A.2 VENTURI SCRUBBER FOR PM CONTROL–FACILITY B

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EXAMPLE COMPLIANCE ASSURANCE MONITORING:
VENTURI SCRUBBER FOR PM CONTROL--FACILITY B

I. Background

A. Emissions Unit

Description:	FCCU catalyst regenerator
Identification:	
Facility:	Facility B Anytown, USA

B. Applicable Regulation, Emission Limits, and Monitoring Requirements

Regulation No.:	40 CFR 60 Subpart J
Regulated pollutant:	Particulate matter
Emission limit (particulate matter):	1 lb/1,000 lb coke burned
Monitoring requirements:	Coke burn rate, air blower rate, number of venturis online (permit) [Note: Although Subpart J requires a COMS, this alternate monitoring approach was approved by the State permitting authority and is reflected in the facility's permit.]

C. Control Technology:

Four parallel venturi scrubbers

II. Monitoring Approach

The key elements of the monitoring approach for particulate matter, including the indicators to be monitored, indicator ranges, and performance criteria are presented in Table A.2-1.

TABLE A.2-1. MONITORING APPROACH

	Indicator No. 1	Indicator No. 2	Indicator No. 3
I. Indicator	Liquid to gas ratio	Scrubber exhaust temperature	Coke burn rate
Measurement Approach	Water flow–magnetic flowmeter. Air rate–venturi flowmeter. L/G calculated.	Scrubber exhaust temperature measured using a thermocouple.	Calculated using NSPS (§ 60.106) equation.
II. Indicator Range[a]	An excursion is defined as a 3-hour average liquid to gas ratio less than 8. Excursions trigger an inspection, corrective action, and a reporting requirement.	An excursion is defined as a 3-hour average scrubber exhaust temperature greater than 165°F. Excursions trigger an inspection, corrective action, and a reporting requirement.	An excursion is defined as a 3-hour average coke burn rate greater than 56,000 lb/hr. Excursions trigger an inspection, corrective action, and a reporting requirement.
III. Performance Criteria A. Data Representativeness[b]	The magnetic flow meter (minimum accuracy of ±1.0% of flow rate) is located in the water inlet line. The venturi flowmeter (minimum accuracy of ±0.75% of flow rate) is located in the gas inlet duct.	Thermocouple located at scrubber exhaust with a minimum accuracy of ±3°F.	Analyzers and monitors are located in the regenerator inlet and exhaust duct.
B. Verification of Operational Status	Not applicable	Not applicable	Not applicable
C. QA/QC Practices	Magnetic water flowmeter and venturi flowmeter–calibrated once/ 6 months.	Thermocouple–calibrated once/ 6 months.	Gas analyzers: per 60.13 and Appendix B of 40 CFR 60. Flowmeter, thermocouple, and pressure indicator–calibrated once/ 6 months.
D. Monitoring Frequency	Water flow and air rate are measured continuously.	Temperature is measured continuously.	O_2, CO, CO_2, air rate, off gas temperature and pressure are measured continuously.
Data Collection Procedure	L/G is calculated and recorded each minute.	Temperature is recorded each minute.	A coke burn rate is calculated and recorded each minute.
Averaging Period	3-hour average.	3-hour average.	3-hour average.

[a]An excursion of any single indicator triggers an inspection, corrective action, and a reporting requirement.
[b]Values listed for accuracy specifications are specific to this example and are not intended to provide the criteria for this type of measurement device in general.

JUSTIFICATION

I. Background

The pollutant specific emissions unit is particulate matter from the catalyst regenerator of a fluid catalytic cracking unit (FCCU). The catalyst regenerator is equipped with a wet gas scrubber. The catalyst regenerator exhaust gases pass through four parallel venturi scrubbers. These scrubbers are the primary control devices for particulate matter emissions. After passing through the scrubbers, the off gases pass through a separating vessel and a spray grid prior to being vented to the atmosphere. The emission unit is regulated under 40 CFR 60 Subpart J--NSPS for petroleum refineries. The monitoring approach is reflected as a specific permit condition in the air permit. Based on the pollutant specific emissions unit design, bypass of the control device is not possible.

II. Rationale for Selection of Performance Indicators

The following parameters will be monitored:

- Liquid-to-gas (L/G) ratio;
- Scrubber exhaust temperature; and
- Coke burn rate.

The licensor of the wet scrubber provided a graph relating the number of operating scrubbers required to maintain the design liquid to gas ratio, to the FCCU regenerator air blower rate. The regenerator air rate and the number of venturis in operation are an indirect measure of liquid to gas ratio, which is an indicator of scrubber performance. The regenerator air rate and the number of venturis in operation are monitored to ensure that these limitations are met.

Although the air permit only requires monitoring of coke burn rate, air blower rate, and number of venturis online, L/G ratio and scrubber exhaust temperature were added to the monitoring approach in early 1997 as further indicators of control device performance. The L/G ratio is determined by measuring scrubber water flow rate and comparing it to the regenerator air blower rate. In addition, the scrubber temperature is monitored downstream of the spray grid. The scrubber exhaust gas temperature was selected because it is indicative of scrubber operation and adequate water flow. With the scrubber water off, the scrubber exhaust temperature would be noticeably higher.

The coke burn rate is an indication of the PM loading to the scrubber.

III. Rationale for Selection of Indicator Ranges

As mentioned above, a graph relating the regenerator air blower rate to the number of venturis necessary to maintain the design L/G ratio, was provided by the licensor of the scrubber. This graph, presented in Figure A.2-1, shows that at regenerator air rates of less than 100 kscfm at least two scrubbers must be operating to maintain the design L/G ratio. At regenerator air rates of greater than or equal to 100 kscfm to less than 136 kscfm, at least three scrubbers must be operating. At air rates of greater than 136 kscfm all four scrubbers must be operating. The facility monitors the regenerator air rate and the number of venturis in operation to ensure that these limitations are met.

The indicator range for L/G ratio is based on results of a January 1996 performance test and historical data. Three 1-hr test runs were conducted and the average measured PM emissions were

0.78 lb PM/1,000 lb coke burned, which is below the 1 lb/1,000 lb PM emission limit. During the performance test, L/G ratio was measured and recorded continuously, concurrent with each of the 1-hour test runs. The average L/G ratio for the three 1-hour test runs was 7.1. Hourly L/G ratio data for a 3-month period (October through December 1996) following the performance test were reduced to three-hour averages and evaluated to determine whether the L/G ratio during normal operation was above the minimum level selected based on the January 1996 performance test demonstrating compliance. Figure A.2-2 graphically presents these data. During the 3-month period, the 3-hour average L/G ratio ranged from 8.5 to 14.9, and averaged 11.4, showing consistent operation at a L/G ratio above the level where compliance was demonstrated. The indicator range selected is a minimum L/G ratio of 8. No QIP threshold has been established.

The maximum scrubber outlet temperature was selected based on data obtained during a performance test conducted at the facility and historical data. The scrubber exhaust gas temperatures during the test averaged 144°F. Hourly scrubber outlet temperature data over a 3-month period (October through December 1996) were reduced to 3-hour averages and are shown in Figure A.2-3. Scrubber outlet temperatures during this 3-month period generally ranged from 132° to 150°F, and averaged 137.5°F. As seen in Figure A.2-3, a significant drop in temperature occurred over a 24-hour period. During this 24-hour period, the thermocouple was reading ambient temperatures because it had been removed from its housing for testing purposes. These ambient readings were not included in the evaluation of the data.

The selected indicator range for scrubber outlet temperature is less than 165°F. This range was selected by adding a 15 percent buffer to the average temperature demonstrated during the performance test (144°F) to account for variability among the data; the 3-months of monitoring data indicate that this temperature operating range can be achieved consistently. No lower action level is necessary. No QIP threshold has been established.

To date, compliance has been demonstrated at a coke burn rate of 55.5 thousand (M) lb/hr. The performance test data obtained in January of 1996 indicate that while operating at a coke burn rate of 55.5 Mlb/hr (average of three 1-hour runs) the emissions unit was in compliance with the PM emission limit. The indicator range is established as less than 56 Mlb/hr. If operation at a higher coke burn rate is planned, additional testing will be conducted to demonstrate compliance with all emission limitations at the higher burn rate. No QIP threshold has been set for this indicator.

When an excursion of any of the indicator ranges occurs corrective action will be initiated, beginning with an evaluation of the occurrence to determine the action required to correct the situation. All excursions will be documented and reported.

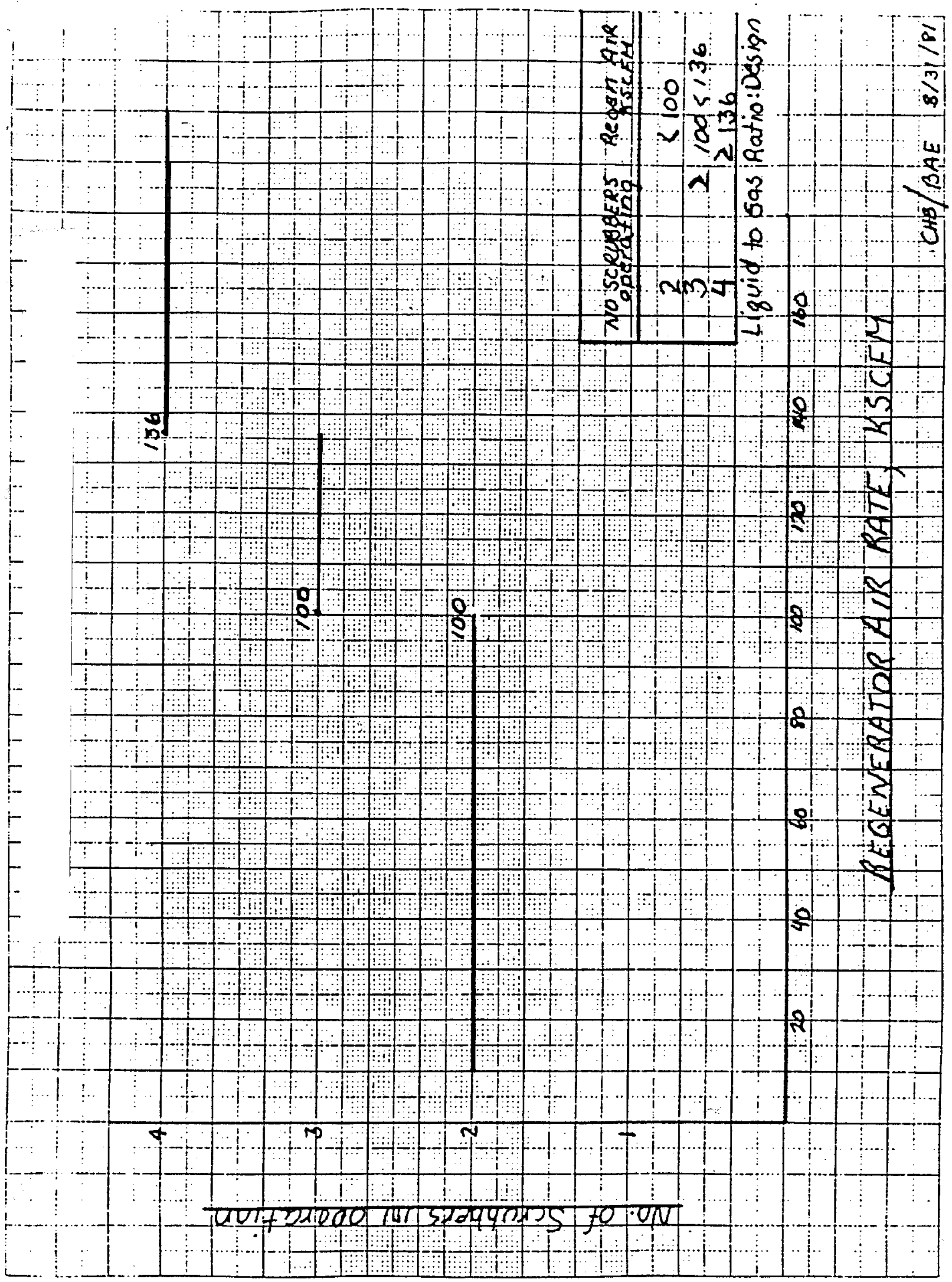

Figure A.2-1. Regenerator Air Rate vs. Number of Scrubbers in Operation.

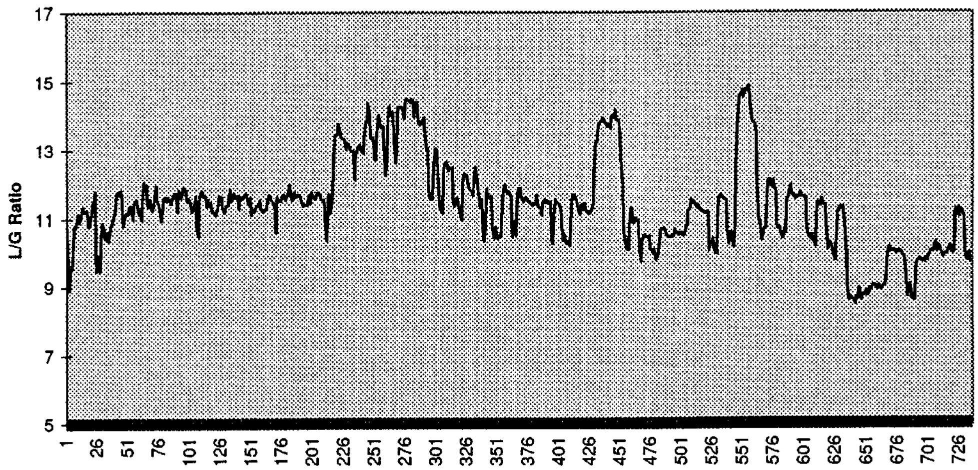

Figure A.2-2. Liquid to Gas Ratios (3-hour averages) for October-December 1996.

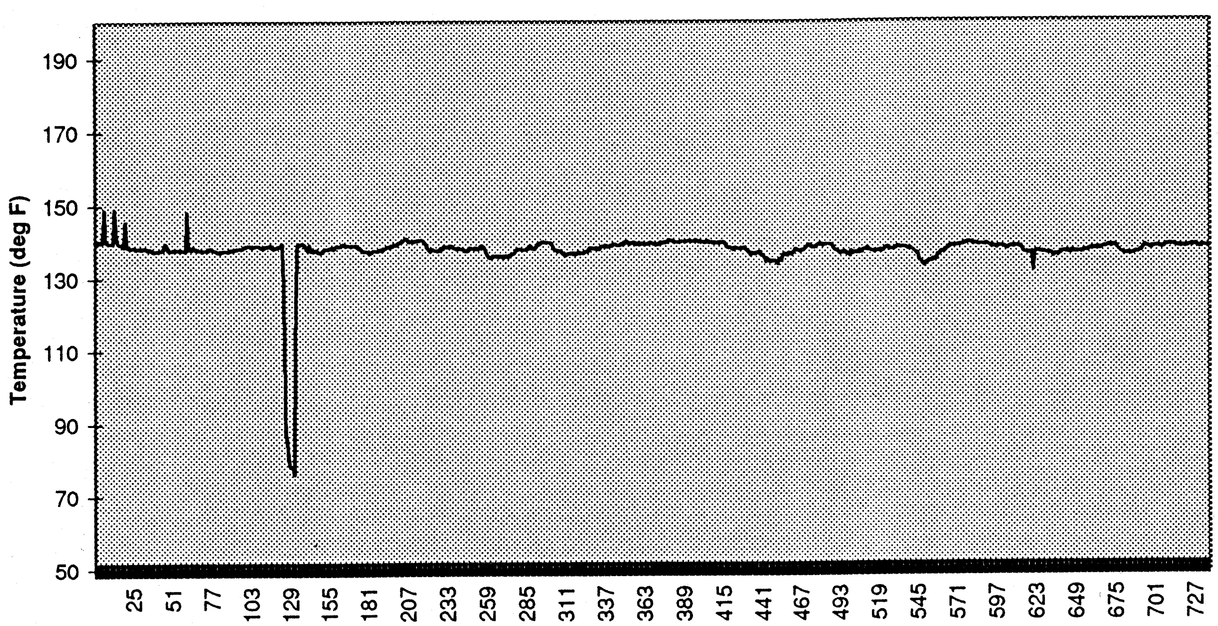

Figure A.2-3. Scrubber Outlet Temperatures (3-hour averages) for October-December 1996.

A.8 SCRUBBER FOR PM CONTROL--FACILITY H

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EXAMPLE COMPLIANCE ASSURANCE MONITORING:
SCRUBBER FOR PM CONTROL--FACILITY H

I. Background

A. Emissions Unit

Description:	Dry Dryers 1-4
Identification:	401, 403, 406, 407
Facility:	Facility H Anytown, USA

B. Applicable Regulation and Emission Limit

Regulation No.:	OAR 340-21, permit
Emission limits:	
Particulate matter:	0.2 gr/dscf (3 hour average)
Monitoring requirements:	Scrubber exhaust temperature

C. Control Technology

Wet scrubber

II. Monitoring Approach

The key elements of the monitoring approach are presented in Table A.8-1.

TABLE A.8-1. MONITORING APPROACH

I. Indicator	Wet scrubber exhaust temperature	Work practice: periodic check of scrubber water filter
Measurement Approach	The wet scrubber exhaust temperature is monitored with a thermocouple.	When the scrubber is shut down for weekly maintenance, the scrubber water filter is inspected and cleaned.
II. Indicator Range	An excursion is defined as a scrubber exhaust temperature greater than 150°F for a 6-minute period, continuously. Excursions trigger an inspection, corrective action, and a reporting requirement.	The filter will be replaced as needed; if there is excess buildup of particulate on the filter, the blowdown will be increased if necessary.
QIP Threshold[a]	Six excursions in a 6-month reporting period.	NA
III. Performance Criteria A. Data Representativeness[b]	The monitoring system consists of a thermocouple at the scrubber exhaust with a minimum accuracy of ±4°F or ±0.75%, whichever is greater.	The filter is visually inspected for holes or other damage.
B. Verification of Operational Status	NA	NA
C. QA/QC Practices and Criteria	The thermocouple will be calibrated annually.	NA
D. Monitoring Frequency	The scrubber exhaust temperature is measured continuously.	The filter is inspected and cleaned weekly.
Data Collection Procedures	Temperature is recorded as a 6-minute average by the DAS.	Maintenance records.
Averaging Period	6 minute average.	NA

[a]Note: The QIP is an optional tool for States; QIP thresholds are not required in the CAM submittal.
[b]Values listed for accuracy specifications are specific to this example and are not intended to provide the criteria for this type of measurement device in general.

MONITORING APPROACH JUSTIFICATION

I. Background

The pollutant-specific emission units are the four dry dryers (finish dryers) which dry wood chips. The dryers are Heil three pass horizontal rotary drum dryers, and burn natural gas or distillate fuel oil or receive heat indirectly from the boilers via steam. Dryers No. 1 and No. 2 are face material dryers; dryers No. 3 and No. 4 are core material dryers. The main wood species dried is Douglas fir. Wood entering the dryers may range from 10 to 20 percent moisture and exit with 4 to 6 percent moisture prior to particleboard production. The dryer exhaust streams are controlled by American Air Filter wet scrubbers. The scrubber water is filtered and recycled.

II. Rationale for Selection of Performance Indicators

The scrubber exhaust gas temperature was selected because it is indicative of scrubber operation and adequate water flow. When the water flow rate is sufficient, contact between the exhaust gas and the scrubber water causes the temperature of the exhaust gas to drop. The temperature range of the exhaust gas stream during normal operation was determined. With the scrubber water off, the scrubber exhaust is approximately 30°F hotter than normal. When the dryers and scrubbers are shut down for maintenance or cleaning, the temperatures drop.

The scrubber water is filtered and recycled, with a fixed amount of blowdown and makeup water. Checking the filter ensures particulate is being removed from the recycled water. Excess particulate in the scrubber water will reduce control efficiency. Any holes or degradation of the filter will be discovered during the weekly inspection.

The dryer exhaust will only bypass its associated scrubber if the scrubber is shut down for maintenance while the process is operating. These periods are documented and reported.

III. Rationale for Selection of Indicator Range

The selected indicator range for scrubber exhaust temperature is less than 150°F. An excursion is defined as any period during which the scrubber exhaust temperature exceeds 150°F for more than 6 minutes, continuously. 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. All excursions will be documented and reported. The level for the exhaust temperature was selected based upon the data obtained during normal scrubber operation and the performance test. Examination of operating data show that the scrubber outlet temperature increases slightly as the ambient temperature increases during the year. During normal operation, outlet temperatures approach 150°F during the summer months, and this value was selected as the upper indicator level (see Figure A.8-1 for a typical summer day's scrubber exhaust temperatures). No lower indicator level is necessary.

The most recent performance test using compliance test methods (ODEQ Method 7 for particulate) was conducted at this facility on April 9-11, 1996. Three test runs were conducted on each of the four dry dryers. During testing, the measured PM emissions ranged from 0.024 to 0.054 gr/dscf. During source testing, the scrubber exhaust gas temperatures ranged from 98° to 128°F, and dry dryer scrubber exhausts were found to be well below the compliance limit for particulate emissions. Dryer exhaust temperatures ranged from 149° to 162°F, 30 to 40 degrees hotter than the scrubber exhaust. During the emissions tests, the scrubber exhaust gas temperatures were measured continuously, and 6-minute averages were charted. The complete test results are documented in the test report dated April 1996. During the performance test, the measured particulate emissions were well under the emission limitation of 0.2 gr/dscf.

Three months of operating data (October through December 1996) were reviewed, which include dry dryer scrubber temperature alarm data, maintenance log book entries, and temperature graphs for those days on which alarms occurred. The scrubber temperature alarm was activated on 4 days out of the 3-month operating period for which data were collected. One alarm was caused due to a data processor malfunction, while the others were caused by lack of water flow to the scrubber or excess temperature during shutdown.

Based on the performance test data and a review of historical data, the selected QIP threshold for the wet scrubber exhaust gas temperature is six excursions in a 6-month reporting period (Note: Establishing a proposed QIP threshold in the monitoring submittal is optional). This level is less than 1 percent of the scrubber operating time. If the QIP threshold is exceeded in a semiannual reporting period, a QIP will be developed and implemented.

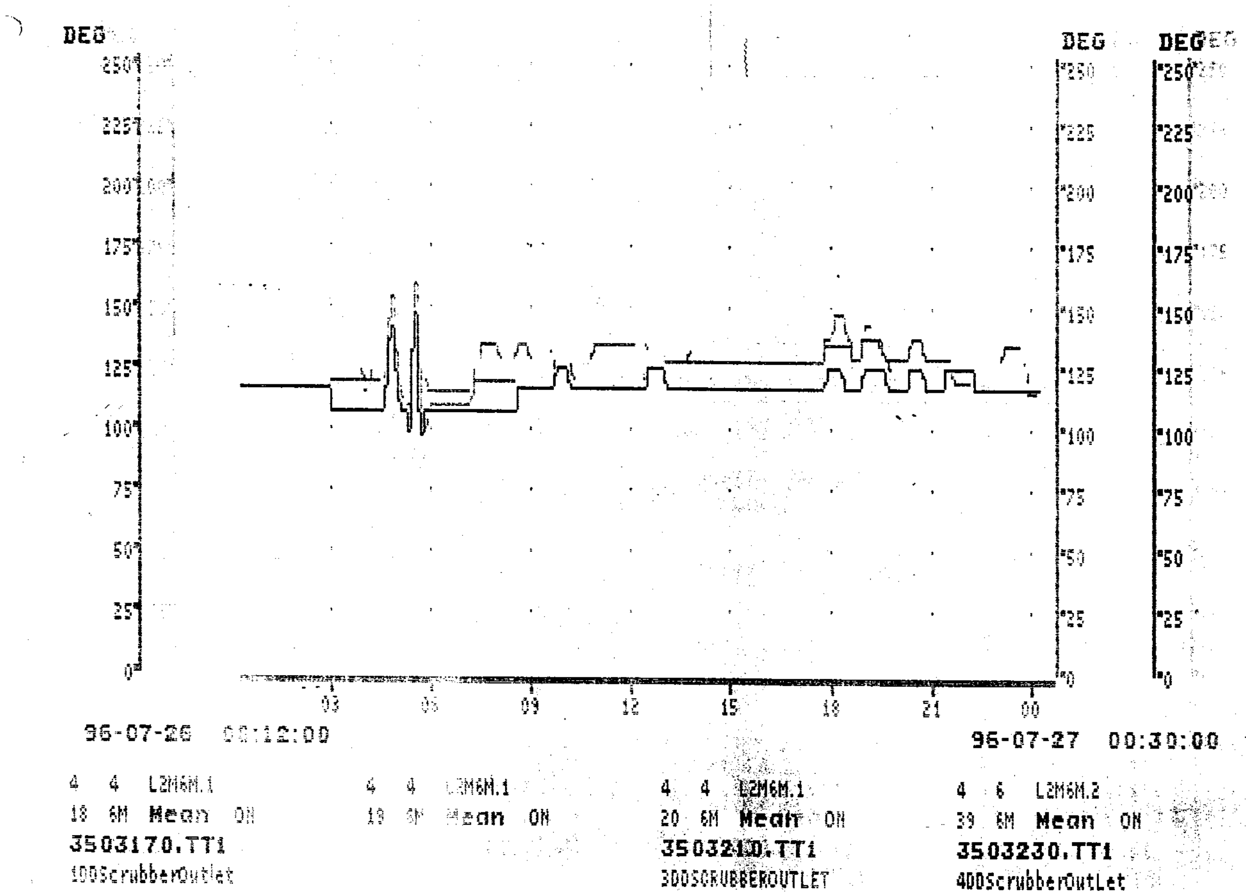

Figure A.8-1. Typical Scrubber Exhaust Temperature (7/27/96)

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A.9 WET ELECTROSTATIC PRECIPITATOR FOR PM CONTROL--FACILITY I

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EXAMPLE COMPLIANCE ASSURANCE MONITORING:
WET ELECTROSTATIC PRECIPITATOR FOR PM CONTROL--FACILITY I

I. Background

A. Emissions Unit

Description:	Green Dryers No. 1 & 2
Identification:	203, 205
Facility:	Facility I Anytown, USA

B. Applicable Regulation, Emission Limits, and Monitoring Requirements

Regulation No.:	OAR 340-21, permit
Emission limits :	
Particulate Matter:	0.2 gr/dscf (No. 1) 0.1 gr/dscf (No. 2) (3-hour average)
Monitoring requirements:	WESP secondary voltage

C. Control Technology
Wet electrostatic precipitator (WESP).

II. Monitoring Approach

The key elements of the monitoring approach are presented in Table A.9-1.

TABLE A.9-1. MONITORING APPROACH

I. Indicator	WESP voltage.
Measurement Approach	The WESP voltage is measured using a voltmeter.
II. Indicator Range	An excursion is defined as a voltage less than 30 kV for more than 6 minutes, continuously. Excursions trigger an inspection, corrective action, and a reporting requirement.
QIP Threshold[a]	Six excursions in a 6-month reporting period.
III. Performance Criteria A. Data Representativeness[b]	The voltmeter is part of the WESP design and is included in the transformer/rectifier set. It has a minimum accuracy of ±1 kV.
B. Verification of Operational Status	NA
C. QA/QC Practices and Criteria	Confirm voltmeter zero when unit not operating (at least semi-annually).
D. Monitoring Frequency	Measured continuously.
Data Collection Procedures	Recorded as a 6-minute average.
Averaging Period	6-minute average.

[a]Note: The QIP is an optional tool for States; QIP thresholds are not required in the CAM submittal.
[b]Values listed for accuracy specifications are specific to this example and are not intended to provide the criteria for this type of measurement device in general.

MONITORING APPROACH JUSTIFICATION

I. Background

The pollutant-specific emission units are green dryers No. 1 and No. 2. The dryers are three pass horizontal rotary drum dryers, with direct heat sources of sanderdust, natural gas, distillate fuel oil, boiler flue gas, or any combination thereof. Green dryer No. 1 was manufactured by Heil and green dryer No. 2 was manufactured by Westec America. Green wood shavings are dried in these dryers before mixing with dry wood shavings and drying in the dry dryers. Wood entering the green dryers may range from 25 to 50 percent moisture and exit with 15 to 20 percent moisture. The green dryer exhaust streams are each controlled by a Geoenergy WESP.

II. Rationale for Selection of Performance Indicator

In a WESP, electric fields are established by applying a direct-current voltage across a pair of electrodes: a discharge electrode and a collection electrode. Particulate matter and water droplets suspended in the gas stream are electrically charged by passing through the electric field around each discharge electrode (the negatively charged electrode). The negatively charged particles and droplets then migrate toward the positively charged collection electrodes. The particulate matter is separated from the gas stream by retention on the collection electrode. Particulate is removed from the collection plates by an intermittent spray of water. The WESP voltage was selected as a performance indicator because the voltage drops when a malfunction, such as grounded electrodes, occurs in the WESP. When the voltage drops, less particulate is charged and collected.

The dryer exhaust will bypass its associated WESP if the WESP is shut down while the process is operating. These periods are documented and reported.

III. Rationale for Selection of Indicator Range

The selected indicator level is a voltage of greater than 30 kV. An excursion is defined as any period during which the voltage is less than 30 kV for more than 6 minutes, continuously. 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. All excursions will be documented and reported.

The indicator range for the WESP voltage was selected based upon the level maintained during normal operation and during the performance test. The normal operating voltage is set at the highest level achievable without having an excessive spark rate. Based on field experience, voltage levels less than 30 kV during normal operation result in unacceptable opacity readings. During abnormal operation or a malfunction (such as grounded electrodes), the WESP kV levels are appreciably lower than normal operational levels. A time interval of 6 minutes was chosen to account for the routine 2-minute flush cycles the WESP's undergo, which cause the voltage to drop below 30 kV. Data obtained during the most recent performance test confirmed the unit was in compliance with the particulate matter emissions limit. During testing, the WESP's operated with voltages in the range of 34 to 45 kV.

The most recent performance test using compliance test methods (ODEQ Method 7 for particulate and RM 9 for visible emissions) was conducted on April 22 and 25, 1996. Three test runs were conducted on each dryer. During this test, the measured PM emissions ranged from 0.009 to 0.013 gr/dscf. Visible emission opacity observations were conducted during the particulate testing. All visible emissions observations during the performance test were 0 to 5 percent opacity (no reading exceeded the permit limit of 20 percent). During the emissions tests, the WESP voltages were measured continuously, and 6-minute averages were charted. During the performance test, the measured particulate emissions were well below the emission limitations (0.2 gr/dscf for green dryer No. 1 and 0.1 gr/dscf for green dryer No. 2). The complete test results are documented in the test report.

Indicator data for the period of October through December of 1996 have been reviewed. These data include 6-minute average WESP voltage graphs and copies of entries in the logbook used to record equipment malfunctions and maintenance. Voltage excursions resulting in an alarm occurred two times during the 3-month period on the WESP on dryer No. 1. One alarm was the result of recycle water overflow and one was the result of a full E-tube chamber. Voltage excursions resulting in an alarm occurred three times during the 3-month period on the WESP on dryer No. 2; once because the recycle water system was plugged, once due to a recycle flow warning, and once because 4 probes were misaligned. Normal operation was in the range of 40 to 50 kV, except during the short flush cycles. Based on the data collected, the indicator level of 30 kV is adequate.

Based on a review of historical data, the QIP threshold established for the WESP voltage is six excursions in a 6-month reporting period. This level is less than 1 percent of the WESP operating time. If the QIP threshold is exceeded in a semiannual reporting period, a QIP will be developed and implemented. (Note: Submitting a proposed QIP threshold with the monitoring approach is not required.)

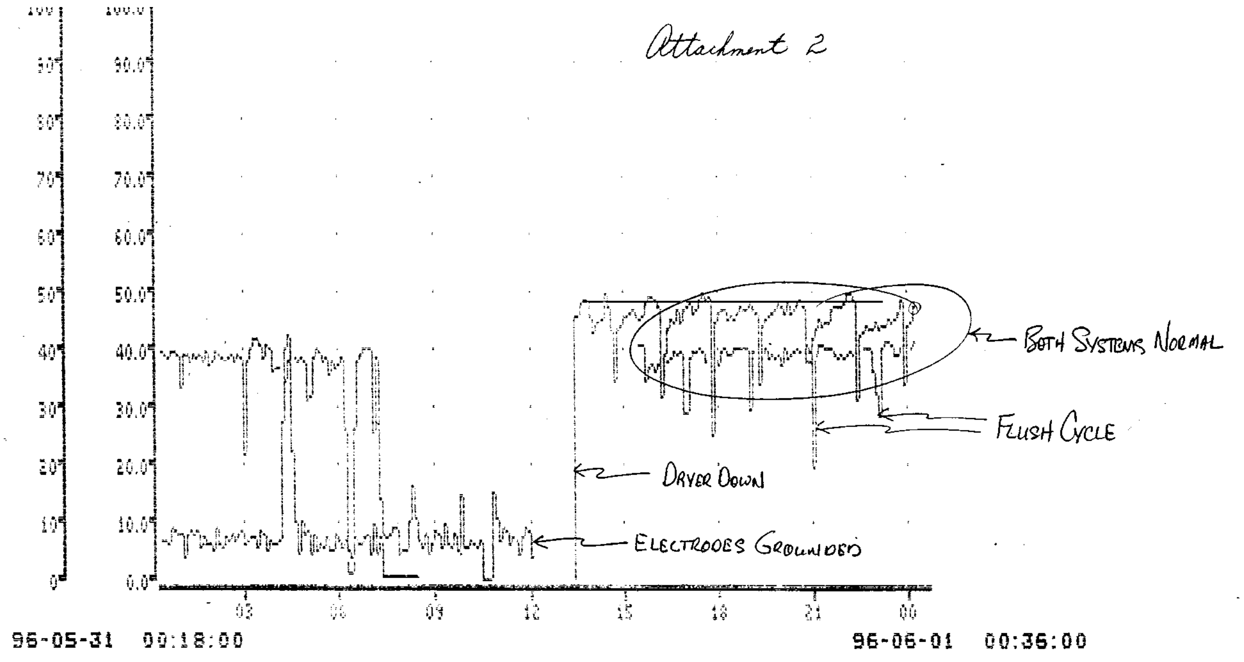

Figure A.9-1. WESP voltage levels.

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A.10 FABRIC FILTER FOR PM CONTROL--FACILITY J

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EXAMPLE COMPLIANCE ASSURANCE MONITORING:
FABRIC FILTER FOR PM CONTROL--FACILITY J

I. Background

A. Emissions Unit

Description:	Line 3 Particleboard Sander
Identification:	M2
Facility:	Facility J Anytown, USA

B. Applicable Regulation, Emission Limit, and Monitoring Requirements

Regulation No.:	OAR 340-21, permit
Emission limits:	
Particulate matter:	0.1 gr/dscf, 3 hr avg.
Monitoring requirements:	Visible emissions, periodic monitoring (RM22)

C. Control Technology

Pulse-jet baghouse operated under negative pressure.

II. Monitoring Approach

The key elements of the monitoring approach are presented in Table A.10-1.

TABLE A.10-1. MONITORING APPROACH

I. Indicator	Visible emissions	Pressure drop
Measurement Approach	Visible emissions from the baghouse exhaust will be monitored daily using EPA Reference Method 22-like procedures.	Pressure drop across the baghouse is measured with a differential pressure gauge.
II. Indicator Range	An excursion is defined as the presence of visible emissions. Excursions trigger an inspection, corrective action, and a reporting requirement.	An excursion is defined as a pressure drop greater than 5 in. H_2O. Excursions trigger an inspection, corrective action, and a reporting requirement. APCD bypass checked if less than 1 in. H_2O.
QIP Threshold[a]	The QIP threshold is five excursions in a 6-month reporting period.	None selected
III. Performance Criteria A. Data Representativeness[b]	Measurements are being made at the emission point (baghouse exhaust).	Pressure taps are located at the baghouse inlet and outlet. The gauge has a minimum accuracy of 0.25 in. H_2O.
B. Verification of Operational Status	NA	NA
C. QA/QC Practices and Criteria	The observer will be familiar with Reference Method 22 and follow Method 22-like procedures.	The pressure gauge is calibrated quarterly. Pressure taps are checked for plugging daily.
D. Monitoring Frequency	A 6-minute Method 22-like observation is performed daily.	Pressure drop is monitored continuously.
Data Collection Procedure	The VE observation is documented by the observer.	Pressure drop is manually recorded daily.
Averaging Period	NA	None.

[a]Note: The QIP is an optional tool for States; QIP thresholds are not required in the CAM submittal.
[b]Values listed for accuracy specifications are specific to this example and are not intended to provide the criteria for this type of measurement device in general.

JUSTIFICATION

I. Background

The pollutant-specific emission unit is the Line No. 3 Sander, which is used to sand particleboard to the customer's desired thickness. It is controlled by a Western Pneumatic pulse-jet baghouse with 542 bags, which filters approximately 50,000 ft^3 of air from the sander.

II. Rationale for Selection of Performance Indicators

Visible emissions was selected as the performance indicator because it is indicative of good operation and maintenance of the baghouse. When the baghouse is operating properly, there will not be any visible emissions from the exhaust. Any increase in visible emissions indicates reduced performance of a particulate control device, therefore, the presence of visible emissions is used as a performance indicator.

In general, baghouses are designed to operate at a relatively constant pressure drop. Monitoring pressure drop provides a means of detecting a change in operation that could lead to an increase in emissions. An increase in pressure drop can indicate that the cleaning cycle is not frequent enough, cleaning equipment is damaged, the bags are becoming blinded, or the airflow has increased. A decrease in pressure drop may indicate broken or loose bags, but this is also indicated by the presence of visible emissions, indicator No. 1. A pressure drop across the baghouse also serves to indicate that there is airflow through the control device.

III. Rationale for Selection of Indicator Ranges

The selected indicator range is no visible emissions. 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. All excursions will be documented and reported. An indicator range of no visible emissions was selected because: (1) an increase in visible emissions is indicative of an increase in particulate emissions; and (2) a monitoring technique which does not require a Method 9 certified observer is desired. Although RM 22 applies to fugitive sources, the visible/no visible emissions observation technique of RM-22 can be applied to ducted emissions; i.e., Method 22-like observations.

The selected QIP threshold for baghouse visible emissions is five excursions in a 6-month reporting period. This level is 3 percent of the total visible emissions observations. If the QIP threshold is exceeded in a semiannual reporting period, a QIP will be developed and implemented. (Note: Proposing a QIP threshold in the CAM submittal is not required.)

The indicator range chosen for the baghouse pressure drop is less than 5 in. H_2O. An excursion triggers an inspection, corrective action, and a reporting requirement. The pressure drop is recorded daily. As the pressure drop approaches 5 in. H_2O, the bags are scheduled for replacement. The bags are typically changed yearly. This indicator is also used to monitor for bypass of the control device. If the pressure drop falls below 1 in. H_2O during normal process operation, the possibility of bypass is investigated. No QIP threshold has been selected for this indicator.

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A.12 FABRIC FILTER FOR PM CONTROL--FACILITY L

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EXAMPLE COMPLIANCE ASSURANCE MONITORING
FABRIC FILTER FOR PM CONTROL -- FACILITY L

I. Background

A. Emissions Unit

Description:	Ceramic Fiber Blanket Manufacture
Identification:	Zone 1 Node 8
Facility:	Facility L Anytown, USA

B. Applicable Regulation, Emission Limit, and Monitoring Requirements

Regulation:	Permit
Emission limits (particulate matter):	0.35 lb/hr
Monitoring requirements:	Bag leak detector required on baghouse exhaust

C. Control Technology

Pulse-jet baghouse operated under negative pressure

II. Monitoring Approach

The key elements of the monitoring approach are presented in Table A.12-1.

TABLE A.12-1. MONITORING APPROACH

I. Indicator	Triboelectric Signal
Approach	A triboelectric monitor is installed at the baghouse exhaust. An alarm will sound when the signal remains over a preset limit for 15 seconds to indicate a broken filter bag.
II. Indicator Range	An excursion is defined as a triboelectric signal greater than 70 percent of scale for 15 seconds. Excursions trigger an inspection, corrective action, and a reporting requirement. A triboelectric signal of zero during process operation will trigger an investigation for control device bypass.
III. Performance Criteria A. Data Representativeness	The data are collected at the emission point - the probe is located inside the baghouse exhaust duct. The triboelectric signal is directly proportional to the amount of particulate in the exhaust if factors such as velocity and particle size remain relatively constant.
B. Verification of Operational Status	NA
C. QA/QC Practices and Criteria	The triboelectric probe is inspected periodically (at least monthly) for dust buildup. The monitor has an automatic internal calibration function for the electronics.
D. Monitoring Frequency	The triboelectric signal is monitored continuously.
Data Collection Procedures	One hour of data are displayed on the monitor in the control room at 2 second intervals. When an alarm occurs (signal over 70 percent for 15 seconds), it is logged electronically. Six-minute averages also are archived on the computer network as a historical data record.
Averaging Period	None.

JUSTIFICATION

I. Background

The baghouse controls emissions from a ceramic fiberboard felting process and a production line in the spun fiber area that is used to manufacture ceramic fiber blankets used for insulation. The raw material (kaolin) is transferred to melting furnaces that are heated using electric current. The liquid melt stream flows from the bottom of the furnace and is spun into fiber in the collection chamber and formed into a fiber mat on a conveyor traveling below the chamber. Needling is used to lock the fibers together and an oven dries the blanket. The blanket then passes over a cooling table and is cooled by the passage of air through the blanket. It is then trimmed to size and packaged. Dust emission points ducted to the baghouse include the board felting process and cooling table.

The process stream exhaust is controlled by a pulse-jet baghouse operated under negative pressure. The controlled air stream is at ambient conditions. The baghouse was manufactured by Sly and is a single compartment baghouse containing 16 rows and a total of 176 bags. The air flow through the baghouse is approximately 12,000 dscfm. Air flow through the system is maintained by a single induced-draft fan downstream of the baghouse. The cleaned gas is exhausted from a 24-inch wide rectangular duct. The baghouse residue is continuously discharged from the collection hopper into a bin by a screw feeder.

II. Rationale for Selection of Performance Indicators

The bag leak monitor operates using the principles of frictional electrification (triboelectricity) and charge transfer. As particles in the baghouse exhaust gas stream collide with the sensor rod mounted on the inside of the exhaust duct, an electrical charge is transferred, generating a small current that is measured and amplified by the triboelectric monitor. The processing electronics are configured to produce a continuous output and an alarm at a specified level.

The signal produced by the triboelectric monitor is generally proportional to the particulate mass flow, but can be affected by changes in a number of factors, such as humidity, exhaust gas velocity, and particle size. However, in baghouse applications, these factors are not expected to vary considerably during normal operation. Therefore, an increase in the triboelectric signal indicates an increase in particulate emissions from the baghouse.

Pulse-jet baghouse filters are cleaned using a burst of air, which dislodges the filter cake from the bags and causes a momentary increase in particulate emissions until the filter cake builds up again. The triboelectric monitor can be configured with a short (or no) averaging time to display the baghouse cleaning cycle activity and monitor increases in a particular row's cleaning peak, or with a long signal averaging period to detect an overall increasing trend in the baghouse's emissions. Trends in the cleaning peaks are monitored and high cleaning peaks that may indicate leaking or broken bags requiring maintenance trigger an alarm.

Bypass of the control device will only occur if the baghouse fan is not operating. In this case, the triboelectric signal would be zero.

III. Rationale for Selection of Indicator Ranges

An excursion is defined as a triboelectric monitor signal greater than 70 percent of scale for 15 seconds. 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. All excursions will be documented and reported.

The triboelectric monitoring system has the capability for dual alarms: an early warning alarm and a broken bag alarm. The early warning alarm is set just above the normal cleaning peak height (40 percent of scale). The broken bag alarm was set by injecting dust into the clean air plenum of the baghouse and noting the signal level just before the point at which visible emissions were observed at the baghouse exhaust (70 percent of scale). A 15-second delay time is also used, so the alarm won't activate due to short spikes that are not associated with the cleaning cycle and do not indicate broken bags (e.g., a short spike due to a small amount of particulate that accumulates on the duct wall and then breaks free).

The most recent performance test using EPA Method 5 was conducted on April 22-24, 1997. Three Method 5 test runs (one 240-minute, one 384-minute, and one 288-minute run) were conducted, one test per day. The average measured PM emissions were extremely low: 0.01 lb/hr. During the emissions tests, the triboelectric signal was recorded continuously at a 1-second frequency. Figure A.12-1 shows the triboelectric signal for 1 hour during Run 2. The sharp peaks represent the brief increase in emissions immediately following the baghouse cleaning cycle, before the filter cake builds up again. All cleaning peaks shown on this graph are less than 35 percent of scale, which is below both alarm levels. There was one momentary spike that could not be explained. The alarms were not activated during the emission testing and the emissions were below the emission limit of 0.35 lb/hr.

Monitoring data for a period of approximately 2 months (January 29 - April 2, 1997) were reviewed, including 6-minute average archived triboelectric signal data and the electronic alarm log. Review of these data indicated that the early warning alarm was activated eight times and the broken bag alarm was activated once (i.e., there was one excursion). Based on all data reviewed, the selected indicator and indicator level appears to be appropriate for this facility.

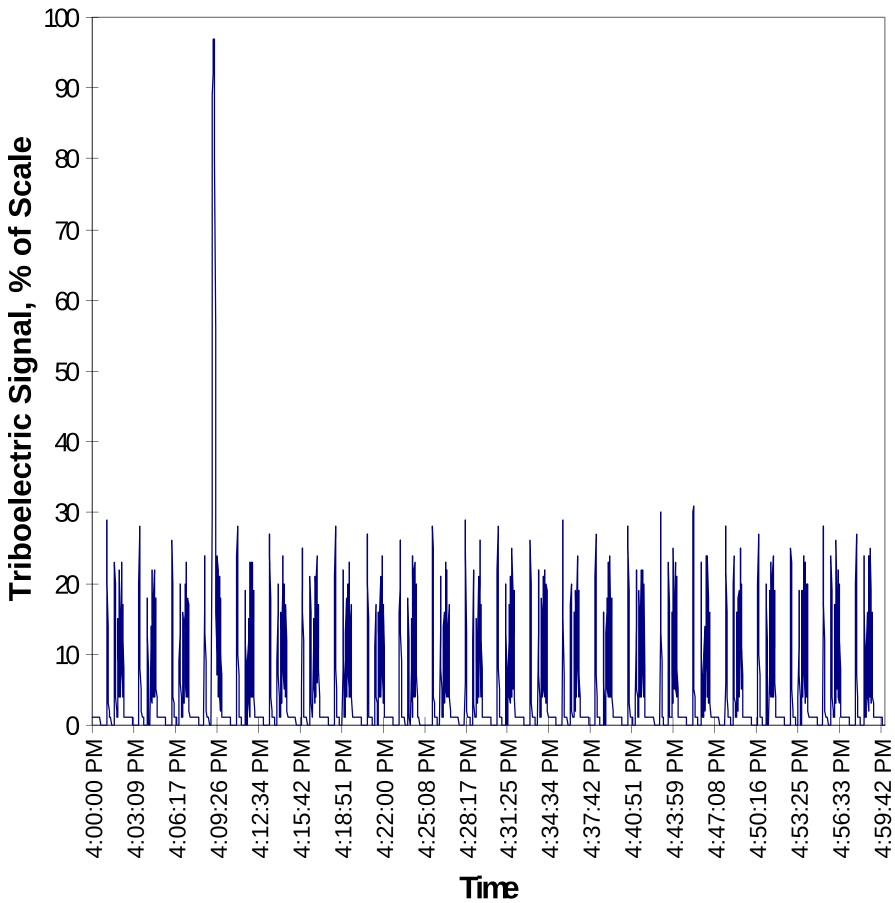

Figure A.12-1. Triboelectric signal during 1-hour of Method 5 Run 2.

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A.13 FABRIC FILTER FOR PM CONTROL--FACILITY M

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EXAMPLE COMPLIANCE ASSURANCE MONITORING:
FABRIC FILTER FOR PM CONTROL -- FACILITY M

I. Background

A. Emissions Unit

Description:	Primary nonferrous smelting and refining
APCD ID:	17-DC-001, 17-DC-002
Facility:	Facility M Anytown, USA

B. Applicable Regulation, Emission Limits, and Monitoring Requirements

Regulation:	Permit; OAR 340-025-0415, 340-021-0030
Emission limits:	
Opacity:	20 percent
Particulate matter:	0.2 gr/dscf
Monitoring requirements:	Visible emissions (VE), pressure drop, fan amperage, inspection and maintenance program

C. Control Technology:

Reverse-air baghouses operated under negative pressure

II. Monitoring Approach

The key elements of the monitoring approach are presented in Table A.13-1.

TABLE A.13-1. MONITORING APPROACH

	Indicator No. 1	Indicator No. 2	Indicator No. 3	Indicator No. 4
I. Indicator	Visible emissions	Pressure drop	Fan amperage	Inspection/maintenance
Measurement Approach	Method 9 observations performed daily.	Pressure drop through the baghouse is measured continuously using a differential pressure gauge.	Fan amperage is measured continuously using an ammeter.	Daily inspection according to I/M checklist; maintenance performed as needed.
II. Indicator Range	The indicator range is an opacity less than 20 percent (6-min. avg.). Excursions trigger an inspection, corrective action, and a reporting requirement.	The indicator range is a pressure drop between 5 and 15 in. H_2O. Excursions trigger an inspection, corrective action, and a reporting requirement.	The indicator range is fan amperage above 100. Excursions trigger an inspection, corrective action, and a reporting requirement. Fan operation also indicates control device is not being bypassed.	NA
III. Performance Criteria A. Data Representativeness[a]	Observations are performed at the baghouse exhaust while the baghouse is operating.	Pressure drop across the baghouse is measured at the baghouse inlet and exhaust. The minimum accuracy of the device is ±0.5 in. H_2O.	Fan amperage is measured at the fan by an ammeter. The minimum accuracy is ±5A.	Inspections are performed at the baghouse.
B. Verification of Operational Status	NA	NA	NA	NA
C. QA/QC Practices and Criteria	Observer is certified annually.	Pressure gauge calibrated quarterly. Pressure taps checked daily for plugging.	Fans checked during daily inspection. Ammeter zeroed when unit not operating.	Qualified personnel perform inspection.
D. Monitoring Frequency	Daily 6-minute observation.	Pressure drop is measured continuously.	Fan amps are monitored continuously.	Daily inspection.
Data Collection Procedures	Method 9 observations are conducted by a certified RM9 observer.	A strip chart records the pressure drop continuously.	A strip chart records the fan amps continuously.	Records are maintained to document the daily inspection and any required maintenance.
Averaging period	6 minutes	None	None	NA

[a]Values listed for accuracy specifications are specific to this example and are not intended to provide the criteria for this type of measurement device in general.

MONITORING APPROACH JUSTIFICATION

I. Background

Primary nonferrous metal smelting and refining operations include mining; drying; crushing, screening, and rejecting; calcining and melting; refining; casting; and other operations. The ore is dried to remove most of the free moisture. The dried ore is then calcined to remove the remaining free moisture and a portion of the chemically-combined moisture. A portion of the iron is reduced, using carbon. The ore is then melted and reduced. The refined metal is cast into ingots or shot, as requested by the customer.

The monitoring approach outlined here applies to melt furnace baghouses Nos. 1 and 2. These baghouses control dust from four 23 MW electric melt furnaces (Nos. 1 through 4) and two rotary kilns. They are ICA reverse-air baghouses with 12 compartments apiece; each compartment contains 128 bags. Air flow through each baghouse is maintained by two induced-draft variable speed fans downstream of each baghouse. The capacity of each baghouse is 275,000 acfm.

II. Rationale for Selection of Performance Indicators

Visible emissions (opacity) was selected as a performance indicator because it is indicative of good operation and maintenance of the baghouse. When the baghouse is operating optimally, there will be little visible emissions from the exhaust. In general, an increase in visible emissions indicates reduced performance of the baghouse (e.g., loose or torn bags). These emissions units have an opacity standard of 20 percent. A 6-minute Method 9 observation is performed daily.

The pressure drop through the baghouse is monitored continuously. An increase in pressure drop can indicate that the cleaning cycle is not frequent enough, cleaning equipment is damaged, or the bags are becoming blinded. Decreases in pressure drop may indicate significant holes and tears or missing bags. However, opacity is a much more sensitive indicator of holes and tears than pressure drop.

Good operation of the fan is essential for maintaining the required air flow through the baghouse. The fan amps setting is selected to be high enough to draw the air required to collect the dust from the four melting furnaces and two rotary kilns. Excess gas velocity can cause seepage of dust particles through the dust cake and fabric. Fan amperage is an indicator of proper fan operation and adequate air flow through the baghouse (the exhaust gas is not bypassing the baghouse).

Implementation of a baghouse inspection and maintenance (I/M) program provides assurance that the baghouse is in good repair and operating properly. Once per day, proper operation of the compressor is verified to ensure that the bags are being cleaned. Proper operation of the cleaning cycle facilitates gas flow through the baghouse and the removal of particulate, and also helps prevent blinding of the filter bags. Operation at low pressures can result in inadequate cleaning, especially near the bottoms of the bags. Other items on the daily I/M checklist include the dust pump, induced-draft fans, reverse air fan, dust screws, rotary feeders, bins, cleaning cycle operation, leak check, and compartment inspection for bad bags.

III. Rationale for Selection of Indicator Ranges

The indicator range for opacity is a 6-minute average opacity of less than 20 percent. This indicator range was selected based on the facility's permit requirements and historical operating data. Review of data collected in May 1997 indicate an average opacity of 10.9 percent (6-minute average) for baghouse No.1, with 6-minute daily average readings ranging from 2.9 to 19.8 percent. For baghouse No. 2, the average was 11.5 percent, with 6-minute average readings ranging from 3.1 to 18.8 percent. The 6-minute average is made up of observations taken at 15-second intervals.

The indicator range for baghouse pressure drop is a pressure drop between 5 and 15 in. H_2O. This range was selected based on historical data obtained during normal operation. The pressure drop is typically around 10 to 11 in. H_2O. A review of data collected during April and May of 1997 show a range of about 9 to 14 in. H_2O. The indicator range selected for the fan amperage is an amperage greater than 100. This range was set based on the level maintained during normal operation. The fan is operated at a high enough setting to draw the required air for dust collection from the four furnaces and two rotary kilns. It typically operates in the 100 to 157 amp range, with an average of 125 amps. When a problem with the baghouse is detected during an inspection, the problem is recorded on the inspection log and corrective action is initiated immediately.

The most recent performance test using compliance test methods (RM 5) was conducted on July 8-9, 1997. During this test, the average measured PM emissions were 0.080 gr/dscf for baghouse No. 1 and 0.053 gr/dscf for baghouse No. 2 (both were below the compliance limit of 0.2 gr/dscf). Opacity observations during testing averaged 17 percent for both baghouses. The complete test results are documented in the test report. Prior to the performance test, an inspection of the baghouse was performed to ensure that it was in good working order, with no leaks or broken bags.

A.14 SCRUBBER FOR PM CONTROL--FACILITY N

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EXAMPLE COMPLIANCE ASSURANCE MONITORING:
SCRUBBER FOR PM CONTROL--FACILITY N

I. Background

A. Emissions Unit

Description:	Wood Fiber Dryer
Identification:	Dryer No. 3
Facility:	Facility N Anytown, USA

B. Applicable Regulation, Emission Limit, and Monitoring Requirements

Regulation:	OAR 340-30-021
Emission limit:	
Particulate matter:	0.55 lb/1,000 sqft dried or 15.5 lb/hr total PM limit for all sources at MDF plant, excluding boiler, truck dump, and storage areas.
Monitoring requirements:	Pressure drop across wet scrubber, scrubber inlet and outlet temperature.

C. Control Technology

Wet scrubber

II. Monitoring Approach

The key elements of the monitoring approach are presented in Table A.14-1.

TABLE A.14-1. MONITORING APPROACH

	Indicator No. 1	Indicator No. 2
I. Indicator	Pressure drop across wet scrubber	Wet scrubber inlet and exhaust gas temperatures
Measurement Approach	The pressure drop is monitored with a differential pressure transducer.	The wet scrubber inlet and exhaust gas temperatures are monitored with RTD's.
II. Indicator Range	An excursion is defined as a pressure drop greater than 6.5 inches of water. Excursions trigger an inspection, corrective action, and a reporting requirement.	An excursion is defined as a 1-hour average scrubber exhaust gas temperature greater than 150°F. Scrubber inlet gas temperature must be greater than the exhaust gas temperature during scrubber operation. Excursions trigger an inspection, corrective action, and a reporting requirement.
III. Performance Criteria A. Data Representativeness[a]	The monitoring system consists of a differential pressure transducer which compares the pressure in the duct immediately upstream of the water spray to the atmospheric pressure. Its minimum accuracy is ±2 percent.	The monitoring system consists of two RTD's located in the ductwork immedately upsream and downstream of the scrubber. Their minimum accuracy is ±2 percent.
B. Verification of Operational Status	NA	NA
C. QA/QC Practices and Criteria	The differential pressure transducer reading is compared to a U-tube manometer monthly.	The RTD's are calibrated monthly by comparison to a calibrated thermocouple, and annually using a NIST traceable thermometer.
D. Monitoring Frequency	The signal from the differential pressure transducer is sampled several times per minute.	The signal from the RTD is sampled several times per minute.
Data Collection Procedures	1-minute averages are computed and displayed. The PC then computes a 1-hour average using each 1-minute average and stores it.	1-minute averages are computed and displayed. The PC then computes a 1-hour average using each 1-minute average and stores it.
Averaging Period	1-minute and 1-hour averaging periods.	1-minute and 1-hour averaging periods.

[a]Values listed for accuracy specifications are specific to this example and are not intended to provide the criteria for this type of measurement device in general.

JUSTIFICATION

I. Background

The pollutant-specific emission unit is a wood fiber dryer denoted as the face system and used in the manufacture of medium density fiberboard. Fiber from the dryer is removed by a low energy cyclone. The exhaust from the cyclone is ducted to the scrubber. In the last 20 feet of the duct, water is sprayed into the air stream. The emissions then enter the scrubber, where baffling removes the suspended water droplets. The temperature drop across the spray section and the pressure drop between the inlet to the spray section and the scrubber discharge are monitored.

II. Rationale for Selection of Performance Indicators

Pressure drop was selected as a performance indicator because it indicates the water level in the scrubber. Maintaining an adequate water flow insures adequate particulate removal. A high pressure drop indicates the water level in the scrubber is too high. Usually, high water level problems are caused by a malfunction of the scrubber water level controller. A low pressure drop is caused by a loss of water in the scrubber.

Temperature was selected because a temperature drop across the scrubber indicates that the water sprays are operating. A loss of temperature differential indicates little or no water is being applied to the exhaust gas stream, which in turn causes little particulate to be removed from the exhaust. The most common cause of water loss is plugged nozzles due to wood fibers in the recycled water.

Bypass of a scrubber only occurs if the scrubber is shut down during process operation. The dryer is then controlled only by the cyclone. These periods are documented and reported.

III. Rationale for Selection of Indicator Ranges

The selected indicator range for the scrubber exhaust gas temperature is less than 150°F (1 hour average). The selected indicator range for scrubber pressure drop is less than 6.5 in. H_2O. There is no lower limit for the pressure drop, since a high exhaust temperature will indicate a loss of water flow. 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. All excursions will be documented and reported.

The indicator levels for the scrubber pressure drop and inlet and exhaust gas temperatures are based on normal scrubber operation and performance test results. During source testing, the scrubber was operating under normal conditions and the average scrubber exhaust gas temperature was 132°F. With no water flowing through the scrubber, the exhaust temperature would be about 30 degrees hotter. Therefore, the exhaust temperature limit was set at 150°F. During the most recent performance test, the average pressure drop was 5.7 in. H_2O.

The most recent performance test using compliance test methods (ODEQ Method 7 for particulate) was conducted at this facility on November 20-21, 1996. Three test runs were conducted on the fiber dryer. During testing, the measured PM emissions from Dryer No. 3 averaged 0.008 gr/dscf (3.6 lb/hr). During the compliance test the scrubber exhaust particulate emissions were below the permit limit of 15.5 lb/hr. During the emissions test, the pressure drop and the scrubber inlet and outlet temperatures were measured continuously. The complete test results are documented in the test report.

Figures A.14-1 and A-14.2 show average hourly temperature and differential pressure data for scrubber No. 3 for the month of August 1997. The dips in the differential pressure and the temperatures indicate periods when the scrubber was not operating. Figure A.14-1 shows that the facility did not exceed the maximum outlet temperature limit of 150°F, and the inlet temperature exceeded the outlet temperature during periods of scrubber operation. The average hourly scrubber inlet temperature was 157°F, with a maximum hourly inlet temperature of 189°F, and the average scrubber outlet temperature was 129°F, with a maximum hourly outlet temperature of 142°F. The average temperature differential was 28°F. Figure A.14-2 shows that the facility did not exceed the maximum pressure drop during the month of August. The average differential pressure was 4.5 in. H_2O during the month of August, with a maximum of 6 in. H_2O.

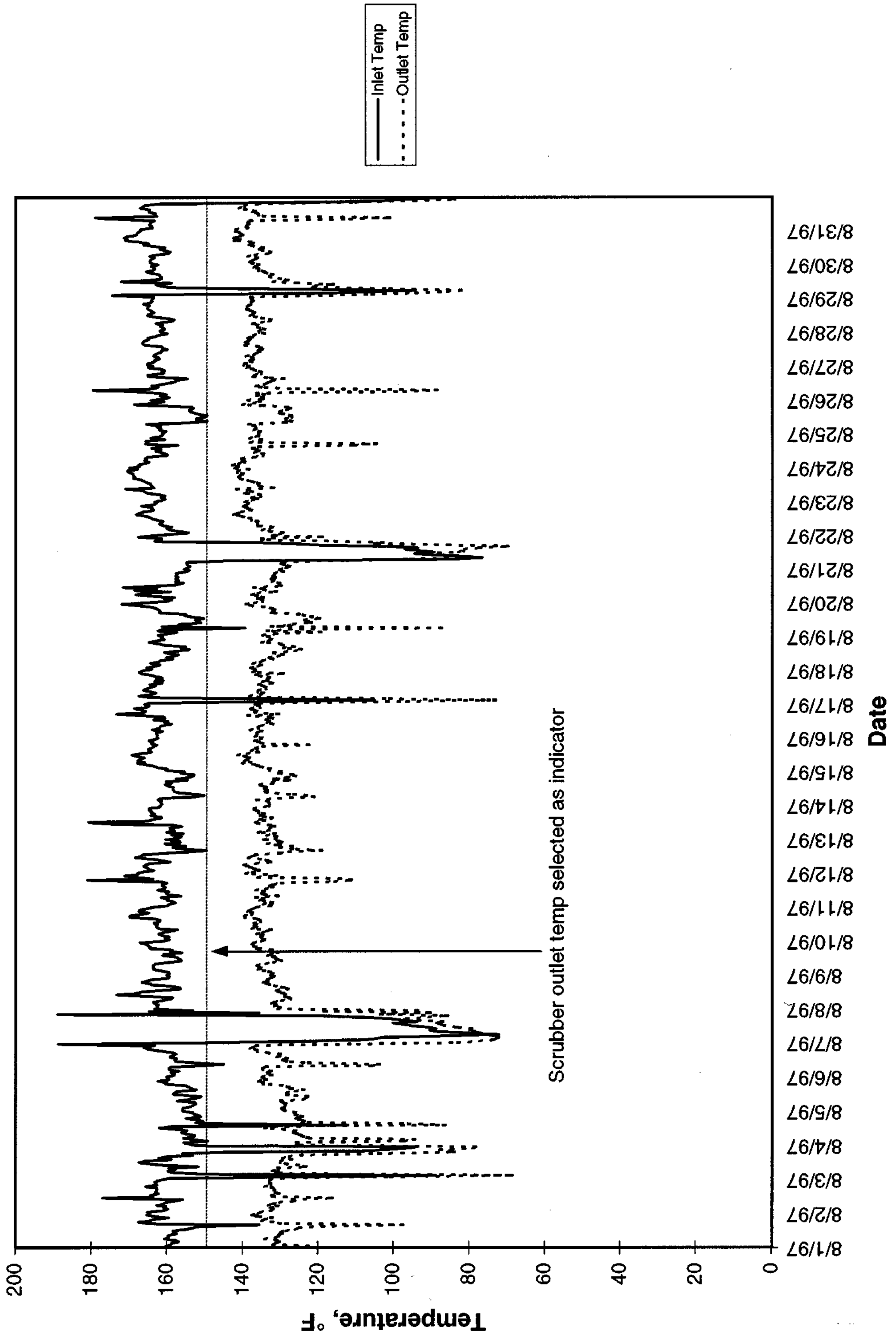

Figure A.14-1. August 1997 scrubber inlet and outlet temperatures.

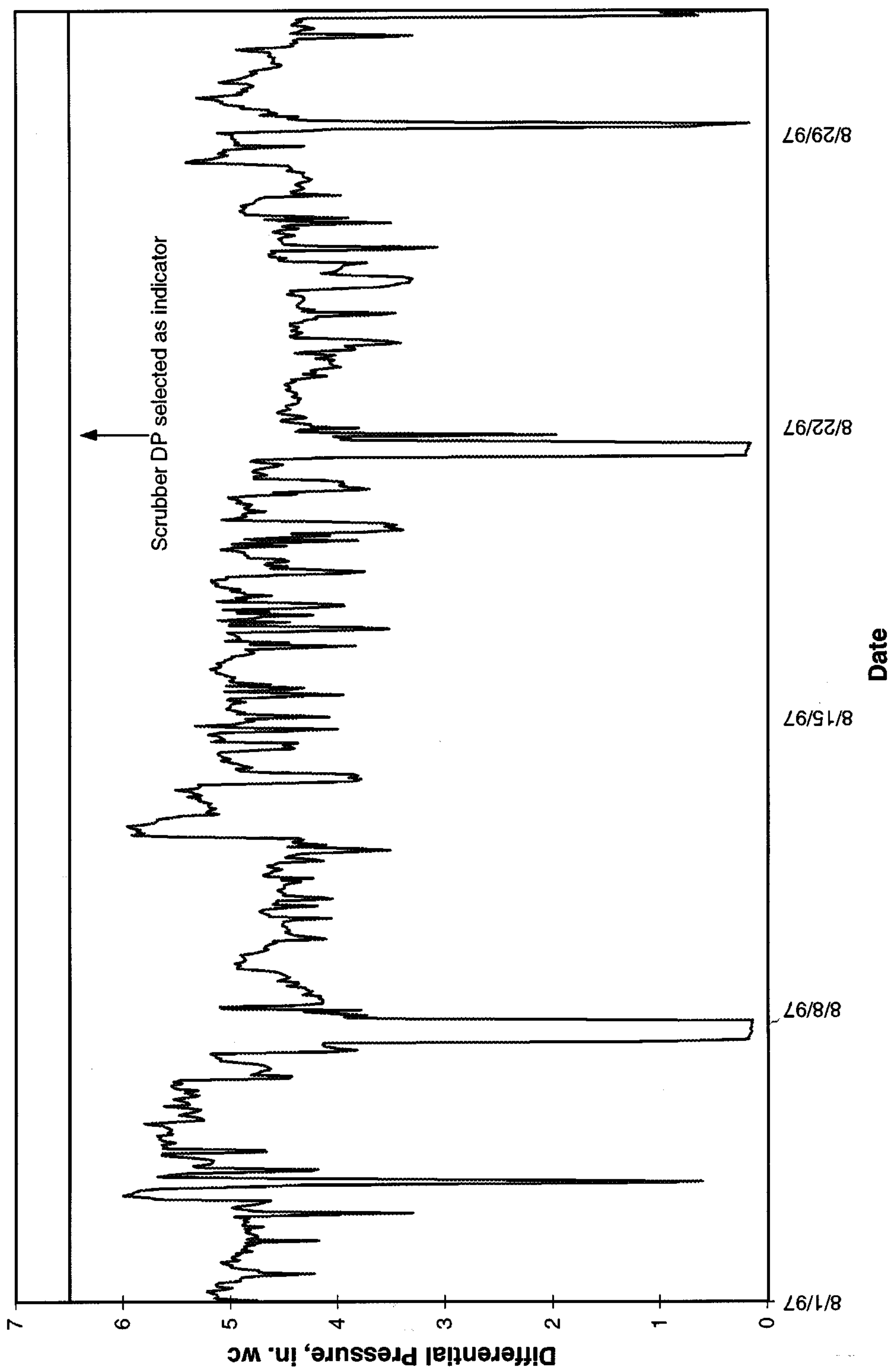

Figure A.14-2. August 1997 scrubber differential pressure.

A.15 VENTURI SCRUBBER FOR PM CONTROL--FACILITY O
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A.9b WET ELECTROSTATIC PRECIPITATORS (WESP) FOR PM CONTROL OF VENEER DRYERS – FACILITY P

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EXAMPLE COMPLIANCE ASSURANCE MONITORING
WET ELECTROSTATIC PRECIPITATORS (WESP) FOR PM CONTROL – FACILITY P

I. Background

A. Emissions Unit

Description:	Steam-heated dryers used in plywood manufacturing
Identification:	Veneer Dryers 1-6 (EU2)
APCD ID:	WESP 1, WESP 2
Facility:	Facility P Anytown, USA

B. Applicable Regulation and Emission Limit

Regulation No.:	Permit, State Regulation
Emission limits:	
Particulate Matter (PM):	0.3 lb/1,000 ft^2 (MSF) dried (3/8-inch thickness basis)
Monitoring Requirements:	Monitor WESP secondary voltage, quench inlet temperature, and WESP outlet temperature.

C. Control Technology — Wet electrostatic precipitator

II. Monitoring Approach

The key elements of the monitoring approach are presented in Table A.9b-1. The selected indicators of performance are: WESP secondary voltage, quench inlet temperature, and WESP outlet temperature. The selected indicator ranges are based on hourly average values.

TABLE A.9b-1. MONITORING APPROACH

	Indicator No. 1	Indicator No. 2	Indicator No. 3
I. Indicator	WESP secondary voltage.	Quench inlet temperature.	WESP outlet temperature.
Measurement Approach	The WESP secondary voltage is monitored using a voltmeter.	The gas temperature is measured with a thermocouple at the quench inlet.	The gas temperature is measured with a thermocouple at the WESP outlet.
II. Indicator Range	An excursion is defined as an hourly average voltage less than 35 kV. Excursions trigger an investigation, corrective action, and a reporting requirement.	An excursion is defined as an hourly average quench inlet temperature >375°F. Excursions trigger an investigation, corrective action, and a reporting requirement.	An excursion is defined as an hourly average outlet temperature >175°F. Excursions trigger an investigation, corrective action, and a reporting requirement.
III. Performance Criteria A. Data Representativeness	The monitoring system consists of a voltmeter that is part of the WESP instrumentation (TR controller). The minimum accuracy of the voltmeter is ±0.5 kV.	The monitoring system consists of a thermocouple located in the quench inlet ductwork. The minimum accuracy of the thermocouple is ±2.2°C (±4°F) or 0.75 percent of the measured temperature in °C, whichever is greater.	The monitoring system consists of a thermocouple located in the WESP outlet ductwork. The minimum accuracy of the thermocouple is ±2.2°C (±4°F) or 0.75 percent of the measured temperature in °C, whichever is greater.
B. Verification of Operational Status	NA	NA	NA
C. QA/QC Practices and Criteria	Voltmeter zero check during scheduled maintenance performed every 3 weeks.	Thermocouples calibrated annually by comparison against an instrument of known accuracy. The acceptance criteria is ±4°F.	Thermocouples calibrated annually by comparison against an instrument of known accuracy. The acceptance criteria is ±4°F.
D. Monitoring Frequency	The voltage on each WESP is monitored continuously (one data point per minute).	The quench inlet temperature is monitored continuously (one data point per minute).	The WESP outlet temperature is monitored continuously (one data point per minute).
Data Collection Procedure	Data are recorded on the continuous parameter monitoring system (CPMS) computer.	Data are recorded on the CPMS computer.	Data are recorded on the CPMS computer.
Averaging Period	Hourly block average.	Hourly block average.	Hourly block average.

MONITORING APPROACH JUSTIFICATION

I. Background

The pollutant-specific emissions units (PSEU) are the two WESPs that control six veneer dryers. The dryers are longitudinal, steam-heated dryers manufactured by Coe and Moore and are used in the manufacture of plywood. Veneer is introduced into the dryer either manually or using automated veneer sheet feeders. The dried veneer sheets pass through a moisture detector as they exit the dryer where any sheets not meeting moisture specifications are marked and sorted for redrying. Dry veneer sheets are coated with mixed glue and formed into panels.

Two WESPs, also referred to as E-tubes, remove particulate matter from the dryer exhaust. WESP No. 1 serves dryers Nos. 1, 5, and 6 and WESP No. 2 serves dryers Nos. 2, 3, and 4.

II. Rationale for Selection of Performance Indicators

A WESP is designed to operate at a relatively constant voltage. A significant decrease in voltage is indicative of a change in operating conditions that could lead to an increase in emissions. Low voltage can indicate electrical shorts or poor contacts that require maintenance or repair of electrical components. However, the regular flush cycles the WESPs undergo to remove the particulate from the collection surfaces may also cause drops in voltage of short duration. These brief voltage drops are part of the normal operation of the WESP.

Monitoring gas stream temperature can provide useful information about the performance of a WESP. Quench inlet temperature primarily is an indication that the inlet gas stream is not so hot that a fire may develop in the duct work or WESP. In addition, the gas stream needs to be cooled in order for some of the pollutants to condense. The WESP outlet temperature indicates that the gas stream has been sufficiently saturated to provide for efficient particle removal, and that the water spray prior to the WESP inlet is functioning. High outlet temperatures could be the result of plugged nozzles, malfunctioning pumps, or broken or plugged piping.

III. Rationale for Selection of Indicator Ranges

The selected indicator ranges are given below:

Secondary voltage:	≥35 kV
Quench inlet temperature:	≤375°F
Stack outlet temperature:	≤175°F

An excursion is defined as (1) an hourly average voltage less than 35 kV; (2) an hourly average quench inlet temperature greater than 375˚F; or (3) an hourly average WESP outlet temperature greater than 175˚F. 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. All excursions will be documented and reported. An hourly average was chosen to account for the intermittent flush cycles the WESPs undergo that cause the voltage to drop temporarily.

The indicator level for the WESP voltage was selected based upon the level maintained during normal operation. Typical operating voltages range from 35 to 55 kV. During the most recent performance test, the voltage ranged from 35 to 54 kV and the PM emissions were below allowable levels. An indicator level at the low end of the normal operating range was selected (35 kV). During a malfunction (such as an electrical short), the WESP voltage levels are appreciably lower than normal operational levels. The voltage also drops for a short period during the normal flush cycles that are performed every few hours to clean the tube surface where particulate is collected. Figure A.9b-1 displays the hourly average WESP secondary voltage during October 1997 for WESP No. 1.

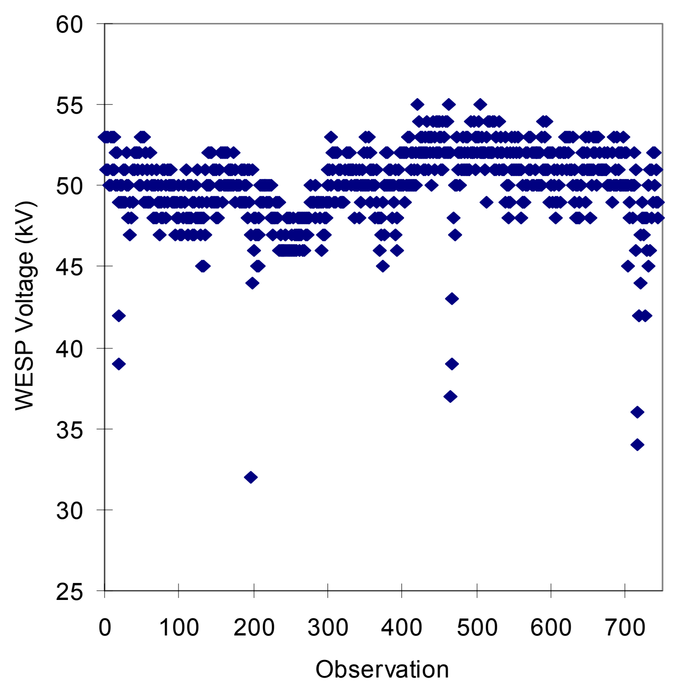

Figure A.9b-1. October 1997 hourly average secondary voltage (WESP No. 1).

The indicator levels for the quench inlet and WESP outlet gas temperatures also were selected based on levels maintained during normal operation. High temperatures may indicate a fire in the dryer or ductwork or a lack of water flow to the WESP. Temperature action levels were selected that are slightly higher than normal operating temperatures. If the water flow to the WESP is lost, the WESP outlet temperature will begin to approach the inlet temperature, which is much higher than 175˚F. Figures A.9b-2 and A.9b-3 display the hourly average quench inlet and WESP outlet temperature during October 1997 for WESP No. 1.

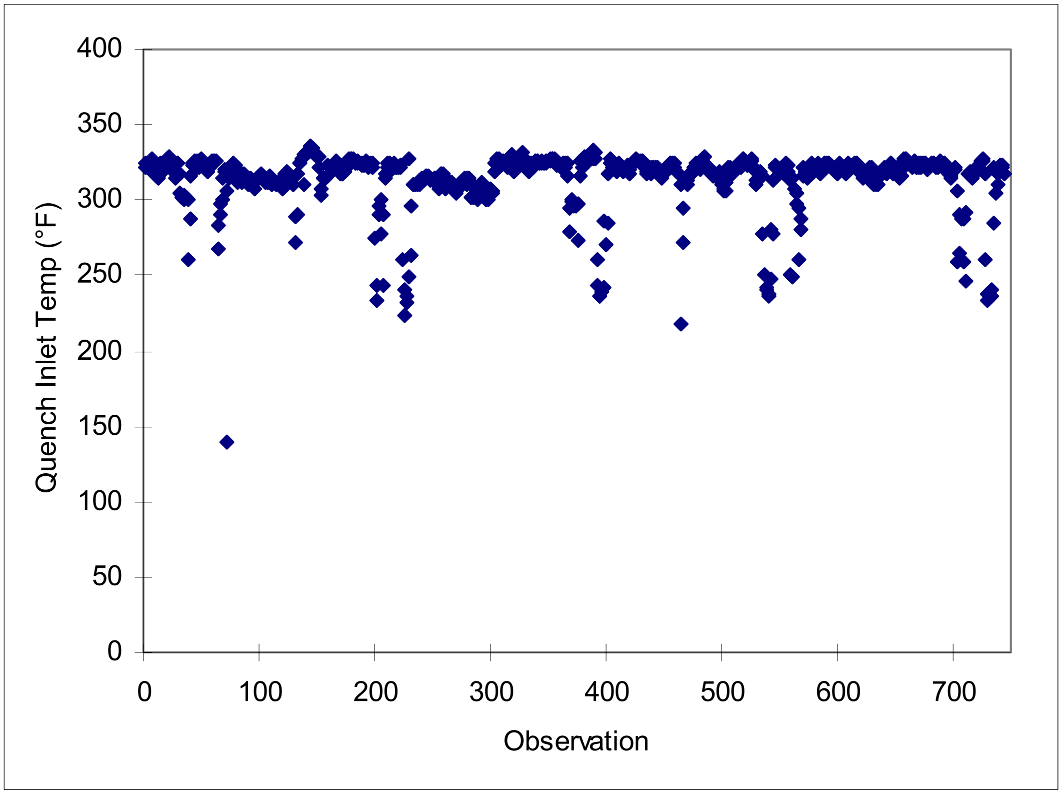

Figure A.9b-2. October 1997 Hourly Average Quench Inlet Temperature (WESP No. 1)

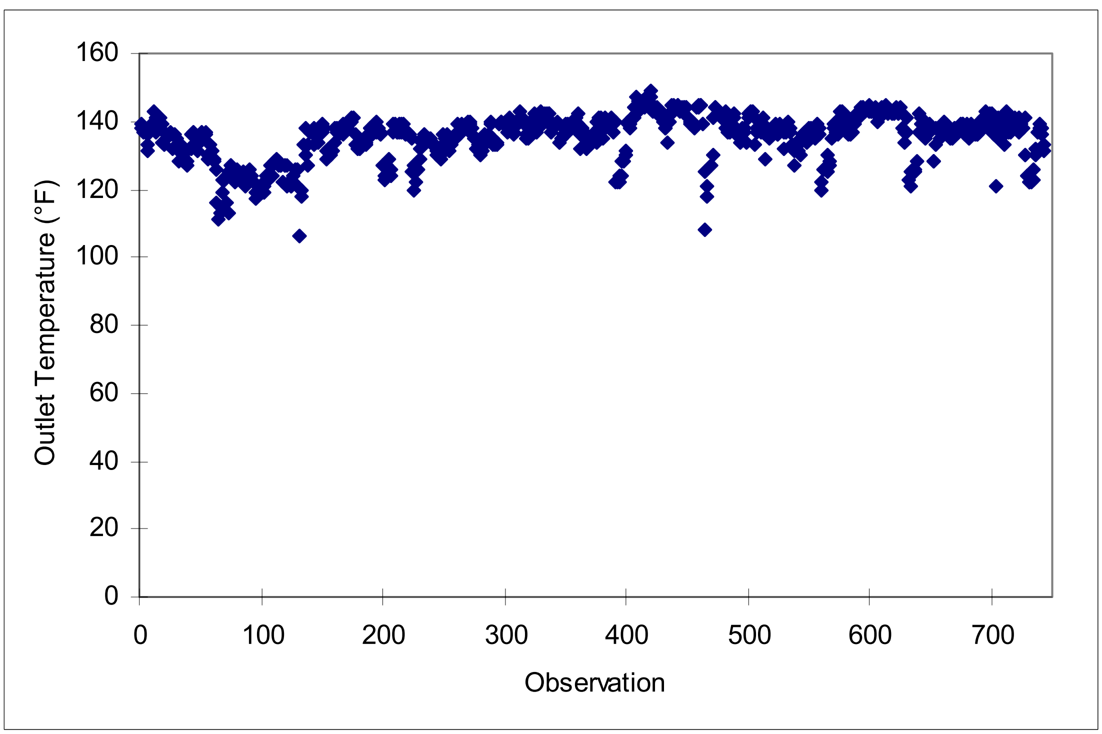

Figure A.9b-3. October 1997 Hourly Average WESP Outlet Temperature (WESP No. 1)

Indicator data for December 1995 to January 1996 and for October 1997 through December 1997 were reviewed. These data included hourly average WESP secondary voltage, quench inlet temperature, and WESP outlet temperature measurements. The maximum hourly average quench inlet temperature for WESP No. 1 was 336˚F, while the maximum for WESP No. 2 was 352˚F. The maximum hourly average stack outlet temperature for WESP No. 1 was 151˚F, while the maximum stack outlet temperature for WESP No. 2 was 178˚F. The average monthly voltages ranged from 47 to 51 kV for WESP No. 1 and from 40 to 46 kV for WESP No. 2.

Data obtained during the most recent performance test (October 1996) confirmed the unit was in compliance. During this test, the average measured PM emissions were 0.19 lb/MSF dried for WESP No. 1 and 0.21 lb/MSF dried for WESP No. 2. The measured particulate emissions were below the emission limitation of 0.3 lb/MSF dried (3/8-inch thickness basis). The WESP operating parameters during the performance test are summarized in Table A.9b-2.

TABLE A.9b-2. WESP OPERATING PARAMETERS DURING THE MOST RECENT PERFORMANCE TEST

WESP No.	Run	Production, ft^2/hr	Particulate, lb/MSF dried (3/8-inch basis)	WESP voltage, kV	Quench inlet T (˚F)	WESP outlet, T (˚F)
1	1	22,760	0.24	54	317	134
	2	23,419	0.17	54	318	134
	3	23,075	0.17	--	--	--
	Average	23,085	0.19	54	318	134
2	1	23,899	0.24	35	328	147
	2	32,238	0.17	38	332	143
	3	26,897	0.20	40	331	147
	Average	27,678	0.21	38	330	146

A.11 ELECTRIFIED FILTER BED FOR PM CONTROL OF VENEER DRYERS – FACILITY K

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EXAMPLE COMPLIANCE ASSURANCE MONITORING
ELECTRIFIED FILTER BED (EFB) FOR PM CONTROL – FACILITY K

I. Background

A. Emissions Unit

Description:	Natural gas-fired dryers used in plywood manufacturing
Identification:	Veneer Dryer 1, Veneer Dryer 2
Facility:	Facility K Anytown, USA

B. Applicable Regulation, Emission Limit, and Monitoring Requirements

Regulation:	Permit, State regulation
Emission Limits:	
Particulate matter (PM):	0.30 lb/1000 ft^2 (MSF) dried (3/8-inch thickness basis), 4.1 lb/hr
Monitoring Requirements:	EFB inlet temperature, EFB voltage, and EFB ionizer current.

C. Control Technology — EFB

II. Monitoring Approach

The key elements of the monitoring approach are presented in Table A.11-1. The selected indicators of performance are: EFB inlet temperature, voltage, and ionizer current. The selected indicator ranges are based upon hourly average values.

TABLE A.11-1. MONITORING APPROACH

	Indicator No. 1	Indicator No. 2	Indicator No. 3
I. Indicator	EFB inlet temperature.	EFB voltage.	EFB ionizer current.
Measurement Approach	Temperature is measured using a thermocouple.	Voltage is measured with a voltmeter.	Ionizer current is measured with an ammeter.
II. Indicator Range	An excursion is defined as an hourly average EFB inlet temperature greater than 170˚F (>145˚F when drying pine veneer). Excursions trigger an investigation, corrective action, and a reporting requirement.	An excursion is defined as an hourly average EFB voltage less than 8 kV. Excursions trigger an investigation, corrective action, and a reporting requirement.	An excursion is defined as an hourly average EFB ionizer current less than 2 mA. Excursions trigger an investigation, corrective action, and a reporting requirement.
III. Performance Criteria A. Data Representativeness	The monitoring system consists of a thermocouple installed at the inlet of the EFB. The minimum accuracy of the thermocouple is ±2.2˚C (±4˚F) or 0.75 percent of the measured temperature in ˚C, whichever is greater.	The monitoring system consists of a voltmeter on the EFB unit. The minimum accuracy of the voltmeter is ±0.5 kV.	The monitoring system consists of an ammeter on the EFB unit. The minimum accuracy of the ammeter is ±0.5 mA.
B. Verification of Operational Status	NA	NA	NA
C. QA/QC Practices and Criteria	The accuracy of the thermocouple is checked annually (or as needed) by calibration using a signal transmitter. The thermocouple wells are periodically checked and cleaned (at least annually).	Voltmeter zero is checked when the unit is not operating.	Ammeter zero is checked when the unit is not operating.
D. Monitoring Frequency	The EFB inlet temperature is measured continuously (at least 4 times per hour).	The EFB voltage is measured continuously (at least 4 times per hour).	The EFB ionizer current is measured continuously (at least 4 times per hour).
Data Collection Procedure	Data are stored electronically and archived for at least 5 years..	Data are stored electronically and archived for at least 5 years..	Data are stored electronically and archived for at least 5 years..
Averaging Period	Hourly block average.	Hourly block average.	Hourly block average.

MONITORING APPROACH JUSTIFICATION

I. Background

The pollutant-specific emissions unit (PSEU) consists of two natural gas direct-fired veneer dryers controlled by an EFB. Dryer 1 is manufactured by Moore and has one zone and four decks. Dryer 2 is manufactured by Coe and has two zones and five decks. The dryers are used in the manufacture of plywood.

II. Rationale for Selection of Performance Indicators

Wood dryer exhaust streams contain dry PM, products of combustion and pyrolysis, and aerosols formed by the condensation of hydrocarbons volatilized from the wood chips. Since some of the pollutants from the dryers are in a gas phase at the normal dryer exhaust temperature of 250˚ to 300˚F, these pollutants must be condensed in order to be collected by the EFB. The gas stream is cooled to a temperature of about 180˚F by the evaporative gas cooler that precedes the EFB, using a water mist. The pollutants condense into fine liquid droplets and are carried into the EFB. The EFB ionizer gives the particles in the gas stream an electrical charge. The high voltage electrode in the gravel bed creates charged regions on the gravel. As the gas passes through the bed, the charged particles are removed from the gas and transferred to the surface of the bed. Liquid and dust continuously build up on the gravel surface; the liquid slowly travels through the bed and is allowed to drip into the drain outlet in the bottom of the unit. The gravel is periodically replaced (about one-third of the gravel is replaced each month).

Factors that affect emissions from wood dryers include wood species, dryer temperature, dryer residence time, dryer loading rate, and previous drying history of the wood. The rate of hydrocarbon aerosol formation (from vaporizing the extractable portion of the wood) is lower at lower dryer temperatures. Small increases in dryer temperature can produce relatively large increases in the PM emission rate. If particles are held in the dryer too long, the surfaces can volatilize; if these emissions are released into the ambient air, a visible blue haze can result.

The CAM indicators selected are EFB inlet temperature, EFB voltage, and EFB ionizer current. The EFB must be maintained at the proper temperature to allow collection of the hydrocarbon aerosol and particulate matter from the dryer. The EFB inlet temperature is monitored to indicate the gas stream was cooled to the proper temperature range before entering the EFB and that the bed is operating at the proper temperature. Information from the EFB manufacturer indicates that high EFB temperatures (e.g., temperatures in excess of 200˚F) may result in excess stack opacity, as will low gravel levels (a low gravel level may cause insufficient PM collection). The voltage on the gravel and the current on the ionizer must be maintained so negatively charged particles in the exhaust gas are attracted to positively charged regions on the gravel bed. An adequate ionizer current level indicates the corona is charging the particles in the gas stream. The bed voltage level indicates the intensity of the electric field in the bed. A drop in voltage or current could indicate a malfunction, such as a short or a buildup of dust or hydrocarbon glaze on the ionizer or the gravel. A short in the bed will show as high current with little or no voltage. A foreign object in the gravel bed which bridges the gap between the electrode and grounded louvers can short the bed, as can a cracked electrical insulator. The bed's PM collection efficiency increases as the voltage and current increase within the unit's operating range.

The parameters selected for monitoring are consistent with technical information on the operation, maintenance, and emissions for EFB's and dryers provided in EPA's September 1992 draft Alternative Control Technology (ACT) document for PM-10 emissions from the wood products industry. These parameters also were recommended by the manufacturer as parameters to monitor to ensure proper operation of the EFB unit.

III. Rationale for Selection of Indicator Ranges

Indicator data for June through August were collected and reviewed. These data include EFB cooler inlet and outlet temperature, bed temperature, bed voltage, and ionizer current measurements. No indicator ranges are specified in the current operating permit, but the permit does state that the EFB bed temperature shall not exceed 145˚F when pine veneer is being dried. Based on the manufacturer's recommendations, historical data, and data obtained during source testing, the following indicator ranges were selected:

EFB bed inlet temperature:	<170˚F (<145˚F when drying pine veneer)
EFB bed voltage:	>8 kV
EFB ionizer current:	>2 mA

An excursion is defined as an hourly average of any parameter which is outside the indicator range. 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. All excursions will be documented and reported.

Figure A.11-1 shows the hourly average EFB inlet temperature for June. The permit requires that the EFB bed temperature be less than 145˚F while drying pine veneer. The EFB inlet temperature is used as a surrogate for bed temperature. During normal operation, the typical inlet temperature was 160 to 165˚F when drying species other than pine. There were short periods of operation at 130 to 140˚F when drying pine veneer, and lower temperatures that indicate the dryers were not operating (e.g., on Fridays during the routine maintenance shutdown). Similar operating ranges were observed for July and August. The maximum hourly average EFB inlet temperatures for June, July, and August were 174˚F, 173˚F, and 176˚F, respectively. The manufacturer recommends maintaining the EFB at a temperature of 160 to 180˚F. Therefore, based on this recommendation and on normal operating conditions, the indicator range chosen was an hourly average inlet temperature less than 170˚F (less than 145˚F when drying pine veneer). If the EFB inlet temperature exceeds 170˚F (145˚F when drying pine), corrective action will be initiated.

Figure A.11-2 shows the hourly average EFB voltage for June. From Figure A.11-2, it can be observed that the EFB typically operates in the range of 10 to 15 kV. Some short periods of operation occur from 5 to 10 kV. The mean hourly voltages for June, July, and August are given below. These statistics do not include data from periods during which the EFB was not operating and the voltage was recorded as 1.0 or zero. (For example, the EFB is shut down every Friday for maintenance.)

Month	Mean hourly average voltage, kV
June	12.4
July	11.6
August	10.9
Average	11.6

The manufacturer's recommended bed voltage range is 5 to 10 kV. The average voltages during the 1992, 1993, and 1996 performance tests were 6.7 kV, 11 kV, and 14 kV, respectively. Based on all data reviewed, greater than 8 kV was chosen as the indicator range for the hourly average EFB bed voltage. If the hourly average bed voltage drops below 8 kV during periods of normal operation (excludes shutdown periods), corrective action will be initiated.

Figure A.11-3 shows the hourly average EFB ionizer current for the month of June. From Figure A.11-3 it can be seen that the EFB typically operates at an ionizer current in the range of 2 to 5 mA. The mean hourly average currents for June, July, and August are shown below. In addition, the manufacturer's recommended range is 2 to 4 mA. Therefore, the indicator range chosen was an hourly average current greater than 2 mA. If the hourly average ionizer current drops below 2 mA during normal operation (excludes shutdown periods), corrective action will be initiated.

Month	Mean hourly average current, mA
June	2.8
July	2
August	2
Average	2.3

Emissions test results and indicator data are presented below for the 1992, 1993, and 1996 performance tests. The 1992 and 1993 tests were conducted while drying pine; the 1996 test was conducted while drying Douglas fir. The EFB is subject to a PM emission limitation of 0.30 lb/MSF (4.1 lb/hr). Both limits were met during all three performance tests.

Year	PM emissions, gr/dscf	PM emissions, lb/MSF	PM emissions, lb/hr	Average voltage, kV	Average ionizer current, mA	Average EFB inlet temperature, ˚F
1992	0.016	0.16	1.5	6.7	4.9	153
1993	0.015	0.22	2.0	10.8	2.8	154
1996	0.02	0.30	1.1	14	1.4	189

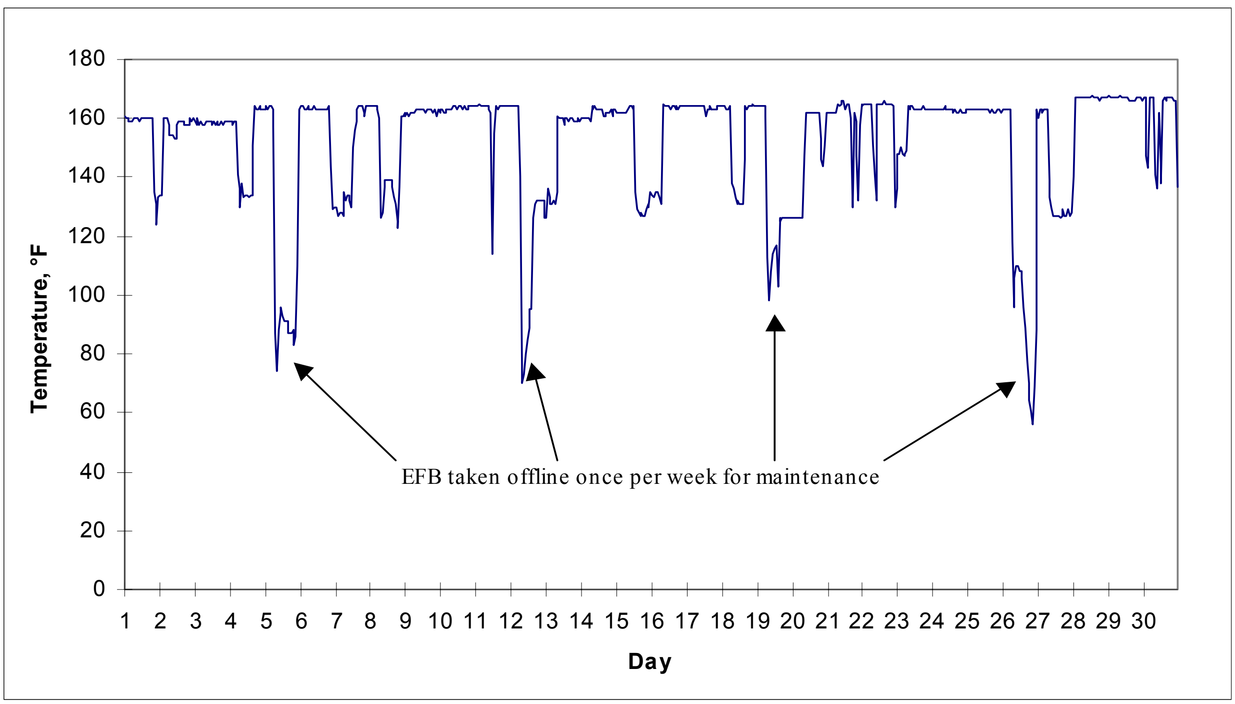

Figure A.11-1. June EFB inlet temperature (hourly average).

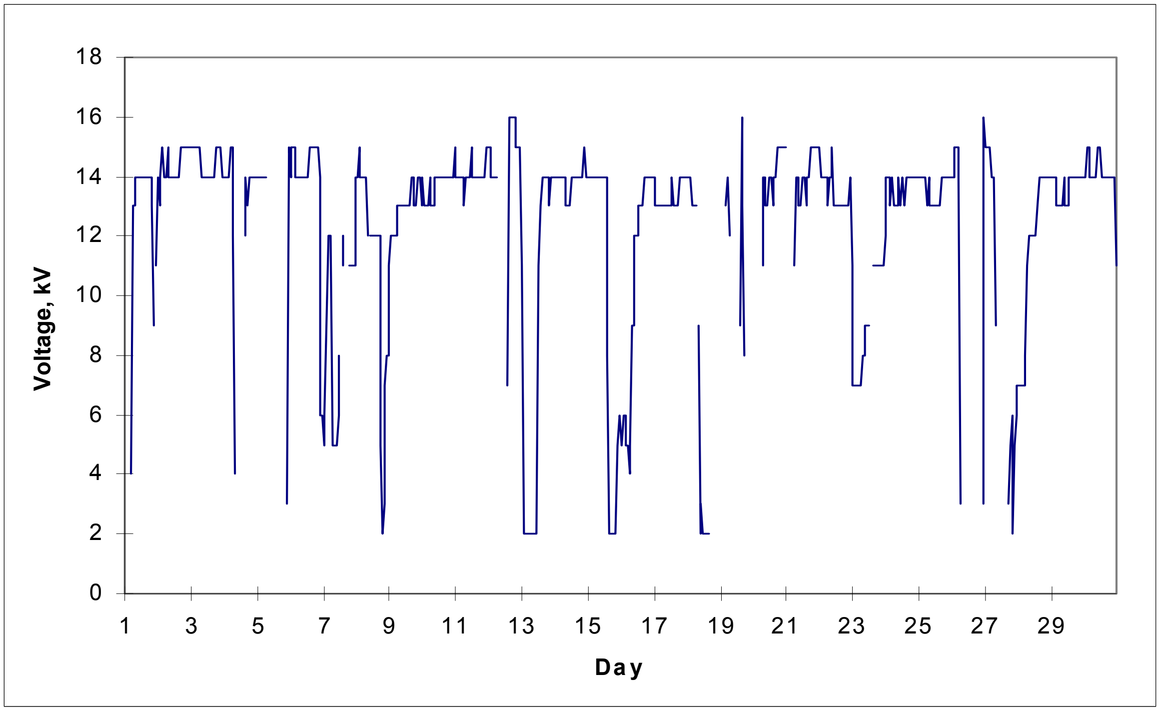

Figure A.11-2. June EFB bed voltage (hourly average).

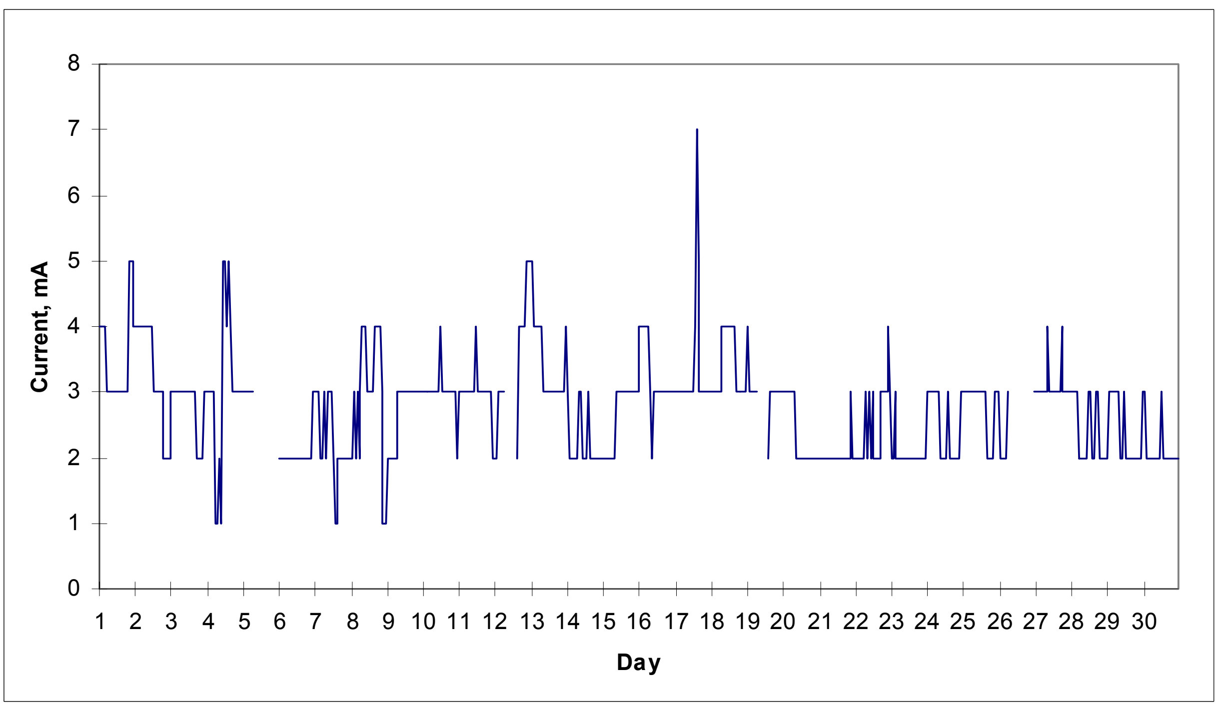

Figure A.11-3. June EFB ionizer current (hourly average).

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A.17 VENTURI SCRUBBER FOR PM CONTROL--FACILITY S

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EXAMPLE COMPLIANCE ASSURANCE MONITORING
VENTURI SCRUBBER FOR PM CONTROL: FACILITY S

I. Background

A. Emissions Unit

Description:	Wood-fired boiler
Identification:	Boiler A
Facility:	Facility S Anytown, USA

B. Applicable Regulation, Emissions Limit, and Monitoring Requirements

Regulation: State regulation (Federally enforceable)

Emissions Limit:
Particulate Matter (PM): Determined using the following equation:

$$P = 0.5 * (10/R)^{0.5}$$

where:

P = allowable weight of emissions of fly ash and/or other PM in lb/mmBtu.

R = heat input of fuel-burning equipment in mmBtu/hr based on the measured percent of O_2 and volumetric flow rate.

The State rule also specifies that the opacity of visible emissions cannot be equal to or greater than 20 percent, except for one 6-minute period per hour of not more than 27 percent.

Monitoring Requirements: Continuous Opacity Monitoring System (COMS)

C. Control Technology

Venturi scrubber

II. Monitoring Approach

The key elements of the monitoring approach are presented in Table A.17-1. The indicators of performance are the boiler exhaust O_2 concentration (a measure of excess air level) and the differential pressure across the scrubber venturi.

TABLE A.17-1. MONITORING APPROACH

	Indicator No. 1	Indicator No. 2
I. Indicator	Exhaust gas oxygen concentration	Scrubber differential pressure
Measurement Approach	O_2 monitor	Differential pressure transducer.
II. Indicator Range	An excursion is defined as an hourly boiler exhaust O_2 concentration of less than 11 or greater than 16 percent. Excursions trigger an inspection, corrective action, and a reporting requirement.	An excursion is defined as a 1-hour average differential pressure below 10.0 inches of water. Excursions trigger an inspection, corrective action, and a reporting requirement.
III. Performance Criteria A. Data Representativeness	The O_2 monitor is located in the boiler exhaust.	The differential pressure transducer monitors the static pressures upstream and downstream of the scrubber's venturi throat.
B. Verification of Operational Status	NA	NA
C. QA/QC Practices and Criteria	Daily zero and span checks. Adjust when drift exceeds 0.5 percent O_2.	Quarterly comparison to a U-tube manometer. Acceptance criteria is 0.5 in. w.c.
D. Monitoring Frequency	Measured continuously.	Measured continuously.
Data Collection Procedures	1-minute averages are computed and displayed. The PC then computes and stores a 1-hour average using the 1-minute averages.	1-minute averages are computed and displayed. The PC then computes and stores a 1-hour average using the 1-minute averages.
Averaging period	1-hour.	1-hour.

MONITORING APPROACH JUSTIFICATION

I. Background

The pollutant-specific emissions unit (PSEU) is PM from a wood-fired boiler. Particulate matter in the boiler's exhaust stream is controlled by a venturi scrubber. A COMS is required by the applicable State rule. However, water droplets in the boiler exhaust will interfere with the COMS measurements and consequently make the use of a COMS impractical. An alternative monitoring program utilizing parametric monitoring has been proposed. The monitoring approach includes continuous monitoring of the wood-fired boiler's excess air, the steam production rate, and the differential pressure across the scrubber's venturi throat.

II. Rationale for Selection of Performance Indicators

The operating conditions for this type of source (wood-fired boiler) can have a significant impact on the amount of particulate emissions created. Furthermore, for a venturi scrubber, the inlet particulate matter loading to the scrubber will have an impact on the emissions level from the scrubber (i.e., emissions from the scrubber are expected to increase as the loading to the scrubber increases for the same scrubber operating conditions). Site-specific emissions test data confirm these expectations. Therefore, indicators of performance of both the control device and process were selected for this source.

The scrubber differential pressure was selected as the indicator of control device performance. The differential pressure is proportional to the water flow and air flow through the scrubber venturi throat and is an indicator of the energy across the scrubber and the proper operation of the scrubber within established conditions.

Excess air levels can have a significant impact on boiler performance. Excess air is defined as that air exceeding the theoretical amount necessary for combustion. Insufficient excess air will result in incomplete combustion and an increase in emissions. A minimum of about 50 percent excess air is necessary for combustion of wood or bark fuels. Provision of too much excess air causes the furnace to cool and also can result in incomplete combustion. Therefore, the proper excess air level is important for proper operation of the boiler. The percent oxygen in the exhaust gas stream is an indicator of the excess air level (0 percent oxygen would equal 0 percent excess air, 8 percent oxygen is approximately 50 percent excess air, and 12 percent oxygen is approximately 100 percent excess air).

III. Rationale for Selection of Indicator Ranges

Baseline information on the relationship among process operating conditions, control device operating conditions, and emissions was necessary to establish the indicators and ranges. A series of test runs was performed at several different boiler operating conditions because parametric monitoring is being proposed as an alternative to COMS.

Emissions tests were performed to establish a basis for indicator ranges that correspond to compliance with the PM emissions limit. A set of nine test runs was performed on the boiler at three different levels of steam generation (three test runs were performed at each steam generation level). Emissions sampling was based on EPA Methods 1 through 5 (40 CFR 60, Appendix A). The results of the first series of emissions tests indicated a problem meeting the emissions limits at the lower load level; the lack of a means to control excess air levels during boiler operation was suspected as the cause of the excess emissions. A second series of tests were performed a year later after automatic boiler control equipment was installed. The second series of tests also was comprised of nine runs at three operating loads. The results of these 18 tests were used in selecting the indicator ranges. The results of these tests are presented and discussed in the following paragraphs.

Figure 1 graphically presents the excess air level versus the nominal boiler load (steam generation rate) for the tests. During the first series of tests, before automatic boiler controls were added, the boiler operated at a very high level of excess air (over 500 percent) at the low-level operating load, at a high level of excess air (over 200 percent) at the mid level operating load, and below 200 percent at the high-level operating load. Without the automatic boiler controls, the same amount of air was being introduced to the boiler regardless of the operating load (wood feed rate), resulting in a significant increase in excess air levels as wood feed rate decreased. After the automatic controls were added, the excess air was maintained at lower levels for the low-level and mid-level load conditions (less than 300 percent and 200 percent, respectively).

The results of the two test series are summarized in Table A.17-2. Three test runs were performed at each steam generation rate.

TABLE A.17-2. TEST RESULTS[a]

	Nominal steam generation rate (lb/hr)	Venturi differential pressure (in. H_2O)	Boiler exhaust O_2 (%)	Particulate emissions (lb/MMBtu)	Allowable particulate emissions (lb/MMBtu)
Series 1: (Before Boiler Control Modifications)	25,000	15.6	18.1	0.73	0.25
	40,000	22.9	16.2	0.43	0.21
	60,000	22.2	12.6	0.06	0.16
Series 2: (After Boiler Control Modifications)	33,000	12.0	15.5	0.07	0.25
	52,000	12.1	13.9	0.06	0.21
	77,000	12.0	13.0	0.05	0.17

[a] All values are 3-run averages.

At the first level of steam generation (25,000 lb/hr), the amount of excess air ranged from 544 percent to 752 percent by volume. The particulate emissions rate ranged from 0.528 to 1.12 lb/MMBtu. The maximum allowable emissions ranged from 0.23 to 0.27 lb/MMBtu. The maximum allowable emissions varies because it is based on the heat input rate. The allowable emissions rate was exceeded for all three test runs. The second set of test runs was performed at a nominal steam generation level of 40,000 lb/hr. The amount of excess air ranged from 244 to 830 percent. The particulate emissions rate ranged from 0.21 to 0.82 lb/MMBtu. The maximum allowable emissions ranged from 0.17 to 0.28 lb/MMBtu. The maximum allowable emissions rate was exceeded for all three test runs. The third set of test runs was operated at a nominal steam generation level of 60,000 lb/hr. The steam generation level actually ranged from 60,000-70,000 lb/hr but dropped below 50,000 lb/hr midway through the third of the three tests performed. The amount of excess air for these three test runs ranged from 123 to 188 percent. The particulate emissions rate ranged from 0.05 to 0.06 lb/MMBtu. The maximum allowable emissions ranged from 0.15 to 0.17 lb/MMBtu. The boiler was well within the maximum allowable emissions rate for all three test runs.

For the test series conducted after the addition of automatic controls, at the first level of steam generation (33,000 lb/hr nominal), the amount of excess air ranged from 255 to 341 percent by volume (15 to 16 percent oxygen). The particulate emissions rate ranged from 0.062 to 0.081 lb/MMBtu. The maximum allowable emissions ranged from 0.23 to 0.29 lb/MMBtu. The particulate emissions were less than the allowable emissions rate for all three test runs. The second set of test runs was performed at a nominal steam generation level of 77,000 lb/hr. The amount of excess air ranged from 128 to 194 percent (12 to 14 percent oxygen). The particulate emissions rate ranged from 0.045 to 0.057 lb/MMBtu. The maximum allowable emissions ranged from 0.16 to 0.18 lb/MMBtu. The particulate emissions were less than the allowable emissions rate for all three test runs. The third set of test runs was performed at a nominal steam generation level of 52,000 lb/hr. The amount of excess air for these three test runs ranged from 196 to 223 percent (13 to 14 percent oxygen). The particulate emissions rate ranged from 0.056 to 0.067 lb/MMBtu. The maximum allowable emissions ranged from 0.20 to

0.21 lb/MMBtu. The boiler operated within the maximum allowable emissions rate for all three test runs.

Figure 2 presents the particulate emissions rate versus boiler load for the two test series. Figures 3 and 4 present the particulate emissions rate versus excess air and boiler exhaust oxygen level, respectively. The test results show that during the first test series the emissions increase significantly as the excess air increases. The allowable emissions limit was exceeded at the low- and mid-level operating loads. The results of the second test series conducted after automatic boiler controls were added also show a relationship among the excess air level, boiler load, and particulate emissions rates. However, the particulate emissions rates were well within the allowable emissions rates for all test runs at all load conditions. Note that the performance of the system (boiler and venturi scrubber) was significantly better during the second series of tests when the automatic boiler controls were being used to control air levels even though the venturi scrubber was operating at a lower pressure drop (12 versus 22 in. w.c.).

The indicator selected for monitoring boiler operation is exhaust gas oxygen concentration. The selected indicator range for the boiler exhaust gas oxygen is greater than 12 and less than 16 percent O_2 (one-hour average). The indicator range was chosen based upon the 1-hr test run averages for the January 1999 test data. During these tests, the average oxygen concentration was maintained between 12 and 16 percent. The oxygen concentration is measured continuously.   An excursion triggers an inspection, corrective action, and a reporting requirement. The selected range will promote maximum efficiency and provide a reasonable assurance that the boiler is operating normally.

The indicator range selected for monitoring venturi scrubber operation is a pressure differential of greater than 10 in. w.c. (one-hour average). An excursion triggers an inspection, corrective action, and a reporting requirement. The differential pressure is measured several times per minute. A one-minute average is calculated, and an hourly average is calculated from the one-minute averages. The selected indicator range was chosen by examining the January 1999 test data. During these tests, the differential pressure was maintained between 10 and 15 in. w.c.   The measured particulate emissions limit during these tests at all three boiler loads was approximately one third of the allowable emissions rate (large margin of compliance). Therefore, a differential pressure of greater than 10 in. w.c. was selected as the indicator range.

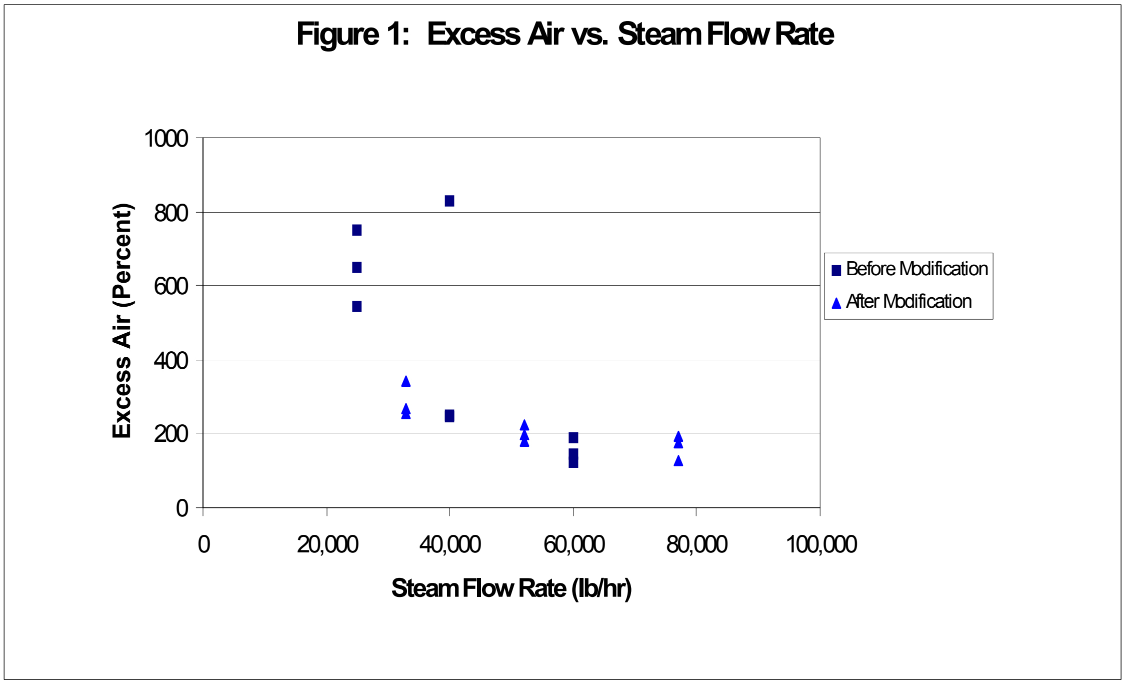
Figure 1: Excess Air vs. Steam Flow Rate
Excess Air (Percent)
1000
800
600
400
200
0
0
20,000
40,000
60,000
80,000
100,000
Steam Flow Rate (lb/hr)
Before Modification
After Modification

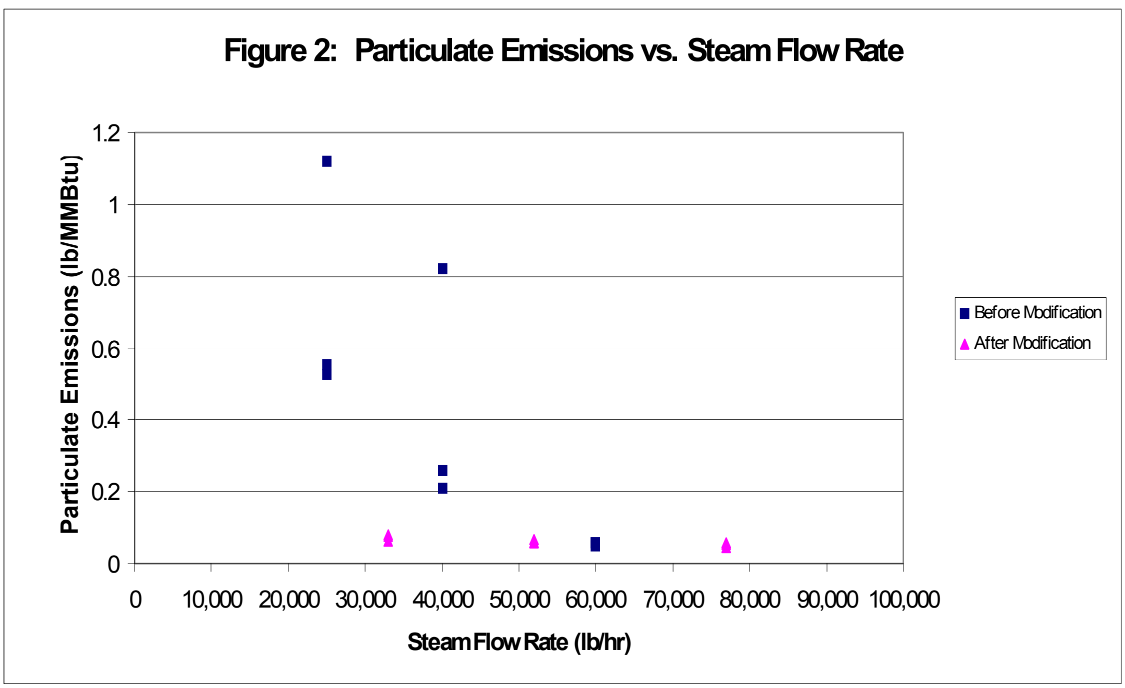
Figure 2: Particulate Emissions vs. Steam Flow Rate
Particulate Emissions (lb/MMBtu)
1.2
1
0.8
0.6
0.4
0.2
0
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
Steam Flow Rate (lb/hr)
Before Modification
After Modification

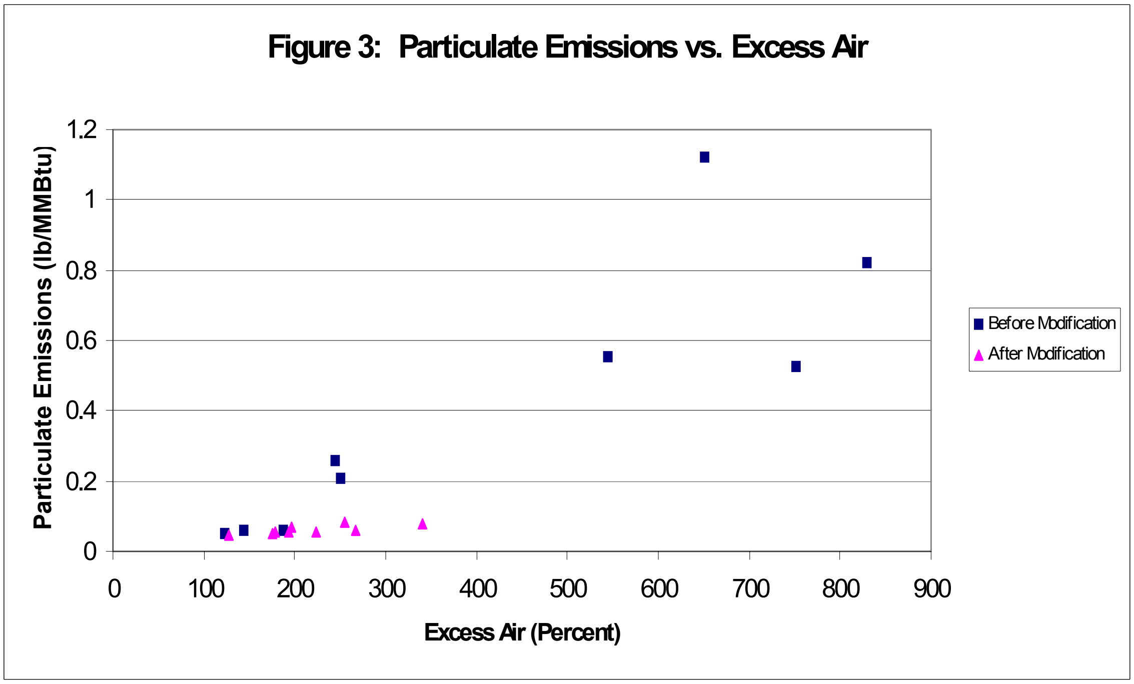
Figure 3: Particulate Emissions vs. Excess Air
Particulate Emissions (lb/MMBtu)
1.2
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
500
600
700
800
900
Excess Air (Percent)
Before Modification
After Modification

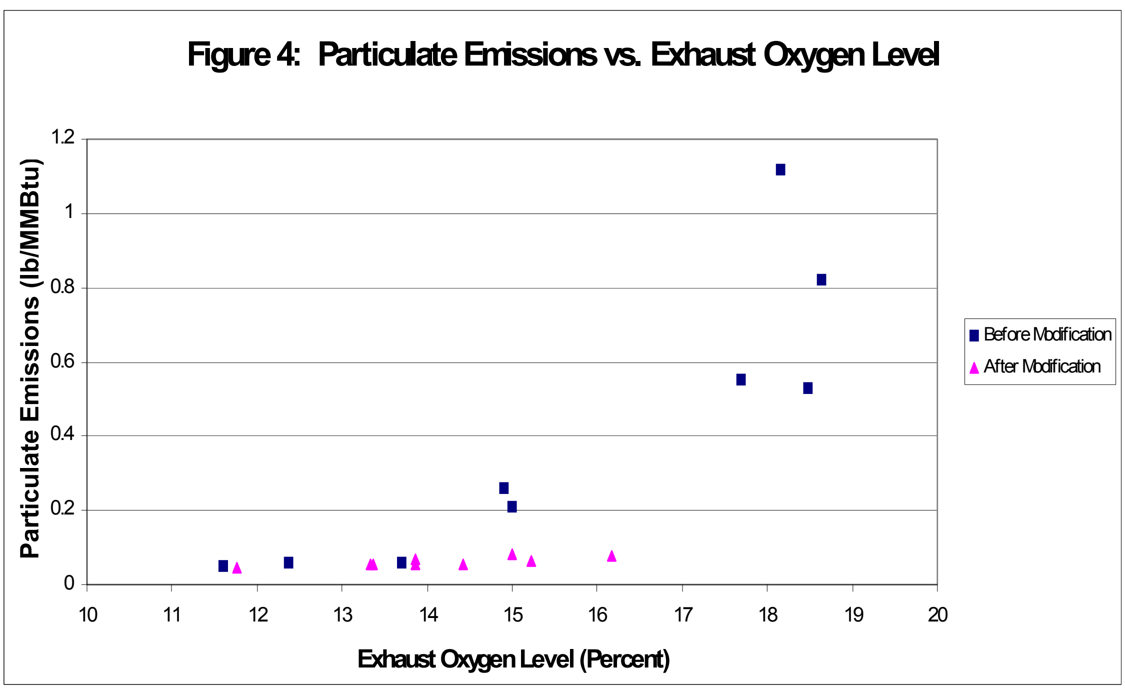
Figure 4: Particulate Emissions vs. Exhaust Oxygen Level
Particulate Emissions (lb/MMBtu)
1.2
1
0.8
0.6
0.4
0.2
0
10
11
12
13
14
15
16
17
18
19
20
Exhaust Oxygen Level (Percent)
Before Modification
After Modification

A.19 BAGHOUSE FOR PM CONTROL – FACILITY V

INTRODUCTION

The examples in section A.19 were developed based on data collected during an EPA study of particulate matter (PM) continuous emissions monitoring systems (CEMS). Data were collected over a period of several months for three PM CEMS installed on a coal-fired boiler. Higher than normal PM concentrations were generated during testing by installing a baghouse bypass line and adjusting a butterfly valve on that line. Examples A.19a and A.19b present two approaches to the use of PM CEMS for CAM using data from one of the PM CEMS evaluated. The first example uses the procedures of proposed Performance Specification 11 (December 2001) to calibrate the PM CEMS over an extended range of PM concentrations. This approach provides a reasonable assurance of compliance over the extended operating range, establishes the indicator level near the high end of the demonstrated operating range, and allows the source flexibility to operate within the extended range without an excursion.

The second example uses a limited amount of test data collected with the APCD operating normally (i.e., no generation of increased emissions utilizing the APCD bypass) to calibrate the PM CEMS. During normal operation there is a large margin of compliance with the emissions limit. However, the indicator range is based on a smaller data set collected over a narrower range of operation. Consequently, the indicator range for an excursion is established at a lower value, near the normal operating range. This approach results in less operating flexibility but lower emissions testing costs because testing is only performed at normal operating conditions.

Details on the PM CEMS evaluation are contained in the report series, "Evaluation of Particulate Matter (PM) Continuous Emission Monitoring Systems (CEMS)," Volumes 1-5, prepared by Midwest Research Institute for the U. S. Environmental Protection Agency's Emissions Measurement Center. The EPA contact is Mr. Dan Bivins at (919) 541-5244, or bivins.dan@epa.gov.

EXAMPLE COMPLIANCE ASSURANCE MONITORING:
BAGHOUSE FOR PM CONTROL – FACILITY V

I. Background

A. Emissions Unit

Description:	375 mmBtu/hr coal-fired boilers
Identification:	Boilers 1 and 2
Facility:	Facility V Anytown, USA

B. Applicable Regulation, Emissions Limit, and Monitoring Requirements

Regulation:	40 CFR 60, Subpart Da Permit
Emissions Limits: PM:	 0.02 lb/mmBtu
Monitoring Requirements:	A baghouse inspection and maintenance program is performed and a PM continuous emissions monitoring system (CEMS) is used as an additional indicator of compliance with the PM limit. [Note: A COMS is used to assure compliance with the opacity limit and NO_x and SO_2 CEMS are used to assure compliance with the NO_x and SO_2 limits, but that monitoring is not addressed here.]

C. Control Technology:

Both boilers have a pulse jet fabric filter to control particulate emissions from the boiler and the lime slurry spray dryer (used for flue gas desulfurization) that follows each boiler. The boilers exhaust to a common stack.

II. Monitoring Approach

The key elements of the monitoring approach for PM are presented in Table A.19a-1. The selected performance indicators are the signal from a PM CEMS and a baghouse inspection and maintenance program.

TABLE A.19a-1. MONITORING APPROACH

	Indicator No. 1	Indicator No. 2
I. Indicator	PM concentration.	Bag condition.
Measurement Approach	A light scattering device is installed at a representative location downstream of the baghouse.	The inspection and maintenance program includes a semi-annual internal inspection of the baghouse and analysis of representative bag samples and bi-annual bag replacement.
II. Indicator Range	An excursion is defined as an hourly average PM concentration greater than 13 mg/acm. Excursions trigger an inspection, corrective action, and a reporting requirement.	An excursion is defined as failure to perform the semi-annual inspection and bi-annual bag replacement. Excursions trigger an inspection, corrective action, and a reporting requirement.
III. Performance Criteria A. Data Representativeness	The light scattering instrument is located where a representative sample can be obtained in the baghouse exhaust. The amount of light reflected back at the optical sensor is proportional to the amount of particulate present in the exhaust. A field test was performed to correlate the monitor's response to PM concentration measured by Method 17.	Baghouse inspected visually for deterioration and bag samples taken to determine bag condition and remaining bag life.
B. Verification of Operational Status	Initial correlation test conducted August 1999.	NA
C. QA/QC Practices and Criteria	Daily drift checks, quarterly absolute calibration audit (ACA), and annual response calibration audit (RCA). Daily zero/span drift cannot exceed 4 percent of the upscale value for 5 consecutive days or more than 8 percent of the upscale value in any one day. The ACA involves challenging the PM CEMS with an audit standard at three operating levels, per Performance Specification (PS) 11. The RCA involves gathering simultaneous CEMS response and manual Reference Method data over a range of operating conditions, per PS 11.	Trained personnel perform inspections and maintenance.
D. Monitoring Frequency	Continuous.	Varies.

(TABLE A.19a-1. Continued)

	Indicator No. 1	Indicator No. 2
Data Collection Procedures	The data acquisition system (DAS) collects a data point every second. The 1-second data are reduced to a 1-minute, a 15-minute, and then a 3-hour average PM emissions rate. The 3-hour average data are archived for at least 5 years.	Results of inspections and maintenance activities performed are recorded in baghouse maintenance log.
Averaging period	3-hour.	NA

MONITORING APPROACH JUSTIFICATION

I. Background

Two 375 mmBtu/hr traveling-grate, stoker-fired boilers are operated at this facility. Each boiler is rated at a nominal steam flow of 275,000 pounds per hour at 950˚F and 1,540 psig. The boilers are fired with bituminous coal that averages 13,000 Btu per pound. The boilers were constructed in 1990 and are subject to 40 CFR 60, Subpart Da.

The boilers include mechanical separators in the boiler back-pass section for cinder collection and re-injection into the furnace area. A separate dust collector is located after the air heater section for heavy fly ash collection. The ash from the traveling grate is collected at the front of the boiler for removal to the ash storage silos.

Each boiler is equipped with a dry flue gas desulfurization (FGD) system for SO_2 control and a pulse jet fabric filter for PM control. The FGD uses a motor-driven atomizer to spray a lime slurry mixture into the gas path to neutralize acid mists from the boiler gas. The particulate from the slurry injection and the fine fly ash from the combustion process are collected in the baghouse. The FGD is designed to reduce the average sulfur dioxide concentration by at least 90 percent. The baghouse is designed to collect at least 99 percent of the total particulate in the boiler gas. Exhaust from both baghouses is routed to a common stack that exhausts to the atmosphere.

II. Rationale for Selection of Performance Indicators

The performance indicators selected are the signal from a PM CEMS and baghouse inspections. The PM CEMS is a light-scattering device that detects particulate matter in the baghouse exhaust by reading the back-scattered light from a collimated, near-infrared (IR) light emitting diode (LED). Because this instrument measures in the near-IR range, the sensitivity to changes in particle size is minimal and the response to particles in the 0.1 to 10 µm range is nearly constant. Preventive maintenance is performed on the baghouse to ensure it continues to operate properly and that the bags are in good condition.

III. Rationale for Selection of Indicator Ranges

The unit's PM limit is 0.02 lb/mmBtu, which corresponds to approximately 17 mg/acm. For the light scattering device signal, an excursion is defined as a PM concentration of greater than 13 mg/acm. At this level, the upper tolerance interval is just below the emissions limit and the unit still has a small margin of compliance. Therefore, corrective action will be initiated when the PM CEMS shows the unit is at approximately 75 percent of the emissions limit. Figure A.19a-1 shows a typical day's worth of data while operating at peak load. The PM monitor's signal is normally 2 to 4 mg/acm. Comparing the 1-minute data on a 1-hr, 3-hr, and daily average basis showed that the averaging period made no difference in this case. A 3-hr averaging period was selected as representative.

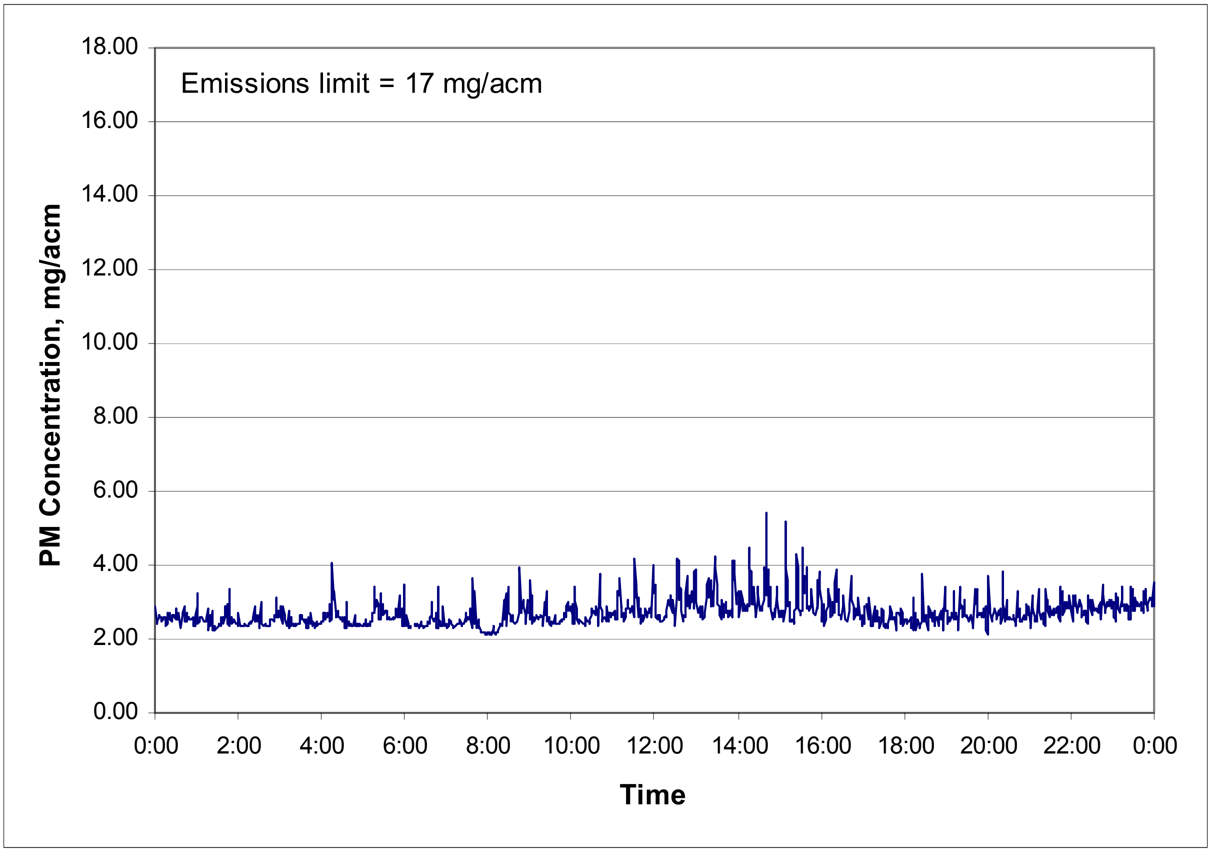

Figure A.19a-1. Light scattering monitor data for a typical day.

A total of 12 Method 17 test runs performed with paired sampling trains at varying PM concentrations were used to develop the relationship between the PM concentration in the baghouse exhaust and the monitor signal. Each test run was one hour in duration. Emissions, boiler load, opacity, and PM CEMS data from the test program are presented in Table A.19a-2. A baghouse bypass line and butterfly valve were installed for the purpose of generating higher than normal PM concentrations to calibrate the PM CEMS. Figure A.19a-2 shows the correlation curve developed during the initial testing, with the upper and lower confidence and tolerance limits calculated per proposed Performance Specification 11. The relationship is a linear equation with an R^2 of 0.96. The confidence interval (CI) is the interval within which one would predict the calibration relationship lies with 95 percent confidence. The tolerance interval (TI) is the interval within which 75 percent of the data are expected to lie with 95 percent confidence.

TABLE A.19a-2. PM CEMS INITIAL CORRELATION TEST DATA

Parameter	Test Run											
	1	2	3	4	5	6	7	8	9	10	11	12
Steam flow, 1,000 lb/hr	271	281	283	282	280	284	281	281	281	285	268	281
Method 17 result, mg/acm[1]	11.6	13.9	14.5	3.03	2.68	3.20	16.3	10.5	9.42	15.4	8.76	18.7
PM CEMS response, mA	9.60	10.0	10.5	5.87	5.78	6.00	12.0	9.45	8.97	13.2	9.57	14.5
Opacity, %	3.72	4.51	5.27	3.71	3.54	3.92	4.01	4.22	4.14	4.25	4.11	5.39

[1]The Method 17 result is the average of sampling train A and sampling train B.

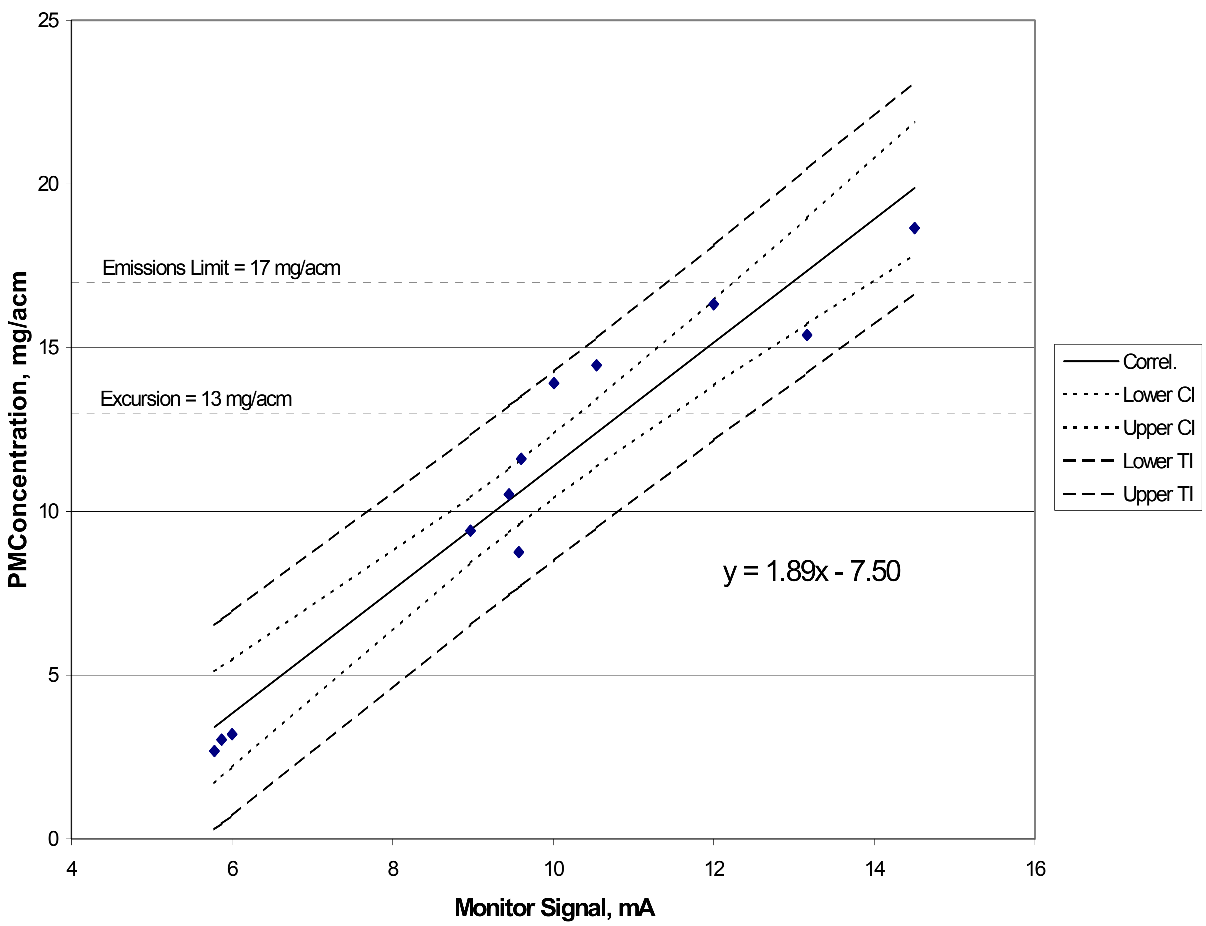

Figure A.19a-2. PM CEMS Correlation Curve.

EXAMPLE COMPLIANCE ASSURANCE MONITORING: BAGHOUSE FOR PM CONTROL – FACILITY V

I. Background

A. Emissions Unit

Description:	375 mmBtu/hr coal-fired boilers
Identification:	Boilers 1 and 2
Facility:	Facility V Anytown, USA

B. Applicable Regulation, Emissions Limit, and Monitoring Requirements

Regulation:	40 CFR 60, Subpart Da Permit
Emissions Limits: PM:	 0.02 lb/mmBtu
Monitoring Requirements:	A baghouse inspection and maintenance program is performed and a PM continuous emissions monitoring system (CEMS) is used as an additional indicator of compliance with the PM limit. [Note: A COMS is used to assure compliance with the opacity limit and NO_x and SO_2 CEMS are used to assure compliance with the NO_x and SO_2 limits, but that monitoring is not addressed here.]

C. Control Technology:

Both boilers have a pulse jet fabric filter to control particulate emissions from the boiler and the lime slurry spray dryer (used for flue gas desulfurization) that follows each boiler. The boilers exhaust to a common stack.

II. Monitoring Approach

The key elements of the monitoring approach for PM are presented in Table A.19b-1. The selected performance indicators are the signal from a PM CEMS and a baghouse inspection and maintenance program.

TABLE A.19b-1. MONITORING APPROACH

	Indicator No. 1	Indicator No. 2
I. Indicator	PM CEMS response.	Bag condition.
Measurement Approach	A light scattering type PM CEMS is installed at a representative location downstream of the baghouse.	The inspection and maintenance program includes a semi-annual internal inspection of the baghouse and analysis of representative bag samples and bi-annual bag replacement.
II. Indicator Range	An excursion is defined as an hourly average PM CEMS response greater than 7.5 mA. Excursions trigger an inspection, corrective action, and a reporting requirement.	An excursion is defined as failure to perform the semi-annual inspection and bi-annual bag replacement. Excursions trigger an inspection, corrective action, and a reporting requirement.
III. Performance Criteria A. Data Representativeness	The PM CEMS is located where a representative sample can be obtained in the baghouse exhaust. An increase in the PM CEMS signal indicates an increase in the PM concentration. A field test was performed to compare the PM CEMS response to PM concentration measured by Method 17.	Baghouse inspected visually for deterioration and bag samples taken to determine bag condition and remaining bag life.
B. Verification of Operational Status	Initial verification test consisting of 3 test runs.	NA
C. QA/QC Practices and Criteria	Daily drift checks and quarterly absolute calibration audit (ACA). Daily zero/upscale drift cannot exceed 4 percent of the upscale value for 5 consecutive days or more than 8 percent of the upscale value in any one day. The ACA involves challenging the PM CEMS with an audit standard at three operating levels, per PS 11.	Trained personnel perform inspections and maintenance.
D. Monitoring Frequency	Continuous.	Varies.
Data Collection Procedures	The data acquisition system (DAS) collects a data point every 5 seconds. Those 5-second data are reduced to a 1-minute, a 15-minute, and then a 3-hour average PM CEMS response. The 3-hour average data are archived for at least 5 years.	Results of inspections and maintenance activities performed are recorded in baghouse maintenance log.
Averaging period	3-hour.	NA

MONITORING APPROACH JUSTIFICATION

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The boilers include mechanical separators in the boiler back-pass section for cinder collection and re-injection into the furnace area. A separate dust collector is located after the air heater section for heavy fly ash collection. The ash from the traveling grate is collected at the front of the boiler for removal to the ash storage silos.

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III. Rationale for Selection of Indicator Ranges

The boiler's PM limit is 0.02 lb/mmBtu, which corresponds to approximately 17 mg/acm. Three Reference Method (Method 17) test runs performed with paired sampling trains were conducted while operating the boiler at full load. These test data were used to develop the relationship between the PM concentration in the baghouse exhaust and the PM CEMS signal. Emissions, load, and PM CEMS data from the test program are presented in Table A.19b-2. Figure A.19b-1 shows a graphical representation of the PM CEMS response versus particulate concentration for the 3 test runs and the indicator range developed based on that data. The linear correlation was forced through the zero point (4 mA). The data showed that when the PM CEMS readings were at or below 6 mA, the PM concentration was less than 3.5 mg/acm, well below the

TABLE A.19b-2. PM CEMS RESPONSE VALIDATION TEST DATA

Parameter	Test Run		
	1	2	3
Steam flow, 1,000 lb/hr	282	280	284
Method 17 result, mg/acm[1]	3.03	2.68	3.20
PM CEMS response, mA	5.87	5.78	6.00

[1]The Method 17 result is the average of sampling train A and sampling train B.

PM limit (see Figure A.19b-1). Figure A.19b-2 shows a typical day's worth of 15-minute average PM CEMS data while operating at peak load. The PM monitor's signal normally is less than 6 mA. Based on the limited test data available and the source's low variability and large margin of compliance, the upper limit of the indicator range was set at 125 percent of the highest measured value. Therefore, for the PM CEMS, an excursion is defined as an hourly average PM CEMS response greater than 7.5 mA (corresponds to a predicted PM concentration of 5.5 mg/acm, about one-third of the PM limit).

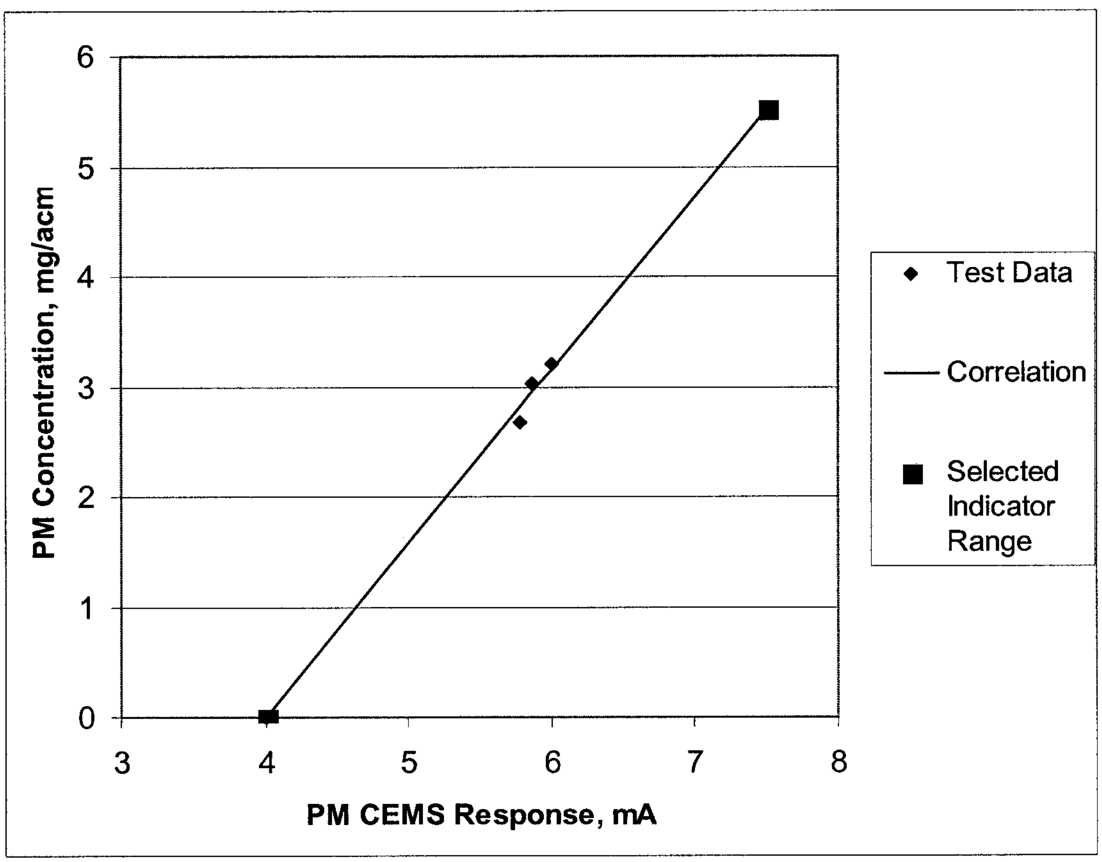

Figure A.19b-1. PM CEMS Calibration Curve and Indicator Range.

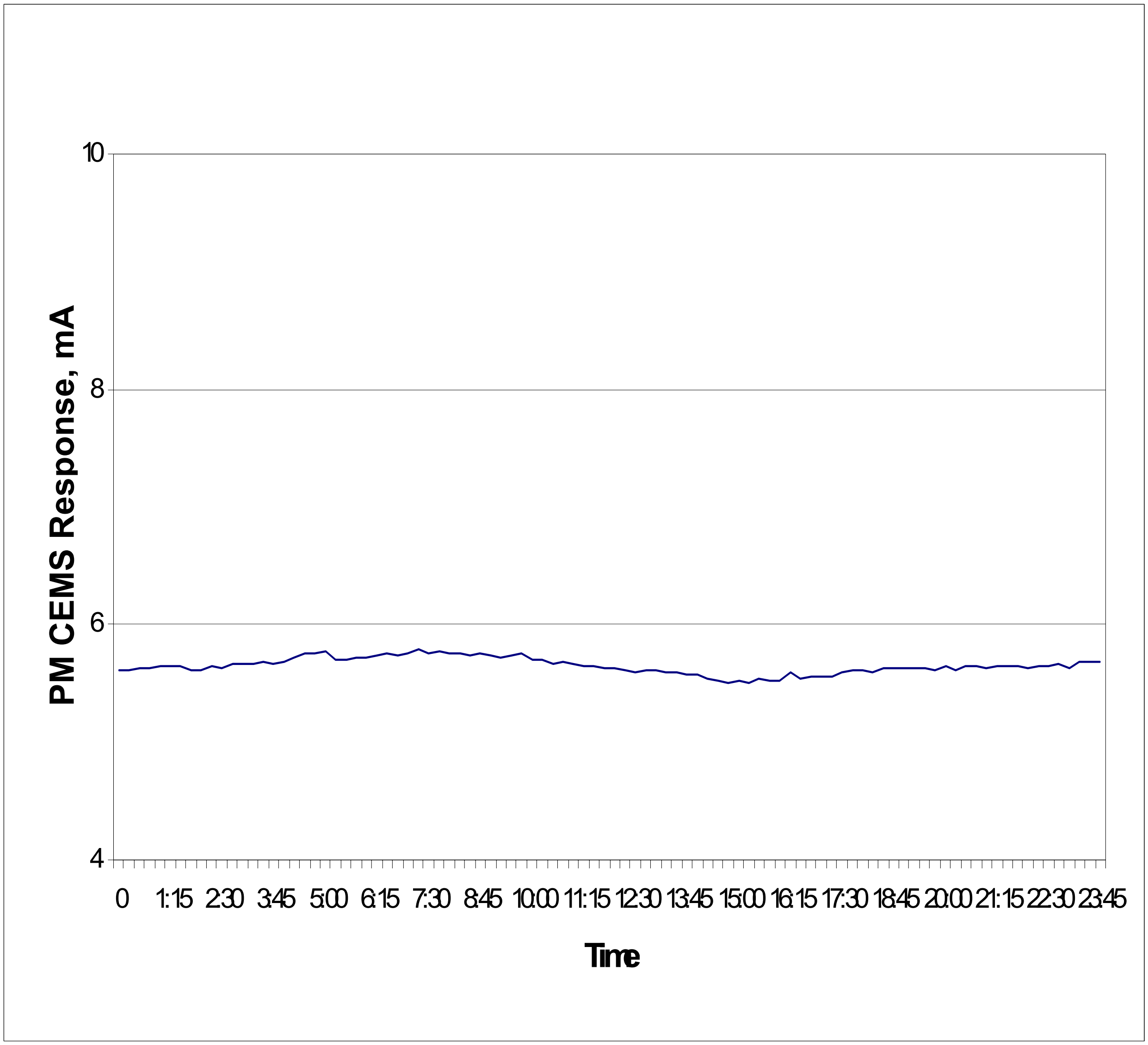

Figure A.19b-2. Typical daily output from PM CEMS while operating boiler at peak load (15-minute averages).

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A.25 ELECTROSTATIC PRECIPITATOR (ESP) FOR PM CONTROL--FACILITY FF

RESERVED

(Awaiting additional information needed from facility to respond to comments received.)

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