Air Quality Impact Analysis Review

Westar Energy, Inc
Jeffrey Energy Center Unit 3
NO_x Reduction Project

Kansas
Department of Health
and Environment
Bureau of Air
Air Permitting Section

Source ID No. 1490001
C-9842

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I. Introduction

Westar Energy, Inc. (Westar) submitted a prevention of significant deterioration (PSD) air permit application for a NO_x Reduction Project, which consists of upgrades to existing low NO_x burners, adjustments to existing separated overfire air (SOFA), and additional SOFA for deeper staging, boiler tuning, and installation of associated equipment to the existing Jeffrey Energy Center Unit 3 steam generator. The PSD application was received by KDHE on October 21, 2011. Amendments were submitted December 15, 2011.

An Air Quality Impact Analysis (AQIA) is required as part of a PSD construction permit application to show the impact of the proposed project on the National Ambient Air Quality Standards (NAAQS) and air quality-related values. This document summarizes the KDHE review and evaluation of Westar's AQIA.

Dispersion modeling for this project includes a demonstration of compliance with the NAAQS for carbon monoxide (CO), since it is the only primary pollutant for which emissions increase due to the NO_x Reduction Project, and which exceeds the PSD significant emission rate for CO of 100 tons per year.

II. Facility Description

The existing Jeffrey Energy Center (JEC) facility is a pulverized coal (PC) electric generating station. Unit 3 is a steam generator is designed to use low sulfur Powder River Basin (PRB). The facility is located in Pottawatomie County, Kansas. Pottawatomie County is designated as an attainment area for all criteria pollutants.

III. Air Quality Impact Analysis Applicability

The proposed facility is a major source as defined by K.A.R. 28-19-350, Prevention of Significant Deterioration. Therefore, the owner or operator must demonstrate that allowable emission increases from the proposed facility would not cause or contribute to air pollution in violation of:

1) any NAAQS in any air quality control region; or
2) any applicable maximum allowable increase of PM_{10}, SO_2, or NO_2 over the baseline concentration in any area (increment).

The emissions changes from the proposed project and significant emission thresholds are listed in Table 1 below. New major stationary sources with pollutant emissions exceeding significant emission rates must undergo PSD review.

Table 1. Emissions Change From the Proposed Project and PSD Significant Emission Rates					
Pollutant	**Baseline Actual Emissions (tpy)**	**Future Projected Actual Emissions (tpy)**	**Emissions Change (tpy)**	**Significant Emission Rate (tpy)**	**PSD Review Required**
CO	4,213	10,634	6,421	100	Yes
NO_x	4,521	3,722	-799	40	No
CO_2	5,502,851	5,492,763	-10,088	75,000	No

IV. Model Selection

The emissions were modeled using the latest version (11126) of AERSCREEN. AERSCREEN is based on AERMOD, EPA's preferred near-field dispersion model, and replaces SCREEN3 as the recommended screening model based on the *Guideline on Air Quality Models*. Similar to SCREEN3, AERSCREEN allows for user entry of emission inputs, source coordinates, building information (for downwash), receptor information, and meteorological information, either through an input file, or interactive prompts. However, AERSCREEN incorporates several enhancements relative to the SCREEN3 model. For example, AERSCREEN generates application-specific worst-case meteorology, via MAKEMET, that takes full advantage of the boundary layer scaling algorithms implemented in the AERMET meteorological processor using representative minimum and maximum ambient air temperatures, and site-specific surface characteristics (albedo, Bowen ratio, and surface roughness). AERSCREEN incorporates the PRIME downwash algorithms that are part of the AERMOD refined model and utilizes the BPIPPRIME tool to provide a detailed analysis of downwash influences on a direction-specific basis. AERSCREEN also incorporates AERMOD's complex terrain algorithms and utilizes the AERMAP terrain processor to account for the actual terrain in the vicinity of the source on a direction-specific basis[1].

AERSCREEN was produced to give the user two options for modeling: either by using the command prompt interface to give a more automated process for the user or by using the MAKEMET program which gives the user more flexibility for defining receptors. The KDHE analysis used the command-prompt interface of the AERSCREEN model for this air quality impact analysis because the MAKEMET approach is more appropriate for an area with a more complex terrain than Pottawatomie County. All "regulatory default" options in the AERSCREEN model were used for this air quality impact analysis.

Based on the proposed facility emissions, carbon monoxide (CO) was evaluated as part of the AQIA. AERSCREEN was used by Westar to evaluate the impacts of CO that will result from the NO_x Reduction Project for 1-hour CO and 8-hour CO. Westar's evaluation was reviewed by KDHE using AERSCREEN version 11126.

[1] *AERSCREEN Released as the EPA Recommended Screening Model* Memorandum by Tyler Fox issued on April 11, 2011 (http://www.epa.gov/ttn/scram/20110411_AERSCREEN_Release_Memo.pdf).

V. Model Inputs

A. Source Data

The emission rate, point location, and stack parameters for the emission source used in the model were based on the data presented in the permit application and amendments. Modeling runs were conducted at full and partial loads to confirm that operation of the steam generator would not result in impacts greater than the NAAQS or PSD increments. Westar submitted modeling for worst case load conditions (see permit application, page D-4). In KDHE verification runs, Unit 3 load and hourly emission rates were modeled at different load points (100%, 75%, and 50%) to account for varying loads and process conditions. This methodology will account for various conditions that are expected to be experienced at the facility. The input data are shown in the table below.

Table 2. Stack Parameters For Unit 3[2]

Load	Stack height (ft)	Stack diameter (ft)	Exit temperature (°F)	Exit velocity (ft/s)
100%	574	25.5	125	64.94
75%				50.19
50%				35.64

B. Urban or Rural

After a review of the appropriate satellite imagery and land use data obtained from the U.S. Geological Survey (USGS), it was concluded that the area is "rural" for air modeling purposes. Refer to Figure 1 for a detailed image showing land use surrounding Jeffrey Energy Center.

[2] Emissions from this unit are based on 1,466 lb/hr.

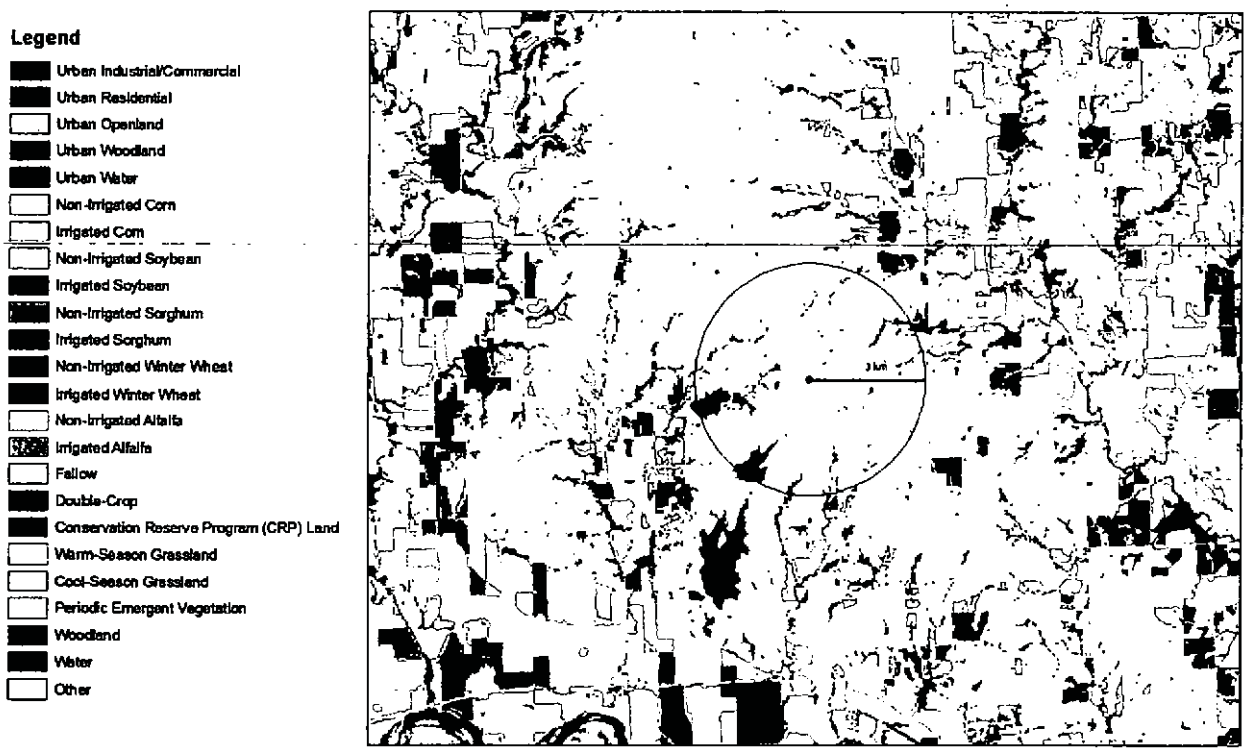

Figure 1. Jeffrey Energy Center Land Use Map

C. Terrain

The facility submitted modeling which included terrain as an input parameter. The terrain in the vicinity of the facility is relatively flat. Therefore terrain was not included in the KDHE verification modeling. Modeled concentrations did not vary significantly between facility and KDHE runs.

D. Meteorological Data

AERSCREEN estimates concentrations without the need for the user to input meteorological data. The "regulatory default" settings for minimum and maximum temperature, minimum wind speed, and anemometer height were used to determine the meteorology in this model. The meteorology was calculated using the AERMET seasonal tables. Based on information shown in Figure 1, option number six selection of "Grassland" was used to represent surface characteristics. Pottawatomie County is considered to be average moisture since northeast Kansas is not classified as an arid region.

E. Building Downwash

Good engineering practice stack height for stacks constructed after January 12, 1979 is defined as the greater of:

- 65 meters, measured from the base of the stack, and
- Stack height calculated from the following formula:

$$Hg = H + 1.5L$$

Where
Hg = the GEP stack height
H = the height of the nearby structure
L = the lesser of the building height or the greatest crosswind distance of the building also known as maximum projected width

The model's Building Downwash option was selected and the building dimensions supplied by Westar were used for the model run.

F. Receptors

Receptors were placed so that the maximum offsite ground-level concentrations can be determined. The only receptor information that AERSCREEN requires in its command-prompt user interface program is the maximum receptor distance, the distance to ambient air, and the height of any flagpole receptor.

The facility modeling was conducted with a minimum distance to ambient air of 1,470 meters from Unit 3. After a review of the Google Earth image shown in Figure 2 and additional discussions with the facility, KDHE verification runs were conducted with a minimum distance to ambient air of 621 meters. Figure 2 shows the approximate minimum distance to ambient air from Unit 3 to public access via a public road. In both cases, maximum impacts occurred at 1515 meters. For the maximum distance to a receptor, a value of 10 kilometers was used. Flag pole receptors were not used in the model.

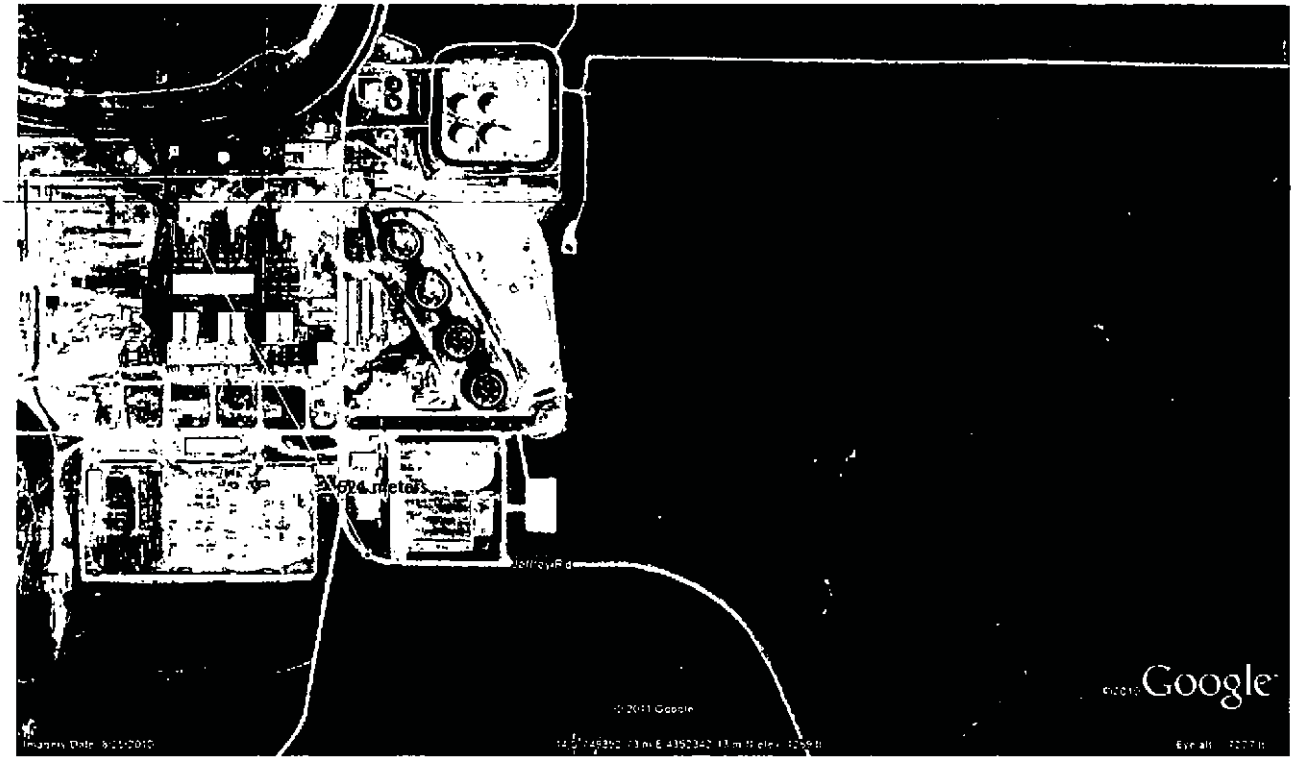

Figure 2. Map Showing Jeffrey Energy Center Unit 3 and Proximity to Ambient Air

VI. Significance Determination

A facility that proposes to emit any pollutant above the PSD significant emission rate thresholds must submit an ambient air quality impact analysis. In order to determine if a full impact model analysis and/or ambient air monitoring is necessary, a facility must complete a preliminary modeling analysis. The preliminary analysis includes only the proposed source or modification so it can be determined if a significant modeled impact will take place. For each pollutant that the model predicts the high first high concentration to be below the significant impact level (SIL) threshold, no further analysis is necessary for that pollutant.

The AERSCREEN program includes averaging time factors for worst-case 1-hour and 8-hour averages. The results from the significance determination are shown in Table 3 below.

Table 3. Significance Determination Table[3]				
Averaging Period	Maximum Concentration ($\mu g/m^3$)	Proposed Emission rate (lb/hr)	Modeling SIL ($\mu g/m^3$)	Exceeds SIL?
1-hour	453.90	1466	2,000	No
8-hour	408.50		500	No

For the 1-hour and 8-hour CO averaging periods the modeled impacts for the proposed facility fall below the modeling SIL. Therefore, no refined modeling is required. The modeling results are also well below the pre-application monitoring threshold of 575 $\mu g/m^3$ for the 8-hour averaging period. There is no pre-application threshold established for the 1-hour averaging period. Therefore, pre-construction monitoring is not required for CO.

VII. Additional PSD Impact Analyses

A. Commercial, Residential, and Industrial Growth

The growth analysis considers predicted air quality impacts due to emissions resulting from the commercial, industrial and residential growth associated with the NO_x Reduction Project. Only permanent growth is considered and impacts from emissions from temporary and mobile sources are not included in the analysis.

There will be no associated growth due to the NO_x Reduction Project. Project construction will be limited and no commercial or residential growth is projected to occur because of this project. Given the temporary nature of the construction and the lack of other source growth in the area, this project is not expected to cause any adverse construction or growth related air quality impacts

B. Visibility Impairment

Federally designated Class I areas are afforded special protection in the air permitting process. Generally, Class I area visibility analyses are only conducted for projects located within 100 km of a Class I area. The nearest Federal Class I Area is Hercules Glades Wilderness Area in Missouri, over 400 km from the proposed project.

An additional visibility impact analysis may be used to determine if the air emission increases associated with a proposed PSD project will have an impact on Class II sensitive areas such as state parks, wilderness areas, or scenic sites and overlooks. Visibility

[3] See also Appendix D of the PSD permit application.

impairment is a function of the emissions of primary particulate matter, NO_x (including NO_2), elemental carbon (soot), and primary sulfate (SO_4). This project will substantially decrease the emissions of NO_x, thereby improving visibility over current conditions. As CO, not a visibility impairing pollutant, is the only pollutant with an emission increase, the project is not predicted to negatively impact visibility.

A visibility analysis was not required since the proposed project results in a substantial decrease in NO_x emissions and there is no increase in any other visibility-impairing pollutants.

C. Vegetation

Air pollutants can affect vegetation through direct absorption through the foliage, or uptake from the soil of trace elements deposited in the soil. The effects of air pollution on vegetation can include visible damage to foliage and fruit, changes in metabolic function, adverse changes in plant activity, and crop yield reduction. The effects of air pollutants on vegetation fall into three categories: acute (short exposure to high concentration), chronic (lower concentration over months or years), and long term (abnormal changes to ecosystems and physiological alterations in organisms that occur gradually over very long time periods).

Analysis of the land cover of the area surrounding JEC shows the primary land cover in the immediate area around JEC is warm-season grassland. This local area is surrounded by agricultural use, such as corn and soybean farming.

According to EPA publications, there are no reports of measured CO levels producing any adverse effects on plants[4]. In its most recent review of the CO NAAQS, EPA concluded that "the currently available scientific information with respect to non-climate welfare effects, including ecological effects and impacts to vegetation, does not support the need for a CO secondary standard."[5]

The results of the air quality analysis presented in Appendix D of the PSD permit application demonstrate that the maximum ambient air impacts due to the increase in CO emissions from the project will be under the applicable SILs, which are lower than the NAAQS.

CO Modeled Impacts vs. CO NAAQS

Averaging Period	CO NAAQS ($\mu g/m^3$)	Maximum Impact ($\mu g/m^3$)	Percentage of CO NAAQS
1-Hour	40,000	453.90	1.1%
8-Hour	10,000	408.50	4.1%

[4] EPA Air Quality Criteria for Carbon Monoxide (EPA 600/P-99/001F), June 2000, p. 1-1.
[5] Federal Register Volume 76, Number 169, Wednesday, August 31, 2011.

Therefore, the proposed project is not expected to result in harmful effects to vegetation.

D. Soils

Carbon monoxide (CO) is not known to harm soils, as there is no deposition of CO onto soil. This project will actually decrease NO_x emissions, providing a benefit to the surrounding area.

Therefore, the proposed project is not expected to result in harmful effects to soils.

IX. Conclusions

The AQIA for Westar's JEC Unit 3 NO_x Reduction Project is summarized in Appendix D of the permit application. Evaluation of the facility potential emissions indicated that emissions of CO above current levels are expected.

The AERSCREEN model (version 11126) was used to determine predicted maximum ground level concentrations. The modeled impacts for the proposed facility fall below the pre-application monitoring threshold and the modeling SIL for the 8-hour and 1-hour averaging periods. The analysis indicated that concentration levels of CO resulting from the proposed project would not significantly cause or contribute to an exceedance of the NAAQS. The analysis indicated that concentration levels of all pollutants resulting from the proposed project would comply with PSD Class II increments. The analysis indicated that no evaluation of visibility impacts is required.