Illinois Environmental Protection Agency
Bureau of Air, Permit Section
1021 North Grand Avenue East
Springfield, Illinois

Project Summary for a Construction Permit Application from AmerenEnergy Resources Generating Company for Alterations to the Duck Creek Generating Unit Canton, Illinois

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I. INTRODUCTION

AmerenEnergy Resources Generating Company (AmerenEnergy) has applied for a construction permit for of alterations to the coal-fired boiler and turbine at its existing Duck Creek Power Station. The alteration would increase generating capacity of the station and be accompanied by improvements to the emission control equipment on the boiler.

The Illinois EPA has reviewed AmerenEnergy's application and made a preliminary determination that the proposed project, as set forth by AmerenEnergy in the application, meets applicable requirements. Accordingly, the Illinois EPA has prepared a draft of the air pollution control construction permit that it would propose to issue for this project. The permit is intended to identify the additional control requirements that apply to the source as a result of the proposed project and to set necessary limitations on those emissions. The permit is also intended to establish appropriate compliance procedures to accompany these new emissions control requirements, including provisions for emissions testing, continuous monitoring, and recordkeeping.

II. PROJECT DESCRIPTION

AmerenEnergy has requested a construction permit for alterations to the single coal-fired generating unit at its Duck Creek Station. This project is intended to increase the potential steam output of the boiler to be able to consistently match the current capacity of generator, 444 MW nominal gross output. The operation of the boiler is currently physically constrained by factors such as ambient temperature so that at times the plant cannot generate more than 370 MW. The proposed alterations to the boiler include work on the superheater, economizer, soot blowers and induced draft fans.

This work would be accompanied by improvements to the air pollution control equipment serving the boiler, including installation of a new electrostatic precipitator (ESP) for enhanced control of particulate matter (PM) and additional catalyst in the selective catalytic reduction (SCR) system for enhanced control of nitrogen oxides (NOx). The boiler would also be served by a new wet scrubber replacing the existing one for control of sulfur dioxide (SO_2) and sulfuric acid mist, which was recently approved by the Illinois EPA under a separate permit, Construction Permit No. 06070049. The exhaust from the boiler would be vented through a new stack that is planned to be 588 feet high.

The proposed alterations to the generating unit may also include work on the steam turbine-generator and other ancillary equipment to improve efficiency and capacity, which would potentially increase the capacity of the generating unit, so that it would be able to produce about 465 MW.

After planned alterations to the boiler, the rated heat input of the boiler would be about 4,500 million Btu per hour. The boiler would continue to fire coal as its primary fuel, with distillate fuel oil used for startup. The design coal supply for the boiler would have 3.63 percent sulfur by weight and 10,750 Btu per pound as received, for an equivalent nominal SO_2 emission rate of 6.75 lb per million Btu.

The coal fuel for the boiler is received by rail and truck. In addition, limestone is received, handled and stored as a raw material for the

scrubber on the boiler. Bottom ash, fly ash and gypsum, which are by-products of the boiler, ESP and scrubber, are also handled, stored and transported by truck.

III. PROJECT EMISSIONS

The changes in annual emissions of the boiler from this project, as projected by AmerenEnergy in its application, are shown below. The historic emissions of the existing boiler are based on data for the actual emissions, calculated as the average of emissions for the 24-month period from February 2002 through January, 2004. Emissions of SO_2 and NOx were determined by continuous emission monitoring conducted under the federal Acid Rain Program. This monitoring data is collected from sources by the Clean Air Markets Division of USEPA's Air and Radiation Branch and posted on the Internet. Emissions of other pollutants were estimated using operating data and appropriate factors from USEPA's *Compilation of Air Pollutant Emission Factors*, AP-42. The projected actual emissions are the emissions from the boiler after alterations, with the new ESP and scrubber and operational enhancement to the SCR system.

The changes in emissions are the differences between the past actual emissions and the future projected actual emissions after the project. As shown below, AmerenEnergy's application indicates that there will not be a significant increase in annual emissions for pollutants except for carbon monoxide (CO).

Table A: Summary of Annual Changes in Emissions of the Boiler (Tons/Year)

Pollutant	Projected Future Emissions	Historic Actual Emissions	Change	PSD Significant Emission Rate
NO_x	4,122.0	4,476.6	- 354.6	40
SO_2	4,858.1	11,175.9	- 6,317.8	40
CO	3,350.7*	2,066.4	1,284.3	100
VOM	71.5	47.6	23.9	40
PM – Filterable	735.3	1090.7	- 355.4	25
PM10 - Total	593.2	898.2	- 305.0	15
Sulfuric Acid Mist	179.5	242.5	- 62.9	7

* Potential emission of CO.

IV. APPLICABLE EMISSION STANDARDS

All emission units in Illinois must comply with Illinois Pollution Control Board emission standards. The Board's emission standards represent the basic requirements for sources in Illinois. The various emission units in the proposed project should readily comply with applicable Board standards.

The boiler is also subject to the federal New Source Performance Standards (NSPS) for Fossil-Fuel-Fired Steam Generators for Which Construction Is Commenced After August 17, 1971, 40 CFR 60 Subpart D,. This NSPS sets standards for NOx, SO_2, and PM emissions from the boiler. Requirements for emissions testing, continuous emissions monitoring, recordkeeping, and reporting related to the NSPS standards are also specified.

It is expected that the alterations to the boiler will not trigger the applicability of the more recent NSPS for Electric Utility Steam Generating Units for Which Construction Is Commenced After September 18, 1978, 40 CFR 60, Subpart Da. In its application and as summarized below, AmerenEnergy has shown that the maximum hourly emissions of PM, SO_2 and NOx, for which this NSPS sets standards, will not increase. Therefore, the alterations to the boiler are not expected to entail a modification of the boiler for purposes of the NSPS, which would be needed for the emission standards and other requirements of 40 CFR 60 Subpart Da to be triggered. However, if the historic maximum emission rate for a pollutant were to be exceeded, it is expected that the boiler would become subject to the requirements of the NSPS, 40 CFR 60 Subpart Da for such pollutant.

Table 2: Change in Maximum Hourly Emissions of the Boiler (Pounds/Hour)

Pollutant	Historic Maximum Emissions	Expected Future Maximum Emissions	Change
PM (filterable)	367.1	356.0	-11.2
SO_2	5,401.8	3,082.4	-2.319.4
NOx	2,213.9	2,160.0	- 53.9

V. OTHER APPLICABLE REGULATIONS

A. Prevention of Significant Deterioration (PSD)

The federal rules for Prevention of Significant Deterioration of Air Quality (PSD), 40 CFR 52.21, address emissions of certain pollutants regulated under the Clean Air Act, i.e., PSD pollutants, from proposed construction and modification projects that qualify as “major.” PSD pollutants are pollutants that are regulated under the Clean Air Act other than hazardous air pollutants and any pollutants for which local air quality is designated nonattainment (which is not of concern for the proposed project, which is located in an attainment area).

Since the Duck Creek power plant is already a major source for purposes of the PSD rules, with permitted annual emissions of more than 100 tons for a number of PSD pollutants, the proposed project would be major for PSD pollutants for which the project would constitute a major modification. For a project involving alterations to existing emission units, such as the proposed project, a project is only considered a major modification for a specific PSD pollutant if the increase in annual emissions of the pollutant due to the project is projected to be above the significant emission rate set by the PSD rules for the pollutant.

This project is subject to PSD for emissions of CO because the projected increase in annual CO emissions with the project is greater than 100 tons, the significant emission rate for CO set by the PSD rules. As set forth in the draft permit, the potential emissions of CO from the boiler after alterations would be 3,351 tons per year. The potential emissions are calculated based on continuous operation at the maximum load. Actual emissions will be significantly less as the boiler will operate at less than its maximum capacity and with a compliance margin for applicable emission limits. As the proposed project is only a major project for

emissions of CO, the draft permit only addresses the substantive requirements of the PSD rules for CO emissions.

AmerenEnergy has projected that the proposed project would be accompanied by decreases or less than significant increases in emissions of PSD pollutants other than CO, as previously discussed. In particular, AmerenEnergy has submitted a demonstration comparing the past actual emissions from the existing Duck Creek Unit and the future emissions that would occur with this project, This demonstration shows that this project should be accompanied by a decrease in annual emissions of at least 6,300 tons of SO_2, 350 tons of NOx, 350 tons of PM and 300 tons of PM_{10} as shown below. Accordingly, draft permit for the project is based on the project not being subject to PSD for emissions of PSD pollutants other than CO, including emissions of SO_2, nitrogen oxides (NOx), particulate matter 10 (PM10), volatile organic material (VOM) and sulfuric acid mist.

B. Federal Control Programs for SO_2 and NOx Emissions from Power Plants

For the boiler, AmerenEnergy would be subject to new requirements for control of SO_2 and NOx emissions that must be developed pursuant to the Clean Air Interstate Rule (CAIR), adopted by USEPA in March 2005. Until these new, more stringent requirements take effect in Illinois, current control requirements under the Acid Rain Program, pursuant to Title IV of the Clean Air Act, Acid Deposition, are unchanged. Most significantly, AmerenEnergy would have to continue to hold SO_2 allowances for the actual SO_2 emissions from the boiler, as it does now. As the boiler is also an Electrical Generating Unit, the boiler would also continue to be subject to current control requirements under 35 IAC Part 217, Subpart W, the NO_x Trading Program for Electrical Generating Units. Under this program, AmerenEnergy would have to hold NO_x allowances for the actual NO_x emissions of the boiler alteration during each seasonal control period, as it does for its existing boilers for other locations. This program addresses NO_x emissions of all but the smallest power plants in the Midwestern and Eastern United States so that the total seasonal NO_x emissions of these plants remain within the emissions budget established by USEPA for power plants for attainment of the historic 1-hour ozone standard.

C. Clean Air Act Permit Program (CAAPP)

The source is a major source under Illinois' Clean Air Act Permit Program (CAAPP), the federal operating permit program for major sources of emissions pursuant to Title V of the Clean Air Act. To address this project, AmerenEnergy would have to submit an application to the Illinois EPA for a modification of the CAAPP permit for the plant within 12 months after initial startup of the boiler alteration project.

VI. BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

Under the PSD rules, AmerenEnergy must demonstrate that Best Available Control Technology (BACT) will be used to control CO emissions from the boiler, which is the emission that will experience a potential increase in CO emissions with the proposed project. BACT is generally set by a "Top Down Process." In this process, the most effective control option that is available and technically feasible is assumed to constitute BACT for a particular project, unless the energy, environmental and economic impacts associated with that control option are found to be excessive. This

approach is generally followed by the Illinois EPA for BACT determinations. In addition to the BACT demonstration provided by an applicant in its permit application, a key resource for BACT determinations is USEPA's *RACT/BACT/LAER Clearinghouse* (Clearinghouse), a national compendium of control technology determinations maintained by USEPA. Other documents that are consulted include general information in the technical literature and information on other similar or related projects that are proposed or have been recently permitted.

A. General Discussion of BACT

CO emissions from boilers are the result of incomplete combustion. The available control techniques involve management of the combustion process to minimize incomplete combustion and the formation. Add-on combustion control technologies, i.e., catalytic oxidation and thermal oxidation or afterburners, have been deemed technically infeasible. Thermal and catalytic oxidation technology is used for control of process sources and engines, in circumstances where high concentration of CO are present, often together with organic emissions. However, add-on control devices are not used to control CO emissions from boilers, as the purpose of a boiler itself is to efficiently combust fuel. Consistent with this purpose, boilers have and are designed with features to minimize formation of CO, such that a properly operated boiler effectively acts as an oxidizer.

There are two basic techniques for management of the combustion process in a boiler to minimize CO emissions: 1) Increased combustion air to specifically reduce CO emissions, and 2) General design and operation with good combustion practices that act to minimize the formation of CO.

Increasing the levels of combustion air introduced into the boiler, above the level of excess air that would otherwise be present for proper operation of the boiler, would theoretically reduce CO emissions of a boiler by raising the amount of oxygen available to complete oxidation of CO into CO_2. However, this technique would have the adverse effect for emissions of other pollutants. It would increase NO_x emissions, as much of the NOx is formed thermally, from the combination of nitrogen and oxygen in the combustion air in the flame, rather than from nitrogen in the fuel. This reaction is facilitated by increased excess air, as more oxygen is present to participate in this reaction. More generally, increased excess air would reduce the energy efficiency of a boiler, requiring consumption of additional fuel with accompanying emissions, to produce the needed amount of electrical power. Generating additional NOx, PM, and SO_2 emissions to reduce CO emissions is an unacceptable consequence of employing excess air. For these reasons, high excess air levels have not been selected as BACT for CO emissions.

As a practical matter, CO emissions from the boiler after alterations can be effectively controlled by good combustion practices, i.e., careful management of the combustion process, accompanied by proper maintenance of the fuel and air systems on the boiler. This is the approach routinely used for control of CO emissions from coal-fired boilers.

AmerenEnergy has provided a BACT demonstration in its application, indicating that the boiler currently achieves an average CO emission rate of 0.17 pound per million Btu, given current design and operation. The Illinois EPA is proposing to set this emission rate as BACT for the normal operation of the boiler, i.e., periods other than startup, shutdown and

malfunction of the boiler. This boiler is an existing boiler and the current performance of good combustion practices is appropriately used as a basis to set a BACT limit for CO emissions. In addition, fundamental aspects of the original design of the boiler act to constrain the ability to achieve lower CO emission rates while also effectively controlling NOx emissions with low-NOx burner technology.

A critical concern is that CO emissions from a given boiler are generally inversely related to NO_x emissions. A lower CO BACT limit would be counterproductive to the objective of reduced NOx emissions, as achievable with low-NOx combustion or burner technology. Reductions in NOx emissions from the boiler are of greater importance to overall air quality and the environment in Illinois than reductions in CO emissions. This boiler has already been retrofit with low-NOx burners to comply with control requirements for NOx emissions that were adopted and became effective many years after the boiler was built. The ability of these low-NOx burners to compensate for potential increase in CO emissions is constrained by various aspects of the original design of the furnace of the boiler. In addition, the CO BACT limit should be set at a level that accommodates developments in NOx burner technology. These objectives would not be met if a more stringent limit were set for CO BACT that required a decrease from the current level of emissions.

The CO BACT limits set for new coal-fired boilers, e.g., 0.12 pounds per million Btu, are not an appropriate basis to assess the BACT limit for this boiler following alterations. Rather, the CO BACT limits set for existing boilers undergoing modifications for CO emissions in conjunction with use of low-NOx burner technology are an appropriate reference point for the BACT limit for this boiler. The CO BACT limits set for certain existing boilers in conjunction with use of low-NOx burner technology, e.g., 0.50 pound/million Btu for the Gerald Gentleman Station in Nebraska and 0.42 pound/million Btu for the George Neal Station in Iowa, are significantly higher than the proposed limit of 0.17 pound/million Btu. The proposed CO BACT limit of provides AmerenEnergy with a reasonable ability to minimize formation of NOx using the low-NOx combustion technology installed on the boiler. It also provides an appropriate margin of compliance to account for normal variation in the operation and CO emissions of the boiler.

Compliance with this BACT limit would be confirmed by continuous emissions monitoring or periodic emission testing and proper operation and work practices between tests, as confirmed by operational monitoring and recordkeeping. Continuous emissions monitoring would initially be required for CO. After two years, with approval of the Illinois EPA, the emissions monitoring system could be converted to an operating parameter monitoring system if measured CO emissions were no more than 0.125 pounds per million Btu, which is about 25 percent below the 0.17 pound per million Btu limit set as BACT.

B. Discussion of BACT for Startup, Shutdown and Malfunction

The effectiveness of good combustion practices for control of CO emissions varies as air flow rates into a boiler goes up or down, burners are brought into or taken out of service, and furnace temperatures fluctuate. During startup, shutdown or malfunction of the boiler, compliance with the CO BACT limit of 0.17 pound per million Btu, which should be reliably achieved when the boiler operating normally, cannot be assured. During startup and shutdown firing rate of the boiler is below the normal operating level,

even as the CO emissions stay within the permitted hourly rate, the emissions rate could reasonably exceed 0.17 pound per million Btu even if the boiler is being properly operated and maintained, given the operating conditions during such periods. Similar circumstances also apply for malfunctions. In addition, specific data for the actual emissions of CO during these periods, in pounds per million Btu, is not available.

These circumstances prevent a CO BACT limit expressed in pound per million Btu from being established for periods of startup, shutdown or malfunction of the boiler. An alternative approach to BACT for such periods is proposed. First, startup and shutdown of the boiler must be carried out in a manner that minimizes CO emissions, in accordance with written procedures that meet certain specific requirements set forth in the permit, such as appropriate use of auxiliary fuel during such events. It must also maintain the boiler to prevent malfunctions that would result in additional CO emissions and appropriately respond to malfunctions to minimize CO emissions. Second, the limit on CO emissions of the boiler expressed in pounds per hour, which would continue to apply during periods of startup and shutdown, would serve as a "secondary" BACT limit.

Even though either emissions or operational monitoring will be required for CO, compliance this alternative CO BACT limit may have to be determined by means of engineering analysis and evaluation. This is because, monitoring still may not provide an accurate or reliable determination of CO emissions during low-load operation or transitory operating conditions. However, such engineering evaluation will be far more practical to perform, and to be reviewed, for limits expressed in pound/hour, rather than in pound/million Btu, as would have to be attempted if the "basic" BACT limits applied during startup and shutdown events. Finally, as the hourly emission limits set for the boiler continue to apply during such events, AmerenEnergy would also have to include and account for emissions during such events when it determines compliance with the annual emission limits set for the boiler.

VII. AIR QUALITY ANALYSIS

A. Introduction

The previous discussion addressed emissions and emission standards. Emissions are the quantity of pollutants emitted by a source, as they are released to the atmosphere from a stack. Standards are set limiting the amount of these emissions primarily as a means to address the quality of air. The quality of air as we breathe it or as plants and animals experience it is known as ambient air quality. Ambient air quality considers the emissions from a particular source after they have dispersed following release from a stack, in combination with pollutant emitted from other nearby sources and background pollutant levels. The concern for pollutants in ambient air is typically expressed in terms of the concentration of the pollutant in the air. One form of this expression is parts per million. A more common scientific form is micrograms per cubic meter, i.e. millionths of a gram of a pollutant in a cubic meter of air.

The USEPA has established standards, which set limits on the level of pollution in the ambient air. These ambient air quality standards are based on a broad collection of scientific data to define levels of ambient air quality where adverse human health impacts and welfare impacts may

occur. As part of the process of adopting air quality standards, the USEPA compiles the various scientific information on impacts into a "criteria" document. Hence the pollutants for which legal air quality standards exist are known as criteria pollutants. Based upon the nature and effects of a pollutant, appropriate numerical limitation(s) and associated averaging times are set to protect against adverse impacts.

Areas can be designated as attainment or nonattainment for criteria pollutants, based on the existing air quality. In attainment areas, like the area in which the Duck Creek power station is located, one wished to generally preserve the existing clean air resource and prevent increases in emissions, which would result in nonattainment. In a nonattainment area efforts must be taken to reduce emissions to come into attainment. An area can be attainment for one pollutant and nonattainment for another.

Compliance with air quality standards is determined by two techniques, monitoring and modeling. In monitoring one actually samples the levels of pollutants in the air on a routine basis. This is particularly valuable as monitoring provides data on actual air quality, considering actual weather and source operation. The Illinois EPA operates a network of ambient monitoring stations across the state.

Monitoring is limited because one cannot operate monitors at all locations. One also cannot monitor to predict the effect of a future source, which has not yet been built, or to evaluate the effect of possible regulatory programs to reduce emissions. Modeling is used for these purposes: Modeling uses mathematical equations to predict ambient concentrations based on various factors, including the height of a stack, the velocity and temperature of exhaust gases, and weather data (speed, direction and atmospheric mixing).

Modeling is performed by computer, allowing detailed estimates to be made of air quality impacts over a range of weather data. Modeling techniques are well developed for essentially stable pollutants like CO, and can readily address the impact of individual sources. Modeling techniques for reactive pollutants, e.g., ozone, are more complex and have generally been developed for analysis of entire urban areas. They are not applicable to a single source with small amounts of emissions.

Air quality analysis is the process of predicting ambient concentrations in an area or as a result of a project and comparing the concentration to the air quality standard or other reference level. Air quality analysis uses a combination of monitoring data and modeling as appropriate.

B. Air Quality Analysis

An ambient air quality analysis was conducted by a consulting firm, Sargent and Lundy, on behalf of AmerenEnergy to assess the air quality impacts of the proposed project due to its CO emissions, the pollutant that is subject to PSD. Under the PSD rules, this analysis must demonstrate that the proposed project will not cause or contribute to a violation of any applicable CO National Ambient Air Quality Standards (NAAQS).

The following table summarizes the results of the air quality analysis conducted for the proposed project. As required by the PSD rules, the analysis for this project evaluated whether the proposed project would have "significant impacts" for CO, the criteria pollutant that is subject to

PSD. In its guidance for the performance of PSD air quality analyses, USEPA has established Significant Impact Levels for different pollutants. If modeled impacts of a project are below the significant impact level for a pollutant, no further air quality analysis is required under the PSD rules. The significant impact levels are a fraction of the applicable for a pollutant, which are the threshold levels set by USEPA for health and welfare effects from a pollutant. The significant impact levels also do not correspond to threshold levels for effects on flora or fauna from a pollutant.

The analysis conducted for the proposed project shows that the impacts for CO air quality are well below the significant impact levels set for CO. This is sufficient to demonstrate that the project will not cause a violation of the CO NAAQS. Because the maximum CO impacts did not exceed the significant impact levels, no additional modeling was performed to address CO emissions from start-up of the boiler on the CO NAAQS, which apply as a 1-hour and 8-hour average. However, a reduced load analysis was conducted for the boiler at 100, 75, 50, and 25 percent loads, to address the possibility that air quality impacts are higher at reduced load of the boiler, due to reduced exhaust velocity and lower effective plume height from the boiler. The modeled impacts of the boiler at reduced loads were considered when the maximum impacts of the project were identified.

Table 1. Significant Impact Modeling for CO (ug/m^3)

Averaging Period	Maximum Project Impact	Significant Impact Level	NAAQS
1-hour	151.7	2000	40,000
8-hour	106.2	500	10,000

C. Other Air Quality Related Impacts

Under the PSD rules, AmerenEnergy must also submit analyses to address changes in air quality from growth in the area that result from the project, and construction of the source itself. It must also evaluate the potential for visibility impairment and address the potential impacts on soil and vegetation.

AmerenEnergy provided an additional impact analysis discussing the emissions impacts resulting from residential and commercial growth associated with the proposed project. Based on the anticipated employment which will result from approximately 23 months planned project, it is expected that there will not be significant growth associated with construction and operation of the boiler alteration project. Most impacts would be temporary, resulting from the work force required during the construction phase. The secondary air emissions (i.e., e.g., increased vehicle traffic) from construction activity and any long-term growth are not expected to significantly impact air quality in the Canton area or in the immediate vicinity of the plant.

AmerenEnergy’s air quality consultant, Sargent and Lundy, provided an additional analysis to evaluate potential impacts to vegetation and soils. Since the planned project’s ambient air quality impact shows minimal level of impact compared to significant threshold and concentration below secondary air quality standards will not result in harmful effects on most

types of soil and vegetation, no further impact analysis for soil and vegetation were deemed necessary for commercial value.

The increase in CO emissions with this project is not expected to contribute to an increase or change in the quantity and nature of particles in the atmosphere that would affect visibility. Visibility impairment is principally the result of particles in the atmosphere, both as directly emitted and due to emissions of reactive precursor compounds like SO_2 or NO. However, CO is a gaseous pollutant that has not been identified as a precursor compound for formation of particulate in the atmosphere. Therefore, this project should not have an adverse impact on visibility.

VIII. REQUEST FOR COMMENTS

It is the Illinois EPA's preliminary determination that the draft permits would meet all applicable state and federal air pollution control requirements, subject to the conditions in the draft permit.

Prior to making a final determination on the application, the Illinois EPA is holding a public comment period to allow the public the opportunity to submit comments on the proposed project and the Illinois EPA’s preliminary determination to issue a permit for the project.