I. INTRODUCTION

Corn Belt Energy Corporation of Illinois, LLC (Corn Belt) is proposing to construct a nominal 91-megawatt Power Plant in Elkhart adjacent to an existing underground coal mine owned and operated by Turris Coal Company. The proposed facility is intended to burn coal from the adjacent mine and provide electricity to the mine as well as the local power grid. Building the plant at the mine site eliminates the cost of transportation and the need to take local farmland out of production.

The project is partially funded by the United States Department of Energy (USDOE) Clean Coal Program and The State of Illinois Department of Commerce and Community Affairs (DCCA).

II. PROJECT DESCRIPTION

The major components of the proposed coal-fired power plant is a U-fired pulverized coal boiler, fuel feed equipment, fly ash reinjection, slag removal system, and air pollution control equipment. The control system for the boiler includes a selective catalytic NO_x reduction system, an electrostatic precipitator, and a wet limestone scrubber flue gas desulfurization (FGD) system. Various systems include coal fuel handling and storage; ash handling and storage; limestone handling and storage; cooling tower; and ancillary operations. The boiler will be fired on coal as its primary fuel with natural gas as the startup fuel.

A U-fired wet bottom boiler consists of a horizontal burner platform firing downward into a refractory lined combustion chamber. At the bottom of the combustion chamber the flue gas turns upward passing through a slag screen into the furnace. The boiler is a natural circulating design consisting of a bare tube economizer, water wall tube panels, steam separation drum, and superheater. For safe, reliable and efficient operation of the thermal power plant, steam temperature control uses a spray water type control .

A coal reburn system would be installed on the boiler initially as part of a USDOE test program at a scale of 91 MW_e. The overall objective is to develop relatively near-term technologies to produce coal-fired boilers ready for full-scale commercial generating plants. The boiler will meet permitted NO_x limits with low NO_x burners, staging air, and SCR.

The planned Low Emission Boiler System boiler is of unique and innovative design. The boiler consists of two firing chambers with multiple low-NO_x pulverized coal burners on each side of the radiant furnace. Firing conditions are such that stable flames with high carbon conversion are achieved even when the burners are operated fuel rich to minimize NO_x emissions. Local temperatures within the firing chamber are high enough throughout the chamber to liquefy the ash to sufficiently low viscosity so that it flows down the wall and can be extracted easily from the bottom of the firing chamber. Reburning involves the injection of some pulverized coal after the main flame zone, after the slag screen separating the firing chamber from the radiant furnace. The design includes a slagging, U-shaped combustor, low NO_x burners, and staged combustion, to minimize air pollutant emissions. The U-shape of the combustor has down-fired chamber which increases the

combustion reaction time and provides for more complete combustion, inherently minimizing NO_x formation. Air staging refers to the introduction of air downstream of the burner. The U-fired shape of the burner offers a unique opportunity to introduce air well downstream of the burner. Similarly coal reburning involves injecting a small portion of the fuel downstream of the burner. The U-fired design provides sufficient resident time for reburning to effectively reduce NO_x as part of the DOE technology demonstration.

A single tubular air heater provides the necessary heat to the primary Combustion air, which supplies hot air to the pulverizers to dry and convey the coal to the low NO_x burners. Air is supplied to the boiler to transport coal from the main mills to the burners. Additionally the secondary air is split between the low NO_x burner wind box and the staging air ports applied to the burners and in the upper section of the furnace.

The material handling facilities consist of coal delivery, limestone delivery, and slag handling. The coal is delivered to the plant at the existing truck loading facility. Rear-dump highway trucks deliver the limestone for the FGD system. The limestone is stored in a building and reclaimed with a wheel loader and above ground hopper, and is conveyed to the day bin. All material handling end points include a fabric filter baghouse for particulate control.

Fly ash is removed from the flue gas at the economizer hoppers, air heater hopper, and in the ESP. A vacuum-conveying system empties the hoppers sequentially and reinjects the fly ash back into the U-fired, lower section of the furnace through a connection at each burner. The fly ash melts into slag, resulting in essentially minimal fly ash leaving the system.

Slag tap, or wet bottom-firing offers the advantages of solid waste minimization and capability for firing a wide range of coals. This advanced U-fired slag tap firing system has been developed with NO_x levels comparable to lower temperature state of the art dry firing. In “once through operation" the glass-like slag is quenched when it is tapped from the bottom of the boiler into the submerged drag chain conveyor. It is conveyed to a small crusher, which discharges to a conveyor. The conveyor moves the slag to a storage pile where it is trucked from the site.

III. PROJECT EMISSIONS

The emissions of the proposed boiler are listed below. Potential emissions are calculated based on continuous operation at the maximum load. Actual emissions may be less to the extent that the plant may not operate year round or its maximum rated capacity.

Contaminant	Emission (Ton/Yr)
Sulfur Dioxide	584.0
Nitrogen Oxides	477.0
Carbon Monoxide	794.0
Particulate Matter/Particulate $Matter_{10}$	79.0
Volatile Organic Material	8.0
Sulfuric acid mist	17.9
Mercury	0.02

A small amount of particulate matter will also be released from the storage and handling of coal, ash and limestone.

III. APPLICABLE EMISSION STANDARDS

All emission sources 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 proposed plant should readily comply with applicable Board standards.

This project is also subject to the federal New Source Performance Standards (NSPS), 40 CFR 60 Subpart Da, for electric utility steam generating unit greater than 250 mmBtu/hr. The Illinois EPA is administering NSPS in Illinois on behalf of the United States EPA under a delegation agreement. The NSPS sets emission limits for nitrogen oxides, sulfur dioxide and particulate matter emissions from the new boiler. Testing, record keeping, reporting and continuous emissions monitoring are also required.

The proposed plant will be a major source, because it is a fossil-fueled steam electric plant with heat input greater than 250 million Btu/hour and potential emissions greater than 100 tons/year for several regulated pollutants. Therefore, the plant is subject to NSR requirements. Because it is located in an area that is classified as attainment for all criteria pollutants, NSR will take the form of a Prevention of Significant Deterioration (PSD) review.

A major project is one that entails construction of a major source or major modification, i.e., a significant net increase in emissions of an attainment contaminant at an existing major source. This project is considered major or significant for emissions of nitrogen oxides, sulfur dioxide, particulate matter and carbon monoxide.

The proposed plant is also a major source for emissions of hazardous air pollutants (HAP). The potential HAP emissions from the plant will be greater than 10 tons of hydrogen chloride and not more than 25 tons in aggregate for a combination of HAP. Therefore, the plant is being subjected to review under Section 112(g) of the Clean Air Act. Compliance with the proposed emission limits will also assure Maximum Achievable Control Technology (MACT) as the source ultimately is subject to the requirements of Section 112 (g).

IV. PROPOSED PERMIT

Under PSD, an applicant must demonstrate Best Available Control Technology (BACT) for controlling NO_x, SO_2, CO, and PM/PM_{10} emissions. In this application, Corn Belt has provided data supporting that BACT will be achieved as established by the Illinois EPA.

The proposed permit contains limitations on all emissions in accordance with the BACT limit. The conditions of the permit also establish appropriate compliance procedures, including continuous emissions monitoring (CEM), record keeping and reporting requirements, and stack testing. The Permittee may carry out these procedures on an ongoing basis to demonstrate that the plant is operating within the limitations as set forth by the permit and that

emissions are properly controlled.

V. BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

A. Introduction

The Clean Air Act defines BACT as:

". . .an emission limitation based on the maximum degree of reduction . . .which the permitting authority, on a case-by-case basis, taking into account energy, environmental and other costs, determines is achievable . . .".

BACT is generally set by a "Top Down Procedure." In this procedure, the most stringent control requirement in practice elsewhere is assumed to constitute BACT for a particular project, unless the impacts associated with the control requirements are shown to be excessive. This approach has generally been followed by the Illinois EPA.

B. Discussion:

Nitrogen Oxide

Review of the USEPA's BACT/LAER Clearinghouse indicates that selective catalytic reduction in combination with combustion controls as proposed by Prairie Energy Power Plant are the NO_x control measures used on new U-fired boiler. Further add-on control devices have not been used.

Based on available data, the following technologies were reviewed as possible control options for NO_x: 1) selective catalytic reduction, 2) selective non-catalytic reduction, and 3) combustion controls.

Selective Catalytic Reduction (SCR) is the top rated NO_x control technology. It provides 80% control of NO_x emissions. SCR involves the reduction of nitrogen oxide to nitrogen and water through reaction with ammonia. A catalyst bed, usually made of vanadium supported by a titanium structure, is used to reduce the activation energy of the reaction. SCR is applied at temperatures between 600 and 750°F. SCR will result in approximately 80% reduction of NO_x with 3-ppm ammonia slip. The slip is the maximum amount of ammonia that will remain unreacted with the NO_x.

Selective non-catalytic reduction (SNCR) also involves injection of a reactant, but without the use of a catalyst. The effectiveness of this method is dependent on initial NO_x concentration, residence time, mixing and on the temperature in the reaction zone. Typical SNCR control efficiency is 60%. In addition, the exhaust temperature must be in the range of 1400 degree F to 1800 degree F, for SNCR operation. The only place where the temperature is greater than 1400 degrees F in the exhaust gas is in the boiler itself. At that point of application both ammonia and urea injection will result in formation of sulfate compounds that can foul downstream components of the boiler system. SNCR is excluded because SCR is more effective and applying both of them together would not result in a higher overall control efficiency. The technically feasible option for controlling NO_x is use of SCR and combustion control and is therefore proposed for the new U-fired boiler.

For the proposed new U-fired boiler the use of SCR in conjunction with the inherent low-NO_x from the U-fired boiler is the most stringent technically feasible alternative. While this alternative will have greater capital and operating costs than the U-fired boiler by itself, for this new U-fired boiler, the increase is not considered excessive.

A summary of the estimated costs for an SCR system is shown in the application. The cost for SCR, the control technology with the highest control efficiency, is $1,167 per ton of NO_x removal. This level of cost is acceptable; therefore, SCR is determined to represent BACT for control of NO_x emissions from the LEBS.

Sulfur Dioxide

Technically feasible SO_2 control alternatives for the proposed new U-fired boiler include wet lime or limestone scrubbing, flue gas desulfurization (FGD), dual alkali FGD, and dry sorbent injection. Of the available FGD alternatives, wet limestone scrubbing FGD is the most effective

Wet scrubbing utilizes calcium, sodium or ammonium based sorbents in a slurry to react with SO_2 in the waste gas. Limestone is the most favored sorbent material because of its wide availability and relative low cost. The chemical reaction that occurs is as follows:

$$SO_2 + CaCO_3 = CaSO_3 + CO_2$$

The reaction product is calcium sulfate and calcium sulfite sludge. If air is injected into the scrubber reactor, a saleable by-product, gypsum, is formed through oxidation. If there is no market for gypsum, which is the case for this project, then the gypsum can be easily disposed of as a stable material. Wet limestone scrubbing can achieve up to 95% control efficiency.

The estimated cost of a wet limestone scrubber system for the LEBS is shown in the Appendix C to this application. The cost for a limestone scrubber, the control technology with the highest SO_2 control efficiency, is $213 per ton of SO_2 removal. This level of cost is acceptable; therefore, a limestone scrubber is determined to represent BACT for control of SO_2 emissions from the LEBS.

Particulate Matter

For the proposed new U-fired boiler, the alternative controls for particulate matter emissions include fabric filters and ESPs. Wet scrubbers are concluded to not represent a demonstrated control technique for U-fired boiler and do not offer more stringent levels of control of particulate matter than fabric filters or ESPs. Beryllium is emitted as a particulate and represents a fraction of the particulate matter emitted from the facility. Therefore, achieving BACT for particulate matter also achieves BACT for beryllium because the same technology is used to control both PM/PM_{10} and beryllium emissions.

Particulate matter and PM_{10} must be controlled to a level that meets

BACT. Both fabric filters and ESPs can achieve greater than 99% removal of particulate matter. Rather than looking at the incremental cost between the particulate control technologies, the preferred technology, an ESP, is evaluated for cost.

An ESP removes solid or liquid particulate matter from a gas stream by imparting an electrical charge on the individual particle and collecting the charged particle to an oppositely charged surface. The collected particle is then removed from the surface through a mechanical shock and falls through bulk movement to a collection hopper.

The estimated cost of an ESP for the LEBS is shown in the Appendix C of this application. An ESP is comparable in efficiency to other highly ranked particulate control technologies. The cost for an ESP is $200 per ton of particulate matter removal. This level of cost is acceptable; therefore, an ESP is determined to represent BACT for control of PM emissions from the LEBS.

Carbon Monoxide and Volatile Organic Compounds

Carbon monoxide (CO) and volatile organic compounds (VOC) - Control of the emissions of CO and VOC from combustion sources may be effected two ways: (1) combustion modifications to minimize the formation of the pollutants, and (2) flue gas catalytic oxidation of any CO and VOC formed in the combustion process.

Combustion controls are concluded to represent BACT for control of CO and VOC emissions from the U-fired boiler. Catalytic oxidation has been utilized on some combustion sources, but is considered technically infeasible on U-fired boiler.

C. BACT Determination

1. Particulate Matter

The Illinois EPA has determined that BACT for particulate matter emissions from wet bottom PC boilers is a limit of 0.02 pounds per million Btu. This boiler will control PM emissions to this level by an electrostatic precipitator.

2. Sulfur Dioxide

The Illinois EPA has determined that BACT for sulfur dioxide emissions is a limit of 0.15 lb/million Btu and 92% sulfur dioxide removal efficiency if emissions are at or greater than 0.15 lb/mmBtu. The new U-fired boiler will meet this requirement.

3. Nitrogen Oxide

The Illinois EPA has determined that BACT for NO_x emissions continues to be a limit of 0.12 lbs/million Btu for new U-fired boiler. The design of the U-Fired wet bottom boiler limits nitrogen oxide emissions allowing it to meet this limit.

4. Carbon Monoxide

The Illinois EPA has determined BACT to be a limit of 0.20 pounds per million Btu for new PC boiler.

5. Sulfuric acid mist

The Illinois EPA has determined that BACT for sulfuric acid emissions is 17.9 TPY for the new U-fired boiler. Costs for add-on controls for this pollutant are excessive. The limit will be achieved by the mist eliminator section of the wet FGD system.

6. Mercury and Hydrogen Chloride

Mercury emissions are below the PSD applicability criteria. Mercury and Hydrogen Chloride pollutants are potentially subject to future control requirements under 112(g) Emissions of both of these pollutants will be controlled at the facility. Mercury will be controlled through a combination of the SCR, ESP, and wet FDG systems. Hydrogen Chloride will be controlled through the wet FGD system.

VI. 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, been added to the background level of pollutants in the air entering the region, and joined with the pollutants emitted from other nearby sources.

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 microgram per cubic meter, millionth of a gram in a cube of air one meter on a side.

The United States EPA 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 United States EPA 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. For some pollutants several standards are set, for others a single standard may suffice.

Areas can be designated as attainment or nonattainment for criteria pollutants, based on the existing air quality. Locations can either have good air quality complying with the air quality standard for a pollutant, in which case the area is known as attainment. If the air quality standard is exceeded the area is known as nonattainment.

In attainment areas one wishes 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 standard and nonattainment for another or comply with the long-term standard for a pollutant but violate the short-term standard.

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 usually 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 particulate matter, NO_x, and 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 for Corn Belt

An ambient air quality analysis was conducted by a consulting firm, Harza Engineering, on behalf of Corn Belt to assess the impacts of its emissions of PM, SO_2, NO_x and CO on ambient air quality. Under the PSD rules, this analysis must determine whether the proposed project will cause or contribute to a violation of any applicable air quality standard.

Modeling was done incorporating proposed new emissions at Corn Belt and major stationary sources in surrounding areas. The analysis performed conforms to the guidance and requirements of the USEPA and the Illinois EPA. Background concentrations were added to modeled impacts for SO_2, NO_x and PM_{10} National Ambient Air Quality Standards (NAAQS). The highest regional values from the particular averaging period of the most recent three years of IEPA monitoring data were used as background.

Table 1 shows the dispersion modeling results of the Elkhart facility with respect to the NAAQS. The modeled impacts on ambient air quality from CO, PM and NO_x are less than the significant impact levels. Under no circumstances is air quality in a PSD area allowed to deteriorate beyond the National Ambient Air Quality Standard (NAAQS).

TABLE 1

Predicted Maximum Concentrations (ug/m^3)

Pollutant	Averaging Period	Project Impact	Significant Impact Level	Existing Background	Total (Project& Background)	NAAQS
SO_2	24 Hour*	32.9*	5	204.4	280.2	365
SO_2	3 Hour*	141.7*	25	550.2	774.2	1,300
SO_2	Annual	1.95	1	15.7	24.6	80
NO_x	Annual	0.86	1			100
PM	24 Hour**	2.43*	5			150
PM	Annual	0.26	1			50
CO	1 Hour	158.8	2000			40,000
CO	8 Hour	6.9	500			10,000

* Highest Second high concentration

** Sixth highest concentration

PSD areas have predetermined maximum allowable pollution increases for sulfur dioxide, nitrogen oxides and PM_{10}, which cannot be exceeded. These limits are called "allowable increments". (See Table 2).

TABLE 2

Comparison of Predicted Concentration
With the Allowable PSD Increment (ug/m^3)

Pollutant	Averaging Period	Maximum Predicted Conc.	Class II PSD Increment
SO_2	24 Hour*	24.5	91
SO_2	3 Hour*	82.8	512
SO_2	Annual	1.5	20

* Highest second high concentration

In summary Corn Belt has provided adequate information to determine that emissions from the facility, when constructed, will not cause a violation of the relevant National Ambient Air Quality Standard (NAAQS) or a violation of PSD increment allowables.

VII. OTHER ANALYSES

At the above air quality impact levels for NO_x, SO_2, CO and PM_{10} emissions as shown in Tables 1 and 2, there will not be a significant affect on soils,

vegetation or visibility.

VIII. REQUEST FOR COMMENTS

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

Comments are requested on this proposed action by the Illinois EPA and the proposed conditions on the draft permit.

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