

**BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

**In the Matter of the Investigation of
AVISTA CORPORATION d/b/a AVISTA
UTILITIES, PUGET SOUND ENERGY,
and PACIFIC POWER & LIGHT
COMPANY
Regarding Prudency of Outage and
Replacement Power Costs**

DOCKET UE-190822

**SECOND EXHIBIT (NONCONFIDENTIAL) TO THE
PREFILED REBUTTAL TESTIMONY OF**

RONALD J. ROBERTS

ON BEHALF OF PUGET SOUND ENERGY

JANUARY 23, 2020

Appendix I Compliance Assurance Monitoring Plan

TalenMontana Particulate CAM Plan

Rev. 4

December 19, 2016

Colstrip SES Particulate Compliance Assurance Monitoring (CAM) Plan

I. Background

A. Emissions Unit Identification:

PPL Montana, LLC
Colstrip Steam Electric Station (CSES)
Rosebud County
Colstrip, Montana
ORSIPL # 6076

Identification	Description	Primary NAICS Code	EPA FINDS #
CSES Unit 1	Tangential Coal-Fired Boiler	221112	MTD000710236
CSES Unit 2	Tangential Coal-Fired Boiler	221112	MTD000710236
CSES Unit 3	Tangential Coal-Fired Boiler	221112	MTD000710236
CSES Unit 4	Tangential Coal-Fired Boiler	221112	MTD000710236

B. Applicable Regulations, Emission Limits, and Monitoring Requirements

Unit	Regulations	Opacity		Particulate	
		Emission Limit*	Compliance Method	Emission Limit	Compliance Method
1	40 CFR 60 Subparts A & D	20% (6-min. Avg)	COMS	0.10 #/mmBtu	3-run RM5 Test
2	40 CFR 60 Subparts A & D	20% (6-min. Avg)	COMS	0.10 #/mmBtu	3-run RM5 Test
3	40CFR60 Subparts A & D, 40CFR52.21, ARM 17.8.710	20% (6-min. Avg)	COMS	0.05 #/mmBtu & 379 #/Hr	3-run RM5 Test
4	40CFR60 Subparts A & D, 40CFR52.21, ARM 17.8.710	20% (6-min. Avg)	COMS	0.05 #/mmBtu & 379 #/Hr	3-run RM5 Test

* Opacity Excess Emission is defined as any block six-minute period during which the average opacity exceeds 20%, except that one six-minute period per hour of up to 27% opacity is allowed and need not be reported.

Monitoring Requirements:
Continuous Opacity Monitoring Systems (COMS)

C. Control Technology Description

Colstrip Units 1 & 2

The scrubbers at Colstrip Units 1 & 2 are three-vessel venturi and spray absorber systems. A typical vessel is shown in Figure IC-1. During normal full load operations all three scrubber vessels are in service, each one treating about 1/3 of the flue gas.

The flue gas enters the scrubber vessel and is accelerated by the converging surfaces of the plumb bob and venturi bowl. The flue gas and slurry meet in the venturi throat where turbulence atomizes the slurry. Acceleration of the flue gas causes particulate to collide with and be absorbed by slurry droplets.

The majority of fly ash particulate and most of the SO₂ are removed in the venturi section. The throat area of the venturi is adjusted by moving the plumb bob up or down to obtain the desired pressure drop across the plumb bob of each scrubber. The flue gas velocity caused by this pressure drop ensures optimum fly ash removal. The slurry and collected fly ash are separated from the flue gas as it turns up to enter the absorption spray area.

The flue gas enters the absorption spray area in the annular space between the downcomer and the shell of the scrubber vessel. The flue gas flows through a sieve tray where it is contacted with recycle slurry for additional removal of SO₂. Above the sieve tray is a set of absorption sprays to provide additional contact the flue gas.

The flue gas then flows through the mist eliminator where entrained water droplets are removed.

After being treated, the flue gas exits the scrubber vessels. The treated gas is raised in temperature as it passes through a steam reheater and then discharged to the stack through the induced draft fan.

Colstrip Units 3 & 4

There are eight wet venturi scrubber vessels on each unit. Six to seven vessels are used during normal full load operations. A typical Units 3 & 4 scrubber vessel is illustrated in IC-2.

The flue gas enters the scrubber vessel and is accelerated by the converging surfaces of the plumb bob and venturi bowl. The flue gas and slurry meet in the venturi throat where turbulence atomizes the slurry. Acceleration of the flue gas causes particulate to collide with and be absorbed by slurry droplets.

The majority of fly ash particulate and most of the SO₂ are removed in the venturi section. The throat area of the venturi is adjusted by moving the plumb bob up or down to obtain the desired pressure drop across the plumb bob of each scrubber. The flue gas velocity caused by this pressure drop ensures optimum fly ash removal. The slurry and collected fly ash are separated from the flue gas as it turns up to enter the absorption spray area.

The flue gas enters the absorption spray area in the annular space between the downcomer and the shell of the scrubber vessel. The flue gas is contacted with recycle slurry for additional removal of SO₂. Above the absorption section is a wash tray which uses recirculation water to contact the flue gas and remove entrained recycle slurry from the flue gas.

The flue gas then flows through the mist eliminator where entrained water droplets are removed.

After being treated, the flue gas exits the scrubber vessels. The treated gas is raised in temperature as it passes through a steam reheater and then discharged to the stack through the induced draft fan.

Figure IC-1: Typical Colstrip Units 1 & 2 Scrubber Vessel w/ Sieve Tray Retrofit

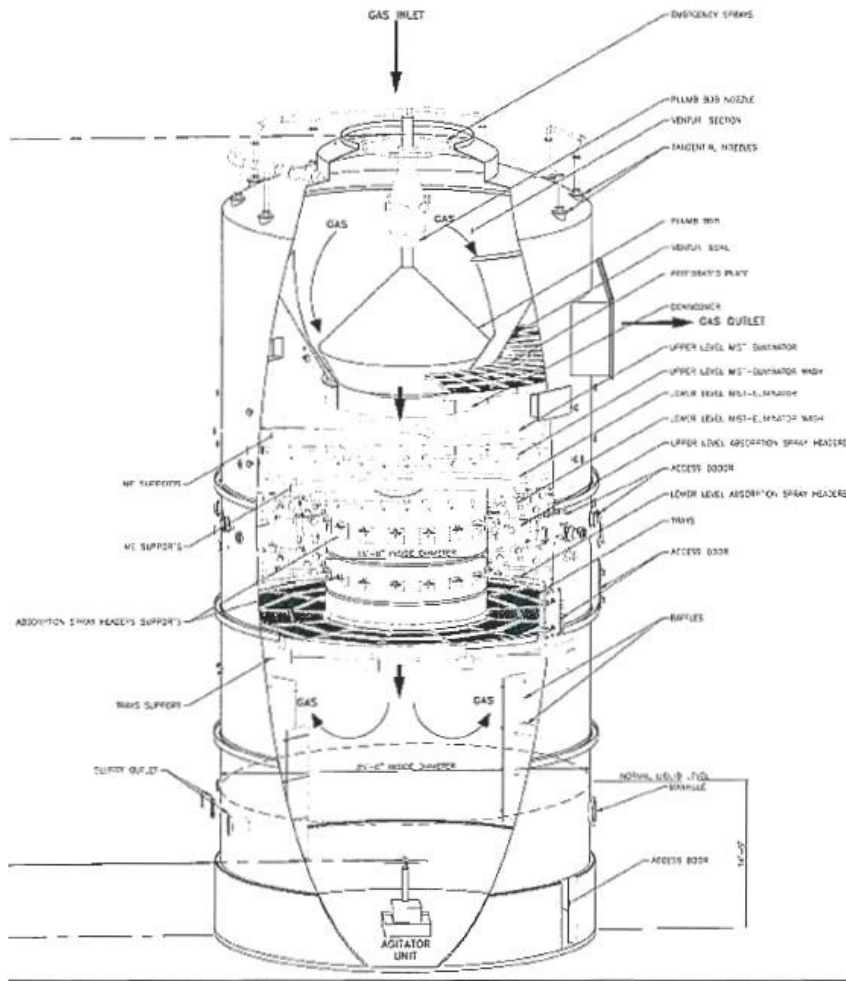
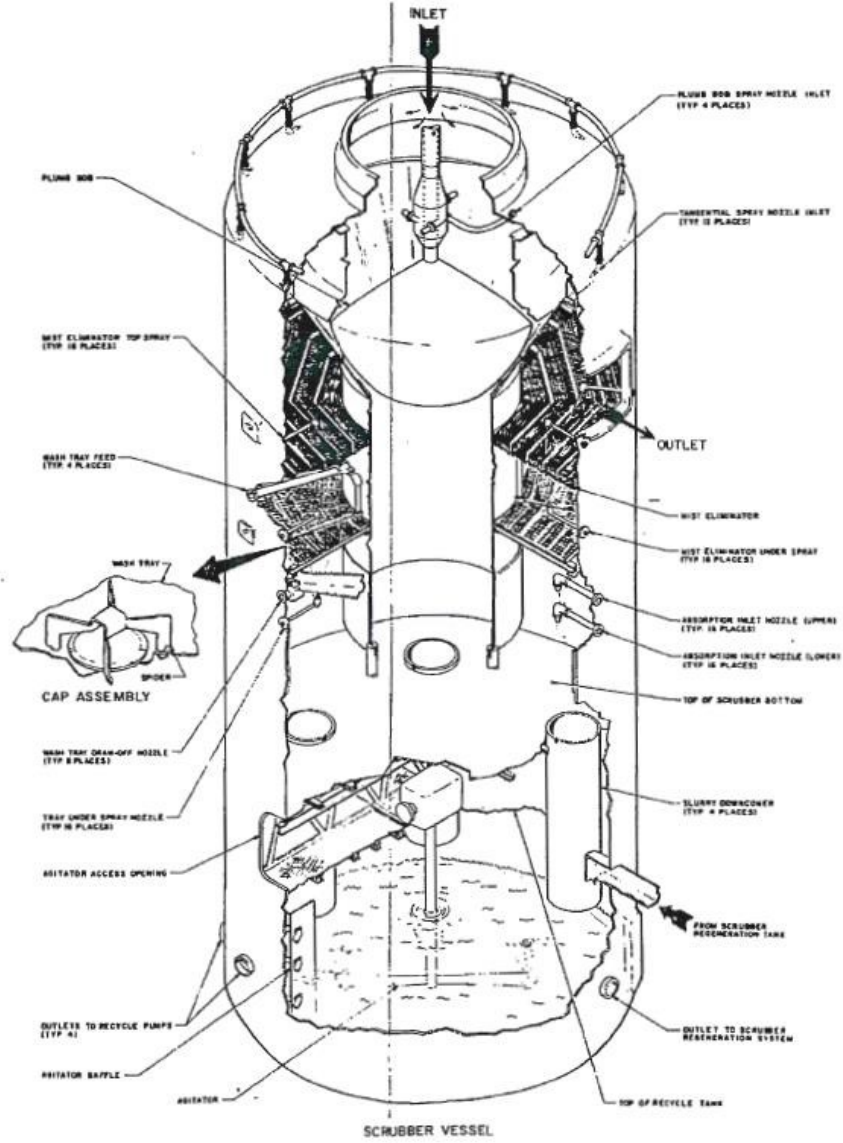


Figure IC-2: Typical Co)strip Units 3 & 4 Scrubber Vessel



II. Particulate CAM Plan Approach and Performance Indicators

The performance indicators of the particulate CAM plan to help ensure compliance to the particulate standard are Opacity and Particulate Matter Continuous Emission Monitors (PM CEMS). The operational parameter indicator of the particulate CAM plan to help ensure compliance to the particulate standard is scrubber plumb bob ΔP .

Opacity Performance Indicator

Opacity will be a performance indicator for assuring compliance with the PM limit. Currently the Unit has a Monitor Labs USI 560 Lighthawk opacity monitor installed on the stack. This is a double-pass, two detector in-situ analyzer that utilizes an electronically modulated intensity-controlled solid state LED to ensure stable operation. Basic system components include the transmissometer, the retroreflector and control unit in the stack; and remote readout that accompanies the B&W-Enertec DAHS in the plant control room. Percent opacity data is recorded as minute averages in the DAHS. Six-minute, hourly, and daily opacity averages are calculated utilizing the base minute data.

Performance Indicator Range

PM emissions on CSES Units 1-4 will be determined to be in compliance with the applicable limits when opacity is <20% as measured on a 6-hr. average. An opacity PM CAM Plan excursion occurs when the 6-hour average opacity is >20%. An excursion is not considered a violation of the Title V Permit, but will require a prompt investigation to identify and correct the condition, followed by a RM 5 test to confirm compliance with the particulate standard. An opacity CAM Plan excursion will be reported in quarterly reports to MDEQ for any 6-hr. average >20%.

Performance Indicator Justification

1. The 6-hr. average opacity indicator is based on the following rationale:
 - A. Annual compliance performance tests have indicated that the PM standard is met when opacity is <20%. These Reference Method 5 performance tests consist of three runs conducted in approximately a 6 hour period.
 - B. Regulatory PM test criteria are:
 - 40CFR60.56c(b)(1), *All performance tests shall consist of a minimum of three test runs conducted under representative operating conditions.*
 - C. Opacity has never exceeded 20% during a CSES Units 1-4 PM compliance test that demonstrated compliance with the particulate standard; therefore, it is appropriate to use a 20% 6-hr. opacity indicator as assurance that the units are in compliance with the applicable PM emission limits.
2. Annual PM compliance testing has been conducted on CSES Units 1-4 since their initial commercial operations. The average results of the annual particulate compliance and PM CEM correlation tests since 2014 are presented in Table II-1.
3. Opacity Accuracy Audits (OAA) and Walkthrough Audits are conducted quarterly on CSES Units 1-4 COMS. Complete descriptions of these assessments can be found in the Talen Montana Continuous Emissions Monitoring Systems (CEMS) Quality Assurance (QA) Plan. Results of the 2014-2016 OAA's are presented in Table II-2. This audit data illustrates the excellent quarterly accuracy of the COMS.

Table II - 1
Stack PM Tests, EPA Method 5 and 5B

Unit	Date	lb./MMBtu	%Opacity	Unit	Date	lb./MMBtu	%Opacity
1	02/26/14	0.037	14.3	3	02/05/14	0.029	17.2
	06/05/14	0.027	14.2		07/10/14	0.025	13.7
	06/12/14	0.029	17.8		07/15/14	0.025	17.5
	12/03/14	0.030	15.1		12/03/14	0.020	16.8
	02/11/15	0.041	14.9		02/04/15	0.023	16.4
	06/16/15	0.039	17.2		06/17/15	0.016	15.8
	08/21/15	0.036	15.8		08/18/15	0.023	15.6
	11/17/15	0.037	17.0		11/18/15	0.019	16.2
	12/15/15	0.038	14.4		02/03/16	0.028	14.3
	01/14/16	0.037	16.8		02/19/16	0.028	15.8
	06/01/16	0.044	13.9		06/02/16	0.016	12.6
	06/09/16	0.036	13.9		08/09/16	0.023	14.3
	06/16/16	0.043	17.5		10/11/16	0.022	14.9
	08/16/16	0.032	12.8				
10/13/16	0.033	14.9					
2	02/19/14	0.028	13.7	4	02/12/14	0.018	14.3
	12/30/14	0.031	18.5		12/29/14	0.023	18.7
	01/22/15	0.035	15.0		01/21/15	0.023	17.8
	04/14/15	0.035	15.3		06/18/15	0.017	16.7
	08/19/15	0.033	16.6		08/20/15	0.025	13.2
	11/17/15	0.039	16.9		11/18/15	0.026	17.9
	12/30/15	0.037	17.1		01/20/16	0.017	17.1
	02/05/16	0.034	14.8		04/06/16	0.019	15.2
	04/04/16	0.027	14.1		08/11/16	0.026	15.3
	09/08/16	0.025	13.5		10/12/16	0.020	15.6
	10/25/16	0.032	15.4				

Table II - 2
Opacity Accuracy Audit Results

Unit	Quarter	Analyzer Range			Response Time
		Low	Mid	High	
1	1st 2014	0.7	0.9	0.9	5.2
	2nd 2014	0.4	0.2	1.1	5.3
	3rd 2014	0.8	0.0	0.1	5.2
	4th 2014	0.4	0.5	0.3	
	1st 2015	0.6	0.5	0.8	5.3
	2nd 2015	0.1	0.3	0.7	5.0
	3rd 2015	0.3	0.5	1.0	5.2
	4th 2015	0.6	0.5	0.5	5.3
	1st 2016	0.5	0.4	0.7	5.4
	2nd 2016	0.7	0.6	0.5	5.2
	3rd 2016	0.6	0.5	0.7	5.0
	4th 2016				
2	1st 2014	1.2	0.9	0.2	5.4
	2nd 2014	0.3	0.1	0.9	4.9
	3rd 2014	0.7	0.6	0.5	5.1
	4th 2014	1.1	0.0	0.5	4.9
	1st 2015	0.6	0.4	0.6	5.2
	2nd 2015	0.4	0.5	0.2	4.8
	3rd 2015	0.2	0.2	0.7	5.4
	4th 2015	0.5	0.5	0.5	5.4
	1st 2016	0.8	0.7	0.4	5.3
	2nd 2016	1.0	0.9	0.2	4.8
	3rd 2016	0.8	0.6	0.3	5.0
	4th 2016				
3	1st 2014	0.1	0.2	0.7	5.6
	2nd 2014	0.6	0.7	0.3	5.4
	3rd 2014	1.0	1.0	0.2	5.4
	4th 2014	1.0	1.1	0.3	5.3
	1st 2015	0.9	0.8	0.6	5.3
	2nd 2015	0.3	0.6	0.1	5.3
	3rd 2015	0.4	0.4	0.6	5.5
	4th 2015	0.7	0.6	0.4	5.3
	1st 2016	0.6	0.5	0.5	5.3
	2nd 2016	0.4	0.4	0.6	5.2
	3rd 2016	0.8	0.9	0.4	5.0
	4th 2016				
4	1st 2014	0.7	0.4	0.6	5.3
	2nd 2014	0.7	0.6	0.5	5.3
	3rd 2014	0.1	0.1	0.9	5.1
	4th 2014	1.9	2.2	1.4	5.3
	1st 2015	0.9	0.7	0.6	5.2
	2nd 2015	0.8	0.9	0.3	5.0
	3rd 2015	0.8	0.8	1.6	5.3
	4th 2015	0.5	0.4	0.7	5.2
	1st 2016	1.2	1.1	0.2	5.1
	2nd 2016	0.5	0.4	0.7	5.0
	3rd 2016	0.7	0.7	0.8	5.1
	4th 2016				

Limits: Cal Error <=3% at Low, Mid, & High Ranges; Response Time <= 10 Seconds

PM CEMS Performance Indicator

PM CEMS will be another performance indicator for assuring compliance with the PM limit. Each unit has a Sick Mahak Dusthunter SP100 installed on each stack. The measuring system works according to the scattered light measurement principle (forward dispersion). A laser diode beams the dust particles in the gas flow with modulated light in the visual range (wavelength approx. 650 nm). A highly sensitive detector registers the light scattered by the particles, amplifies the light electrically and feeds it to the measuring channel of a microprocessor as a central part of the measuring, control and evaluation electronics. The measuring volume in the gas duct is defined through the intersection of the sender beam sent and the receive aperture. Continuous monitoring of the sender output registers the smallest changes in brightness of the light beam sent which then serves to determine the measurement signal. Mg/m³ data is recorded as minute averages in the B&W-Enertec DAHS. Hourly and daily PM averages are calculated utilizing the base minute data. Units 1 & 3 PM CEMS installations were completed in August 2014. PM CEMS installations on Units 2 & 4 were completed in February 2015.

The PM CEMS performance indicator was added to the CAM Plan as part of a settlement agreement between Sierra Club, MEIC, and PPL Montana dated February 12, 2014.

PM CEMS Performance Indicator Range

PM emissions on CSES Units 1-4 will be determined to be in compliance with the applicable CAM limits when the PM CEMS monitor is $<73 \text{ mg/m}^3$ for Units 1&2 and $<36 \text{ mg/m}^3$ for Units 3&4 as measured on a daily average.

PM CEMS Performance Indicator Justification

1. As specified in the settlement agreement, the PM CEMS will be operated and maintained as addressed below:

- A. Installed according to manufacturer's standards.
- B. Daily zero and span checks will be performed using manufacturer's standards.
- C. The initial calibration/correlation will be based on three levels (zero, normal operations, and at scrubber operations that increase PM concentration, but not at a level that put Title V requirements at risk), using three RM 5 runs at normal operations and two RM 5 runs at the higher PM concentration. The zero level monitor response (when no PM is in the flue gas) will be estimated to be zero (e.g., 4 mA = 0 mg/acm).
 - a. Unit 1 - The initial correlation resulted in a mathematical relationship of $y=0.2996x+3.4982$ with a R^2 of 0.9129, where x is the PM CEMS mg/m^3 value and y is the RM 5 mg/m^3 value. From this equation, an initial correlation was applied to the PM CEMS monitor.
 - b. Unit 2 - The initial correlation resulted in a mathematical relationship of $y=0.5081x+5.1712$ with a R^2 of 0.7148, where x is the PM CEMS mg/m^3 value and y is the RM 5 mg/m^3 value. From this equation, an initial correlation was applied to the PM CEMS monitor.
 - c. Unit 3 - The initial correlation resulted in a mathematical relationship of $y=0.2681x+3.3584$ with a R^2 of 0.7740, where x is the PM CEMS mg/m^3 value and y is the RM 5 mg/m^3 value. From this equation, an initial correlation was applied to the PM CEMS monitor.
 - d. Unit 4 - The initial correlation resulted in a mathematical relationship of $y=0.2751x+0.8389$ with a R^2 of 0.9571, where x is the PM CEMS mg/m^3 value and y is the RM 5 mg/m^3 value. From this equation, a correlation was applied to the PM CEMS monitor.
- D. The PM CEMS CAM Plan excursion limit in terms of mg/m^3 has been determined by conversion of the applicable compliance limit (lb/mmBtu) from section 1.B to units of mg/m^3 based on current operating conditions and may be changed if combustion (CO_2) or scrubber (H_2O) operating conditions change significantly. It is important to note that the actual compliance limit (lb/mmBtu) is set by regulation and does not change. The Settlement Agreement calls for a CAM Plan excursion limit for the PM CEMS to be at a level less than the corresponding PM emission limit. The CAM Plan excursion limit for the PM CEMS will be 90% of the corresponding PM emission limit.
 - a. Units 1&2, the CAM Plan excursion limit for the PM CEMS is 73 mg/m^3 .
 - b. Units 3&4, the CAM Plan excursion limit for the PM CEMS is 36 mg/m^3 .
- E. A PM CEMS CAM Plan excursion is not considered a violation of the Title V Permit, but will require a prompt investigation to identify and correct the condition, followed by a RM 5 test to confirm compliance with the particulate standard. A PM CEMS excursion will be reported in quarterly reports to MDEQ for any daily average above the respective PM CEMS CAM Plan excursion limit.
- F. On a quarterly basis, one RM 5 test will be conducted to update the initial calibration/correlation. This test is comprised of three RM 5 runs. If the result from the average of the three runs differs from the initial correlation/calibration by 25% or more of the CAM Plan excursion limit, then the initial calibration/correlation will be repeated.
- G. PM CEMS monitoring data and maintenance records will be maintained in accordance with the Title V operating permit requirements. PM CEMS data will be provided to MDEQ upon request. At a minimum, PM CEMS daily averages (mg/m^3) will be submitted to MDEQ for each unit on a quarterly basis.
- H. An on-going PM CEMS correlation adjustment will be made quarterly based on the correlation from all RM 5 test data.

Particulate CAM Operational Parameters (Range and Justification)

In addition to the performance indicators of opacity and PM CEMS, the CSES will also monitor an operational parameter to indicate proper on-going performance of the particulate control equipment. As described in the Control Technology Description; plumb bob ΔP is an important operating parameter for the control of particulate.

A review of historical plumb bob ΔP indicates that operation of the scrubbers with plumb bob ΔP greater than 21 inches water column helps ensure compliance with the applicable particulate emission limits found in section I.B. The control room operators monitor scrubber plumb bob ΔP on a regular basis to ensure proper operation and will take corrective action as needed to make sure the scrubber is operating at the proper plumb bob ΔP conditions. A daily average of the operating scrubber plumb bob ΔP 's below 21 inches water column will initiate an action to promptly investigate and remedy the low plumb bob ΔP condition. This excursion is not considered a violation of the Title V Permit, but will be reported along with results of the investigation in the quarterly report.

The scrubber venturi spray system was previously identified as another operational parameter. A review of this parameter indicates that it is not an effective CAM Plan operational parameter because operation of the scrubber is dependent on the venturi sprays being in service anyway. If there are no venturi sprays, the scrubber is removed from service in a matter of minutes due to high temperatures and the Unit is reduced in load accordingly. As such, the scrubber venturi spray system has been removed as an operational parameter.

III. CAM Plan Summary

Performance Indicator - Opacity	
A. General Criteria	
1. Performance Indicator	Stack % Opacity
2. Measurement Approach	COMS
3. Performance Indicator Range	6-hour average opacity is <20%.
B. Performance Criteria	
1. Data Representativeness	Opacity is measured in the stack on a continuous basis.
2. Verification of Operational Status	An operator in the Colstrip SES control room is continually monitoring the performance indicators (opacity & PM CEMS) and the plant operational assessment parameters shown below
3. QA/QC Practices	Daily – COMS Calibration Drift
	Quarterly – Walkthrough Audit Assessment
	Quarterly – Opacity Accuracy Audit
4. Monitoring Frequency	Opacity data is collected & stored in the DAHS. Averaging Periods: 6-minute, hourly, and daily averages are calculated based on minute data.
5. Opacity Exceedance	6-minute average opacity excesses >20%, except that one six-minute period per hour of up to 27% opacity is allowed.
6. CAM Plan Opacity Excursion	6-hour opacity average >20%. An excursion is not considered a violation of the Title V Permit, but will require a prompt investigation to identify and correct the condition, followed by a RM 5 test to confirm compliance with the particulate standard. An opacity CAM plan excursion will be reported in quarterly reports to MDEQ for any 6-hr. average >20%
7. Reporting	Reported on quarterly basis.

Performance Indicator - PM CEMS	
A. General Criteria	
1. Performance Indicator	Stack PM CEMS, mg/m ³
2. Measurement Approach	PM CEMS
3. Performance Indicator Range	Daily average <73 mg/m ³ – Units 1&2
	Daily average <36 mg/m ³ – Units 3&4
B. Performance Criteria	
1. Data Representativeness	PM CEMS is measured in the stack
2. Verification of Operational Status	An operator in the Colstrip SES control room is continually monitoring the performance indicators (opacity & PM CEMS) and the plant operational assessment parameters shown below
3. Operations & Maintenance Practices	Install PM CEMS according to the manufacturer's standards
	Establish an initial calibration/correlation mathematical relationship
	Establish PM CEMS excursion limit in terms of mg/m ³
	Daily – PM CEMS Calibration Drift Quarterly Verification & Initial Correlation Update – RM 5 Test
4. Monitoring & Data Collection	PM CEMS is measured on a continuous basis. PM CEMS data is collected & stored in the DAHS. Averaging Period: Minute (Daily averages are calculated).
6. CAM Plan Excursion	Daily averages over 73 mg/m ³ for Units 1&2 and over 36 mg/m ³ for Units 3&4. A PM CEMS CAM Plan excursion is not considered a violation of the Title V Permit, but will require a prompt investigation to identify and correct the condition, followed by a RM 5 test to confirm compliance with the particulate standard. A PM CEMS excursion will be reported in quarterly reports to MDEQ for any daily average above the respective PM CEMS CAM Plan excursion limit.
7. Reporting	Reported on quarterly basis.

Plant Operational Assessment Parameter - Scrubber Plumb Bob ΔP	
A. General Criteria	
1. Performance Indicator	Scrubber Plumb Bob ΔP, inches H ₂ O
2. Measurement Approach	Plant Instrumentation
3. Performance Indicator Range	Daily average operating scrubber plumb bob ΔP >21" H ₂ O
B. Performance Criteria	
1. Data Representativeness	Scrubber Plumb Bob ΔP is measured at each scrubber vessel on a continuous basis.
2. Verification of Operational Status	An operator in the Colstrip SES control room is continually monitoring the scrubber plumb bob ΔP. Data is recorded and stored in the PI Historian Data System.
3. Operations & Maintenance Practices	PMs are performed to ensure accuracy. The operator may request maintenance if measurements appear to be inaccurate.
4. Monitoring & Data Collection	ΔP is monitored on a continuous basis. ΔP data is recorded and stored in the PI Historian Data System.
6. CAM Plan Excursion	Daily average operating scrubber plumb bob ΔP <21" H ₂ O. A daily average of the operating scrubber plumb bob ΔP's below 21 inches water column will initiate an action to promptly investigate and remedy the low plumb bob ΔP condition. This excursion is not considered a violation of the Title V Permit, but will be reported along with results of the investigation in the quarterly report.
7. Reporting	Reported on quarterly basis.