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CASE STUDY 1: ELECTRIC UTILITY STEAM GENERATING STATION

<u>Issues</u>:
- o BACT Design Standards
- o Fugitive Emissions
- o NSPS Regulations for Utility Boilers
- o 30-Day Average Emission Limits
- o Compliance Testing and Monitoring
- o PSD Compliance
- o Enforceability
- o Excess Emissions

CASE STUDY 1 -- ELECTRIC UTILITY STEAM GENERATING STATION

This case study involves an electric utility generating station. The case study is presented in two parts. First, we deal with the construction of two new coal-fired boilers at an existing site that contains one oil-fired boiler, which will be shut down as a result of the new boiler construction. The project triggers a new source review of the proposed project. Second, we address the issues raised when the utility decides to repair and restart the previously shut down oil-fired boiler.

In this presentation we first discuss the background to the case and provide the regulatory and location context for the project and attendent permitting activities. Following the presentation of the background material, specific information is presented for the activities that are to be covered by an air quality permit. The construction of the new boilers and the restart of the oil boiler occur at different times and each requires a separate permit review and permit issuance. Part A of this case discusses the permitting activity for the new boilers and Part B discusses permitting the oil boiler restart.

BACKGROUND

A preconstruction permit application subject to the August 7, 1980 PSD regulations was submitted for the construction and operation of two 6650 M^2BTU/hr, coal-fired boilers and coal and limestone storage and handling facilities. The two large coal-fired boilers are subject to New Source Performance Standards for Electric Utility Generating Stations (40 CFR Part 60, Subpart Da) for PM, SO_2, and NO_x emissions.

Annual emissions rates proposed for the new coal-fired boilers are estimated to be as follows:

PM - 890 tons/year (includes 16 tons of fugitive emissions)
SO_2 - 15,770
NO_x - 17,475
CO - 1,395
VOC - 33

Emissions of lead and non-criteria pollutants are below the PSD "significant emissions" levels.

Also located at the utility generating station is an existing 300 MMBtu per hour (heat input) residual oil-fired boiler. This boiler was initially permitted under state regulations and is subject to new source performance standards under 40 CFR Part 60, Subpart D. The oil-fired boiler was constructed before the PSD regulations went into effect. The utility is proposing to shutdown the existing oil-fired boiler. The utility has not, at this time, decided whether to dismantel the oil-fired boiler or to rebuild it for future use.

The proposed source is located in an area that is attainment for all pollutants and thus is subject to the provisions of the PSD regulations. Specifically, the PSD regulations require a control technology assessment or BACT analysis, an ambient air quality impact analysis, and an analysis of other air quality related impacts such as visibility, soils and vegetation impacts, and impacts from associated growth. Additionally, there is a Class 1 area located 40 Km. from the utility generating site, which may make air quality impact analyses more complex.

The applicant performed one year of ambient monitoring for PM and SO_2 at two sites in the vicinity. The state agency operates a monitoring station for NO_x and O_3 (ozone) at a site approximately 8 Km. from the plant site. A summary of the monitored background data used in the applicants air quality analysis is shown in Table 1. Ambient background concentrations of carbon monoxide (CO) were not determined through monitoring. Rather, the applicant demonstrated through dispersion modeling that the maximum expected ambient impacts of CO were well below the ambient monitoring significance level. Because of the small ambient CO impacts and because the proposed source site is in a rather rural area, the permit review agency exempted the source from preconstruction monitoring requirements for CO. It is important to note that much of the background PM, SO_2, and NO_x concentrations are due to emissions from another utility power plant and a cement plant, which are located about 30 and 20 Km. from the site of the proposed source, respectively.

Table 1. Summary of Preconstruction Ambient Monitoring Data

Pollutant	Averaging Time	Value (ug/M^3)	
		Maximum	2nd Maximum
PM	24-hour	103	93
	Annual	48	--
SO_2	3-hour	636	510
	24-hour	199	167
	Annual	28	--
NO_x	Annual	30	--
O_3	24-hour	226(0.115ppm)	218(0.111ppm)

Part A -- Permitting a New Electric Utility Steam Generator

This part of Case 1 involves the permitting of the two new coal-fired boilers.

Description of Permit Analysis

The BACT analyses focused on SO_2 emissions and fugitive PM. Attachment 1 was extracted from the permit agency's Final Determination Summary and defines the BACT for the two large boilers and fugitive PM sources. Table 2 shows the allowable emissions rates for the two coal-fired boilers that were proposed by the applicant.

The controls proposed for coal and limestone storage and handling are shown in Attachment 2, which was extracted from the agency's preliminary determination summary. In those cases where baghouse filters are proposed, the emissions rates and control efficiency estimates were based on a maximum outlet concentration of 0.02 grains/dscf. The review agency agreed that the controls proposed for fugitive PM emissions are BACT.

The emission rates shown in Table 2 minus the actual emissions of the oil-fired boiler were input to dispersion modeling for the air quality analysis. Both the applicant and the review agency performed dispersion modeling of the proposed emissions to determine the maximum impacts in two locations:

- o at the Class I area (40 Km. away); and
- o in the vicinity of the plant

Dispersion modeling of the boilers for both the short term and annual periods considered three levels of operation: 50%, 75% and 100% of full load. Maximum impacts occured at the full load level.

Table 3 presents the results of the air quality analysis showing the maximum impacts and highest ambient concentrations expected to result from full operation of the proposed source. As shown in Table 3, the maximum increment consumed by others in the proposed source's impact area when added to the maximum ambient impacts of the proposed source will not threaten any increment or NAAQS.

Table 4 shows the results of dispersion modeling of the maximum PM and SO_2 impacts expected to occur in the Class I area, 50 Km. from the proposed

CHMENT 1. SUMMARY OF BACT EXTRACTED FROM FINAL DETERMINATION SUMMARY

Particulates

Particulates will be controlled by an electrostatic precipitator with a guaranteed design removal efficiency of 99.78%. This will be a cold-sided precipitator having an operating range of 230-300^{0}F. Total gas flow from the steam generator at full load and at ESP operating temperature will be 2.480 X 10^{6} ACFM. Under the NSPS, the utility will be required to perform a compliance test of the unit to ensure that all NSPS emission limitations are met.

The fly ash will be collected in hoppers beneath the precipitators and then transported by pipeline in the dry state to a storage silo. From there it will be transported to the sludge stabilization system for mixing with the wet sludge from the desulfurization system and stabilizing agents as required.

Fugitive Emissions

Control of coal dust resulting from the operation of the coal handling system will be accomplished by the use of dust collection equipment and enclosures. Dust collection systems consisting of dust pickups and bag-type filters (99 percent efficiency) will be used to control dust generated at conveyor transfer points and at crushers. The dust collection systems will also be designed to provide control of the coal storage silos and surge bins. Additionally, all coal conveyors, as well as the active coal pile, will be enclosed. Finally, a wet suppressant will be applied to the inactive coal pile and reclaim and stock-out areas during dry periods and each time the pile and these areas are disturbed to prevent wind erosion.

he limestone handling system will be similar to the coal handling ystem. The limestone handling system will be enclosed and equipped with ust collection systems and bagfilters at all transfer and discharge oints.

n addition to the above controls, all unpaved access and haul roads will e oiled or watered as needed to prevent dust emissions due to vehicular ctivities.

$)_2$ Emissions

ne proposed controls for SO_2 emissions will be a limestone throw-away ystem. Combined with the removal of pyritic sulfur in the coal ulverizers and dry absorption of some SO_2 by fly ash alkalinity, it will rovide an overall removal efficiency of 91.8%. It will be designed to erate continuously and to maintain performance during all modes of iler operation, including various boiler loads and sulfur contents of e coal. The pressure drop across the scrubber system will be in the nge of 12-18 inches (H_2O) with a gas velocity of 9 to 10 feet per cond (fps). The scrubber gas pH range should be between 5.5 to 6.5. e expected number of SO_2 absorber modules is 3 to 5, with one always moved from service for inspection and maintenance. The system will be signed and constructed to operate continuously as specified for a sign life of 35 years with minimum servicing and maximum reliability.

Removal of SO_2 will occur as flue gas is forced into the absorbers, which will be fed with alkaline reactant in the form of a slurry. SO_2 will react with the calcium-based alkali to form calcium sulfite. This and the reactant slurry will be agitated in a reactant recirculating tank. Capacity of each tank will be sufficient for completing the reaction to calcium sulfate, which will precipitate while the reactant slurry is recirculating through the absorbers. Flue gas exiting the absorbers will be reheated by hot air injection or by passing it through a reheat exchanger. A mist eliminator system with demister sprays and sootblowers will remove entrained moisture and particulate matter before the flue gas exhausts into the chimneys. Waste slurry will be discharged to a surge tank and then to the waste stabilization system.

4. NO_x Controls

The amount of nitrogen oxides (NO_x) emitted from a coal-fired unit is determined by the design parameters and operating practices applied to the steam generator. The amount of NO_x produced for a given amount of excess air is proportional to the combustion temperature. Longer residence time in the combustion chamber would result in increased production of NO_x.

The utilities proposes to control NO_x emissions on both its units by a windbox burner design with low excess air and controlled combustion, and other internal boiler modifications. The boiler manufacturer will guarantee to control boiler emissions to 0.6 lb NO_x/MMBtu or less.

TABLE 2. Allowable Emissions As Proposed By The Applicant

Facility	Table of Allowable Emission Limits								
	SO_2		NO_x		TSP		CO		Opacity
	lb/MMBtu	lb/hr	lb/MMBtu	lb/hr	lb/MMBtu	lb/hr	lb/MMBtu	lb/hr	
Units 1&2 30-day rolling average	0.54	3600	0.6	3900	-	-	-	-	
Continuous Limit	-	-	-	-	0.3	199.5	.048	319	20%
Fugitive Emissions	-	-	-	-	-	3.6*	-	-	10%

*Total fugitive emissions calculated on annual basis.

Attachment 2. Summary of BACT and PM Emissions for Fugitive Emission Units Extracted from Preliminary Determination Summary (continued)

Emissions Source	Control Technique	Handling Rate (tons/hr) Daily	Uncontrolled Emissions Factor	Control Efficiency (%)	Unit Emissions (lb/hr) Annual
Coal Conveyor Dust Pickup Point No. 1	Baghouse	4000	0.014 lb/ton	99	0.56
Coal Conveyor Dust Pickup Point No. 2	Baghouse	4000	0.014 lb/ton	99	0.56
Limestone Stackout	Partial Enclosure, Telescopic Chute	4000	0.00014 lb/ton	90	0.06
Limestone Reclaim	Baghouse	1300	0.00014 lb/ton	99	0.01
Lime Unloading	Baghouse	75	0.014 lb/ton	99	0.01
Limestone Preparation Building (Limestone Transfer)	Baghouse	1300	0.014 lb/ton	99	1.18
Limestone Preparation Building (Limestone Transfer)	Baghouse	50	0.014 lb/ton	99	0.007
Limestone Preparation Building (Limestone Transfer)	Baghouse	50	0.014 lb/ton	99	0.007

Attachment 2. Summary of BACT and PM Emissions for Fugitive Emission Units Extracted from Preliminary Determination Summary

Emissions Source	Control Technique	Handling Rate (tons/hr) Daily	Uncontrolled Emissions Factor	Control Efficiency (%)	Unit Emissions (lb/hr) Annual
Barge Unloader (Coal and Limestone)	Partial Enclosure and Baghouse	2400 (coal + limestone)	0.014 lb/ton	90	3.36 (coal + limestone)
Transfer House No. 1 (Coal and Limestone)	Baghouse	2400 (coal + limestone)	0.014 lb/ton	99	0.34 (coal + limestone)
Coal Stockout	Telescopic Chute	2400	0.00014 lb/ton	50	0.17
Transfer House No. 2	Baghouse	2400	0.014 lb/ton	99	0.34
Coal Slides	Baghouse	2400	0.014 lb/ton	99	0.34
Coal Reclaim	No Control	4000	0.00014 lb/ton	0	1.6
Transfer House No. 3	Baghouse	4000	0.014 lb/ton	99	0.56
Crusher House	Baghouse	4000	0.06 lb/ton	99	2.4
Crusher Surge Bins	Baghouse	4000	0.06 lb/ton	99	0.56
Emergency Coal Discharge	Telescopic Chute	4000	0.00014 lb/ton	50	0.28
Transfer House No. 4	Baghouse	4000	0.014 lb/ton	99	0.56

Attachment 2. Summary of BACT and PM Emissions for Fugitive Emission Units Extracted from Preliminary Determination Summary (continued)

Emissions Source	Control Technique	Handling Rate (tons/hr) Daily	Uncontrolled Emissions Factor	Control Efficiency (%)	Unit Emissions (lb/hr) Annual
Waste Stabilization Building (Limestone Transfer)	Baghouse	50	0.014 lb/ton	99	0.007
Coal Stock-out Pile (52 acres)	No Control	-	10.4 lb/ acre/day	0	0.23
Inactive Coal Pile (21.5 acres)	Wet Suppression	-	10.4 lb/ acre/day	50	4.66
Limestone Stockout Pile (0.15 acres)	Partial Enclosure	-	10.4 lb/ acre/day	70	0.02
Inactive Limestone Pile (21.5 acres)	Wet Suppression	-	10.4 lb/ acre/day	50	0.89

TABLE 3. Maximum Impact And Total Ambient Concentrations Expected To Result From The Proposed Coal-Fired Boilers[a]

Pollutant	Averaging Period	Maximum Ambient Impact	Increment Consumed by Others	Maximum Total Increment Consumed	Allowable Increment	Background Concentration	Total Ambient Concentration	NAAQS 1°/2°
PM	24-hour	19	4	23	37	93[c]	116	260/150
	Annual	2.2	.1	2.3	19	48	50.3	75/60
SO_2	3-hour	252	6	258	512	510[c]	768	-/1300
	24-hour	50	1	51	91	167[c]	218	365/-
	Annual	9.6	.2	9.8	20	28	37.8	80/-
NO_x	Annual	10	-	-	-	30	40	100/-

[a]This table presents the net air quality impact; the impact of the coal-fired boilers minus the impact of the shutdown oil-fired boiler.

[b]Ambient impacts of CO are not significant and are not considered further in this analysis

[c]hightest, 2nd highest

TABLE 4. Class I Area Increment Impact Analysis For The Coal-Fired Boilers[a]

Pollutant	Averaging Time	Maximum Impact (ug/M^3)	Allowable Increment (ug/M^3)
PM	24-hour	.1	10
	Annual	<.1	5
SO_2	3-hour	.1	25
	24-hour	<.1	5
	Annual	<.1	2

[a]this table presents the net air quality impacts; the impact of the coal-fired boilers minus the impact of the shutdown oil-fired boilers.

site. The applicant demonstrated through dispersion modeling that the increment impact in the Class I area resulting from other sources was less than 0.1 ug/m^3 for all pollutant averaging times. Thus, these other increment emissions were ignored for this analysis. No Class I increment is expected to be threatened by the proposed source's emissions, which seems to satisfy the Federal Land Manager.

DISCUSSION

Based on the information and data presented in the this case and your knowledge of the Utility Boiler New Source Performance Standard (40 CFR 60 Subpart Da), respond to the following questions.

1. Is the allowable SO_2 emission rate proposed by the applicant more stringent than NSPS? Discuss the reason for your answer. ______________

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2. Specify the permit conditions(s) that will ensure to the maximum degree continuous application of BACT to fugitive emissions sources.

Emission Unit	Permit Condition(s)

Emission Unit	Permit Condition(s)

3. For each of the following pollutants, specify the means by which initial boiler compliance should be determined.

Pollutant	Initial Compliance Means
SO_2	
NO_x	
PM	

4. For each of the following pollutants, specify the means by which continuous boiler compliance can be verified or indicated.

Pollutant	Continuous Compliance Means
SO_2	____________________
	____________________
	____________________
	____________________
NO_x	____________________
	____________________
	____________________
	____________________
PM	____________________
	____________________
	____________________
	____________________

5. Identify operating conditions that can serve as "surrogate" means to determine compliance with allowable emissions that cannot be otherwise monitored continuously.

Pollutant	Surrogate Compliance Measures
__________	____________________
__________	____________________
__________	____________________
__________	____________________
__________	____________________
__________	____________________
__________	____________________
__________	____________________
__________	____________________
__________	____________________

6. Specify below conditions that constitute "excess emissions" for which reporting to the regulatory agency might be required: ________________

7. Based on the proposed allowable emission rates and the air quality impact analysis presented in this case, is there adequate demonstration that the PSD increments and NAAQS will not be exceeded. If yes, why? If no, _____