I INTRODUCTION

Southern Illinois Power Cooperative (SIPC) is proposing three projects at its Marion Power Generating Station, on Lake of Egypt, south of Marion. The facility has four existing coal fired generating units. Units 1-3 are each rated at 33 MW capacity. Unit 4 is rated at 173 MW. electrical power. Steam produced in these boilers is primarily used for electric power generation. All four units burn a blend coal and coal refuse. SIPC is proposing to proceed with three significant projects at the Marion Generating Station. Project I consists of constructing a new CFB boiler to replace Units 1 through 3. The boiler would be designed to use coal refuse its main fuel. Project II consists of installing two natural gas fired simple cycle combustion turbines, to be used as peaking generators, during periods when demand for power is greater or when other units are out of service. Project III consists of installing a selective catalytic reduction (SCR) system for NO_x on Unit 4. These projects are expected to provide flexibility and efficiency in meeting current needs as well as accommodating future needs.

II. PROJECT DESCRIPTION

Project I - In a CFB boiler, crushed limestone is added directly into the bed of the boiler with the fuel, and air is forced in from the bottom. The pressure floats the limestone and fuel within the combustion chamber allowing it to behave like a fluid. This provides certain combustion benefits, including reduced formation of nitrogen oxides (NO_x). In addition the limestone chemically absorbs sulfur dioxide (SO_2) directly from the gases in the boiler, reducing SO_2 emissions. Particulate matter (PM) suspended in the flue gas, as well as fine particulates of limestone, are captured by a fabric filter, also known as a baghouse.

The emissions of the new boiler are listed below. Potential emissions are calculated based on continuous operation at the maximum load. Actual emissions will be much less to the extent that the boiler probably will not operate continuously at the maximum rated load

Contaminant	Emission (Ton/Yr)
Sulfur Dioxide	3,690.0
Nitrogen Oxides	841.0
Carbon Monoxide	921.0
Particulate Matter	67.5
Particulate $Matter_{10}$	67.5
Volatile Organic Material	44.2

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

Project II – The two gas turbines will fire natural gas as the primary fuel and distillate fuel oil as a backup. The turbines will be used in a simple cycle configuration, with all power produced by a generator connected to the shaft of the turbine. This facility is designed to function primarily as a peaking station, to generate electricity in the peak demand periods, and at other times when other power plants are not available due to scheduled or forced outages.

The nitrogen oxide (NO_x) emissions from each turbine are controlled through dry low NO_x combustors while burning natural gas. If fuel oil is used, water injection will be used for NO_x emission control. Low NO_x combustors lower NO_x formation by controlling flame turbulence and staging the mixing of fuel and combustion air. Water injection controls (lowers) the combustion temperature of the fuel to lower the NO_x emissions.

The total annual emissions from the combustion turbines are limited to 119 tons of NO_x, 106 tons of CO, 10 tons of PM, 11 tons of SO_2 and 4 tons of VOM. These limits are based on the manufacturer's experience with similar equipment and their expected values at various modes of operation, loads and types and varying quantity of fuel, based on the potential utilization of the generation system. Actual emissions will be less than the maximum limited emissions.

Project III –The Selective Catalytic Reduction (SCR) system will significantly reduce nitrogen oxide emissions from existing Unit 4 coal fired boiler. SCR system is considered a pollution control device.

SCR is a post-combustion control technology in which ammonia is injected downstream of the boiler and reacts with NO_x in the presence of a catalyst to form water and nitrogen. The catalyst's active surface is usually a noble metal. The SCR system is expected to achieve approximately an 85% reduction in NO_x emissions.

The total annual emissions decrease from the SCR system is estimated to be 2,362 tons of NO_x per year.

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 projects boiler should readily comply with applicable Board standards.

The new CFB boiler and turbine projects are also subject to federal New Source Performance Standards (NSPS), 40 CFR 60 Subpart Da, for electric utility steam generating unit greater than 250 million Btu/hr and Subpart GG for gas turbines. 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 CFB boiler and gas turbines only. Testing, record keeping, reporting and continuous emissions monitoring are also required.

The existing Marion Generating Station is a major source of emissions for purposes of federal rules for Prevention of Significant Deterioration (PSD), 40 CFR 52.21. Under PSD, major project is one, which entails construction of a major source or major modification, i.e., a project that results in a significant net increase in emissions of an attainment contaminant at an existing major source. Therefore, the proposed projects at the Marion Generating Station would be subject to NSR requirements if the projects result in a net change in emissions, after considering contemporaneous and creditable emissions increases and decreases when summed with the emissions from the projects, which exceeds any of the significant emission rates listed below.

The new emission units are considered a major modification for CO. For emissions of nitrogen oxides, sulfur dioxide, volatile organic materials, and particulate matter, the net increase accompanying the operation of the new boiler and combustion turbines is less than the significance level (less than 40, 40, 40 and 15 tons/year, respectively). The net increase for carbon monoxide is above the significance level, as discussed below. The new boiler's emission rates for other contaminants are not significant.

Under federal regulations (40 CFR 52.21(b)) a modification to an existing major source of air pollution is subject to NSR permitting requirements if the modification results in a net emission increase for any pollutant greater than the following significant emission rates:

Pollutant	Significant Emission Rate (Tons/Year)
Nitrogen Oxides (NO_x)	40
Sulfur Dioxide (SO_2)	40
Carbon Monoxide (CO)	100
Ozone (As VOM)	40
Total Suspended Particles (TSP)	25
Small Particles (PM_{10})	15
Lead	0.6

IV. NET CHANGE IN EMISSIONS

The net change in NO_x, SO_2, CO, VOM, TSP, PM_{10}, Lead and H_2SO_4 emissions accompany the project is shown below in Tables I and II. The emissions for the existing four boilers are based on average actual data from previous representative years. This evaluation was made in terms of emissions of criteria pollutants. This evaluation describes the potential change in emissions for the purposes of regulation applicability. In performing this accounting of increases and decreases one must also consider other current projects.

Emission estimates for the existing Units 1 through 4 were based on continuous emission monitoring data, annual emission reports, and AP-42 emission factors, as appropriate for each pollutant. Emission estimates for the two most recent years of operation (1998 and 1999) were used to establish baseline (pre-modification) emissions. Creditable emission decreases will be available from retirement of Units 1 through 3 and installation of selective catalytic reduction for NO_x on Unit 4.

Emission estimates for the proposed circulating fluidized bed (CFB) boiler, combustion turbines (CTs), and associated material handling facilities were based on equipment vendor guarantees and AP-42 emission factors, as appropriate for each pollutant. Predicted emission increases assumed the highest annual capacity factors expected following completion of the projects.

The overall increases and decreases from the proposed combustion turbines new CFB boiler and existing coal fired boilers are shown in Table III. The operation of the new boiler will be coordinated with the operation of the combustion turbines and the existing coal fired boiler with added SCR so that net significant increases in emissions of SO_2, PM, VOM and NO_x do not occur, except for CO. The expected operation of the new facility reflecting predominant usage of the new boiler (85%), significant usage of the existing coal fired boiler (85%) and limited usage of combustion turbines (22%) shows substantial decrease in emissions.

TABLE I –INCREASES IN EMISSIONS

Proposed Overall Increases for Combustion Equipment:

Pollutant	Material Handling Increases	CFB Increases*	CT Increases*	Total Increases	Significant Emission Rate
	(Tons/Yr)	(Tons/Yr)	(Tons/Yr)	(Tons/Yr)	(Tons/Yr)
NO_x	----	715.1	118.6	833.7	40
SO_2	----	3,131.8	11.0	3,142.8	40
CO	----	783.0	105.9	888.9	100
VOM	----	37.6	4.0	41.5	40
TSP	10.52	57.4	10.1	78.1	25
PM_{10}	2.81	57.4	10.1	70.3	15
Lead	----	0.085	0.001	0.09	0.600
H_2SO_4	----	47.9	1.2	49.1	7

TABLE II – DECREASES IN EMISSIONS

Proposed Contemporaneous and Creditable Decreases for Combustion Equipment

Pollutant	Unit 4 SCR Decreases*	Unit 1, 2 & 3 Decreases	Total Decreases
	(Tons/Year]	(Tons/Year)	(Tons/Year)
NO_x	2,361.9	2,329.8	4,691.7
SO_2	------	12,227.4	12,227.4
CO	------	55.4	55.4
VOM	------	9.5	9.5
TSP	------	83.0	83.0

PM_{10}	------	56.4	56.4
Lead	------	0.087	0.09
H_2SO_4	------	278.2	278.2

Note: * - Highest expected capacity factor for CFB, Unit 4, and CTs during the years 2003 - 2013 for each combustion source expected is 85%, 85%, and 22%, respectively.

All contemporaneous and creditable increases and decreases are summed with the increases from the proposed modification to determine if a significant net emissions increase will occur. The estimated emission increase, decreases and net changes are summarized below.

TABLE III – NETTING FOR EMISSIONS
Annual Net Emissions Calculation for Marion Station Combustion Equipment

Pollutant	Total Increase	Total Decrease	Net Change	Major Modification Threshold
	(Tons/Year)	(Tons/Year)	(Tons/Year)	(Tons/Year)
NO_x	833.7	4,691.7	- 3,858.0	40
SO_2	3,142.8	12,227.4	- 9,084.6	40
CO	888.9	55.4	833.5	100
VOM	41.5	9.5	32.1	40
TSP	78.1	83.0	- 5.0	25
PM_{10}	70.3	56.4	13.9	15
Lead	0.09	0.09	0	0.600
H_2SO_4	49.1	278.2	- 229.0	7

Notes: The total increase in pollutant emissions represents the operation of the new CFB boiler system, including the associated material handling operations, and existing coal fired boiler at a projected maximum annual capacity factor of 85%, and the operation of two new combustion turbines at a projected maximum annual capacity factor of 22%. Operation of the CFB boiler system is described in the permit #00070030, while operation of the combustion turbines is described in a separate permit #00070029.

The total decrease in pollutant emissions represents retirement of three existing boilers (Marion Generating Station Units 1 through 3), as described in this permit, and installation of selective catalytic reduction on a fourth existing boiler (Marion Generating Station Unit 4), as described in a separate permit #00070028.

The net change in pollutant emissions is the Total Increase minus the Total Decrease. Although the actual net change in emissions each year may not be exactly as shown in the table, there will never be a net increase above the Major Modification Threshold for any pollutant except carbon monoxide.

It can be seen that carbon monoxide (CO) is the only pollutant for which there will be a significant net increase in emissions. Therefore, CO is the only pollutant for which the projects are subject to NSR.

The following sections describe the criteria, input data, assumptions, methods, and calculations used to evaluate NSR applicability.

The Illinois EPA therefore is proposing to issue a construction permit to allow construction and initial operation of the CFB boiler firing bituminous coal refuse, bituminous coal, petroleum coke and other incidental minor sources of solid fuel so as to meet tonnage emission limitations for NO_x, SO_2, CO and PM on a 12 months rolling average. Emissions of NO_x and SO_2 shall be measured on a daily basis in lb/day using a continuous emission monitoring system. PM and CO emissions shall be calculated using fuel consumption and supporting technical data.

The permit will contain appropriate conditions to assure that the new boiler will not result in a significant net increase in emissions for any pollutant except CO. Compliance with emission limitations on SO_2 and NO_x, will be determined from a daily computer report using data from the continuous emission monitoring and data acquisition system showing daily emission rates in lb/Million Btu for the new boiler.

This project is subject to Prevention of Significant Deterioration (PSD) review as a major modification because the expected increase in emissions of CO is greater than the significant emission level. Emissions of PM, VOC, SO_2, and NO_x are expected to decrease or not increase significantly. The PSD rules, which were intended to preserve clean air, require: 1) an “emission limit” on new or modified equipment which represents Best Available Control Technology (BACT), 2) an air quality assessment of the impact of new emissions, and 3) an analysis of impacts on soils, vegetation, and visibility. The Illinois EPA has been delegated authority by USEPA to administer the PSD program in Illinois.

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

Carbon monoxide - Control of the emissions of CO from combustion sources may be effected two ways: (1) combustion modifications to minimize the formation of CO, (2) add-on control devices to reduce CO formed in the combustion process by catalytic or (3) thermal oxidation.

Thermal oxidation reduces CO emissions by supplying adequate heat and oxygen to convert CO to CO_2. Thermal oxidation requires operating gas temperatures of 1500°F and greater to achieve significant oxidation of CO to CO_2. These temperatures are present in the exhaust gas outlet of the units themselves. Accordingly a subsequent device to operate at these temperatures is not technically feasible.

Catalytic Oxidation system are designed such that the exhaust gas passes over a precious metal catalyst surface which promotes the oxidation reaction of carbon monoxide to form carbon dioxide. Catalytic oxidation requires temperature of 1000°F and greater to achieve significant oxidation of CO to CO_2. Because particulate matter in the coal fired boiler exhaust would likely poison the catalyst surface, a catalytic oxidation system would need to be located downstream of the baghouse. Since the outlet temperature from a baghouse is less than 350°F, catalytic oxidation is not technically feasible. Catalytic oxidation has been utilized on some combustion sources, but is considered technically infeasible on CFB boilers.

Catalytic Oxidation as applied to turbines consists of a passive reactor located in the gas turbine exhaust duct. Exhaust gas passes over the catalyst surface, promoting the oxidation reaction of CO to CO_2. This reaction occurs spontaneously, without the need to inject reactants such as ammonia into the exhaust gas. Optimal catalytic control of CO generally is achieved within an exhaust gas temperature range of 700^0 F to 900^0 F. The exhaust gas temperature of the Marion gas turbine is expected to range from 948^0F to $1,100^0$F, depending on the operating load and the ambient air temperature. The temperature range for these turbines should be feasible for the oxidation catalyst.

Combustion Controls: The other method for controlling CO emissions is by the design and operation of the unit in a manner so as to limit formation of CO. Such controls are commonly referred to as combustion controls. The Marion Fluidized Bed Boiler Control System will maintain proper boiler conditions to ensure complete combustion through the following design features: uniform fuel/air distribution and mixing, oxygen monitoring and adjustment of staged combustion air to minimize CO formation.

Catalytic oxidation is not justifiable as BACT for this project for the following reasons: 1. The cost of catalytic oxidation is estimated to be excessive for BACT. 2. The peaking turbine may sometime burn distillate oil, which is significant degradation of catalyst. 3. Turbines will operate at low annual capacity factor, and will be equipped with efficient combustion systems, and 4. Catalytic oxidation has not been demonstrated on any operating simple cycle unit as large as these or with a range of exhaust gas temperatures as high these turbine temperatures.

Combustion controls are concluded to represent BACT for control of CO emissions from the new CFB boiler and gas turbines and 25 ppmvd for the new gas turbines.

C. BACT Determination

Carbon Monoxide

The Illinois EPA has determined BACT to be a limit of 0.15 pounds of CO per million Btu for new CFB boiler.

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 people 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 time 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, or 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 SIPC

An ambient air quality analysis was conducted by a consulting firm, McVehil-Monnett Associates, on behalf of SIPC to assess the impacts of CO emissions from all of the proposed new Marion facilities 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 SIPC and major stationary sources in surrounding areas. The analysis performed conforms to the guidance and requirements of the USEPA and the Illinois EPA.

Table IV shows the dispersion modeling results of the Marion facility with respect to the National Ambient Air Quality Standards (NAAQS) and the significant impact levels specified in federal regulations. The modeled impacts on ambient air quality from CO emissions are much less than the NAAQS and the significant impact levels.

TABLE IV

Comparison of Predicted Concentrations (ug/M^3) and Applicable National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Period	Maximum Project Impact	Significant Impact Level	NAAQS
CO	1 Hour	109.3	2,000	40,000
CO	8 Hour	26.6	500	10,000

PSD areas have predetermined maximum allowable pollution increases for sulfur dioxide and nitrogen oxides, which cannot be exceeded. These limits are called “allowable increments”. However, there are no applicable allowable increments for CO. The NAAQS were established to protect human health and environmental values. Under no circumstances is air quality in a PSD area allowed to deteriorate beyond the NAAQS.

Air quality modeling was also conducted for SO_2, NO_X and PM10 from the proposed new Marion sources. For NO_X and PM10, all predicted concentrations are less than the applicable significant impact levels.

For SO_2, the model analysis included all emission sources that will be operating at the Marion plant after completion of the proposed project, as well as proposed new emissions from major stationary sources in the surrounding area. Background concentrations were added to modeled impacts for comparison with the SO_2 NAAQS. The highest regional values from the particular averaging period of five years of Illinois EPA monitoring were used as background. All predicted total SO_2 concentrations, including background concentrations, were far below the NAAQS.

In summary, SIPC has provided adequate information to determine that emissions from the CFB boiler and combustion turbines, when constructed, will not cause a violation of the relevant NAAQS.

VII. OTHER ANALYSES

At the air quality impact levels for NO_x, SO_2, PM10, and CO as indicated by air quality modeling,, there will not be any significant effect on soils, vegetation or visibility.

VIII. REQUEST FOR COMMENTS

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

Prior to meeting a final determination, a public comment period will be held to obtain comments from the public. The Illinois EPA will hold a public hearing on April 18, 2001 at 7:00 p.m. at Marion High School Auditorium, 1501 South Carbon Street, Marion, Illinois. The hearing will be held by the Illinois EPA to receive comments and data and to answer questions from the public prior to making a final decision concerning the permit. Lengthy comments and questions should be submitted to the Illinois EPA in writing. Written comments must be postmarked by midnight May 18, 2001. Comments need not be notarized and should be sent to, Bill Seltzer, Hearing officer, Illinois Environmental Protection Agency, 1021 North Grand Avenue, East, P. O. Box 19506, Springfield, Illinois 62794-9506 Telephone: 217/782-5544 217/782-9143 TDD

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