December 12, 2016

Lisa Alam
c/o Records Management
Nebraska Department of Environmental Quality
1200 "N" Street, Suite 400
P.O. Box 98922
Lincoln, Nebraska 68509-8922

Subject: SO_2 Final Modeling Report for PPGA, Whelan Energy Center (Facility ID #33563)

Dear Ms. Alam:

HDR has completed the sulfur dioxide (SO_2) dispersion modeling analysis for the Whelan Energy Center, near Hastings, Nebraska.

Attached are two copies of the following:

1) The final report of modeling results.
2) The referenced dispersion modeling protocol approved by NDEQ in June of this year.
3) A compact disk containing all the supporting documents and data files.

If you have any questions regarding this report, please contact Ed Liebsch at 763-591-5452 or via email at Ed.Liebsch@hdrinc.com.

Sincerely,
HDR Engineering, Inc.

Edward Liebsch, V.P.
Senior Air Quality Scientist

Cc: Marty Stange, PPGA/Hastings Utilities

hdrinc.com

701 Xenia Avenue S., Suite 600, Minneapolis, MN 55416
T 763-591-5400 F 763-591-5413

Public Power Generation Agency

Sulfur Dioxide 1-Hour NAAQS Designations Modeling

for

Whelan Energy Center (Facility ID #33563)
Hastings, Nebraska

For submittal to:

Lisa Alam
c/o Records Management
Nebraska Department of Environmental Quality
Suite 400, The Atrium
1200 N Street
P.O. box 98922
Lincoln, Nebraska 69509-8922

Prepared by:

HDR Engineering, Inc.

December 2016

INTRODUCTION

This modeling report summarizes dispersion modeling of the Whelan Energy Center (WEC), and nearby emissions sources, to demonstrate attainment with the sulfur dioxide (SO_2) National Ambient Air Quality Standard (NAAQS) for the 1-hour averaging period, which is equal to 75 parts per billion (ppb) or approximately 196.5 micrograms per cubic meter ($\mu g/m^3$). This modeling has been completed for submission to the Nebraska Department of Environmental Quality (NDEQ) for review and approval. The results of the dispersion modeling analysis will be used by the NDEQ to formulate recommendations to EPA on the status of compliance with the 1-hour SO_2 NAAQS for the area around the WEC.

MODELING PROTOCOL

The dispersion modeling results summarized in this report were obtained using the EPA's AERMOD dispersion modeling system, using the modeling procedures and data as described in a modeling protocol developed in collaboration with NDEQ, as provided in Attachment 1 to this report. The referenced modeling protocol (as revised) was submitted to the NDEQ (Lisa Alam) via e-mail dated June 21, 2016 from Ed Liebsch of HDR, and was approved by NDEQ as documents in an e-mail from NDEQ/Lisa Alam dated June 29, 2016 to Ed Liebsch of HDR. In addition to this report, this submittal to NDEQ includes a compact disk/DVD containing all the data files listed at the end of the modeling protocol in Attachment 1.

MODEL INPUTS

This modeling report contains figures detailing the modeled sources, receptors, background SO_2 concentration and meteorological data locations, and the resulting 1-hour SO_2 modeled impacts. The SO_2 modeling was conducted in accordance to the attached detailed dispersion modeling protocol.

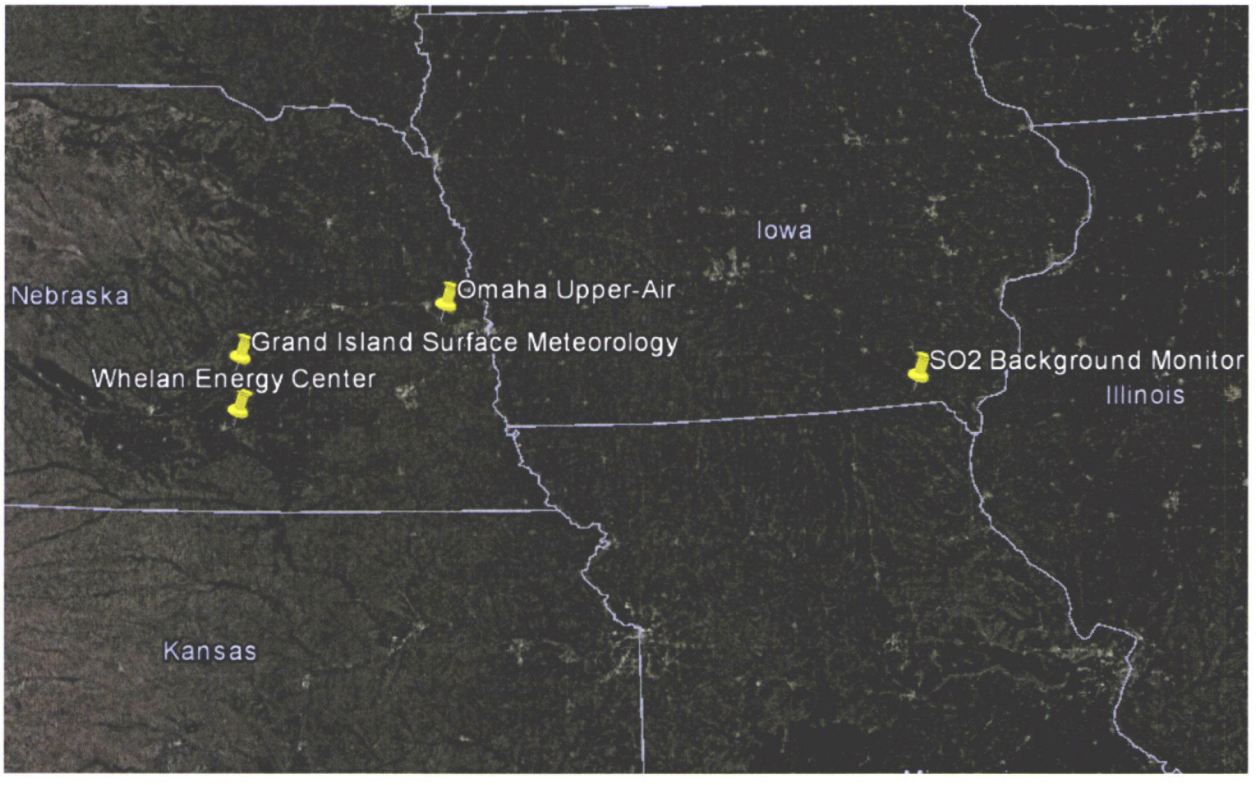
Figure 1 of the attached modeling protocol displays facility locations for the point sources included in the model. These sources include:

1) the coal-fired boiler stacks for WEC Units 1 and Unit 2,
2) Chief Ethanol's coal-fired industrial boiler and gas-fired industrial boiler, near WEC
3) AGP's coal-fired industrial boiler near Hastings, and
4) Grand Island Utilities District's coal-fired boiler at Platt Generating Station (PGS) near Grand Island.

The referenced Figure 1 from the attached modeling protocol displays the receptor grid used in the modeling. This grid was extended to cover areas around all of the nearby sources included in the model.

Figure 1 below displays the WEC facility location in relation to the background SO_2 monitor location (Van Buren, IA) and meteorological data stations for surface data (Grand Island, Nebraska) and upper-air data (Omaha, Nebraska, station, located near Valley, Nebraska).

Figure 1: WEC Site, SO_2 Background Monitor, and Meteorological Station Locations.



The stack parameter inputs for WEC Unit 1 (WEC1, Source ID 101), WEC Unit 2 (WEC2, Source ID 202) and the nearby sources modeled are provided in Table 1. The stack temperature and velocity for WEC1 and WEC2 are placeholder design values. Actual temperature and velocity data for WEC 1 and WEC2 were input to the AERMOD model on an hourly basis with an hourly emission file that contains emission rates, stack temperatures and exit velocities for both stacks for each hour of the model simulation, which spanned the years 2013-2015. Emission rates modeled for the nearby sources (those other than WEC1 and WEC2) represented allowable emission rates, as provided on April 19, 2016, via e-mail from Lisa Alam of NDEQ to Ed Liebsch of HDR.

Table 1: Source Input Data for Modeling Analysis

	UTM Coordinates		Base Elev.	Stack Height	Stack Temp.	Stack Exit Vel.	Stack Diam.	SO2
Source/ID	X (m)	Y(m)	(m)	(m)	(K)	(m/s)	(m)	(g/sec)
WEC1/101	558240	4492461.3	579.8	80.77	416.48	21.84	2.96	HOURLY
WEC2/202	558312.1	4492396.3	579.9	83.82	353.15	24.63	4.57	HOURLY
Chief Coal/9CH	557686.9	4492952.8	579.8	59.44	460.37	9.27	1.83	8.28E+00
Chief Gas/10CH	557669.6	4492853.4	579.3	27.43	420.37	7.71	1.68	1.90E-02
AGP/9117	555824.5	4493783.2	581.8	56.39	435.93	15.28	2.39	5.29E+00
PGS/PGSP001	554942.7	4522730.4	569.4	125.58	523.15	16.46	3.66	1.58E+02

The hourly emissions data for WEC1 and WEC2 that were input to AERMOD were based on continuous emissions and stack parameter monitoring data, which have been collected and reported consistent with Acid Rain program monitoring procedures as provided in 40 CFR 75. The hourly emissions data file (including stack exhaust temperature and velocity data) is provided electronically on the CD/DVD accompanying this report.

MODEL RESULTS

Modeled design impact for the 3-year average 1-hour SO_2 concentration is summarized in Table 2 and presented visually in Figure 2. The 4th high 3-year average concentrations are compared with the 1-hour SO_2 NAAQS of 75 parts per billion (ppb) or approximately 196.5 micrograms per cubic meter ($\mu g/m^3$). The modeled concentration is the combined impact of Units 1 and 2. The background 1-hour SO_2 concentration of 9 $\mu g/m^3$ was added to the modeled concentration. The modeled plus background concentration is well below the NAAQS as shown in Table 2.

Table 2: Modeled Impacts (with background of 8 µg/m^3)

Pollutant	Averaging Period	Years	UTM Coordinates Easting (m)	UTM Coordinates Northing (m)	Modeled Concentration (µg/m^3)	Modeled Plus Background (µg/m^3)	NAAQS (µg/m^3)
SO_2	1-hour	2013-15	557,950	4,493,250	180.7	188.7	196.5

Figure 2: Modeled Result vs. SO_2 Standard

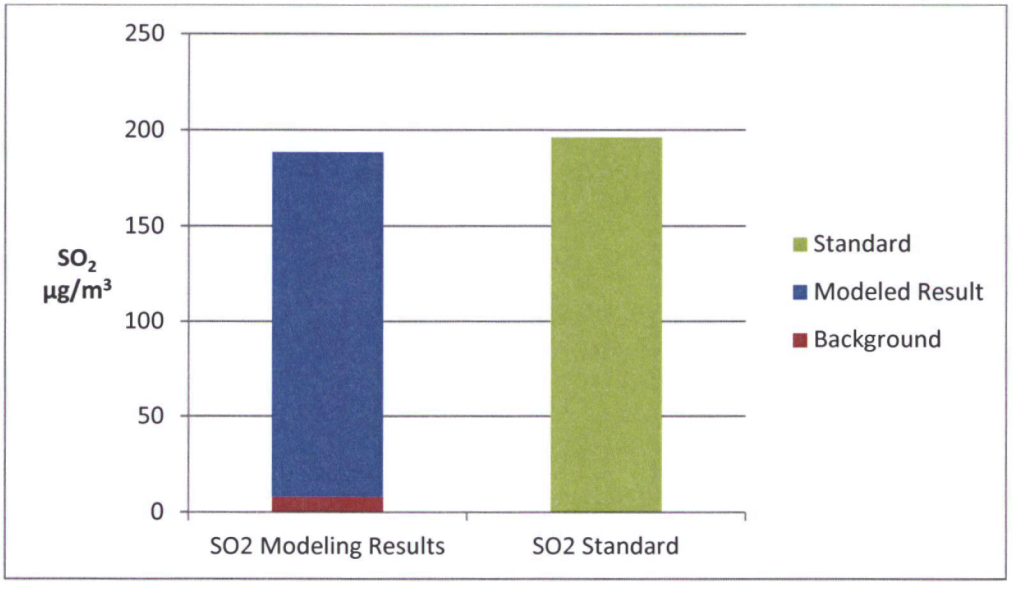
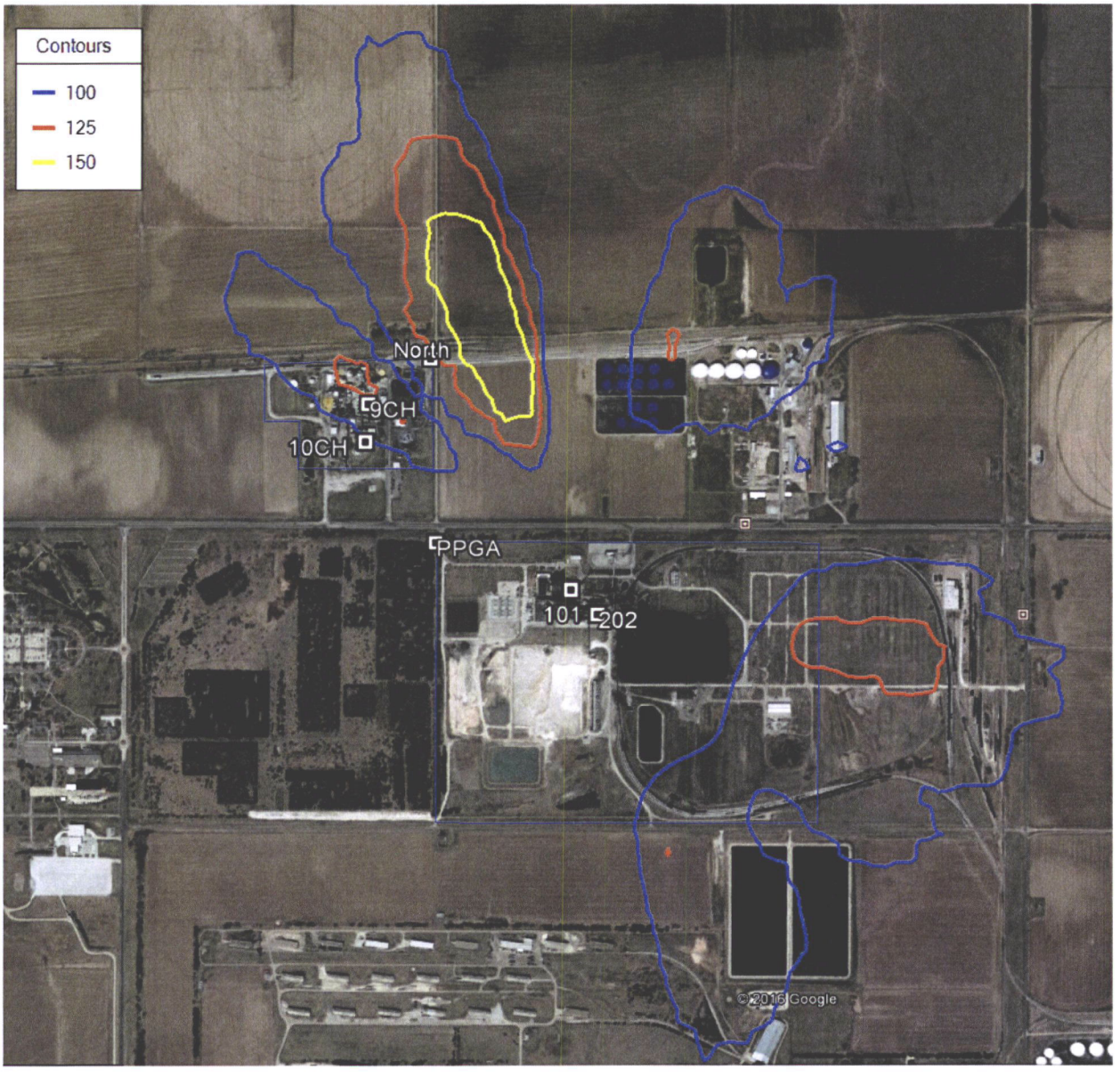


Figure 3 is a contour plot of the modeled 1-hour design concentrations (not including background), representing the average of the daily maximum 4th high values over the 3 years of meteorological data. The contour levels are: Blue 100 µg/m^3, Orange: 125 µg/m^3, and Yellow: 150 µg/m^3. The location of the maximum 4th high 3-year average modeled (without background) concentration (180.7 µg/m^3) is within the yellow contour shown in Figure 3, and occurred approximately 925 meters north-northwest of the WEC2 stack.

Figure 3: Contour Plot of SO_2 1-Hour Design Concentrations



CONCLUSION

This modeling analysis shows that the design maximum SO_2 impact from WEC, when added to the estimated background concentration of 8 µg/m^3, and including nearby sources, results in a maximum predicted concentration of 188.7 µg/m^3, which is below the SO_2 1-hour NAAQS of 196.5 µg/m3 (75 ppb).

Sulfur Dioxide 1-Hour NAAQS – Data Requirement Rule, Dispersion Modeling Protocol
Public Power Generation Agency/Hastings Utilities, Whelan Energy Center
(Facility ID #33563)
Hastings, Nebraska
June 21, 2016

INTRODUCTION

This modeling protocol addresses proposed dispersion modeling for the Public Power Generation Agency (PPGA)/Hastings Utilities, Whelan Energy Center (WEC), in Adams County, near Hastings, Nebraska. The protocol summarizes the information that will be used to conduct dispersion modeling with respect to the National Ambient Air Quality Standard (NAAQS) for 1-hour average sulfur dioxide (SO_2) concentration, which is equal to 75 parts per billion (ppb) or approximately 196.5 micrograms per cubic meter ($\mu g/m^3$)

This protocol has been prepared to satisfy the dispersion modeling option in the Data Requirements Rule (DRR – see 40 CFR 51, Subpart BB) for implementing the 1-hour SO_2 NAAQS, and is being submitted to the Nebraska Department of Environmental Quality (NDEQ) for review and approval. The results of the dispersion modeling analysis will be used by the NDEQ to formulate recommendations to EPA on the NAAQS attainment/nonattainment area designations for State Implementation Plan (SIP) purposes. EPA will review and use this information, along with any available monitoring data, to propose and finalize attainment/nonattainment designations for affected areas with respect to the 1-hour SO_2 NAAQS.

MODELING SOFTWARE

The following EPA modeling software will be used for this analysis.

- AERMOD (Version 15181)
- BPIP-Prime (Version 04274)
- AERMAP (Version 11103)

The AERMOD model will be executed using the rural dispersion mode, given the predominantly rural character of the land surrounding the subject facility.

METEOROLOGICAL DATA

Meteorological data for this analysis were provided by NDEQ in preprocessed format, based on the most recent versions of AERMET (Version 15181), AERMINUTE (Version 15272), and AERSURFACE (Version 13016).

The surface meteorological data to be used are from Grand Island, Nebraska and the upper air data are from Omaha, Nebraska, which are considered representative of the Hastings area. This analysis will use three years of meteorological data for the years 2013 through 2015.

POLLUTANT AND AVERAGING PERIOD

The AERMOD model will be executed for SO_2 for 1-hour averages. By selecting SO_2 as the pollutant and 1-hour as the averaging period, AERMOD will automatically average the results over the three years of meteorology. The model result for comparison with the 1-hour SO_2 NAAQS of

196.5 $\mu g/m^3$ (75 parts per billion) will be the maximum of the 3-year average of the 4th highest (99th percentile) daily 1-hour maximum concentration, as automatically output by AERMOD from the multiyear (3-year) model run.

POINT SOURCES

Emission points to be modeled for the WEC analysis will include the Unit 1 and 2 coal boiler stacks at the site, plus several nearby facility SO_2 sources. The nearby facilities that will be included are:

- Platte Generating Station (PGS) - coal-fired power plant near Grand Island
- Ag Processing (AGP) – corn and soybean processing plant with coal boiler near Hastings
- Chief Ethanol – ethanol (from corn) production facility with coal boiler

The locations of these facilities in relation to WEC are shown in Figure 1.

Emission rates of SO_2 for the WEC boilers will be based on actual, hourly emission data for the 2012-2014 period. The actual, hourly SO_2 emissions measured by the continuous emissions monitoring system (CEMS) on the Unit 1 and 2 stacks will be used for this analysis, by using the optional hourly emissions input file for input to AERMOD. The single hourly emissions file will correspond with the same period of record represented by the three year period of meteorological data (2012-2014) input to AERMOD.

In addition to hourly SO_2 emissions in grams/second, the hourly emissions file will include hourly average stack gas exhaust temperature and exhaust gas exit velocity. These additional hourly parameters will be based on measurements recorded by the same CEMS systems being used to track hourly SO_2 emissions for each stack, in accordance with the routine monitoring requirements under 40 CFR 60 (New Source Performance Standards) and 40 CFR 75 (Continuous Emission Monitoring under the Acid Rain program).

All the nearby sources will be modeled based on their potential-to-emit (PTE) emission rates, in accordance with current permitted allowable emission rates.

The AERMOD model output will be set up to produce source contributions for WEC and for each nearby facility, to assist in diagnosing any impacts that might be caused wholly or mostly by one of the nearby facilities. In addition, a source group will be used to provide the total ("ALL" source group) concentrations.

BUILDING DOWNWASH INPUTS

The AERMOD input will include building downwash parameters calculated using the EPA's Building Profile Input Program "PRIME" (BPIPPRIME) software (Version 04274). The BPIPPRIME input and output (I/O) files will be provided along with all the other modeling I/O files on CD with the final modeling report.

Downwash structures for WEC will be input to the BPIP-Prime preprocessor and the AERMOD model, based on data used in prior approved modeling analyses for WEC. A review of the building dimensions and exhaust stack heights for the other nearby facilities indicate that only the AGP facility has a structure that might create downwash of plumes leading to significant impacts.

The PGS boiler stack is at least equal to the good engineering practice (GEP) height needed to avoid plume downwash. The coal boiler stack at the Chief site is tall enough to avoid downwash, based structure heights and locations on the site. The AGP boiler stack is significantly less than GEP height

with respect to the adjacent boiler building, which is the dominant structure at the site. Therefore, the AGP boiler building will be input to the BPIP-Prime downwash analysis and AERMOD to account for potential downwash effects.

TERRAIN ELEVATIONS

Terrain data will be processed to determine receptor elevations and "hill heights" for input to AERMOD using AERMAP, Version 11103. The AERMAP input will include terrain elevation data from the National Elevation Dataset (NED). The NED data available on-line in 1 arc-second spacing from the US Geological Survey will be used for this analysis. The receptor grid (extent defined below) will include receptors only in UTM Zone 14. The NED data for this analysis will be based on North American Datum (NAD) 83 for horizontal locations and NAD88 for vertical locations (elevations).

The NED terrain file downloaded from the USGS will be provided on CD along with all other model I/O files.

RECEPTOR GRID

The receptor grid to be used for this analysis will include the vicinity of WEC, and will be extended sufficiently to encompass the locations of the three nearby SO_2 (Chief, AGP, PGS) emitting facilities to be included in the analysis. The receptor grid will include the following spacing on the WEC fence lines and at downwind distances from the nearest WEC fence lines.

- 50 meter spacing on the fence line
- 50 meter spacing from the fence to 1 kilometer from the fence
- 100 meter spacing from 1 kilometer to 2 kilometers from the fence
- 250 meter spacing from 2 kilometer to 5 kilometers from the fence
- 500 meter spacing from 5 kilometer to 7 kilometers from the fence
- 1000 meter spacing from 7 to 10 kilometers from the fence

In addition to the grid centered on WEC as described above, an enhanced density grid of additional receptors will be placed around each of the "nearby" sources to be modeled. These grids will extend out to at least one kilometer from each facility fence line, with 100-m spacing at PGS and 50-m spacing at the AGP and Chief sites.

The extent of the entire receptor grid as described above is shown in Figure 1.

Any hot spots in the 250 meter and coarser receptor spacing will be refined by performing a separate model run centered on the hot spot, with a 1000-meter by 1000-meter grid of 50-meter spacing centered on the highest impact receptor from the initial model run.

BACKGROUND CONCENTRATION

The background 1-hour SO_2 concentration will be based on data from a rural monitor located in Van Buren County, Iowa, with a site address of 24430 Lacey Trail (EPA Site ID number 191770006). This monitor is far from any nearby large SO_2 sources, and is located at approximately at the same latitude as Hastings, Nebraska, in a corn growing region. Given that the PPGA analysis will model all significant nearby SO2 sources, the rural Iowa monitoring site data are considered to be representative of background concentrations in rural areas of Nebraska (exclusive of nearby major source impacts). The background concentration will be based on the most recent three years (2013-2015) of data from this site. The table below shows the calculated average of the 99th percentile daily

maximum 1-hour value as 7.9 $\mu g/m^3$ across the three years of Van Buren County data. Therefore, a background 1-hour SO_2 concentration of 8 $\mu g/m^3$ will be used for the Whelan Energy Center analysis.

Year	Daily Maximum 1-hour, 99th Percentile SO_2, Van Buren County, IA	
	(ppm)	($\mu g/m^3$)
2013	3	7.9
2014	3	7.9
2015	3	7.9
Average	**3.0**	**7.9**

MODELING REPORT

A final modeling report will be submitted to NDEQ for review, describing modeling procedures (attaching this protocol), mitigation features (design changes), if any, proposed by the utility, and including all model and preprocessor input and output files on CD/DVD. The data on CD/DVD will include all the hourly emissions (CEM) data files used to input actual emissions to AERMOD.

The modeling report will contain graphics displaying, at a minimum,

- source locations,
- receptor locations,
- meteorological data locations,
- background monitor location,
- contour plots displaying modeled design values (for general receptor grid and any refined grid model runs), and
- a bar chart showing background plus source impact for comparison with the NAAQS.

A copy of the final modeling files used to support the analysis will be provided on CD/DVD to:

Lisa Alam
c/o Records Management
Nebraska Department of Environmental Quality
1200 "N" Street, Suite 400
P.O. Box 98922
Lincoln, Nebraska 68509-8922

The data and graphics files included on the CD/DVD will include as a minimum:

- AERMOD input and output files (source and receptor input data file, hourly emissions file, output listing file, and output graphics/plot file)
- Contour plot and bar chart graphics file(s)
- Source location graphic file (*.kml) from Google Earth
- Source, met data and background monitor location map/graphic
- AERMAP terrain data processor input file
- Preprocessed meteorological data (*.sfc and *.pfl) files provided by NDEQ
- BPIP-PRIME preprocessor input and output files

Figure 1. Receptor Grid for Whelan Energy Center SO_2 Dispersion Modeling