

**COMPLIANCE ASSURANCE MONITORING PLAN  
WET LIMESTONE SCRUBBER AND ELECTROSTATIC PRECIPITATOR  
FOR PARTICULATE MATTER CONTROL  
NAVAJO GENERATING STATION  
UNITS 1, 2, AND 3**

**I. Background**

**A. Emissions Unit**

Description:	Pulverized Coal-Fired Boilers
Identification:	U1, U2, and U3
Facility:	Navajo Generating Station Page, Arizona

**B. Applicable Regulation(s) and Emission Limit(s)**

Regulation No.:	Federal Implementation Plan
Emission Limits:	
Particulate Matter:	0.060 lb/MMBtu on a plant-wide basis, as averaged from at least 3 sampling runs, each at a minimum of 60 minutes in duration, each collecting a minimum sample of 30 dry standard cubic feet
Monitoring Requirements:	Annual particulate matter mass emission test

**C. Control Technology**

Electrostatic Precipitator and Wet Limestone Scrubber

**II. Monitoring Approach**

The key elements of the monitoring approach are presented in Table 1.

**A. Background**

The emission units that are addressed in this Compliance Assurance Monitoring (CAM) plan include three 750 megawatt (net) pulverized coal-fired boilers. Each boiler is equipped with an electrostatic precipitator (ESP) for particulate control and a wet limestone scrubber for sulfur dioxide (SO<sub>2</sub>) removal. The wet limestone scrubbers also remove particulates from the flue gas.

Table 1. Monitoring Approach

I. Indicator	Electrostatic Precipitator	Wet Limestone Scrubber <sup>1</sup>	Wet Limestone Scrubber <sup>1</sup>	Wet Limestone Scrubber <sup>1</sup>
Measurement Approach	Number of chambers/fields in service The number of chambers/fields in service is monitored and logged on a continuous basis.	Number of spray levels in service The number of wet limestone scrubber spray levels in service is monitored on a continuous basis.	Wet limestone scrubber exhaust temperature The wet limestone scrubber exhaust temperatures are monitored at the absorber outlets prior to the stack using a J-type thermocouple.	Wet limestone scrubber on/off The wet limestone scrubber on/off signal is monitored on a continuous basis.
II. Indicator Threshold	Please see Section II.C below.	Please see Section II.C below.	Please see Section II.C below.	Please see Section II.C below.
III. Performance Criteria	The monitoring system consists of status bits from the Automatic Voltage Controllers (AVCs), supplemented with operating logs, which indicate the number of chambers/fields that are operational.	The monitoring system consists of a signal indicating the number of wet limestone scrubber spray levels that are operational.	The monitoring system consists of a J-type thermocouple at the wet limestone scrubber exhaust with a minimum accuracy of $\pm 5$ percent.	The monitoring system consists of an on/off signal indicating that the wet limestone scrubber is operational.
A. Verification of Operational Status	Not Applicable	Not Applicable	Not Applicable	Not Applicable
B. QA/QC Practices and Criteria	Monitoring equipment will be maintained and operated according to manufacturer recommendations.	The wet limestone scrubber spray level signal will undergo an annual verification check.	The thermocouple will undergo a quarterly verification check using a standard temperature indicator.	The wet limestone scrubber on/off signal will undergo an annual verification check.
C. Monitoring Frequency	Continuous	Continuous	Continuous	Continuous
D. Data Collection Procedures	The AVC status bits are recorded by the BHA WinDAC Data Acquisition and Control Software, and supplemented with operating logs.	The wet limestone scrubber spray level signal will be recorded on a continuous basis by the data acquisition handling system.	The wet limestone scrubber exhaust temperature will be recorded as an hourly average by a data acquisition handling system.	The wet limestone scrubber on/off signal will be recorded on a continuous basis by the data acquisition handling system.
E. Averaging Period	Not Applicable	Not Applicable	1-Hour Average	Not Applicable

<sup>1</sup> A unit wet limestone scrubber consists of an "A" and "B" absorber.

## **B. Rationale for Selection of Performance Indicators**

### Number of ESP Fields in Service

Each ESP consists of 16 chambers, which each have 6 fields, yielding a total of 96 fields per ESP unit. In an ESP, electric fields are established by applying a direct-current voltage across a pair of electrodes: a discharge electrode and a collection electrode. Particulate matter suspended in the gas stream is electrically charged when it passes through the electric field surrounding each discharge electrode. The negatively charged particles then migrate toward the positively charged collection electrodes. The particulate matter is separated from the gas stream by retention on the collection electrode.

The ESP is designed with automatic voltage controllers that aggressively push each transformer to the highest possible power level at all times and under any load condition. Therefore, it is the number of electric chambers/fields in service that impacts particulate removal efficiency and is the best performance indicator for the ESP.

### Wet Limestone Spray Levels

Each wet limestone scrubber contains four spray levels. One level serves as a spare. 2-3 spray levels are typically operated depending upon the sulfur content of the coal and what is needed to maintain compliance with the 365 boiler operating day sulfur dioxide (SO<sub>2</sub>) emission limit of 0.10 lb/MMBtu.

### Wet Limestone Scrubber Exhaust Temperature

Each wet limestone scrubber is made up of two modules and normally operates with two spray levels in each module. The wet limestone scrubber removes particulate matter from the exhaust gas stream by wetting dust particles through contact with a scrubbing liquid and then collecting those wet particles for removal. When the exhaust gas stream comes into contact with the scrubbing liquid, it results in the dissipation of mechanical energy and a corresponding reduction in exhaust temperature. Therefore, monitoring the exhaust temperature will be a good indicator that the wet limestone scrubber is operating properly.

### Wet Limestone Scrubber On/Off Signal

The wet limestone scrubbers were designed to be taken out of service for short periods of time for maintenance purposes. It has been demonstrated that if one wet limestone scrubber is bypassed, the plant-wide average particulate emission limit of 0.060 lb/MMBtu can still be met.

### C. Rationale for Selection of Indicator Threshold

#### Excursion Criteria

An excursion is defined as the occurrence of any one or more of the following events:

1. When an ESP unit is operating with more than 3 chambers (18 fields) out of service during normal operation of the boiler;
2. When an ESP unit is operating with more than one chamber (6 fields) out of service and less than 2 spray levels are operating in the wet limestone scrubber associated with the same boiler, during normal operation of the boiler;
3. When the wet limestone scrubber exhaust temperatures exceed 145°F for more than one unit, on a 1-hour average basis, during normal operation of the boilers;
4. When the wet limestone scrubber is bypassed for more than one unit, for at least 1 hour, during normal operation of the boilers.

When an excursion occurs, corrective action will be initiated beginning with an evaluation of the occurrence to determine the action required to correct the situation. Once the cause of the occurrence is determined, the situation will be remedied as expeditiously as practicable.

#### Number of ESP Fields in Service and Wet Limestone Scrubber Spray Levels (Excursion Criteria #1 and 2)

On April 5, 2000, a performance test was conducted during which 4 precipitator chambers (i.e., 24 fields) were out of service. The performance test results are included in Attachment 1. The measured particulate matter emissions over a 1.5-hour period were 0.032 lb/MMBtu, which is well below the plant-wide average particulate matter emission limit of 0.060 lb/MMBtu. To provide adequate compliance assurance, a lesser number of chambers and fields (3 chambers or 18 fields) will be used as a threshold to identify an excursion. To provide additional compliance assurance, a second criterion involving a combination of the number of fields in service and the number of wet limestone scrubber spray levels will be used to address a possible situation in which both the wet limestone scrubber and ESP are not operating at the maximum control levels.

SRP is willing to conduct performance testing in accordance with Title 40 of the Code of Federal Regulations (40 CFR) Part 64, Section (d), if EPA Region 9 and/or NNEPA requires additional assurance that compliance with the particulate matter emission limits can be achieved when more than 3 chambers of an Electrostatic Precipitator (ESP) unit are out of service. The

testing would be conducted at the first possible opportunity; i.e., at the earliest time at which more than 3 chambers are out of service on an ESP unit.

#### Wet Limestone Scrubber Exhaust Temperature (Excursion Criteria #3)

The selected indicator threshold for the wet limestone scrubber exhaust temperature is no more than 145 degrees Fahrenheit (°F) on a 1-hour average, as measured by a J-type thermocouple, during normal operation. This temperature threshold was selected based upon the manufacturer's specified operating permissive.

#### Wet Limestone Scrubber On/Off Signal (Excursion Criteria #4)

The selected indicator threshold is no more than one unit wet limestone scrubber bypassed for at least one hour. This indicator threshold was selected based on upon performance test data collected during various operating scenarios, as described below:

- Attachment 2 contains a summary of particulate matter performance tests conducted between 2000 and 2009 when the wet limestone scrubbers were operating. The highest 3-hour average particulate matter emission rate from any single unit that was measured during any of the performance tests conducted during this period was 0.047 lb/MMBtu.
- Attachment 3 contains a summary of performance tests that were conducted in which particulate matter was measured when the wet limestone scrubber was bypassed. The highest particulate matter emission rate from any one unit that was measured during any of the tests was 0.067 lb/MMBtu.

Therefore, a conservative estimate of the plant-wide average emission rate can be developed for a situation in which one of the wet limestone scrubbers is bypassed. If a single bypassed unit is assumed to emit the highest tested emission rate of 0.067 lb/MMBtu, and the other two units that are not bypassed are conservatively assumed to emit the highest tested emission rate of 0.047 lb/MMBtu, the plant-wide average emission rate would be 0.054 lb/MMBtu, which is less than the plant-wide average particulate emission limit of 0.060 lb/MMBtu. Therefore, this demonstrates that if no more than one unit wet limestone scrubber is bypassed, compliance with the plant-wide emission limit of 0.060 lb/MMBtu can be achieved.

### **III. Recordkeeping**

All excursions will be documented including when the excursion occurred, the cause for the excursion, and corrective actions taken to remedy the excursion.

**Attachment 1. April 2000 Performance Test Results**

## Navajo Generating Station Particulate Test Results

Purpose: 4 Chambers Out of Service - Special Particulate test with absorbers in service

Date: 4/5/2000

Unit: 2

### SUMMARY

Run #	Run Time	Particulate Results		% Stack Moisture	Isokinetics
		lbs/hour	lbs/mmBTU		
1	0923-1058	245.8	0.032	14.2	100.3
2					
3					
Average					

### CALCULATIONS

Run #	Coal Burn Rate (lbs/hr)	Coal Data		Calculated Heat Rate (BTUs)
		Total Moisture (%)	BTU/LB (dry)	
1	719,850	12.49	12,179	7,672,048,212
2				
3				

**Attachment 2. 2005-2009 Performance Test Results**

**PARTICULATE MATTER PERFORMANCE TEST RESULTS**  
**Navajo Generating Station**

<b>Year</b>	<b>Unit 1 (lb/MMBtu)</b>	<b>Unit 2 (lb/MMBtu)</b>	<b>Unit 3 (lb/MMBtu)</b>	<b>Plant-wide Average (lb/MMBtu)</b>	<b>Emission Limit (lb/MMBtu)</b>
2000	0.011	0.013	0.011	0.011	0.060
2001	0.020	0.012	0.007	0.013	0.060
2002	0.025	0.021	0.013	0.020	0.060
2003	0.019	0.014	0.018	0.017	0.060
2004	0.013	0.020	0.031	0.021	0.060
2005	0.036	0.019	0.032	0.029	0.060
2006	0.014	0.018	0.021	0.017	0.060
2007	0.015	0.013	0.018	0.015	0.060
2008	0.013	0.019	0.047	0.026	0.060
2009	0.013	0.008	0.009	0.010	0.060

**Attachment 3. Wet Limestone Scrubber Bypass Test Results**

**PARTICULATE MATTER PERFORMANCE TEST RESULTS**  
**WET LIMESTONE SCRUBBER BYPASS OPERATION**  
Navajo Generating Station

<b>Unit</b>	<b>Date</b>	<b>Particulate Matter (lb/MMBtu)</b>
3	7/15/2003	0.051
3	11/11/2003	0.067
2	4/7/2004	0.017
2	6/21/2004	0.062
1	5/5/2005	0.022
1	6/13/2005	0.044