inlet
 - SO₂ CEMS concentration at stack outlet
 - Boiler O₂
 - CEMS O₂
 - CEMS flue gas flow rate
 - SCR ammonia injection rate
 - AMM hydrated lime injection rate
 - Absorber pH

During each test, a representative fuel (coal) sample will be collected for proximate analysis.

In order to complete the SAM performance testing, DEF intends to use engineering calculations in combination with data gathered during the previous testing and operation of the temporary hydrated lime injection system.

At a minimum, one 1-hr test run will be conducted at each of the operating conditions listed in Table 2-1, which provides a summary of the SAM performance test program. However, additional testing may be performed (e.g., at additional injection rates or load conditions) if deemed necessary during the test program.

While SAM emissions limits are not expected to be exceeded during this testing, DEF notes that in accordance with Air Permit No. PSD-FL-383F, Emissions Unit Specific Condition No.3.A.16, DEF is exempt from the SAM emission standards of the permit for the purposes of this SAM performance test program.

Table 2-1. SAM Performance Test Matrix – Unit 4 and 5

GROUP	TEST #	H.LIME TYPE	LOAD	INJECTION LOCATION						TOTAL [lb/hr]	UNIT	DATE	TIME
				SCR OUT		AH OUT		ESP OUT					
				[lb/hr]	[%]	[lb/hr]	[%]	[lb/hr]	[%]				
A	1	STANDARD	760 MW	400	15%	-	-	2300	85%	2700	4&5	8/26/13	Min 3 hrs at OP 0900-1000
	2	STANDARD	760 MW	500	18%	-	-	2300	82%	2800	4&5	8/26/13	1100-1200
	3	STANDARD	760 MW	600	21%	-	-	2300	79%	2900	4&5	8/26/13	1300-1400
	4	STANDARD	760 MW	400	16%	-	-	2100	84%	2500	4&5	8/26/13	1600-1700
	5	STANDARD	760 MW	400	14%	-	-	2500	86%	2900	4&5	8/26/13	1800-1900
B	6	STANDARD	760 MW	400	15%	2300	85%	-	-	2700	4&5	8/28/13	Min 3 hrs at OP 0900-1000
	7	STANDARD	760 MW	400	16%	2100	84%	-	-	2500	4&5	8/28/13	1100-1200
	8	STANDARD	760 MW	400	14%	2500	86%	-	-	2900	4&5	8/28/13	1300-1400
C	9	STANDARD	500 MW	400	36%	-	-	700	64%	1100	4	8/27/13	0700-0800* Min 3 hrs at Mid load
	9	STANDARD	500 MW	400	36%	-	-	700	64%	1100	5	8/27/13	0700-0800* Min 3 hrs at Mid load
	10	STANDARD	250 MW	400	50%	-	-	400	50%	800	4&5	8/27/13	0300-0400 Min 3 hrs at Low load
D	11	ENHANCED	760 MW	400	15%	-	-	2300	85%	2700	4	8/29/13	1100-1200 Min 3 hrs at OP
	12	ENHANCED	760 MW	400	16%	-	-	2100	84%	2500	4	8/29/13	1300-1400
	13	ENHANCED	760 MW	400	21%	-	-	1500	79%	1900	4	8/29/13	1500-1600
E	14	ENHANCED	760 MW	400	15%	2300	85%	-	-	2700	4	8/28/13	1500-1600
	15	ENHANCED	760 MW	400	16%	2100	84%	-	-	2500	4	8/28/13	1700-1800
	16	ENHANCED	760 MW	400	21%	1500	79%	-	-	1900	4	8/28/13	1900-2000
F	17	ENHANCED	500 MW	400	36%	-	-	700	64%	1100	4	8/29/13	0700-0800* Min 3 hrs at Mid load
	18	ENHANCED	250 MW	400	50%	-	-	400	50%	800	4	8/29/13	0300-0400 Min 3 hrs at Low load

3.0 FACILITY DESCRIPTION

3.1 Facility Location

Duke Energy's Crystal River Power Plant is located in the Crystal River Energy Complex in Citrus County, Florida.

3.2 Process Description

Units 4 and 5 are fossil fuel-fired electric utility steam generators with dry bottom, wall fired boilers rated at 760 megawatts (MW), with a heat input capacity of 7,200 mmBtu/hr. The boilers are capable of burning bituminous coal, a bituminous coal and bituminous coal briquette mixture, and used oil. No. 2 oil can be used as a startup fuel, and natural gas can be used for startup and for low-load flame stabilization. Air pollution control equipment includes, in order: low-NO_x burners, an SCR system, an AMM system, an ESP, and a FGD system. Flue gas exhausts through the stack at ~130 °F.

To clarify, note that the SCR and AMM are two distinct and separate air pollution control devices. The SCR is used for NO_x control. For the purposes of this test program, the AMM system is used for the control of SAM emissions.

3.3 Reference Method Sampling Locations

The sampling locations for the SAM performance test program will be at the stack outlet. The test location will consist of single-point sampling at a minimum of at least 1 meter from the inside wall of the test port, duct, or stack. Note that the stacks of Unit 4 and Unit 5 are separate, identically designed stacks that are both located inside of a common stack annulus.

4.0 REFERENCE METHOD PERFORMANCE TESTING PROCEDURES

This section includes a brief discussion of the test methods that will be used for sampling and analysis for the Crystal River Units 4 and 5 SAM performance test program. Unless stated otherwise, all stack sampling will be performed in accordance with the applicable test methods as prescribed in the referenced air permit. Any deviations from the standard procedures are clearly noted in the following subsections of this protocol. Testing will be conducted as described in the Table 2-1 matrix.

During the performance test program, all process data will either be electronically logged and printed out by the plant's distributed control system (DCS), CEMs, or manually recorded at 15-minute increments. The process data summarized in Section 2.0 of this protocol will be provided by the plant for each test run (where applicable).

4.1 Traverse Point Selection

Single-point sampling will be performed for each test run. The traverse point will be located at a minimum of at least 1 meter from the inside wall of the stack.

4.2 Wet Chemistry Methods – SAM (Method 8A)

Testing for SAM will be performed using Method 8A. As described in Section 2.0 of this protocol, a single 1-hour test run will be performed at each of the proposed test conditions.

5.0 PERFORMANCE TEST REPORT AND OPERATING PROTOCOL

5.1 SAM Performance Test Report

Air Permit No. PSD-FL-383F, Emissions Unit Specific Condition No. 3.A.16d requires that the SAM performance test report be submitted within 45 days after the last sampling run of the test program is completed.

5.2 SAM Operating Protocol (SAMOP)

Per Air Permit No. PSD-FL-383F, Emissions Unit Specific Condition No. 3.A.16e the revised SAMOP will be submitted within 45 days after submitting the SAM performance test report (but no later than 90 days following the last sampling run of the test program). The purpose of the SAMOP is to outline how the AMM system will be operated at various load levels and operating conditions, based upon the results of the SAM performance tests.

6.0 PERFORMANCE TEST SCHEDULE

At the current time, the SAM performance test is scheduled to take place from August 26-29, 2013. The entire test program should take 4 days, not including test delays. However, please note that the time in between runs is currently considered an unknown variable, since it is not known exactly how much time will be needed to let the unit “settle out” at various operating loads/injection rates, coupled with the turn-around time associated with the test firm providing the preliminary SAM results. Note also that, where possible and depending upon electrical demand, testing may be performed at any hour of the day (i.e., mornings, evenings, or nights) during the test program. Because of the number of part-load conditions required during this test program, it may be necessary to perform some of the test runs during off-peak (i.e., overnight) hours.

DEF also requests that any changes to the test schedule, which cause the original test schedule to be revised, be provided to FL DEP via periodic email and/or telephone updates. To the extent possible, at least seven (7) days notice will be provided in this manner should the testing dates be revised.

7.0 SAMOP IMPLEMENTATION AND COMPLIANCE TESTING

It is DEF's interpretation that the SAMOP will serve as the basis for implementing the SAM "correlation curve/algorithm" that will be used to demonstrate ongoing compliance with the permitted SAM emission limits.

Air Permit No. PSD-FL-383F, Emissions Unit Specific Condition No. 3.A.19a requires that the initial compliance tests for SAM emissions (coupled with the verification of the SAM correlation curve/algorithm) be performed within 120 days after "completing construction on the associated air pollution control systems" (and after completing the SAM performance testing).