Illinois Environmental Protection Agency
Bureau of Air, Permit Section
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Project Summary for the Construction Permit Applications from Ameren and the FutureGen Industrial Alliance, Inc., for Construction of an Oxy-Combustion Power Plant at the Meredosia Energy Center in Meredosia, Illinois

Site Identification No.: 137805AAA
Application No.: 12020013
Date Received: February 9, 2012

Schedule:

Public Comment Period Begins: August 24, 2013
Public Hearing: October 9, 2013
Public Comment Period Closes: November 8, 2013

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I. INTRODUCTION

Ameren Energy Resources Generating Company (Ameren) and the FutureGen Industrial Alliance (Alliance) have submitted a construction permit application for a coal-fired oxy-combustion power plant at Ameren's existing power plant in Meredosia. The proposed project would be developed to enable the use of carbon capture and sequestration technology, with a portion of the carbon dioxide (CO_2) emissions from the plant being captured and sent by pipeline to a sequestration facility. The sequestration facility would be located about 30 miles east of the plant in rural northeastern Morgan County.

The project is being developed so that it will not be accompanied by significant net increases in emissions of pollutants that are addressed by the federal rules for Prevention of Significant Deterioration (PSD), 40 CFR 52.21. In particular, there will be decreases in emissions from permanently shutting down the existing boilers at the Meredosia plant so that the net increases in emissions of PSD pollutants with this project will not be significant.

The Illinois Environmental Protection Agency (Illinois EPA) has reviewed the application and made a preliminary determination that the application for the proposed plant meets applicable requirements. Accordingly, the Illinois EPA has prepared a draft of the construction permit that it would propose to issue for the plant. Before issuing a permit, the Illinois EPA is holding a public comment period and a public hearing to receive comments on the proposed issuance of the permit and on the proposed terms and conditions of the draft permit.

II. PROJECT DESCRIPTION

Ameren and the Alliance have requested a construction permit for an oxy-combustion power plant[1] at Ameren's existing electrical power station in Meredosia, the Meredosia Energy Center. This project, which is formally known as FutureGen 2.0, takes the place of the original FutureGen project.[2] The new plant will generate electricity that will be sent to the grid. In addition, the initial purpose of the plant will be to demonstrate oxy-combustion and carbon capture and sequestration technologies at full-scale for a coal-fired electrical generating unit. As compared to conventional boiler technology, use of oxy-combustion technology will result in a smaller volume of exhaust from the plant with a higher concentration of CO_2 in the exhaust. As a consequence, the CO_2 from the new plant will be able to be more readily captured than

[1] This project is currently a partnership between the United States Department of Energy (USDOE) and the Alliance with cooperation from Ameren. This project is being pursued to provide performance and emissions data and operating and maintenance information that would be necessary for subsequent large-scale projects to be developed commercially that rely on oxy-combustion and/or carbon capture and sequestration technologies. The initial period of operation of the new plant would specifically be designed to evaluate the performance and capabilities of these technologies as installed at this new plant.

[2] The USDOE decided not to pursue the original FutureGen project, which had its inception about ten years ago. That project would have been developed to demonstrate coal gasification technology in conjunction with carbon capture and sequestration. The site selected for that project was also in Illinois, near Mattoon.

from a conventional steam boiler power plant.[3] This will facilitate the use of carbon capture and sequestration technology by the plant. Carbon capture and sequestration is the process of capturing waste CO_2 from large point sources, such as fuel-fired power plants, and transporting and depositing the CO_2 in a permanent storage site, normally an underground geological formation. The development of this technology is being pursued to reduce the emissions of CO_2 to the atmosphere from fuel combustion for power generation and from other large industries, mitigating their contribution to global warming and climate change.

The principal emission unit at the new plant will be a new oxy-combustion coal-fired boiler. This boiler will replace the existing coal and oil-fired boilers at the source, which will be permanently shut down. This boiler will produce steam that will be used to generate electricity in the existing steam turbine generator at the Meredosia Energy Center that was previously supplied by the oil-fired boiler.

Other emission units that would be part of this project include new material handling operations to support the operation of the new boiler and its air pollution control equipment. Minor changes would be made to the existing coal handling operations to enable coal to be supplied to the new boiler. Two new cooling towers would be constructed and an existing cooling tower would be rebuilt. A small, oil-fired auxiliary boiler, which will be installed as part of the new plant, would supply steam for the plant for purposes other than generating electricity when the new coal-fired oxy-combustion boiler is not in service.

III. DESCRIPTION OF THE OXY-COMBUSTION BOILER

The new oxy-combustion boiler would be designed for operation with over 95 percent oxygen. This oxygen would be supplied by an Air Separation Unit that would be built as part of the new plant. The boiler will be designed so that 90 percent of the CO_2 generated during normal operation in oxy-combustion mode would be captured and would not be released to the atmosphere. This CO_2 would be geologically sequestered by means of deep well injection at a site east of Meredosia.[4]

This boiler will also have the capability to operate with air, like a conventional boiler. The boiler would start up with air. The boiler would then transition to the oxy-combustion mode. In the event of an upset in the operation of the boiler or an outage or upset in the CO_2 pipeline or sequestration facility, the boiler could transition back into air-firing mode.

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[3] Oxy-fuel combustion is the process of burning a fuel with oxygen instead of with air, which is about 80 percent nitrogen and only 20 percent oxygen.

[4] The CO_2 injection wells for the FutureGen 2.0 project must be permitted under the federal Underground Injection Control (UIC) program. The USEPA currently administers UIC permitting for proposed CO_2 injection wells in Illinois. USEPA is currently processing the application that the Alliance submitted for the UIC permit for the CO_2 injection well that would be part of this project.

The boiler will be equipped with a multi-step control train to remove pollutants from the flue gas from the boiler and prepare the gas for processing in the CO_2 compression unit. The first step in the system will be a circulating dry scrubber. This device will use hydrated lime to remove sulfur dioxide (SO_2) and other acid gases and mercury from the flue gas. The dry scrubber will be followed by a fabric filter or baghouse, which will remove particulate matter, i.e., flyash and entrained lime, from the flue gas. All flue gas from the boiler would pass through these devices to control emissions of the boiler.

In oxy-combustion mode, the flow of flue gas from the fabric filter will be split into two streams. One stream will be recycled back to the boiler, after being supplemented with oxygen from the Air Separation Unit. The other stream will pass through a "polishing system," with another scrubber and baghouse. The primary purpose of this system is to reduce the moisture content of the flue gas and adjust its temperature for further processing in the Compression Purification Unit. This system will also remove additional SO_2 and particulate from the flue gas. The flow of flue gas from the polishing system is again split, with one stream again being recycled back to the boiler. The other stream will go to the Compression Purification Unit to be prepared for sequestration. The Compression Purification Unit will separate the CO_2 from the flue gas with the remainder of the flue gas, composed mainly of nitrogen, oxygen, argon and some CO_2, then being emitted from the stack for the Compression Purification Unit.

Startup of this boiler will begin on oil in air-firing mode, using air for combustion like a typical boiler, with emissions occurring through the boiler stack. The oil-fired igniters will maintain stable combustion until the boiler can sustain firing of coal. Startup on air will continue until stable operation is achieved with air. The boiler can then transition to the oxy-combustion mode. The oxygen stream from the Air Separation Unit and recycled flue gas will then be substituted for air beginning the transition to oxy-combustion. At this point, flue gas can begin to be processed in the Compression Purification Unit. The CO_2 stream from the Compression Purification Unit can then begin to be sequestered when it meets the specifications for sequestration.

IV. PROJECT EMISSIONS

Meredosia is in an attainment area so that emissions of regulated pollutants from the proposed project are potentially subject to the federal rules for Prevention of Significant Deterioration of Air Quality (PSD), 40 CFR 52.21. Because the existing power plant is a major source under the PSD rules, the proposed project must be reviewed to address whether it is a major modification or major project for one or more PSD pollutants.

The potential increases in emissions from this project are listed below. The potential emissions of the project are generally calculated based on continuous operation of the oxy-combustion boiler at the

maximum emission rate under the mode of operation with the greatest emissions. The actual emissions of the project will be less than these potential emissions. In particular, the oxy-combustion boiler would not normally operate in the mode of operation with the greatest emissions for an entire year. Actual emissions will also be lower to the extent that the plant does not operate at its capacity and operates with a reasonable margin of compliance.

Table 1: Potential Emissions of the Oxy-Combustion Plant	
Pollutant	Potential Emissions (Tons Per Year)
Particulate Matter (PM)	72.9
Particulate Matter$_{10}$ (PM_{10})	97.0
Particulate Matter$_{2.5}$ ($PM_{2.5}$)	97.0
Sulfur Dioxide (SO_2)	323.0
Nitrogen Oxides (NO_x)	1734.4
Carbon Monoxide (CO)	497.6
Volatile Organic Material (VOM)	13.7
Sulfuric Acid Mist	10.5
Lead	0.154
Fluorides	2.8
Greenhouse Gases (GHG), as CO_2e[5]	1,522,503

For many of these pollutants, as further addressed in the following table, the increases in emissions with the proposed plant exceed the significant emission thresholds for a major project under the PSD rules. For these pollutants, the application evaluated the net changes in emissions with this project to show that the proposed plant would not be a major project for purposes of the PSD rules. The sequestration facility was also addressed as part of the netting analysis.[6] This is because the sequestration facility is considered a support facility for this new plant under the provisions of the PSD rules.[7]

The netting analysis considered the decreases in actual emissions that will be contemporaneous with this project. In particular, there will be

[5] CO_2e or carbon dioxide equivalents are the means used by USEPA to address the combined emissions of the compounds that are regulated under the Clean Air Act as greenhouse gases (GHG). Values for global warming potential (GWP) of compounds other than CO_2 have been developed to account the effect that the emissions of those compounds have on global warming compared to CO_2. For these GHG compounds other than CO_2, the mass of emissions of the compound must be multiplied by their GWP to calculate their equivalent mass as CO_2, expressed as CO_2e. The emissions of CO_2 and other GHG compounds in CO_2e are then summed to provide a single value for GHG emissions as CO_2e.

[6] The FutureGen Industrial Alliance has applied to the Illinois EPA for a separate air pollution control construction permit for an emergency diesel engine-generator at the sequestration facility (Application No. 12020051). This engine-generator would be used to supply electricity to the buildings at this facility in the event of a power outage.

[7] In addition to contemporaneous decreases in emissions at the Meredosia Energy Center, this netting analysis also considered contemporaneous increases in emissions. In particular, Ameren installed an emergency diesel engine-generator at this source within the contemporaneous time period.

decreases from the permanent shut down of the existing coal and oil-fired boilers at the Meredosia Energy Center. Considering the decreases in actual emissions of different pollutants that will be contemporaneous with this project, the project will not result in any significant net increases in emissions.[8, 9] The net emissions increases resulting from this project are provided below. For most of the pollutants for which netting was conducted, there will be a substantial net decrease in emissions with the proposed project. This is what one would reasonably expect since the capacity of the new oxy-combustion boiler will be less than the total capacity of the coal-fired boilers at the Meredosia Energy Center. The emissions of the new boiler will also be better controlled than those of the existing coal-fired boilers.

Table 2: Net Changes in Emissions from the Project (tons/year)[10]

Pollutant	Project Emission Increases	Contemporaneous Changes in Emissions		Net Increase	PSD Emission Threshold
		Decreases	Increases		
PM	72.9	313	1.9	-238.2	25
PM_{10}	97.0	313	0.8	-215.2	15
$PM_{2.5}$	97.0	189	0.8	-91.2	10
SO_2	323.0	9,541	0.4	-9217.6	40
NO_x	1734.4	2,813	32	-1047.6	40
CO	497.6	1369	39.4	-832.0	100
Acid Mist	10.50	3.58	-	6.92	7

[8] Four of the existing coal-fired boilers were removed from service in November 2009. The other coal-fired boiler and the oil-fired boiler were removed from service in January 2012. The decreases in emissions that result from the permanent shut down of these boilers were determined as the “baseline emissions” of these boilers, that is, the average actual annual emissions of these boilers during the 24-month period from March 2007 through February 2009, during which period all these boilers operated.

The Meredosia Energy Center is an affected source under the federal Acid Rain Program. Data for the fuel heat input to the existing boilers and their emissions of SO_2, NOx and CO_2 is directly collected by monitoring required under the Acid Rain Program. For particulate matter, the actual emissions of the existing boilers were determined using the monitored data for the heat input to the boilers and source-specific emission factors developed from the result of emission testing supplemented as needed with standard ratios for the size distribution of particulate. For CO, the actual emissions of the existing boilers were also determined using the monitored data for the heat input and a site-specific emission factor for the boiler with process instrumentation for CO and a standard emission factor for the other boilers. As the existing boilers have operated in compliance with applicable emission standards, downward adjustments to monitored emission data and emission factors were not needed to address excess emissions.

[9] The permitting of the project also relies on a small decrease in emissions of particulate matter, 3 tons/year, from the existing cooling tower at the Meredosia Energy Center which will be rebuilt as part of this project.

[10] Emissions of VOM, lead and fluorides are not addressed in the netting analysis. This is because the emissions of these pollutants from the proposed project are below the significant emission rate under the PSD rules, i.e., 40, 0.6 and 3 tons/year, for VOM, lead and fluorides, respectively.

GHG, as CO_2e	1,522,503	1,937,858	2,280	-413,075	75,000

In summary, for the proposed project, the increases or net increases in emissions of different pollutants regulated by the PSD rules are below the respective PSD significant emission thresholds. Accordingly, the project is not considered a major project for any pollutant regulated by the PSD rules. Accordingly, the substantive requirements of the PSD rules do not apply to the project for any pollutant.

V. APPLICABLE EMISSION STANDARDS

All emission units in Illinois must comply with state emission standards adopted by the Illinois Pollution Control Board. The state's emission standards represent the basic requirements for sources in Illinois. The application demonstrates that the proposed new emission units should readily comply with applicable state standards.[11]

Certain emission units that are being built as part of this project would also be subject to federal New Source Performance Standards (NSPS), at 40 CFR Part 60. The oxy-combustion boiler will be subject to the NSPS for Electric Utility Steam Generating Units, 40 CFR 60 Subpart Da. The auxiliary boiler will be subject to the NSPS for Industrial-Commercial-Institutional Steam Generating Units, 40 CFR 60 Subpart Dc. New coal handling operations to serve the oxy-combustion boiler will be subject to the NSPS for coal preparation plants, 40 CFR 60 Subpart Y. The various units that are subject to the NSPS should readily comply with these standards.[12]

Certain emission units that are part of this project would also be subject to federal National Emission Standards for Hazardous Air Pollutants (NESHAP), at 40 CFR Part 63. The oxy-combustion boiler will be subject to the NESHAP for Electric Utility Steam Generating Units, 40 CFR 63 Subpart UUUUU. The auxiliary boiler will be subject to the NESHAP for Industrial-Commercial-Institutional Steam Generating Units, 40 CFR 63 Subpart JJJJJJ. These boilers should readily comply with these standards

VI. DRAFT PERMIT

[11] The state standard for CO emissions from fuel combustion units, 35 IAC 216.121, will apply to the oxy-combustion boiler when it is in air-firing mode. This standard will not apply to this boiler when it is in oxy-combustion mode, i.e., the boiler is being fired with oxygen and recirculated flue gas rather than with air. This is because 35 IAC 216.121 only addresses boilers fired with air, as it limits CO emissions from a fuel combustion unit to 200 ppm, corrected to 50 percent excess air.

[12] The draft permit for the proposed power plant does not address the requirements of the NSPS for Greenhouse Gas Emissions for Electric Utility Generating Units, 40 CFR 60 Subpart TTTT, proposed by USEPA in the Federal Register on April 13, 2012 (77 FR 22392; FR Doc. 2012-07820). This is because USEPA has not completed this rulemaking. However, the plant would be designed to sequester CO_2, as the USEPA proposed for new coal-fired generating units.

The Illinois EPA has prepared a draft of the construction permit that it would propose to issue for the proposed oxy-combustion power plant. The conditions of the permit set forth the air pollution control requirements that the plant must meet. These requirements include the applicable emission standards that apply to the new emission units. They also include the measures that must be used and the emission limits that must be met for emissions of different regulated pollutants from the project.

The permit also establishes enforceable limitations on the amount of emissions for which the plant is permitted. Limits are established for the emissions of pollutants from this plant to ensure that the project is not subject to the federal PSD rules. In addition, to limit annual emissions, the permit includes short-term emission limits and operational limits, as needed to provide practical enforceability of the annual emission limits.

The permit also establishes appropriate compliance procedures to accompany the emission limits, including requirements for emission testing, required work practices, emissions monitoring, operational monitoring, recordkeeping, and reporting. These measures are imposed to assure that the operation and emissions of the source are appropriately tracked to confirm compliance with the various limits and requirements established for individual emission units.

VII. REQUEST FOR COMMENTS

It is the Illinois EPA’s preliminary determination that the application for an air pollution control construction permit for the proposed oxy-combustion power plant meets all applicable state and federal requirements, subject to the conditions in the draft permit. The Illinois EPA is therefore preparing to issue a construction permit for this plant. Comments are requested on this proposed action by the Illinois EPA and the conditions of the draft permit.