AIR POLLUTION CONTROL DIVISION
COLORADO DEPARTMENT OF PUBLIC HEALTH & ENVIRONMENT

ACTION:
[X] Initial Approval
[ ] Final Approval
[ ] Modification IA / FA
[ ] Permit Exempt-APEN Required
[ ] HAPs [ ] Criteria
[ ] < 2/1/72 [ ] Specific
[ ] Exempt-No APEN
[ ] Increase in throughput
[ ] Transfer of Ownership

SUMMARY OF PRELIMINARY ANALYSIS

APPLICANT/ PLANT LOCATION	**Public Service Company of Colorado** **Pawnee Generating Station** **Located at 14940 County Road 24, Brush, CO 80723, in Morgan County**	**PERMIT NOs.**	**12MR1927, 12MR1928, 12MR1929 12MR1930 & 12MR2007**
		SOURCE NO.	**087/0011/006, 011 and 023 thru 028**
REVIEW ENGINEER	**JACKIE JOYCE**	**DATE: August 7, 2012 Revised September 5, 2012**	
CONTROL ENGINEER	**Roland C. Hea, P.E.**		

PROJECT DESCRIPTION: In order to meet the Regional Haze (RH) requirements in Colorado Regulation No. 3, Part F, Section VI.C.2, the coal-fired boiler (Unit 1) at Pawnee will be required to install NO_X and SO_2 control devices to meet the RH emission limitations. Unit 1 is required to meet the RH emission limitations by December 31, 2014. Public Service Company (PSCo) will be installing a lime spray dryer (LSD) to reduce SO_2 emissions and a selective catalytic reduction (SCR) device to reduce NO_X emissions. Various support equipment are necessary for the planned control devices and the purpose of this project is to permit the proposed new support equipment and to revise permits for existing equipment that will be affected by the addition of the Unit 1 NO_X and SO_2 control devices.

The proposed new equipment for the Pawnee Station NO_X and SO_2 emissions control project, are as follows:

- Lime Handling: two (2) storage silos and two (2) ball mill slakers
- Recycle Ash Handling: two (2) storage silos and two (2) recycle ash mixers
- Waste Ash Handling: one (1) waste ash silo (note this unit will replace the existing silo)
- Combustion Additives: one(1) storage silo (the combustion additive is a preventative measure used to avoid contamination of the catalyst)

Operation of the Unit 1 boiler and its support equipment (i.e., coal handling equipment, cooling tower) is not expected to change with this project. However, there will be an increase in the waste product generated from the boiler primarily due to the reagents used in the LSD, therefore, some existing equipment/activities will be affected by this project. The following equipment and/or activities will be affected by the modification due to the increased throughput of waste material:

- Waste Ash Disposal Site
- Haul Roads

Unit 1 is being equipped with a LSD and SCR in order to meet the lower NO_X and SO_2 Regional Haze limits, hence there will be an overall reduction of NO_X and SO_2 emissions from this unit. It is not expected that the addition of the LSD and SCR will increase the emissions of any other pollutant, nor is it expected that the addition of the LSD and SCR will increase the utilization of the boiler. Therefore, there is no expected increase in emissions from Unit 1 as a result of this project and as a result Unit 1 has not been included in this analysis. Further discussion regarding Unit 1 and the expectation that there will not be an increase in emissions from Unit 1 due to the addition of LSD and SCR is included under "Discussion" on page 10 of this document.

EMISSION FACTOR SOURCE: Emissions from the support equipment associated with the Pawnee Station NO_X and SO_2 emissions control project were estimated as follows.

Lime Handling

Emissions from the lime silos are based on the baghouse rating of 0.005 gr/dscf, the blower design rate of 1,200 dscfm and 8,760 hrs/yr of operation. The emissions from the lime slakers are based on the scrubber rating of 0.015 gr/dscf, the blower design rate of 500 dscfm and 8,760 hrs/yr of operation. Emission rates were determined as follows:

Silos: (rates are per silo)

$$\text{Emissions } (PM = PM_{10} = PM_{2.5}) = \frac{0.005 \text{ gr/dscf} \times 1{,}200 \text{ scfm} \times 60 \text{ min/hr}}{7{,}000 \text{ gr/lb}} = 0.051 \text{ lbs/hr}$$

Slakers: (rates are per slaker)

$$\text{Emissions } (PM = PM_{10} = PM_{2.5}) = \frac{0.015 \text{ gr/dscf} \times 500 \text{ scfm} \times 60 \text{ min/hr}}{7{,}000 \text{ gr/lb}} = 0.064 \text{ lbs/hr}$$

Recycle Ash Handling

Emissions from the recycle ash silos are based on the baghouse rating of 0.005 gr/dscf, the blower design rate of 10,884 dscfm and 8,760 hrs/yr of operation. The emissions from the recycle ash mixers are based on the scrubber rating of 0.015 gr/dscf, the blower design rate of 500 dscfm and 8,760 hrs/yr of operation. Emission rates were determined as follows:

Silos: (rates are for both silos together)

$$\text{Emissions } (PM = PM_{10} = PM_{2.5}) = \frac{0.005 \text{ gr/dscf} \times 10{,}884 \text{ scfm} \times 60 \text{ min/hr}}{7{,}000 \text{ gr/lb}} = 0.466 \text{ lbs/hr}$$

Mixers: (rates are per mixer)

$$\text{Emissions } (PM = PM_{10} = PM_{2.5}) = \frac{0.015 \text{ gr/dscf} \times 500 \text{ scfm} \times 60 \text{ min/hr}}{7{,}000 \text{ gr/lb}} = 0.064 \text{ lbs/hr}$$

Combustion Additive Silo

Emissions from the combustion additive silo are based on the baghouse rating of 0.01 gr/dscf, the blower design rate of 700 dscfm and 8,760 hrs/yr of operation. Emission rates in lbs/hr from

the combustion additive silo were determined as follows:

Emissions (PM = PM_{10} = $PM_{2.5}$) = $\frac{0.01 \text{ gr/dscf} \times 700 \text{ scfm} \times 60 \text{ min/hr}}{7{,}000 \text{ gr/lb}}$ = 0.06 lbs/hr

Waste Ash/Scrubber Sludge Handling

Waste Ash/Scrubber Sludge Silo

Loading

Emissions from the waste ash silo include the activities of silo loading and silo unloading. Emissions from silo loading are vented through the bin vent filter.

The emission factors used to estimate emissions are from EPA's Compilation of Emission Factors (AP-42), Section 11.17, Table 11.17-4, Product Unloading - Enclosed Truck, dated February 1998, as follows:

Pollutant	Emission Factor (lbs/ton)	Control Device / Efficiency
PM / PM_{10} / $PM_{2.5}$	0.61	Bin vent filter – 99.9%

Assumes that PM= PM_{10} = $PM_{2.5}$

Unloading

The application indicates that ash can be unloaded from the silo either wet or dry. The source has indicated that the preferred method of unloading would be wet and that dry unloading would primarily be used as a backup. During dry unloading a long hose is connected to an enclosed truck. This hose is equipped with an outer exhaust pipe that collects dust from around the inner hose and also pulls air out of the enclosed truck or rail car. Air from this exhaust is ducted to the ash silo and eventually passes through the silo's bin vent filter. For wet ash unloading, ash passes through a pug mill, where is it mixed with water and then unloaded to an open truck. When the dry fly ash is wetted, it "sets up" like cement and has a rock or aggregate-like consistency. Estimated emissions are higher for dry unloading, therefore, requested emissions are based on dry unloading.

The emission factors used to estimate emissions from dry unloading are from AP-42, Section 11.17, Table 11.17-4, Product Unloading - Enclosed Truck, dated February 1998, as follows:

Pollutant	Emission Factor (lbs/ton)	Control Device / Efficiency
PM / PM_{10} / $PM_{2.5}$	0.61	Hose Attachment to Enclosed Truck – 95%

Assumes that PM= PM_{10} = $PM_{2.5}$

The emission factors used to estimate emissions from wet ash unloading are from AP-42, Section 13.2.4, Aggregate Handling and Storage Piles, dated November 2006, Equation 1 for drop or transfer points, as follows:

$$E \text{ (lbs/ton)} = \frac{k \times 0.0032 \times (U/5)^{1.3} \times D \times \text{tons of ash unloaded}}{(M/2)^{1.4}}$$

Where: E = Emission factor (lbs/ton)
k = particle size multiplier, dimensionless
k = 0.74 for PM (< 30 µm)
k = 0.35 for PM_{10}

k = 0.053 for $PM_{2.5}$
U = mean wind speed, mph
D = number of drop or transfer points, dimensionless
M = moisture content, %

For the above calculations, PSCo used a mean wind speed of 8.2 mph and a moisture content of 20%.

Ash Disposal Site

At the ash disposal site, sources of emissions include the unloading of trucks at the disposal site, maintenance at the disposal site and wind erosion at the disposal site.

Emissions from unloading trucks at that ash disposal site are estimated using the same method for wet unloading from the ash silo. Note that unloading of all waste materials (bottom ash, water treatment sludge and fly ash/scrubber sludge was included in the calculation).

During processing of the original Title V permit for Pawnee, emissions from wind erosion of the ash disposal site were considered in the emission limitations. In the Pawnee NO_X and SO_2 emission controls project, emissions from wind erosion were not included. The source noted in the application that since only wet ash would be unloaded at the disposal site that emissions from wind erosion would be negligible. As previously indicated when fly ash is mixed with water, it "sets-up" like cement and has a rock-like consistency. Therefore, the Division agrees that emissions from wind erosion are negligible under the scenario when only wet fly ash is deposited at the disposal site. The Division considers that for this project emissions from wind erosion of the ash pile are negligible.

During processing of the original Title V permit for Pawnee, emissions from ash landfill maintenance were not included in the emission limitations. As part of this application emissions from ash landfill maintenance were addressed. Based on actual data most of the fly ash is currently sold, in fact less than 15% was disposed based on the 2010 and 2011 data provided. Therefore, it's likely that under the current operating scenario emissions from landfill maintenance are low. Therefore, for this analysis, the Division is considering that baseline actual emissions from landfill maintenance are zero.

In the application, the source estimated emissions from ash pile maintenance using the emission factors from AP-42, Section 11.9, Western Surface Coal Mining, dated October 1998, Table 11.9-1 - bulldozing overburden, as follows:

$$PM\ (lb/hr) = \frac{5.7 \times s^{1.2}}{M^{1.3}}$$

$$PM_{10}\ (lb/hr) = \frac{1.0 \times s^{1.5} \times 0.75}{M^{1.4}}$$ (multiply the PM_{15} factor in Table 11.9-1 by 0.75)

$$PM_{2.5}\ (lb/hr) = \frac{5.7 \times s^{1.2} \times 0.105}{M^{1.3}}$$ (multiply the TSP factor in Table 11.9-1 by 0.105)

Where: M = material moisture content, assumed to be 20%
s = material silt content (%), used 51.6 %
Silt content is based on a weighted average of fly ash silt content (80% per AP-42, Table 13.2.4-1 (dated 1/95) and 1% for scrubber sludge).

An 80% control efficiency for additional watering may be used if the landfill is watered as necessary to reduce

fugitive particulate matter emissions.

Emissions were based on bulldozing occurring 12 hours per day, 365 days per year.

Haul Roads

Emissions from the vehicle traffic on haul roads were estimated using emission factors from AP-42 (dated September 1998), Section 13.2.2 Unpaved Roads, as follows:

$E\ (lbs/VMT) = k \times (s/12)^a \times (W/3)^b \times ((365-p)/365)$ (equations 1a and 2)

where:
E = Emission factor (lbs/VMT)
VMT = vehicle miles traveled per year
k = constant, dimensionless, see table below
a = constant, dimensionless, see table below
b = constant, dimensionless, see table below
s = silt content of road surface material, in % (used 5.1, per AP-42, Table 13.2.2-1, for coal mine plant road)
p = number of days with > 0.01 inches of precip. (PSCo – used 80 from AP-42, figure 13.2.2-1)
W = mean weight of vehicle, in tons (used 40.5, the average of empty 28 and full 53 weights)

Constant	$PM_{2.5}$	PM_{10}	PM
K	0.15	1.5	4.9
A	0.9	0.9	0.7
B	0.45	0.45	0.45

A control efficiency of 90% was applied to the above equation to simulate the paved roads. In addition a control efficiency of 80% was applied to the above equation for daily watering/chemical stabilization on the unpaved roads.

In the above calculations, PSCo indicated that the capacity of each truck would be no less than 25 tons. The number of trips (and subsequently the number of vehicle miles traveled) was based on the amount of material hauled, truck capacity and the length of the haul roads. The haul road lengths (round trip) and vehicle miles traveled that were used to calculate emissions were as follows:

Source	No. of Trips	Road Length – Round Trip (miles)		Annual Vehicle Miles Traveled	
		Paved	Unpaved	Paved	Unpaved
Bottom Ash Disposed	1,286	1.2	1.2	1,543.2	1,543.2
Bottom Ash Sold	**1,286**	**3.5**	**1.2**	**4,501**	**1,543.2**
Waste Ash Disposed	**8,751**	**1.1**	**1.1**	**9,626.1**	**9,626.1**
Waste Ash Sold	7,292	3.5	N/A	25,522	N/A
Water Treatment Facility Sludge Disposed	**1,536**	**1.4**	**1.5**	**2,150.4**	**2,304**

Note that as discussed below, permitted emissions are based on the information in bold.

In their application, the source indicated that the most likely scenarios would be for bottom ash to be sold and waste ash disposed so emissions from those activities were used in their emission estimates. It should be noted that the only option for the water treatment facility sludge is for disposal. The Division considers that for bottom ash and waste ash the method that generates the highest emissions should be considered in the evaluation unless the permit limits the options

for bottom and waste ash handling. The most conservative emission estimate is based on bottom ash sold and fly ash disposed.

Although the emission factors are based on vehicle miles traveled the Division has included in the permit conditions regarding the minimum truck capacity and the amount of material hauled to make the PM and PM_{10} limits practically enforceable, since vehicle miles traveled are based on these factors.

THROUGHPUTS:

The quantities of material processed through the various equipment associated with the Pawnee NO_X and SO_2 Emissions Control Project are as follows:

Equipment/Activity	Annual Throughput (tons/yr)	Monthly Throughput (tons/month)
Recycle Ash Silos and Mixers	891,019	74,252
Lime Silos and Slakers	26,280	2,190
Combustion Additive Silos	986	82
Waste Silo – Loading	182,299	15,192
Waste Silo – Unloading	218,759	18,230
Ash Disposal Site – Waste Ash Unloaded	218,759	18,230
Ash Disposal Site – Bottom Ash Unloaded	32,136	2,678
Ash Disposal Site – Water Treatment Sludge Unloaded	38,400	3,200
Haul Roads – Waste Ash	218,759	18,230
Haul Roads – Bottom Ash	32,136	2,678
Haul Roads – Water Treatment Sludge	38,400	3,200

Throughput levels for the recycle ash silos, recycle ash mixers, lime silos, lime slakers and combustion additive silo are based on specifications for the equipment. Note that for this equipment, emissions are based on an hourly emission rate and hours of operation, not on throughput.

Throughput for waste ash silo loading is based on the allowable coal consumption rate (2,921,460 tons/yr), an ash content of 5%, an assumption that 80% of ash produced is fly ash and a 56% increase in the fly ash rate to address scrubber sludge (i.e. LSD waste).

Throughput for waste ash silo unloading is based on a 20% increase in the quantity loaded, to address the water that is mixed with the waste ash during unloading. This throughput rate is also applicable to waste ash unloading at the disposal site and waste ash hauling.

Throughput of bottom ash unloaded at the disposal site is based on the maximum coal consumption rate (2,921,460 tons/yr), an ash content of 5%, an assumption that 20% of ash produced is bottom ash and a 10% increase in the bottom ash produced to account for the water content (wet bottom ash is handled). This throughput rate is also applicable to bottom ash hauling.

Throughput for the water treatment sludge unloaded at the disposal site is based on estimates provided by the source. This throughput rate is also applicable to water treatment sludge hauling.

In all cases the monthly throughput limit is based on the annual limitation divided by twelve. Monthly

throughput limits are applicable for the first twelve months of operation.

SOURCE STATUS: Pawnee Station is a major stationary source for purposes of prevention of significant deterioration (PSD) review requirements.

SUMMARY OF PROJECT EMISSIONS (TONS PER YEAR):

PUBLIC NOTICE REQD. ? [X] YES [ ] NO

Emissions from the project are based on the estimated emissions from the new equipment and the increase in emissions from existing equipment that will be affected by the modification. Colorado Regulation No. 3, Part D, Section I.B, sets forth the tests for determining the emission increases for new and existing equipment and stipulates that post-project emissions be based on potential to emit (or requested emissions) for new sources and projected-actual emissions for existing sources. For this project the source relied on potential (or requested) emissions for post-project emissions from the existing equipment, which is considered more conservative and is acceptable. For new equipment, the baseline actual emissions (BAE), i.e. pre-project emissions, is considered to be zero (per Reg 3, Part D.II.A.4.c) and for existing equipment BAE is based on 2010 and 2011 emissions.

It should be noted that although the source has proposed a new waste ash silo as part of this project, since the silo will replace the existing silo, it is considered a replacement unit, as defined in Reg 3, Part D.II.A.39, and is treated as an existing unit.

Project emissions is the sum of the difference between potential to emit (or requested emissions) and BAE for each new and/or existing emissions unit affected by the project. Project emissions for the Pawnee NO_X and SO_2 emissions control project are shown on the following page.

Since the source is relying on bin vent filters and scrubbers for the new equipment and control measures for the fugitive sources to keep emissions below the significance level, public comment is required.

Project Emission Increase (tons/yr)

Emission Unit	PM			PM_{10}			$PM_{2.5}$		
	PTE[1]	BAE	Emissions Increase	PTE[1]	BAE	Emissions Increase	PTE[1]	BAE	Emissions Increase
Lime Silos	0.45	0	0.45	0.45	0	0.45	0.45	0	0.45
Lime Slakers	0.564	0	0.564	0.564	0	0.564	0.564	0	0.564
Recycle Ash Silos	2.043	0	2.043	2.043	0	2.043	2.043	0	2.043
Recycle Ash Mixers	0.564	0	0.564	0.564	0	0.564	0.564	0	0.564
Combustion Additive Silo	0.263	0	0.263	0.263	0	0.263	0.263	0	0.263
Waste Ash Silo[2]	2.84	1.24	1.6	2.84	1.24	1.6	2.84	1.24	1.6
Ash Unloading at Disposal Site[3]	2.59E-02	7.08E-04	2.52E-02	1.23E-02	3.35E-04	1.20E-02	1.85E-03	5.07E-05	1.80E-03
Ash Pile Maintenance[4]	5.77	0	5.77	1.84	0	1.84	0.6	0	0.6
Wind Erosion from Ash Pile[5]	0	0	0	0	0	0	0	0	0
Haul Roads	14.65	4.53	10.12	3.78	1.17	2.61	0.38	0.12	0.26
Total	27.17		21.40	12.36		9.95	7.71		6.35
Significance Level			25			15			10

For new units baseline actual emissions (BAE) = 0

For existing or replacement units BAE is based on the average of 2010 and 2011 emissions.
The new waste ash silo is considered a replacement unit and is treated as an existing unit. The permit will require that the existing silo be removed and/or disabled upon startup of the new silo.

[1]Potential to emit (PTE) = requested emissions. Requested emissions will be included in the permit(s) as emission limitations.

[2]Emissions from the waste ash silo are based on silo loading and silo unloading (dry unloading)

[3]The current permit uses different emission factors for unloading at the disposal site, than those proposed in the application. In order to determine the change in emissions, BAE was calculated using the same methods as those proposed in the application.

[4]The fugitive emission limits in the current permit for the ash disposal site did not consider emissions from ash pile maintenance. Actual data indicates that currently most fly ash is sold, therefore, the Division is assuming that BAE from ash landfill maintenance is zero.

[5]In the application, the source indicated that since ash will be unloaded at the landfill wet, that emissions from wind erosion are negligible. The Division agrees. Therefore, the Division assumes that project emissions from wind erosion are negligible.

Change in Requested (allowable) emissions:

The below table shows the change in permitted (or allowable) emissions from the new or existing affected emission units based on this application.

	Emissions (tons/yr)		
	PM	PM_{10}	$PM_{2.5}$
Requested Emissions (PTE) for Project*	27.17	12.36	7.71
Current Permitted Emissions – Waste Ash Silo, Ash Handling and Disposal & Haul Roads**	69.69	21.41	4.41
Change in Requested Emissions	-42.52	-9.05	3.3

*Total Requested emissions (PTE) as indicated in the previous table displaying the project emissions increases. Includes new equipment (lime silos & slakers, recycle ash silos & mixers, and waste ash silo) and requested emissions for existing equipment/activities (waste ash silo, ash disposal site and haul roads)

**Limitations as indicated in the current Title V permit (last revised 11/15/11). Note that the current permit does not include emission limitations for $PM_{2.5}$. Equivalent $PM_{2.5}$ emission limitations were presumed based on the following assumptions: for the waste ash silo: $PM = PM_{10} = PM_{2.5}$, for ash handling and disposal, $PM_{2.5} = 0.15 \times PM_{10}$ (per AP-42, Section 13.2-4 (dated 11/06) table for k values for eqn 1) and for haul roads $PM_{2.5} = 0.10 \times PM_{10}$ (based on ratio of emission factors used to estimate project emissions).

The permits will include monthly emission limitations for the first twelve months of operation. The monthly emission limitations that will be included in the permit are included in the following table:

	Monthly Limitations (lbs/month)		
Equipment/Activity	PM	PM_{10}	$PM_{2.5}$
Recycle Ash Silos	347.1	347.1	347.1
Recycle Ash Mixers	95.7	95.7	95.7
Lime Silos	76.5	76.5	76.5
Lime Slakers	95.7	95.7	95.7
Combustion Additive Silos	44.6	44.6	44.6
Waste Silo	473.3	473.3	473.3
Ash Disposal Site	966.7	308.3	100
Haul Roads	2,442	630	63.3

Monthly emissions for the recycle ash silos and mixers, lime silos and slakers and the combustion additive silos are based on the hourly emission rate identified previously under the “emission factor source”, and 744 hours/month of operation (31 day month). Monthly emissions for the other equipment and/or activities are based on requested annual emissions divided by twelve.

HAZARDOUS POLLUTANTS (NOTE MAIN TYPES AND QUANTITIES WHICH REQUIRE REPORTING):

The emission units/activities addressed in this project are not sources of hazardous air pollutant emissions.

PROPOSED CONTROLS & EFFICIENCY:

The lime, recycle ash, combustion additive and waste ash silos are equipped with bin vent filters to control particulate matter emissions. The lime slakers and recycle ash mixers are equipped with scrubbers to reduce particulate matter emissions. Various control measures are used to reduce

fugitive particulate matter emissions from operations at the ash disposal site (unloading and maintenance). Such control measures include i watering at the disposal site, limiting vehicle speed, the application of chemical stabilizers and water on unpaved haul roads and requirements to sweep or water paved roads.

MODELING RESULTS:

For this project there is a decrease in requested (allowable) emissions of PM and PM_{10} and a 3.26 tons/yr increase in requested (allowable) emissions of $PM_{2.5}$. The increase in $PM_{2.5}$ emissions is below the 5 tons/yr threshold in the Division's Modeling Guidance, therefore, modeling was not required for this project.

DISCUSSION:

Unit 1 – Projected Changes in Emissions

In the "project description" of this document, the Division indicated that the addition of a LSD and SCR to Unit 1 would not increase the emissions of any other pollutant, nor would the addition of a LSD and SCR increase the utilization of Unit 1 (and subsequently increase emissions of other pollutants). Specifically the LSD and SCR are being installed on Unit 1 to reduce NO_X and SO_2 emissions in order to meet the Regional Haze requirements, so clearly there will be no increase in NO_X and SO_2 emissions from Unit 1. However, the addition of controls could potentially increase emissions from other pollutants and it is these potential increases that will be examined here. There is no reason to believe that the addition of the LSD and SCR would increase CO or VOC emissions. However, given that additional particulate waste by-products are generated by the LSD it is reasonable to assume that the addition of LSD could potentially increase filterable PM. In addition, it is certainly reasonable to assume that SCR may result in the formation of condensable PM due to the presence of ammonia. Therefore, at the request of the Division, the source submitted additional information on September 4, 2012 to address the potential for an increase in either filterable or condensable PM emissions from Unit 1 due to the addition of a LSD and SCR.

Filterable PM

The application submitted for this project clearly shows an increase in waste by-products captured from the baghouse due to the addition of the LSD. Therefore, it would seem likely that the addition of a LSD to a coal-fired boiler might cause a collateral increase in filterable PM emissions from the boiler. The Division reviewed available performance test data to review test results on filterable PM before and after installation of an SO_2 control device. The results of the Division review are shown in the table below and show that filterable PM emission levels are lower with the SO_2 control device, even though there is an increase in a waste by-product with the installation of the SO_2 control device.

	Uncontrolled (No SO_2 Control)		Controlled (With SO_2 Control)	
Unit Description	Test Result	Year of Test	Test Result	Year of Test
Valmont Unit 5, LSD installed August 2002	0.0073 lb/MMBtu	2001	0.003 lb/MMBtu	2010
Comanche Unit 1, LSD installed June 2009	0.00729 lb/MMBtu	2003	0.0026 lb/MMBtu	2011
Comanche Unit 2, LSD installed January 2009	0.00514 lb/MMBtu	2003	0.0043 lb/MMBtu	2011
Arapahoe Unit 3, dry sodium injection (DSI) installed January 2003	0.0316 lb/MMBtu	2001	0.0023 lb/MMBtu	2009
	0.0059 lb/MMBtu	2009		

While test data can vary, the Division considers that even though there is more particulate waste by-product generated by the boiler, the baghouse is capable of accommodating the additional material and therefore, no increase in emissions is expected. Typically manufacturer's guarantees are based on a grain-loading specification and are independent on the amount of particulate entrained in the exhaust. Additional information submitted by PSCo on September 4, 2012 echoed the trend the Division has seen with lower PM test results seen after the installation of LSD. PSCo's additional information indicated that the particulate control achieved by a baghouse is primarily a function of the filter cake on the bags, rather than the bags themselves. PSCo has indicated that the decrease in emissions is due to the increase in filter cake on the bags and the consistency of the filter cake itself. PSCO has not quantified a reduction in filterable PM emissions due to the addition of the LSD and SCR but generally presumes that there is no change in filterable PM emissions and the Division agrees with this presumption.

Condensable PM

Condensable PM is the portion of PM emissions that exits the stack in gaseous form and condenses upon mixing with cooler ambient air to form particulate matter. Gaseous materials that can form condensable PM include acids (e.g. H_2SO_4, HCl and HF), organic materials (i.e. VOCs) and some metals. Generally for a coal-fired power plant the acid gas emissions will likely make up the bulk of the condensable PM. SO_2 emissions are generated from the combustion of fuels containing sulfur and some of the SO_2 can be converted to SO_3 in the combustion chamber. The SO_3 can form H_2SO_4 or other sulfate (SO_4) compounds, which represent a portion of condensable PM emissions. The addition of SCR, tends to promote the conversion of SO_2 to SO_3, which can result in the formation of additional H_2SO_4, as well as other sulfate compounds that combine with the ammonia utilized with the SCR to form ammonium sulfate ($(NH_4)_2SO_4$) and ammonium bisulfate ($(NH_4)HSO_4$), both of which contribute to condensable PM. So the addition of SCR by itself is in fact likely to increase the condensable PM emission rate. However, both LSD and SCR will be installed on Unit 1 and in addition to reducing SO_2 emissions, the LSD also reduces acid gas emissions. So while there may be an increase in condensable PM emissions with the addition of SCR, the addition of the LSD will off-set that increase.

The Division requested additional information from PSCo regarding the potential for increased condensable PM emissions due to the addition of SCR. PSCo submitted information via e-mail on September 4, 2012 addressing this issue. PSCo requested an evaluation from Babcock and Wilcox (B & W), a boiler and control device (SCR and LSD) provider to assess potential pre- and post-control device condensable PM emission rates from Unit 1. B & W estimated that pre-control device emissions from Unit 1 were 0.0192 lb/MMBtu and post-control device emissions would be 0.0097 lb/MMBtu, which is approximately a 50% reduction in emissions. PSCo also requested an assessment of the change in condensable particulate emissions from the engineer for the LSD/SCR project (Sargent and Lundy) and PSCo's environmental consultant (CH_2M Hill) and both of these analyses indicated reductions of condensable PM emissions in the vicinity of 50%.

The Division reviewed the information submitted by PSCo and available data and concluded that there is unlikely to be an increase in condensable PM emissions from Unit 1 with the installation of LSD and SCR on the Unit 1 boiler.

PSCo has installed LSDs on a number of their existing coal fired boilers and a review of emissions data reported on APENs was conducted on some of these units to determine the reductions in acid gas emissions that could be achieved by installing a LSD. The data indicates that for Valmont Unit 5

HCl and HF emissions were reduced by approximately 90 and 96%, respectively after the addition of a LSD. For Comanche Units 1 and 2, the data indicates the following reductions:

	Percent Reduction	
	HCl	HF
Unit 1	90%	88%
Unit 2	82-90%	79 – 88%

Although the Division's analysis only addressed HCl and HF emissions (as these are the only pollutants reported, the Division considers that similar percent reductions in H_2SO_4 and in ammonium sulfate and bisulfate would also be achieved. So even though additional condensable PM components may be generated by the SCR system (such as ammonium sulfate and ammonium bisulfate) and some condensable PM species, such as H_2SO_4 may be increased, the reductions achieved by the LSD will more than offset these increases and no increase in condensable PM is expected. In fact it is expected that the condensable PM emission rate from Unit 1 will decrease.

Conclusion

It is likely that there will be no change or a decrease in filterable PM emissions and a decrease in condensable PM emissions from Unit 1 when the LSD and SCR are installed. Therefore, Unit 1 has been omitted from the project emissions analysis.

Regulatory Applicability

Colorado Regulation No. 1

The point sources (waste ash silo, recycle ash silos and mixers, combustion additive silo and lime silos and slakers) are subject to the opacity requirements in Reg 1, Section II.A.1 and 4.

- 20 % opacity requirement, except as provided for below (Reg 1, Section II.A.1)
- 30% opacity requirement under certain special conditions (Reg 1, Section II.A.4)

  Based on engineering judgment, the Division believes that for purposes of opacity emissions none of the conditions under Reg 1, Section II.A.4 apply. Specifically activities such as fire building, cleaning of fire boxes and soot blowing are not germane to silos, slakers, and mixers. In addition, there is really no "startup" involved in operating these types of sources. Finally, the Division does not believe that adjustment of the control devices (bin vent filters or scrubbers) can be done effectively while operating these emission units and that process modifications would be limited. Therefore, the 30% opacity requirement will not be included in the construction permit as the specific operating activities under which it applies does not occur with these sources.

Note that although these emission units are sources of particulate matter emissions, none of the Regulation No. 1 particulate matter requirements apply since these emission units are not fuel-burning equipment (Reg 1, Section II.A), incinerators (Reg 1, Section II.B), manufacturing equipment (Reg 1, Section II.C) or a sources of fugitive emissions (Reg 1, Section II.D). For similar reasons, none of the state-only new source performance standards apply, since these units are not fuel-burning equipment (Reg 6, Part B, Section II), manufacturing processes (Reg 6, Part B, Section III), sources of SO_2 emissions (Reg 6, Part B, Section IV) or incinerators (Reg 6, Part B, Sections IV thru VII).

The fugitive emission sources (ash disposal site and haul roads) are subject to the following requirements:

- Fugitive particulate matter emission control plan (Reg 1, Section III.D.1.b).
- 20% opacity, no-off property transport and nuisance emission limitations guidelines (Reg 1, Section III.D.1.c)

  The requirements in Reg 1, Section III.D.1.c are guidelines, not enforceable standards. However failure to comply with the guidelines may trigger the Division to require revisions to the fugitive particulate matter control plan. In accordance with Reg 1, Section III.D.1.e(ii)(B) and (C), if a control plan is required, it shall be a permit violation to operate an activity for which a control plan has been disapproved or to fail to comply with the provisions of an approved control plan.

RACT Requirements (Reg 7 and Reg 3, Part B, Section III.D.2)

The RACT requirements in Reg 3, Part B, Section III.D.2 apply to new or modified minor sources located in either a non-attainment area or an attainment maintenance area. In general the RACT requirements in Reg 7 apply to sources located in the 1-hr ozone attainment maintenance area and to sources located in an area designated as non-attainment for ozone (either the 1-hr or 8-hr standard). Since the area in which Pawnee is located is neither an attainment maintenance or non-attainment area, for any pollutant (including ozone), the RACT requirements in Reg 7 or Reg 3, Part B, Section III.D do not apply to these emission units and/or activities.

Portions of the regulation No. 7 apply state-wide, but these emission units are not the types of sources regulated under the state-wide portions (i.e., emission units are not tanks, oil and gas equipment or engines). Therefore, the state-wide portions of Reg 7 do not apply to these emission units and/or activities.

Federal NSPS or NESHAP (40 CFR Parts 60, 61 or 63, Colorado Regulation No. 6, Part A and Colorado Regulation No. 8, Parts A and E)

Neither the point sources or the fugitive sources are subject to any Federal new source performance standards (NSPS) and/or national emission standards for hazardous air pollutants (NESHSAP).