Permit Summary Sheet

Midwest Energy, Inc.

Goodman Energy Center Expansion Project

Proposed Air Quality Construction Permit

Source ID No. 0510057
C-11921

Bureau of Air

Permitting Section

July xx, 2014

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PREVENTION OF SIGNIFICANT DETERIORATION (PSD)

PERMIT SUMMARY SHEET

Permit No.: 0510057, C-11921

Source Name: Midwest Energy, LLC

Source Location: Southeast Quarter of Section 7, Township 13, Range 18 West

Ellis County, Kansas

I. Area Designation

K.A.R. 28-19-350, Prevention of significant deterioration of air quality, affects new major sources and major modifications to major sources in areas designated as "attainment" or "unclassifiable" under section 107 of the Clean Air Act (CAA) for any criteria pollutant. Ellis County, Kansas, where this construction is taking place, is in attainment for all the criteria pollutants.

II. Project Description

Midwest Energy, Inc. plans to install three new spark ignition Wartsila four stroke lean burn reciprocating internal combustion engines (RICE) electric generating units (EGUs) plus auxiliary equipment at the Goodman Energy Center (the Project) to be located in Ellis County, Kansas, approximately 4 miles northwest of Hays, Kansas. The Project will have a total nominal power output of approximately 28 megawatts (MW) and will be fired by pipeline quality natural gas. The facility will also include a one million Btu per hour (MMBtu/hr) gas heater, a 100 horsepower (hp) emergency fire pump, a 250 kW emergency diesel generator, one 200 gallon fuel oil storage tank, and one 20 gallon fuel oil storage tank.

III. Significant Applicable Air Emission Regulations

This source is subject to Kansas Administrative Regulations relating to air pollution control. The application for this permit was reviewed and will be evaluated for compliance with the following significant applicable regulations:

A. K.A.R. 28-19-300 Construction Permits and Approvals

"Any person who proposes to construct or modify a stationary source or emissions unit shall obtain a construction permit before commencing such construction or modification."

B. K.A.R. 28-19-350 Prevention of significant deterioration of air quality

"The provisions of K.A.R. 28-19-350 shall apply to the construction of major stationary sources and major modifications of major stationary sources in the areas of the state designated as an

attainment area or an unclassified area for any pollutant under the procedures prescribed by section 107(d) of the federal clean air act (42 U.S.C. 7407 (d))."

C. K.A.R. 28-19-720 New Source Performance Standards, which adopts by reference 40 CFR Part 60

The EGUs are subject to 40 CFR Part 60 Subpart JJJJ, Standards of Performance for Compression Ignition Internal Combustion Engines. The emergency fire pump and the emergency diesel generator are subject to 40 CFR Part 60 Subpart IIII, Standards of Performance for Stationary Spark Ignition Internal Combustion Engines.

D. K.A.R. 28-19-750 Maximum Achievable Control Technology, which adopts by reference 40 CFR Part 63

The EGUs, the emergency diesel generator, and emergency fire pump are subject to 40 CFR Part 63 Subpart ZZZZ, National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines. The fuel-gas heater is subject to 40 CFR Part 63 Subpart DDDDD, National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters.

IV. Air Emissions from the Project

Emissions of oxides of nitrogen (NOx), carbon monoxide (CO), sulfur dioxide (SO_2), volatile organic compounds (VOC), particulate matter (PM), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), greenhouse gases (GHGs), sulfuric acid mist (H_2SO_4), lead, and hazardous air pollutants (HAPs) from the project were evaluated The potential to emit PM, PM_{10}, $PM_{2.5}$, and GHGs from this project exceed major source thresholds under 40 CFR 52.21, which is adopted by reference in K.A.R. 28-19-350. The potential-to-emit from the project is listed in Table 1-1 and Appendix C of the permit application submitted November 26, 2013. Emissions of NOx, CO, SO_2, VOC, and H_2SO_4, and lead were below the PSD significant emission thresholds.

Table 1 contains the potential to emit (PTE) for air pollutants to be emitted from the proposed Project:

Table 1. Proposed Project Emissions and PSD Significant Emission Rates (SER)

Pollutant [a]	Project Potential Emissions (tons per year, tpy)	PSD Significant Emission Rate (tpy)	Exceeds Significant Emission Rate (SER)?
NO_x	36.7	40	No
CO	47.1	100	No
SO_2	0.7	40	No
VOC	37.8	40	No
PM	28.4	25	Yes
PM_{10} [b]	28.4	15	Yes
$PM_{2.5}$ [b]	28.4	10	Yes
CO_2e	123,117	75,000	Yes
H_2SO_4 Mist	0.1	7	No
Lead	2.2×10^{-3}	0.6	No

[a] NOx = Nitrogen oxides; SO_2 =Sulfur dioxide; CO = Carbon monoxide; PM = Total particulate matter; PM_{10} = Particulate matter less than 10 micrometers (µm) in diameter; $PM_{2.5}$ = Particulate matter less than 2.5 µm in diameter; VOC = Volatile organic compounds; H_2SO_4 = sulfuric acid; and CO_2e = carbon dioxide equivalent.
[b] Filterable plus condensable.

Emissions of the EGUs are discussed in Section 4.2.1 of the permit application submitted November 26, 2013 and in Appendix C. Emissions were analyzed at 40, 75, and 100 percent load. Startup emissions were based on a length of 30 minutes per startup, and 1,095 startup/shutdown events per year per engine. Normal operation has higher emissions than shutdown. Therefore, total emissions on an annual basis include the maximum number of start-ups, with the remaining hours assumed to be full load operation, as both of those cases result in greater emission than does a shutdown condition. Except as specified, emissions estimates are based on the vendor's guaranteed emission rates with specified emission controls. PM emissions estimates are vendor supplied and are listed in Appendix C of the permit application. PM_{10} and $PM_{2.5}$ include both filterable and condensable particulate matter. SO_2 emissions are based on AP-42. GHG emissions are based on vendor data for CO_2, methane, and nitrous oxide and were calculated using 40 CFR Part 98 emission factors, the appropriate CO_2 equivalency ratio applied, and summed to obtain total GHGs, or CO_2e. Startup emissions for the EGUs are based on the manufacturer's startup profile, 1460 startups per year per engine, and 30 minutes per startup.

Appendix C and Sections 4.1.3 through 4.1.7 discuss emission estimates for other facility emission units. The emissions from the fuel gas dew point heater were calculated using AP-42 emission factors. Emissions from the emergency fire pump are based on the NSPS emission rates for all pollutants except GHGs. GHG emission factors from the EPA Mandatory Greenhouse Gas Reporting Rule (40 CFR Part 98) are used to estimate GHG emissions. Emissions from the emergency diesel generator are based on NSPS emission rates for CO, NO_X, PM, PM_{10}, and $PM_{2.5}$, while other pollutants were estimated using AP-42 emission factors. GHG emission factors from the EPA Mandatory Greenhouse Gas Reporting Rule (40 CFR Part 98) are used to estimate GHG emissions. Emissions from the two fuel oil storage tank were estimated using EPA TANKS software.

The potential to emit GHGs, PM, PM_{10}, and $PM_{2.5}$ from this project exceed major source and/or significant emission thresholds under K.A.R. 28-19-350. This project will be

subject to the various aspects of K.A.R. 28-19-350, such as the use of best available control technology, ambient air quality analysis, and additional impacts upon soils, vegetation and visibility.

V. Best Available Control Technology (BACT)

BACT requirements apply to each new emissions unit and pollutant emitting activity. Also, individual BACT determinations are performed for each pollutant emitted from each emission unit. Consequently, the BACT determination must separately address, for each regulated pollutant with a significant emissions increase at the source, air pollution controls for each emissions unit or pollutant emitting activity subject to review. The facility was required to prepare a BACT analysis for KDHE's review according to the process described in Attachment A. KDHE's evaluation of the BACT for PM, PM_{10}, $PM_{2.5}$ for the 3 EGUs, the emergency fire pump, the diesel fired emergency generator, and the natural gas fired indirect fuel dew point heater is presented in Attachment B. KDHE's evaluation of the BACT for greenhouse gases for the same emission units is presented in Attachment C.

KDHE has concurred with the facility's BACT analysis, and has required the following in the permit:

A. BACT emission of pollutants from each EGU

The BACT emission of pollutants from each EGU shall be no greater than the specified limitations listed below. 40 CFR Part 60 Subpart JJJJ requirements are included in a separate section of the permit as applicable. A violation of a BACT limitation is not necessarily a violation of an NSPS limitation. NSPS limitations are not applicable during startup, shutdown, or malfunction. For the purpose of demonstrating ongoing compliance with BACT-based emission limitations, startup ends 30 minutes after a start sequence is initiated.

1. The emission of PM_{10}/PM/$PM_{2.5}$ shall not exceed 2.10 lb/hour at all times, except during startup and shutdown (3-hour averaging period).
2. The emission of CO_2e shall not exceed 9,330[1] lb/hour at all times except during startup and shutdown (annual averaging period).
3. The 12-month rolling average CO_2 emissions from the EGUs are limited to no more than 1.13 lb/kWh[2]; the total average EGU emissions for each month is determined as follows:

   $ER = x * k * y \div z$

   Where:

[1] The CO_2 emitted is 9320 lb/hour; the remaining 10 lb/hour is the GHG equivalent attributed to methane and nitrous oxides.
[2] Fuel carbon dioxide is not included in this calculation. Startup fuel and energy produced during startups will not be included in this calculation. Fuel gas heater natural gas consumed is not included in the calculation.

ER= emission rate of carbon dioxide from the EGUs, lb/kW-hr;
k = 3.667 lb carbon dioxide emitted per pound carbon in the fuel;
x = lb carbon per cubic foot of natural gas, based on a monthly average fuel analysis by the pipeline supplier;
y = total monthly cubic feet of natural gas burned in the EGUs; and
z = total monthly gross kilowatt hours generated by the EGUs.

4. The emission limit for $PM/PM_{10}/PM_{2.5}$ shall not exceed 2.55 lb/hr during startup (24-hour averaging period).
5. The emission limit for $PM/PM_{10}/PM_{2.5}$ shall not exceed 2.13 lb/hr during shutdown (24-hour averaging period).
6. The emission of CO_2e shall not exceed 6,847 lb/hour during startup (annual averaging period).

B. BACT emission of pollutants from any emergency diesel generator

The BACT emission of pollutants from any emergency diesel generator shall be no greater than limitations specified below, excluding periods of startup, shutdown, and malfunction.

1. The emissions of PM, PM_{10}, and $PM_{2.5}$ shall not exceed 0.15 g/hp-hr.
2. BACT for CO_2e shall be use of the most efficient engine that meets the facility's needs.

C. BACT emission of pollutants from the emergency fire pump

The BACT emission of pollutants from the emergency fire pump shall be no greater than limitations specified below, excluding periods of startup, shutdown, and malfunction.

1. The emissions of PM, PM_{10}, and $PM_{2.5}$ shall not exceed 2.20E-1 g/hp-hr.
2. BACT for CO_2e shall be the selection of the most efficient engine that meets the facility's needs.

D. BACT emissions of pollutants from the indirect dew point fuel-gas heater

The BACT emissions of pollutants from the indirect dew point fuel-gas heater shall be no greater than limitations specified below, excluding periods of startup, shutdown, and malfunction.

1. The emissions of PM, PM_{10}, and $PM_{2.5}$ shall not exceed 0.0075 lb/MMBtu.
2. BACT for CO_2e shall be use of clean fuels, and proper maintenance and tuning of the heater.

VI. Ambient Air Impact Analysis

A. Air Quality Impact Analysis (AQIA) Applicability

1. The proposed project is a major source as defined by K.A.R. 28-19-350, Prevention of Significant Deterioration (PSD). Major sources with pollutant emissions exceeding significant emission rates must undergo PSD review. The owner or operator must demonstrate that allowable emission increases from the proposed project would not cause or contribute to air pollution in violation of:

   a. any National Ambient Air Quality Standard (NAAQS) in any air quality control region; or

   b. any applicable maximum allowable increase (PSD increment) over the baseline concentration in any area.

2. Emissions from the proposed project and significant emission rate (SER) thresholds are listed in Table 1 above.

B. Model Selection

1. A dispersion model is a computer simulation that uses mathematical equations to predict air pollution concentrations based on weather, topography, and emissions data. AERMOD is the current model preferred by EPA for use in near-field regulatory applications, per 40 CFR Part 51 Appendix W, Section 3.1.2, and Appendix A to Appendix W:

   "AERMOD is a steady-state plume dispersion model for assessment of pollutant concentrations from a variety of sources. AERMOD simulates transport and dispersion from multiple sources based on an up-to-date characterization of the atmospheric boundary layer. AERMOD is appropriate for: point, volume, and area sources; surface, near-surface, and elevated releases; rural or urban areas; simple and complex terrain; transport distances over which steady-state assumptions are appropriate, up to 50 km; 1-hour to annual averaging times; and continuous toxic air emissions."

2. KDHE used the current AERMOD and AERMET version 13350 (released on December 24, 2013) when the verification runs were conducted for the following pollutant and averaging times:

   a. 24-hour and annual PM_{10}; and
   b. 24-hour and annual $PM_{2.5}$;

The facility used AERMOD and AERMET version 12345 because it was the regulated version at the time the PSD permit application was submitted

3. AERMINUTE Version 11325 was used to process 1-minute ASOS wind data to generate hourly average winds for input to AERMET. AERMET Version 13350 was used to prepare meteorological data for the years 2008-2012.

C. Model Inputs

1. Source Data

a. Input data used in the dispersion modeling such as emission rates and stack parameters were based on the data supplied in Section 7.0 of the PSD permit application received by KDHE on November 26, 2013.

b. Emission rates used in the dispersion modeling were based on the results of the BACT analysis.

c. The proposed project was modeled by the facility using four (4) different operating scenarios: 100% load, 75% load, 40% load and "start-up". The "start-up" operating scenario is a combination of emissions rates from 100% load and start-up operations. The following are the details of each operating scenario used in the dispersion modeling:

i. 100% load operating scenario assumes all three (3) reciprocating internal combustion engines (RICE) electrical generating units (EGUs) operate at 100% load for 8,760 hours per year on natural gas fuel; one (1) dew point heater operates at 100% load for 8,760 hours per year on natural gas fuel; one (1) emergency fire pump operates at 100% load for 100 hours per year on diesel fuel; and one (1) emergency generator operates at 100% load for 100 hours per year on diesel fuel.

ii. 75% load operating scenario assumes all three (3) RICE EGUs operate at 75% load for 8,760 hours per year on natural gas fuel; one (1) dew point heater operates at 100% load for 8,760 hours per year on natural gas fuel; one (1) emergency fire pump operates at 100% load for 100 hours per year on diesel fuel; and one (1) emergency generator operates at 100% load for 100 hours per year on diesel fuel.

iii. 40% load operating scenario assumes all three (3) RICE EGUs operate at 40% load for 8,760 hours per year on natural gas fuel; one (1) dew point heater operates at 100% load for 8,760 hours per year on natural gas fuel; one (1) emergency fire pump operates at 100% load for 100 hours per year on diesel fuel; and one (1) emergency generator operates at 100% load for 100 hours per year on diesel fuel.

iv. Start-up operating scenario assumes all three (3) RICE EGUs operate at 100% load for 8,760 hours per year on natural gas fuel (Note: emission rates of this scenario were based on 30-minutes start-up emissions and 30-minutes 100% load emissions); one (1) dew point heater operates at 100% load for 8,760 hours per year on natural gas fuel; one (1) emergency fire pump operates at 100% load for 100 hours per year on diesel fuel; and one (1) emergency generator operates at 100% load for 100 hours per year on diesel fuel.

2. Center of the facility

The center of the proposed project is located at the following:
Zone: 14
Easting: 468,611.50 meters
Northing: 4,309,109.0 meters

3. Urban or Rural

A review of the United States Geological Survey (USGS) National Land Cover Data (NLCD) for 1992 for the site and a surrounding three (3) kilometer radius was conducted to determine if rural or urban classification should be used for modeling. The area was deemed rural for air dispersion modeling purposes.

4. Terrain

The proposed project was modeled using the elevated terrain option. AERMAP processor Version 11103 was used to process the National Elevation Data (NED) files from the USGS to interpolate elevations at each receptor.

5. Meteorological Data

KDHE supplied to the facility five (5) consecutive years (2008 through 2012) of meteorological data. The surface data was obtained from the Russell Municipal Airport (RSL) meteorological station in Kansas. The

upper air data was obtained from the Dodge City Regional Airport (DDC) meteorological station in Kansas. Table 2 shows additional information about the representative meteorological stations.

Figure 1 shows the wind rose (localized winds patterns) for the cumulative 5-year meteorological data, showing that prevailing wind originates mainly from the south. Figure 2 shows a map that includes the proposed facility, the RSL and the DDC airport meteorological stations.

Table 2. Meteorological Data Sites

Station Type	Station Name	WBAN #	Latitude/ Longitude	Elevation (m)	Years of Data
Surface Air Station	Russell Municipal Airport (RSL), KS	93997	38.8720/ -98.8089	568.1	2008-2012
Upper Air Station	Dodge City Regional Airport (DDC), KS	13985	37.7711/ -99.9692	787.0	2008-2012

6. Building Downwash

a. Good Engineering Practice (GEP) stack height for stacks constructed after January 12, 1979 is defined as the greater of

i. 65 meters, measured from the ground-level elevation at the base of the stack, and

ii. Stack height calculated from the following EPA's refined formula:

$H_g = H + 1.5L$

where,

H_g = GEP stack height, measured from the ground-level elevation at the base of the stack

H = height of nearby structure(s) measured from the ground-level elevation at the base of the stack

L = lesser of the Building Height (BH) or Projected Building Width (PBW); PBW is the greatest crosswind distance of a building also known as maximum projected width.

b. Emissions released at stack heights greater than GEP are modeled at GEP stack height. Emissions released at or below GEP are modeled at their true release height.

c. Building downwash was calculated using the Building Profile Input Program (BPIP) with plume rise model enhancements (PRIME).

7. Receptors

a. AERMOD estimates ambient concentrations using a network of points, called receptors, throughout the region of interest. Model receptors are typically placed at locations that reflect the public's exposure to the pollutant.

b. The minimum receptor spacing used in the dispersion modeling for the proposed project consisted of a multi-tiered grid is shown in Table 3.

c. Receptors along the facility's fence line were placed at 50 meter spacing.

Table 3. Receptor spacing used in dispersion modeling of the proposed project

Distance From Facility Boundary (meters)	**Receptor Spacing (meters)**
Facility Center to 1000	50
1000 to 2,000	100
2,000 to 10,000	250
10,000 to 50,000	500

8. Modeling domain

Preliminary modeling analysis establishes the distance (from the center of the facility) to the farthest receptor with modeled concentration greater than the significant impact level (SIL) thresholds. This area is often referred to as the significant impact area (SIA).

The SIA is a circular area with radius extending from the proposed project to (1) the most distant point where approved dispersion modeling predicts a significant ambient impact will occur, or (2) a modeling receptor distance of 50 km, whichever is less.

Initially, for each pollutant subject to review the SIA is determined for every averaging time. The SIA used for the refined (cumulative) modeling

analysis of a particular pollutant is the largest of the SIAs determined for that pollutant.

Refined (cumulative) modeling analysis includes the facility's total emissions along with emissions from other nearby sources. The modeling domain for refined modeling can be up to SIA or up 50 km using AERMOD.

D. Preliminary Modeling Analysis

1. In order to determine if a refined (cumulative) impact modeling analysis and/or ambient air monitoring is necessary, a preliminary modeling analysis is first conducted.

2. The preliminary modeling analysis only included the proposed project's emission sources to determine if the highest, first-highest (HIH) modeled impact (or concentration) will exceed the SIL thresholds.

3. For each pollutant and averaging time that the modeled HIH concentration is below the SIL threshold, no further analysis is necessary for that particular pollutant and averaging time. KDHE considers this to be a sufficient demonstration that the project does not cause or contribute to a violation of the NAAQS or PSD increment. As discussed in EPA's May 20, 2014 Guidance for $PM_{2.5}$ Permit Modeling, if the $PM_{2.5}$ SIL is relied on for permitting decisions, additional supporting material will be made part of the permit record.

4. The preliminary modeling results of the worse-case operating scenario from the dispersion modeling runs conducted by the facility are shown in Table 4.

5. The modeled H1H impacts of annual and 24-hour $PM_{2.5}$ exceed the SIL thresholds. Refined (cumulative) modeling analyses are required for these pollutants and averaging times. Since refined modeling is required, KDHE did not rely on the SIL for permitting decisions for this portion of the analysis.

6. The modeled H1H impacts of annual and 24-hour PM_{10} fall below SIL thresholds. Therefore, refined (cumulative) modeling analyses are not required for these pollutants and averaging times.

7. Table 4 also shows that the pre-application monitoring threshold was exceeded for 24-hour $PM_{2.5}$, therefore, the pre-application monitoring for

$PM_{2.5}$ is required. Midwest Energy requests that preconstruction monitoring for $PM_{2.5}$ be fulfilled with existing Cedar Bluff (20-195-0001) monitor. Sections 7.3.5.1 through 7.3.5.4 of the PSD application discussed the reasons why the existing KDHE monitor is a representative monitor for $PM_{2.5}$. KDHE has approved the use of the existing monitor for 24-hour $PM_{2.5}$ monitoring.

Table 4. Preliminary/Significance Modeling Results

Pollutant	**Averaging Period**	**Modeled Year(s)**	**UTM Coordinates**		**Modeled Concentration [a] (Highest, First-Highest, H1H) (µg/m3)**	**Modeling Significant Impact Level (SIL) (µg/m^3)**	**Pre-application Monitoring Threshold Concentration (µg/m^3)**
			Easting (meters)	**Northing (meters)**			
PM_{10}	Annual	2010	468,550.0	4,309,550.0	0.36	1	--
	24-hour	2010	468,550.0	4,309,550.0	4.54	5	10
$PM_{2.5}$	Annual	2010	468,550.0	4,309,550.0	**0.36**	**0.3**	--
	24-hour	2010	468,550.0	4,309,550.0	**4.54**	**1.2 [b]**	**0 [c]**

[a] Results from dispersion modeling conducted by the facility. The facility used AERMOD and AERMET version 12345 because it was the regulated version at the time the PSD permit application was submitted. The KDHE used the current AERMOD and AERMET version 13350 when the verification runs were conducted. The modeled results from the facility and KDHE modeled results were comparable.
[b] The $PM_{2.5}$ Significant Impact Levels are addressed in K.A.R. 28-19-350(f).
[c] From http://www.epa.gov/nsr/documents/20131127fr.pdf. The Significant Monitoring Concentration threshold for $PM_{2.5}$ 24-hour averaging period was vacated on January 22, 2013.

E. NAAQS Modeling Analysis

1. Refined (cumulative) modeling was conducted to demonstrate compliance with the NAAQS for each pollutant and averaging period for which the SIL was exceeded. Evaluation of compliance with the NAAQS requires that the refined modeling accounts for the combined impact of the proposed project, nearby sources, and background concentrations.

2. The refined modeling results for NAAQS compliance demonstration of the worse-case operating scenario from the dispersion modeling conducted by the facility are shown in Table 5.

3. For annual $PM_{2.5}$ impacts:

There are no modeled exceedances for the annual $PM_{2.5}$ NAAQS. The annual NAAQS standard for $PM_{2.5}$ is 12.00 ug/m^3. The background concentration for the annual averaging period is 7.00 ug/m^3. The modeled concentration (1.5 ug/m^3), when combined with the background concentration (7.00 ug/m^3), gives a total concentration of 8.5 ug/m^3. Since no NAAQS exceedances were modeled, KDHE did not rely on the SIL for permit decisions in this portion of the analysis.

4. For 24-hour $PM_{2.5}$ impacts:

There are no modeled exceedances for the 24-hour $PM_{2.5}$ NAAQS. The 24-hour NAAQS standard for $PM_{2.5}$ is 35.00 ug/m^3. The background concentration for the 24-hour averaging period is 17.00 ug/m^3. The modeled concentration (17.2 ug/m^3), when combined with the background concentration (17.00 ug/m^3), gives a total concentration of 34.2 ug/m^3. Since no NAAQS exceedances were modeled, KDHE did not rely on the SIL for permit decisions in this portion of the analysis.

5. Figures 3 and 4 show the NAAQS dispersion modeling isopleths, from KDHE verification modeling, for 24-hour $PM_{2.5}$ and annual $PM_{2.5}$, respectively.

6. Table 9 shows the receptor grid size, number of emission sources used for NAAQS and PSD increment modeling analysis and the distance (radius) used for the selection of nearby sources.

7. Table 10 shows the emission sources of Midwest Energy used in the dispersion modeling.

Table 5. NAAQS Modeling Results

Pollutant	**Averaging Period**	**Modeled years**	**UTM Coordinates**		**Modeled Concentration (µg/m^3) [a, b]**		**Background concentration (µg/m^3) [c]**	**Total concentra-tion (µg/m^3)**	**NAAQS Standard (µg/m^3)**	**Any exceedances of the NAAQS?**
			Easting (meters)	**Northing (meters)**						
$PM_{2.5}$	Annual	2008-2012	468,679.0	4,309,068.0	1.50	H1H	7.00	8.5	12.00	None
	24-hour	2008-2012	468,679.0	4,309,052.8	17.2	H1H	17.00	34.2	35.00	None

[a] Results from dispersion modeling conducted by the facility. The facility used AERMOD and AERMET version 12345 because it was the regulated version at the time the PSD permit application was submitted. The KDHE used the current AERMOD and AERMET version 13350 when the verification runs were conducted. The modeled results from the facility and KDHE modeled results were comparable.
[b] H1H = Highest, First-Highest
[c] Background concentrations provided by KDHE

F. PSD Increment Modeling Analysis

1. PSD increment is the maximum allowable increase in concentration that is allowed to occur above a baseline concentration for a pollutant. Table 6 shows the PSD increment for PM_{10} and $PM_{2.5}$ for Class II areas. Significant deterioration in air quality is said to occur when the amount of new pollution would exceed the applicable PSD increment. Table 7 shows the major source and trigger dates for PM_{10} and $PM_{2.5}$.

Table 6. PSD increment (maximum allowable increase) for Class II areas

Pollutant	Averaging period	PSD increment (maximum allowable increase) for Class II area (µg/m^3)
PM_{10}	24-hour	30
	Annual	17
$PM_{2.5}$	24-hour	9
	Annual	4

Table 7. Major source baseline date and trigger dates for PM_{10} and $PM_{2.5}$

Pollutant	Major Source Baseline Date [a]	Trigger Date [a]
PM_{10}	January 6, 1975	August 7, 1977
$PM_{2.5}$	October 20, 2010	October 20, 2011

[a] The major source baseline date is the date after which actual emissions associated with construction at a major stationary source affect the available PSD increment. The trigger date is the date after which the minor source baseline date may be established. (*October 1990 Draft New Source Review (NSR) Workshop Manual for PSD and Nonattainment Area Permitting).*

2. To determine the PSD increment consumption (or expansion) in a PSD area, a PSD increment inventory is needed for increment dispersion modeling analysis. The PSD increment inventory is not yet available/completed in Kansas, thus, the NAAQS nearby source inventory was used to determine compliance with PSD increment for a Class II area annual and 24-hour $PM_{2.5}$.

3. The facility verified with KDHE if a particular source is an increment consuming emission source for $PM_{2.5}$. Non-increment consuming sources can be removed from the nearby source inventory for increment modeling.

4. The Midwest Energy facility established the minor source baseline date for $PM_{2.5}$ (the significant ambient impact of 0.3 µg/m^3 was exceeded) on **March 28_, 2014** and will be the first $PM_{2.5}$ PSD increment consuming source in **Ellis County**. The minor source baseline date marks the point in time after which actual emissions changes from all sources affect the amount of available increment (regardless of whether the emissions changes are a result of construction) *(October 1990 Draft New Source Review (NSR) Workshop Manual for PSD and Nonattainment Area Permitting).*

5. Table 8 shows the PSD increment modeling results and increment consumption from the proposed project. The allowable annual averaging period increment for $PM_{2.5}$ is 4 ug/m^3. The allowable 24-hour averaging period increment for $PM_{2.5}$ is 9 ug/m^3. The annual averaging period modeled concentration of 2.1 ug/m^3 is less than the allowable increment. The 24-hour averaging period modeled concentration of 3.9 ug/m^3 is less than the allowable increment. Since no increment exceedances were

modeled, KDHE did not rely on the SIL for permit decisions in this portion of the analysis.

6. Figure 5 and 6 show the PSD increment dispersion modeling isopleths, from KDHE verification modeling, for annual $PM_{2.5}$ and 24-hour $PM_{2.5}$, respectively.

Table 8. PSD Increment Modeling Results

Pollutant	Averaging Period	Modeled year with the highest concentration	UTM Coordinates		Modeled Concentration ($\mu g/m^3$) [a]		PSD increment for Class II areas ($\mu g/m^3$)	Exceeds PSD Increment?	Increment Consumption of the Proposed Project (%)
			Easting (meters)	Northing (meters)					
$PM_{2.5}$	Annual	2011	468,707.0	4,309,239.7	2.1	H1H	4	No	52.5
	24-hour	2010	468,500.0	4,309,550.0	3.9	H2H	9	No	43.2

a From dispersion modeling conducted by the facility. The facility used AERMOD and AERMET version 12345 because it was the regulated version at the time the PSD permit application was submitted. The KDHE used the current AERMOD and AERMET version 13350 when the verification runs were conducted. The modeled results from the facility and KDHE modeled results were comparable.

G. Analysis of Secondary $PM_{2.5}$ Formation

Section 7.8 of the PSD permit application presented the analysis of the secondary $PM_{2.5}$ formation from the proposed project.

H. Additional Impact Analysis

The owner or operator of the proposed facility shall provide an analysis of impairment to visibility, soils and vegetation that would occur as a result of the source or modification. The owner or operator shall provide an analysis of the air quality impact projected for the area as a result of general commercial, residential, industrial and other growth associated with the source or modification (40 CFR 51.166 and 40 CFR 52.21).

The proposed project will not have a significant adverse impact on the air quality, soils, vegetation, visibility, and or growth in the surrounding area. For details and references/sources of information for the additional impact analysis, please refer to Sections 8.0 and 9.0 of the PSD permit application.

i. Section 8.1 for Construction Impacts:

Construction at the proposed project has the potential for short-term adverse effects on air quality in the immediate area around the site. Diesel fumes from construction vehicles and dust from site preparation and construction vehicle operation can affect local air quality during certain

meteorological conditions. However, these instances are limited in time and area of effect.

The Ellis County area is in attainment or is unclassified for all criteria pollutants. Low sulfur fuel will be used for construction vehicles that use diesel fuel. Operation of these vehicles is not expected to significantly affect ambient air quality. Emissions will be minimized as much as practicable by reducing engine idling, operating vehicles as little as possible and employing vehicles with highly efficient engines. Fugitive dust will be minimized through the application of water to on-site roads used by construction equipment.

ii. Section 8.2 for Vegetation Impacts:

This section includes Section 8.2.1 for the effects of particulate matter and Section 8.2.2 for the effects of carbon monoxide on vegetation.

The general land use in the vicinity of the project is rangeland for grazing cattle. Agricultural production in Ellis County consist mostly of livestock (cattle), wheat (*Triticum aestivum*), and grain sorghum (*Sorghum bicolor*); however, small amounts of alfalfa (*Medicago sativa*), barley (*Hordeum vulgare*), corn (*Zea mays*), rye (*Secale cereale*), oats (*Avena sativa*), and native hay are also produced. Trees are generally uncommon but may sporadically occur along stream corridors, drainage ways, and the banks of impoundments. These species include Siberian elm (*Ulmus pumila*), eastern red cedar (*Juniperus virginiana*), cottonwood (*Populus deltoides*), and black willow (*Salix nigra*). Remnants of native shortgrass prairie may occur near Goodman Energy Center. Common grasses in this community include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), sideoats grama (*Bouteloua curtipendula*), blue grama (*Bouteloua gracilis*), switchgrass (*Panicum virgatum*), Indiangrass (*Sorghastrum nutans*),western wheatgrass (*Pascopyrum smithii*), and eastern gamagrass (*Tripsacum dactyloides*).

The maximum PM_{10} and $PM_{2.5}$ 24-hour modeled values for the proposed project are 4.54 $\mu g/m^3$. This level is low, so it is highly unlikely that PM_{10} and $PM_{2.5}$ emissions will impact vegetation adjacent to the proposed project.

CO_2 is not known to injure plants. Long-term exposure to elevated CO_2 levels has shown to improve the efficiency of nutrient, water, and photosynthesis in some plants. However, the improved efficiencies that result from elevated CO_2 levels may not necessarily result in greater yields for crop plants. No adverse impacts to vegetation at or near the proposed project are expected from CO_2 stack emissions from the project.

iii. Section 8.3 for Soil Impacts:

Seven (7) soil types are mapped at, or in the immediate vicinity of (within one mile) the proposed project site.

They include:

a. Roxbury silt loam, frequently flooded
b. Armo loam, 3 to 7 percent slopes and 7 to 15 percent slopes
c. Brownell gravelly loam, 2 to 10 percent slopes
d. Harney silt loam, 1 to 3 percent slopes and 3 to 7 percent slopes
e. Mento silt loam, 1 to 3 percent slopes
f. Mento soils, 3 to 7 percent slopes
g. Wakeen silt loam, 3 to 7 percent slopes

Experimental evidence shows that elevated CO_2 levels indirectly affected soils by reduced soil respiration. The elevated CO_2, levels resulted in increased soil respiration sensitivity to soil temperature changes and decreased soil respiration sensitivity to soil moisture changes. Elevated CO_2 levels also increased the abundance of bacteria and fungi in the soil, however, the experimental evidence indicated that elevated CO_2 levels had no significant effect on microscopic arthropod and nematode abundance within soils. The expected CO_2 stack emissions from the project are relatively low and are not expected to have a measureable effect on the soils at or in the vicinity of the proposed project.

Particulate deposition on soils can have an effect over time, depending on the concentration and composition of the airborne particulates. However, the maximum PM_{10} and $PM_{2.5}$ 24-hour modeled values for the project are relatively low, so it is highly unlikely that PM_{10} and $PM_{2.5}$ emissions will result in significant impacts to soils adjacent to proposed project.

iv. Section 8.4 for Industrial, Residential, and Commercial Growth Impacts:

The project is expected to increase employment in the area. The building phase will last approximately one year. Construction employment is expected to peak at approximately 100 skilled construction jobs. Projected employment, reflecting full-time jobs directly tied to the operation of the facility, is estimated to be eight people at the facility and will not increase as a result of the project. This will result in moderate amounts of secondary employment being created by the economic activity of the facility. In the immediate vicinity of the facility and as a result of the proposed project, increased vehicular traffic is expected. However, these activities are expected to significantly impact air quality.

The construction work at the facility may temporarily increase the number of people residing in the area. Many of the new employees are expected to already live in the area. However, some new employees are expected to move into the area, with only a slight increase in the residential growth in the area. This small increase in new residences is not expected to have a measureable impact on air quality.

The need for the project is based on meeting projected electrical demand from existing customers. While adding additional electricity to the grid in this area may increase the potential for industrial growth, the specifics concerning how increasing available electrical power in this area may affect future industrial growth are unknown.

v. Section 8.5 for Visibility and Deposition Analysis:

For details of information for visibility and deposition analysis, please refer to Sections 8.5 of the PSD permit application.

FLM guidance requires that a proposed major source, in the course of a PSD application, perform an assessment of air quality impacts at Class I areas if these areas are located within approximately 300 kilometers of the proposed facility. There are no Class I areas that are within 300 kilometers of the proposed project; therefore, no assessment of air quality impacts at Class I areas was performed for this project. However, KDHE requested that a visibility analysis be performed on the Class II area to demonstrate that no significant deterioration of visibility will result from the operation of the proposed facility. In addition to the Class II area, sensitive local areas listed below were included in the visibility analysis:

- Cedar Bluff State Park, the nearest state park located approximately 39.5 kilometers southwest of the proposed project location;
- Wilson State Park, a state park located approximately 75 kilometers east of the proposed project location; and
- Hays Regional Airport, located approximately 12.5 kilometers southeast of the proposed project location.

The visibility analysis was performed in accordance with the guidelines set forth in EPA-450/4-88-015, Workbook for Plume Visual Impact Screening and Analysis. Within the document, the model VISCREEN is recommended for plume visibility analysis. Several refinement levels of VISCREEN are described. The first-level VISCREEN analysis uses worst-case meteorological conditions (F-class stability, one meter per second wind speed). This level of screening results in the most conservative (worst-case) visibility results. If the plume visibility against the sky and terrain is below a level perceivable to the human eye, the visibility modeling is complete. If the plume is above this level, a second-

level VISCREEN analysis that uses actual meteorological data and refined particle characteristics can be performed. The second-level model will result in a more realistic visibility analysis. If this plume visibility still does not meet sky and terrain contrast levels, a third-level model may be performed which can add more statistical analysis.

The first-level VISCREEN analyses show that the emissions from the proposed Project do not exceed the Class I sky and terrain perceptibility threshold at Cedar Bluff State Park and Wilson State Park. However, the analysis exceeds the Class I sky and terrain perceptibility threshold at the Hays Regional Airport; therefore, a second-level VISCREEN analysis was performed for the Hays Regional Airport.

The visual results of the second-level VISCREEN analysis for Hays Regional Airport show that the emissions from the project pass the Class I sky and terrain perceptibility thresholds. The results of the first-level and second-level VISCREEN model are included in Appendix G of the PSD permit application.

I. Summary and Conclusions for the Ambient Air Impact Analysis

1. The modeled H1H impacts of annual $PM_{2.5}$ and 24-hour $PM_{2.5}$ exceed the SIL thresholds as shown in Table 4. Therefore, refined (cumulative) modeling analyses are required for these pollutants and averaging times. The modeled H1H impacts of annual and 24-hour PM_{10} fall below SIL thresholds. Therefore, refined (cumulative) modeling analyses are not required for this pollutant and averaging time.

2. Table 4 also shows that the pre-application monitoring threshold was exceeded for 24-hour $PM_{2.5}$, therefore, pre-application monitoring for $PM_{2.5}$ is required. Midwest Energy requests that preconstruction monitoring for $PM_{2.5}$ be fulfilled with existing Cedar Bluff (20-195-0001) monitor. Sections 7.3.5.1 through 7.3.5.4 of the PSD application discussed the reasons why the existing KDHE monitor is a representative monitor for $PM_{2.5}$. KDHE has approved the use of existing monitor for 24-hour $PM_{2.5}$ monitoring.

3. There are no modeled impacts that exceed the NAAQS for annual $PM_{2.5}$ and for 24-hour $PM_{2.5}$.

4. The PSD increment for Class II areas that are expected to be consumed is as follows: 52.5 % of the annual $PM_{2.5}$ Class II allowable increment and 43.2 % of the 24-hour $PM_{2.5}$ Class II allowable increment.

5. The proposed project will not have a significant adverse impact on the air quality, soils, vegetation, visibility, and or growth in the surrounding area.

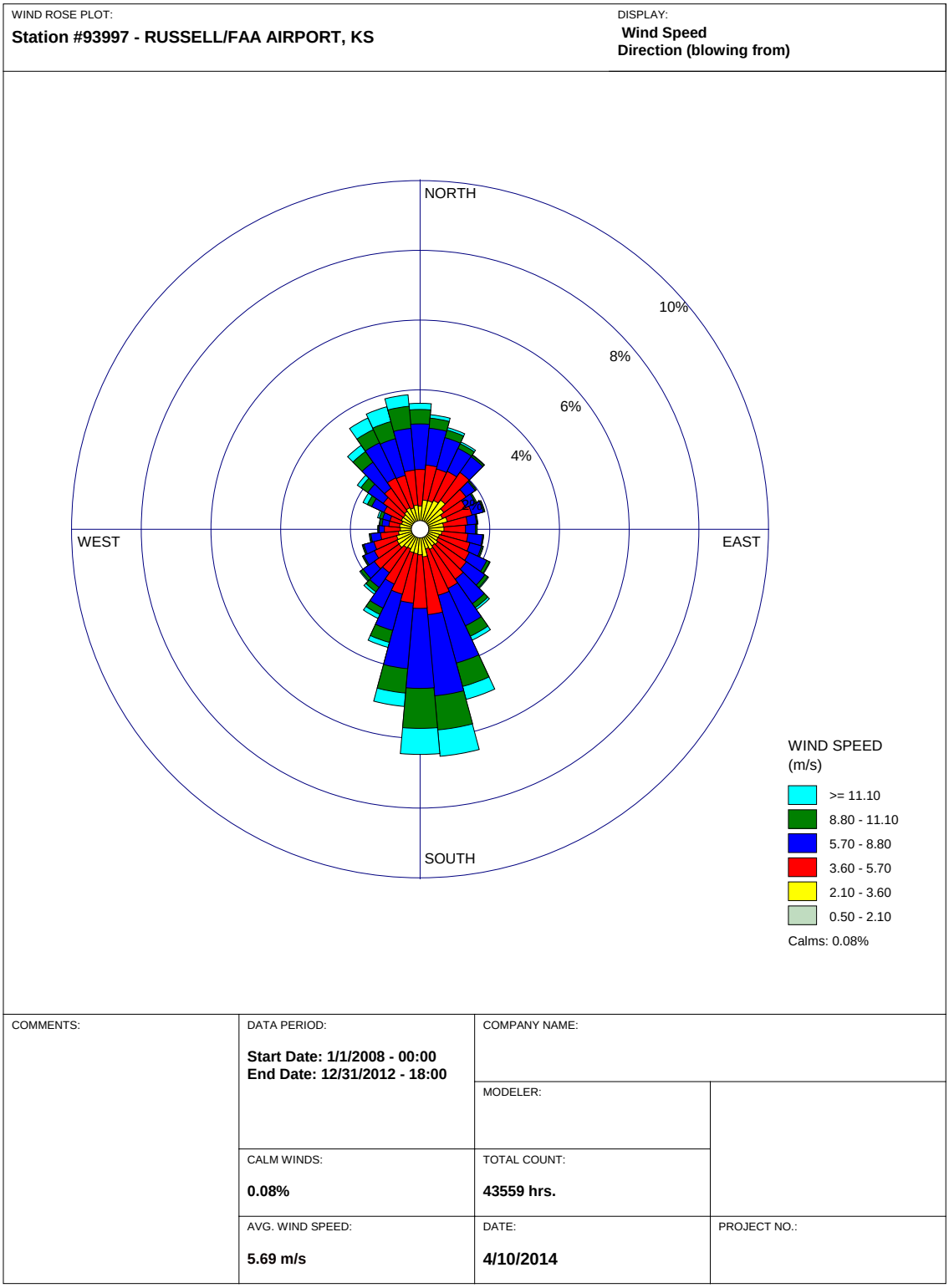

Figure 1. Wind Rose for Years 2008 to 2012

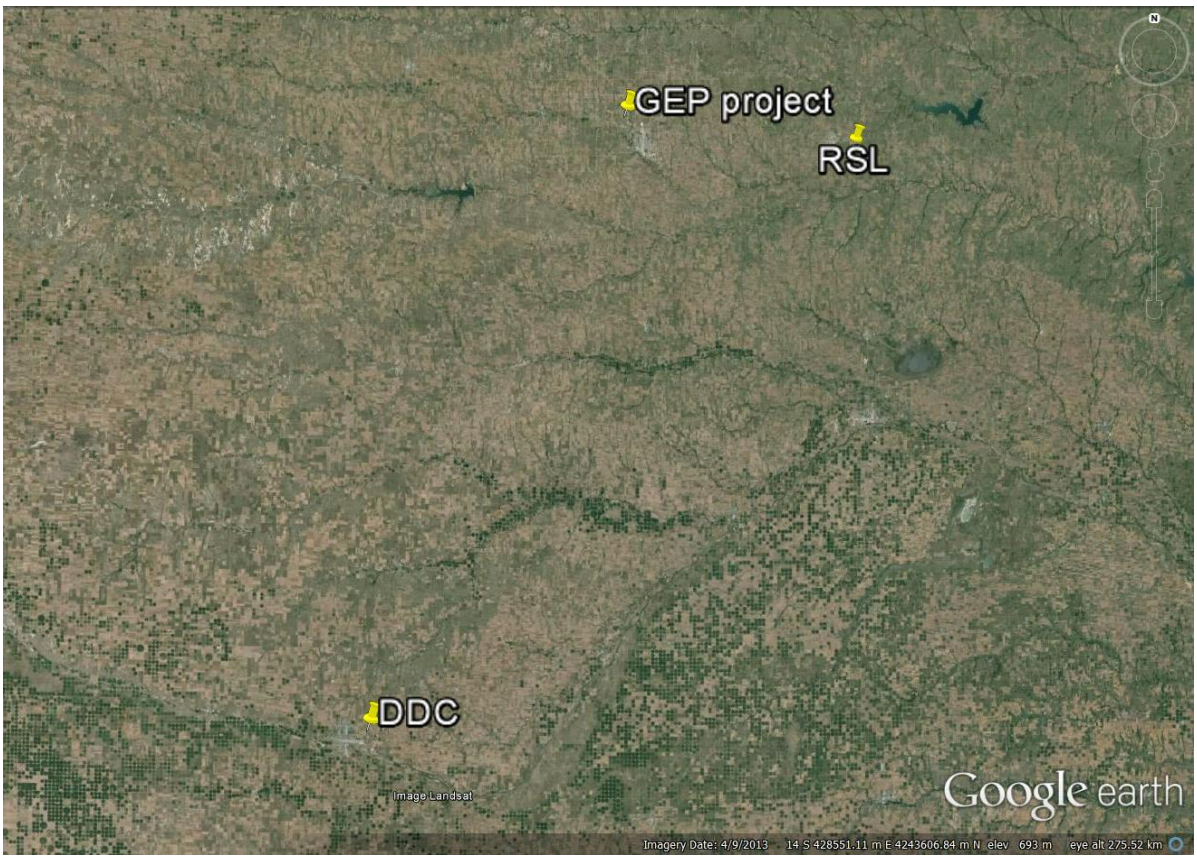

Figure 2. Map showing the proposed project of Midwest Energy, Inc. in Ellis County in Kansas, the Russell Municipal Airport (RSL) and the Dodge City Regional Airport (DDC) meteorological stations in Kansas.

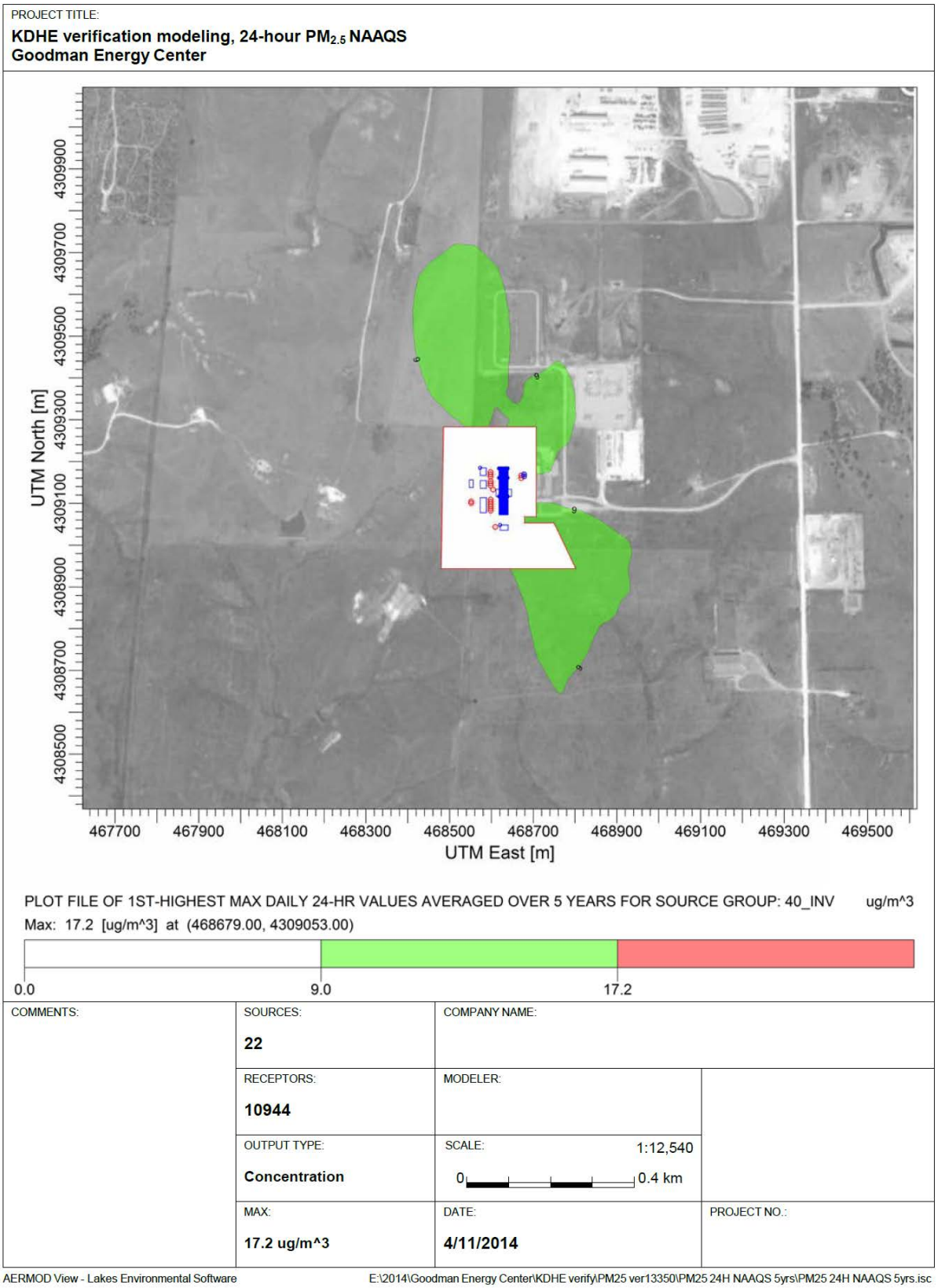

Figure 3. NAAQS Modeling Isopleths for 24-hour $PM_{2.5}$

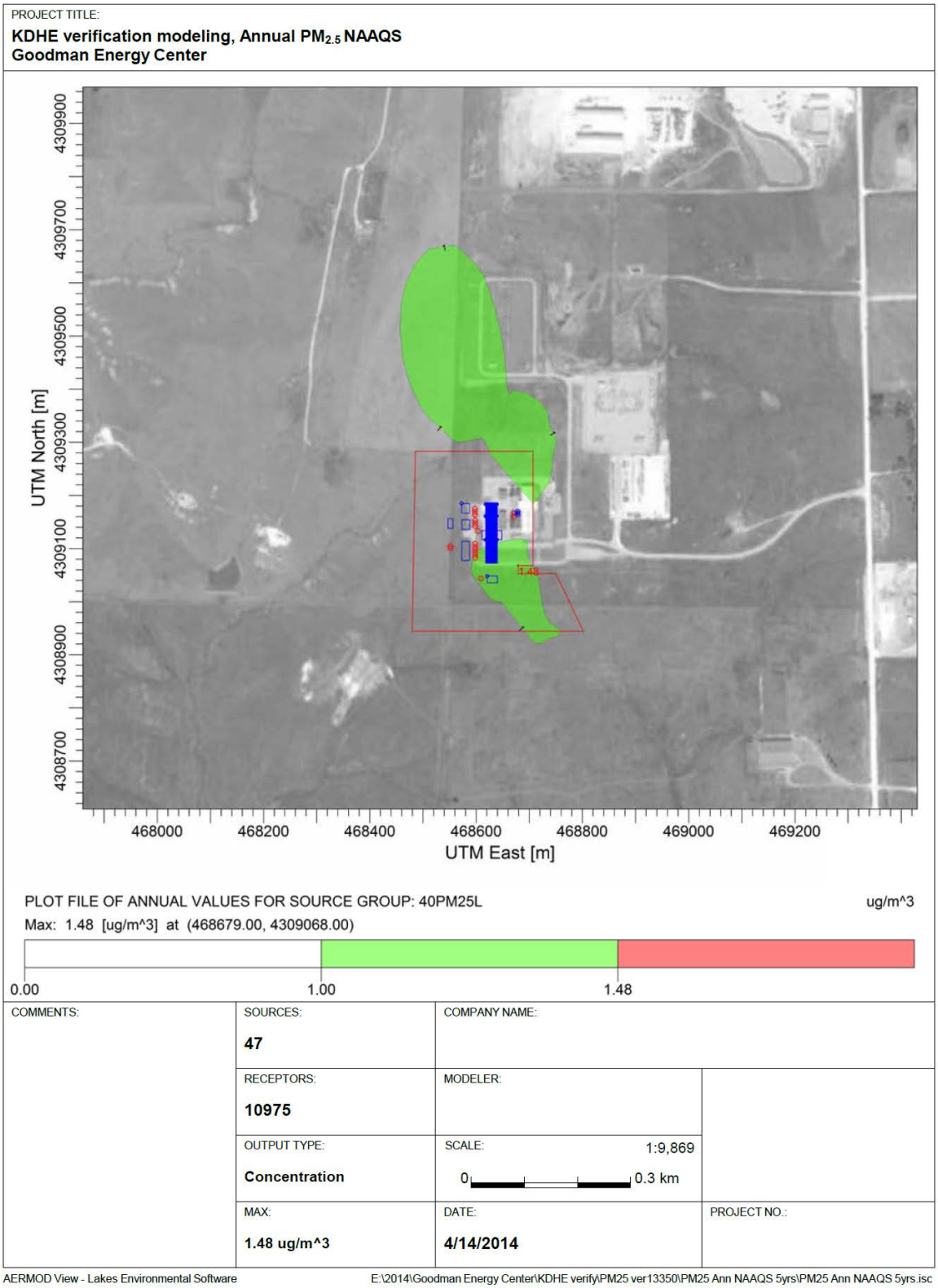

Figure 4. NAAQS Modeling Isopleths for Annual $PM_{2.5}$

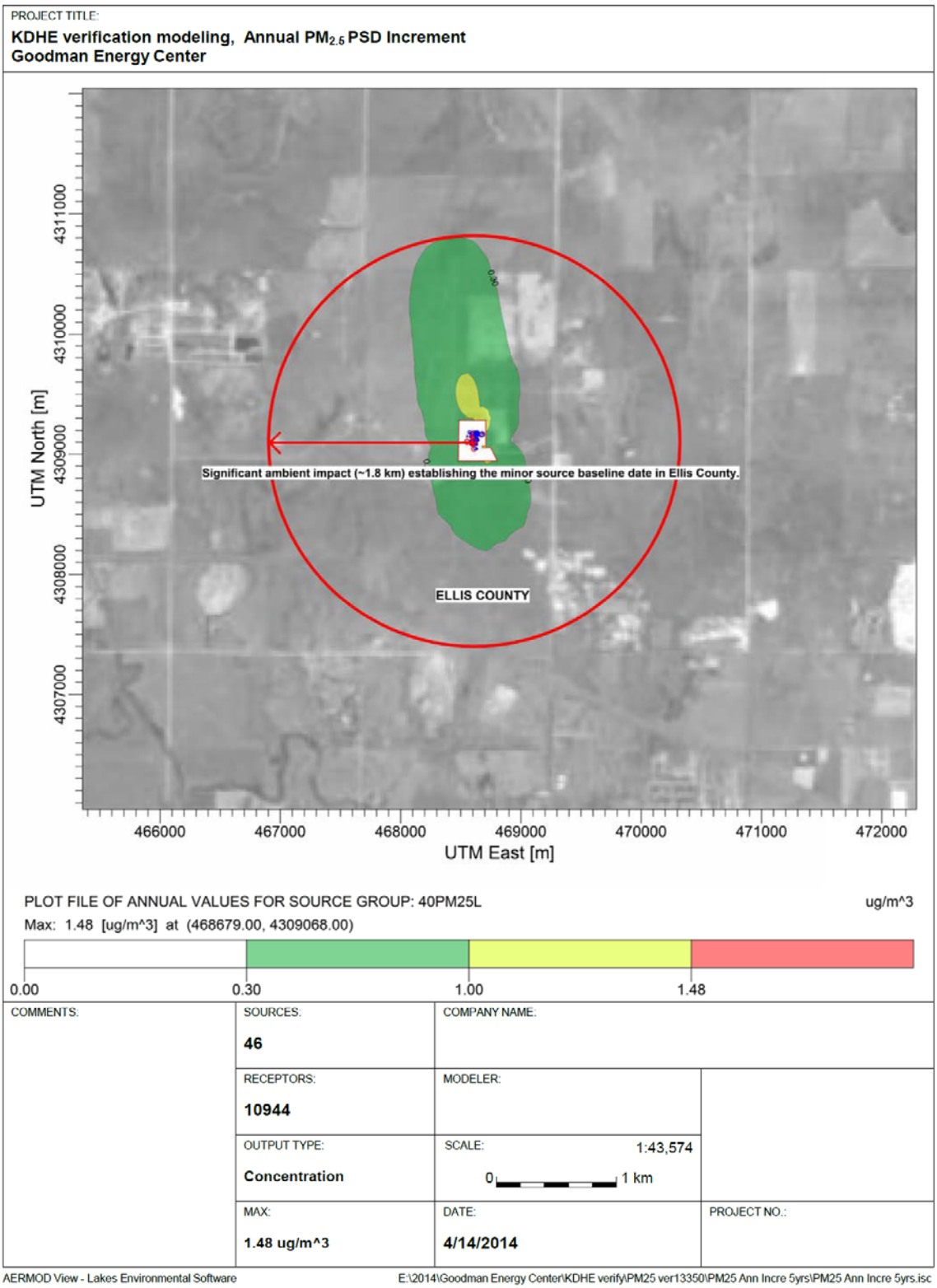

Figure 5. PSD Increment Modeling Isopleths for Annual $PM_{2.5}$

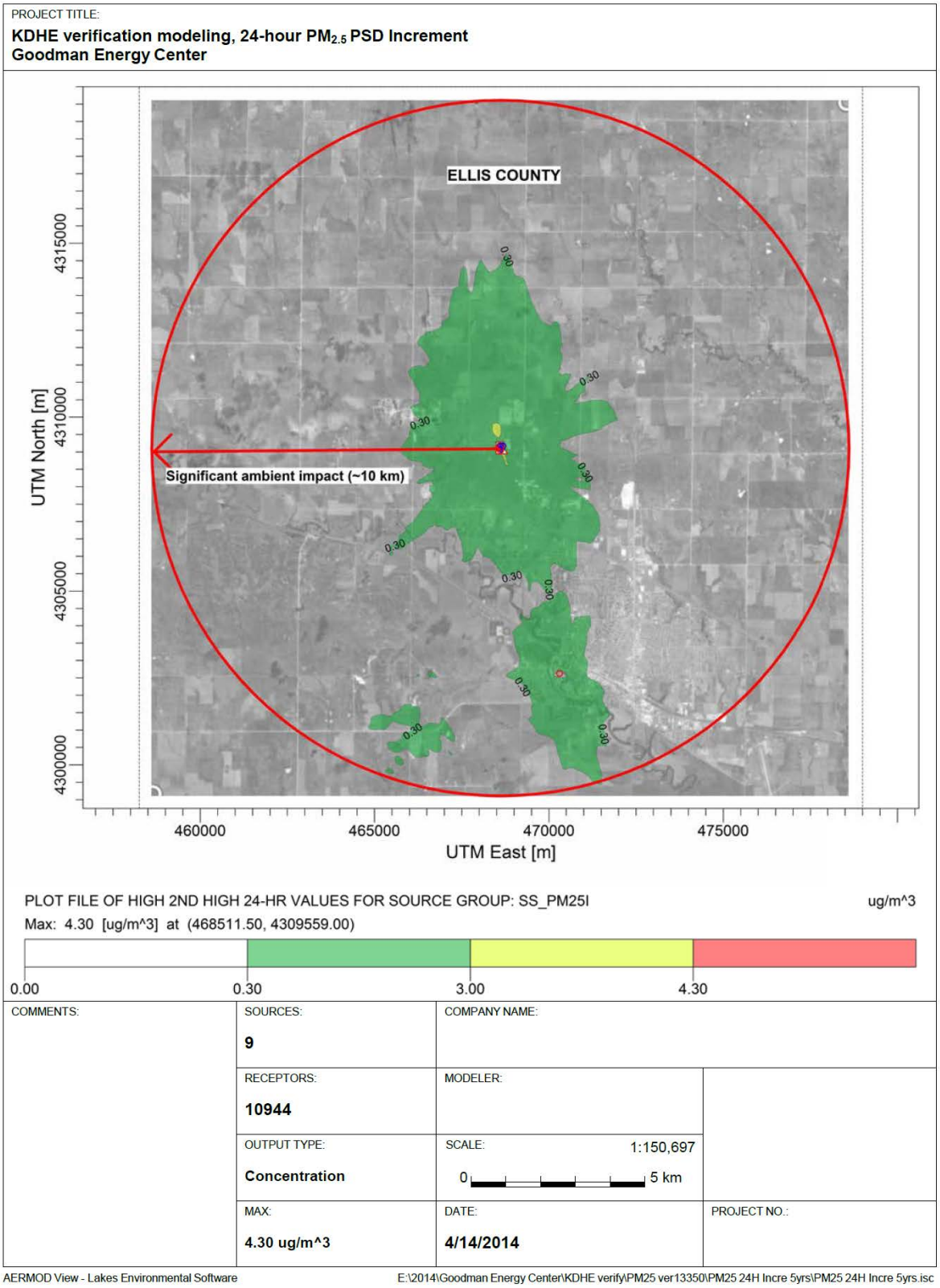

Figure 6. PSD Increment Modeling Isopleths for 24-hour $PM_{2.5}$

Table 9. Receptor grid size, number of emission sources used for NAAQS and PSD increment modeling analysis and distance (radius) used for the selection of nearby sources.

Pollutant	Averaging Period	Receptor grid size	Number of emission sources used in NAAQS modeling	Number of emission sources used in PSD Increment modeling	Radius (km) used for selection of nearby sources (from facility center)
$PM_{2.5}$	Annual	10 km by 10 km grid	47 point sources (6 new point sources, 12 existing point sources and 29 nearby point sources)	46 point sources (6 new point sources, 12 existing point sources and 28 nearby point sources)	50
	24-hour	10 km by 10 km grid	22 point sources (6 new point sources, 12 existing point sources and 4 nearby point sources)	9 point sources (6 new point sources and 3 nearby point sources)*	20

*The 12 existing point sources are not increment consuming for 24-hour $PM_{2.5}$.

Table 10. Midwest Energy, Inc. emission sources used in the refined dispersion modeling

Pollutant Averaging Period	Midwest Energy emission sources
24-hour PM_{10} and Annual and 24-hour $PM_{2.5}$	**6 New Point Sources** 1. ENG_10 (9,341 kW natural gas-fired electrical power generation engine; 78.93 MMBTU/hr max. heat input rate; with SCR and OC) 2. ENG_11 (9,341 kW natural gas-fired electrical power generation engine; 78.93 MMBTU/hr max. heat input rate; with SCR and OC) 3. ENG_12 (9,341 kW natural gas-fired electrical power generation engine; 78.93 MMBTU/hr max. heat input rate; with SCR and OC) 4. HTR_1 (1.0 MMBTU/hr max. heat input rate natural gas-fired indirect heating unit; with Dry Low NOx Burner) 5. FP_1 (100 bhp diesel-fueled fire pump engine; no APC device; diesel sulfur content is 0.0015% by weight) 6. GEN_1 (250 kW diesel-fueled electrical power generation engine; 2.68 MMBTU/hr max. heat input rate; no APC device; diesel sulfur content is 0.0015% by weight) **12 Existing Point Sources** (EU_ENG1 through EU_ENG9, EMGDFP1, EMGGEN1, and IA_HTR1)

Attachment A

Key Steps In The "Top-Down" BACT Analysis

Step 1: Identify All Potential Available Control Technologies

The first step in a "Top-Down" analysis is to identify, for the emission unit in question, "all available" control options. Available control options are those air pollution control technologies or techniques with a practical potential for application to the emissions unit and the regulated pollutant under review. This includes technologies employed outside of the United States. Air pollution control technologies and techniques include the application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of the affected pollutant.

Step 2: Eliminate Technically Infeasible Options

The technical feasibility of the control options identified in Step 1 is evaluated with respect to the source-specific (or emissions unit specific) factors. In general, a demonstration of technical infeasibility should be clearly documented and should show, based on physical, chemical, and engineering principles, that difficulties would preclude the successful use of the control option on the emissions unit under review. Technically infeasible control options are then eliminated from further consideration in the BACT analysis.

Step 3: Rank Remaining Control Technologies By Control Effectiveness

All remaining control alternatives not eliminated in Step 2 are ranked and then listed in order of over-all control effectiveness for the pollutant under review, with the most effective control alternative at the top. A list should be prepared for each pollutant and for each emissions unit subject to a BACT analysis. The list should present the array of control technology alternatives and should include the following types of information:

1) control efficiencies;
2) expected emission rate;
3) expected emission reduction;
4) environmental impacts;
5) energy impacts; and
6) economic impacts.

Step 4: Evaluate Most Effective Controls and Document Results

The applicant presents the analysis of the associated impacts of the control option in the listing. For each option, the applicant is responsible for presenting an objective evaluation of each impact. Both beneficial and adverse impacts should be discussed and, where possible, quantified. In general, the BACT analysis should focus on the direct impact of the control alternative. The applicant proceeds to consider whether impacts of unregulated air pollutants or impacts in other media would justify selection of an alternative control option. In the event the top candidate is shown to be inappropriate, due to energy, environmental, or economic impacts, the rationale for this finding should be fully documented for the public record. Then the next most stringent alternative in the listing becomes the new control candidate and is similarly evaluated. This process continues until the technology cannot be eliminated.

Step 5: Select BACT

The most effective control option not eliminated in Step 4 is proposed as BACT for the emission unit to control the pollutant under review.

Attachment B

Kansas Department of Health and Environment's Evaluation of Midwest Energy, Inc. Proposed PM, PM_{10}, $PM_{2.5}$ BACT Options

Midwest Energy, Inc. evaluated the BACT options to control emissions from the Wartsila four stroke lean burn reciprocating internal combustion engine electric generating units (EGUs), the dew point fuel gas heater, the emergency fire pump, and the emergency diesel generator. The BACT analysis included normal operation and startup. The emergency fire pump and the emergency diesel generator will operate only for testing and maintenance and during periods of emergency. KDHE has reviewed and concurred with BACT as described in the following.

I. $PM/PM_{10}/PM_{2.5}$ BACT for the EGUs

Particulate matter emissions from natural gas combustion sources consist of inert contaminants in natural gas, sulfates from fuel sulfur or mercaptans used as odorants, dust drawn in from ambient air, and particulate of carbon and hydrocarbons resulting from incomplete combustion. Units firing low ash fuel, such as pipeline quality natural gas, and with high efficiency engines have low particulate emissions. No similar units have been identified that use ESPs or baghouses for particulate control. Because proper combustion control and firing fuels with negligible or zero ash content, such as natural gas, are the only control methods, they are considered to be BACT for the EGUs.

The facility has proposed and KDHE has concurred with a BACT emission level of 2.10 lb/hr for $PM/PM_{10}/PM_{2.5}$, based on manufacturer's data. PM emission estimates, for the purposes of this permit, are based on filterable and condensable $PM/PM_{10}/PM_{2.5}$ emissions. The $PM/PM_{10}/PM_{2.5}$ BACT emission rate averaging period is 3-hours.

V. Startup and Shutdown BACT for the EGUs

Controls that are functional during normal operation are not available to control start-up and shutdown emissions. SCR and oxidation catalysts require minimum operating temperatures to control emissions. Minimum temperatures may not be reached until 30 minutes after the unit is turned on. Shutdown emissions occur when catalysts are at proper operating temperature. Therefore, there are no technically feasible control technologies for start-up and shut-down emissions from the EGUs.

For the purpose of BACT emission limits, startup ends 30 minutes after a start sequence is initiated. Startup emission limits for the EGUs are as follows: the BACT emission limit for $PM/PM_{10}/PM_{2.5}$ is 2.55 lb/hour during startup (24-hour averaging period).

VI. VII. $PM/PM_{10}/PM_{2.5}$ BACT for the Fuel Gas Dew Point Heater

BACT control for these pollutants consists of good combustion practices. BACT emission limit for $PM/PM_{10}/PM_{2.5}$ is 0.0075 lb MMBtu/hr. BACT limits exclude startup, shutdown, and malfunction.

VIII. $PM/PM_{10}/PM_{2.5}$ BACT for the Emergency Diesel Generator

The unit will operate 100 hours per year or less and will operate on ULSD fuel. Combustion control is the only technically and economically feasible control and therefore is BACT for the emergency diesel generator. The BACT emissions limit for $PM/PM_{10}/PM_{2.5}$ is 0.15 g/hp-hr. BACT limits exclude startup, shutdown, and malfunction.

IX. $PM/PM_{10}/PM_{2.5}$ BACT for the Emergency Fire Pump

The unit will operate 100 hours per year or less and will operate on ULSD fuel oil. Combustion control is the only technically feasible control and therefore is BACT for the emergency fire pump. The BACT emission limit for $PM/PM_{10}/PM_{2.5}$ is 0.22 g/hp-hr. BACT limits exclude startup, shutdown, and malfunction.

Attachment C

Kansas Department of Health and Environment's (KDHE) Evaluation of MIDWEST ENERGY, INC. Proposed GHG BACT Options

I. Greenhouse Gas Emission Units Subject to Best Available Control Technology

The following greenhouse gas (GHG) best available control technology (BACT) analyses are based on the information prepared and submitted by the Midwest Energy, Inc. to the Kansas Department of Health and Environment (KDHE) for evaluation. The GHG BACT analyses determine the most effective control of GHG emissions from the proposed project at the existing Goodman Energy Center (GEC). The proposed project will increase nominal power output of the facility by approximately 28 megawatts (MW).

Midwest Energy is proposing to expand the electric generating capacity at its existing GEC facility located in Ellis County, Kansas, approximately four (4) miles northwest of Hays, Kansas. The proposed project will consist of three (3) natural gas-fired spark ignition (SI), 4-stoke lean burn (4SLB) reciprocating internal combustion engines (RICEs) (each with 9,341 kW nominal power output) and auxiliary equipment that include one (1) 1.0 MMBTU/hr natural gas dew point heater, one (1) emergency diesel fire pump engine (with 100 hp power output), and one (1) emergency diesel generator (with 250 kW power output).

For more details, please refer to the Prevention of Significant Deterioration Air Construction Permit Application by Midwest Energy received by KDHE on November 26, 2013.

The potential maximum GHG emissions from the proposed project are shown in Tables C-1 and C-2. The combined CO_2 emissions from the RICEs during steady-state operation at full load and start-up operation account for 99.6 % of total facility-wide CO_2 (mass-based) and CO_2e (CO_2-equivalent-based) emissions.

The GHG BACT and BACT emission limits are summarized in Table C-3

Table C-1. Potential maximum greenhouse gas (GHG) emissions from the proposed project (showing contribution per GHG)

Emission Unit/Process	Carbon dioxide (CO_2), CO_2 equivalent, proposed project [a]	Methane (CH_4), CO_2 equivalent, proposed project [a]	Nitrous Oxide (N_2O), CO_2 equivalent, proposed project [a]	All GHGs CO_2 equivalent, proposed project [a]	Contribution, %
	tons/yr	tons/yr	tons/yr	tons/yr	
Natural gas-fired RICE (steady-state operation at 100 % load)	114,806.6	52.4	73.4	114,932.4	98.4
Start-up emissions from natural gas-fired RICE [b]	26,751.1	3.5	4.9	26,759.5	
Natural Gas Dew Point Heater	515.1	0.22	2.6	517.9	1.57
Emergency Diesel Fire Pump	5.8	0.003	0.003	5.9	
Emergency Diesel Generator	15.6	0.01	0.01	15.7	
TOTAL	**142,094.3**	**56.1**	**80.9**	**142,231.3**	

[a] CO_2 equivalent (CO_2e)-based emissions; Global Warning Potentials (GWP) used are as follows: CO_2 = 1, CH_4 = 25, N_2O = 298; Consisting of three (3) natural gas-fired RICEs, one (1) natural gas dew point heater, one (1) emergency diesel fire pump, and one (1) emergency diesel generator.

[b] Start-up events are assumed to take up to 30 minutes, after which control technologies will be fully functional. Shutdown takes about a minute. There are 1,095 events per year per engine.

Table C-2. Potential maximum greenhouse gas (GHG) emissions from the proposed project (showing contribution per emission unit)

Emission Unit/Process	Carbon dioxide (CO_2), per unit [a]		Methane (CH_4), per unit [a]		Nitrous Oxide (N_2O), per unit [a]		All GHGs, CO_2 equivalent, per unit [b]	
Natural gas-fired RICE (steady-state operation at 100 % load)	9,320.2	lbs/hr	0.17	lbs/hr	0.02	lbs/hr	**9,330.4**	lbs/hr
Start-up emissions from natural gas-fired RICE [c]	2171.7	lbs/start-up					**2,181.9**	lbs/hr
Natural Gas Dew Point Heater	117.6	lbs/hr	2.0E-03	lbs/hr	2.0E-03	lbs/hr	**118.2**	lbs/hr
Emergency Diesel Fire Pump	116.9	lbs/hr	2.2E-03	lbs/hr	2.2E-04	lbs/hr	**117.0**	lbs/hr
Emergency Diesel Generator	312.9	lbs/hr	5.9E-03	lbs/hr	5.9E-04	lbs/hr	**313.2**	lbs/hr
TOTAL							**12,060.8**	lbs/hr

[a] Mass-based emissions

[b] CO_2e-based emissions; Global Warning Potentials (GWP) used are as follows: CO_2 = 1, CH_4 = 25, N_2O = 298; Consisting of three (3) natural gas-fired RICEs, one (1) natural gas dew point heater, one (1) emergency diesel fire pump, and one (1) emergency diesel generator.

[c] Start-up events are assumed to take up to 30 minutes, after which control technologies will be fully functional. Shutdown takes about a minute. There are 1,095 events per year per engine.

Table C-3. Greenhouse gas (GHG) best available control technology (BACT), BACT emission limits and compliance demonstration

Emission Units	GHG BACT, BACT emission limits and compliance demonstrations
Natural gas-fired RICE	GHG BACT • Use of high energy efficiency design and operation technology that includes the use of lean-burn, four-stroke combustion configuration employing spark ignition, use of clean fuels, air-to-fuel ratio control, turbocharger technology, open interface cooling system, and a lube oil cooling system. • Use of pipeline quality natural gas only for power generation • Good combustion practices in accordance with the manufacturer's recommendation to maintain high energy efficiency/operational design. BACT emission limits • The **CO_2 equivalent (CO_2e) emissions** (or the GHGs CO_2e emissions) from each RICE are limited to the following emissions guaranteed by the manufacturer: **9,330 lbs/hr** during steady-state operation at full load **6,847 lbs/hr** during start-up operation (the 30 min start-up emissions of 2,181.9 lbs/hr plus the 30 min steady-state full load emissions of 4,665.2 lbs/hr) • The **CO_2 emissions, not including other GHGs**, (for CO_2, mass-basis is equivalent to CO_2e-basis) from each RICE are limited to the following emissions guaranteed by the manufacturer: **9,320 lbs/hr** during steady-state operation at full load **6,832 lbs/hr** during start-up operation (the 30 min start-up emissions of 2,171.7 lbs/hr plus the 30 min steady-state full load emissions of 4,660.2 lbs/hr) • The **CO_2 emissions per power output** is limited to the following emissions guaranteed by the manufacturer: **1.13 lbs/kWh (or 511 g/kWh)** based on a 12-month rolling average CO_2 emissions per power output Compliance Demonstration • The owner or operator shall keep records of the type and/or specifications of engine installed at proposed station. • The owner or operator is limited to firing pipeline quality natural gas only in the three (3) RICEs and shall keep records of the type and/or specifications of the pipeline quality natural gas used. • The owner of operator shall keep records of the good combustion practices done on each RICE, in accordance with the manufacturer's recommendation to maintain efficiency of the engines. • Initial performance testing of each RICE is to demonstrate compliance with **9,320 lbs/hr** CO_2 during steady-state operation at full load and **6,832 lbs/hr** CO_2 during start-up is required.

Emission Units	GHG BACT, BACT emission limits and compliance demonstrations
	• Subsequent compliance demonstration is the **recordkeeping of CO_2 emissions per power produced** by the facility using the following formula and shall comply with the **1.13 lbs/kWh limit**: E = (x * k * y)/ z where, E = CO_2 emissions per power output (lb/kWhr) x = amount of carbon (C) per cubic foot of natural gas (lb/ft^3), based on a monthly average fuel analysis by the pipeline supplier k = 3.667 or the ratio of the molecular weight of CO_2 to C y = amount (ft^3) of natural gas burned in the RICEs during the most recent 12-month period; and z = total power output (kWh, gross) from the RICEs during the most recent 12-month period. • Compliance demonstration for the other GHGs emissions (CH_4 and N_2O), which are very minimal relative to the GHGs emissions of the RICEs, is established by the BACT analysis and emissions calculations submitted with the permit application
Natural Gas Dew Point Heater	GHG BACT • Use of clean fuel (exclusive use of pipeline quality natural gas); • Good combustion practices in accordance with the manufacturer's recommendation to operate the unit in the most efficient manner possible; • Tuning the unit every two (2) years according to the manufacturer's specifications; and • Recording of the annual hours of operation and annual fuel use and reporting GHG emissions annually. Compliance Demonstration • Compliance demonstration for the GHGs emissions (CO_2, CH_4 and N_2O), which are very minimal relative to the GHGs emissions of the RICEs, is established by the BACT analysis and emissions calculations submitted with the permit application
Emergency Diesel Fire Pump	GHG BACT • Use of the most efficient stationary fire pump engine that meets the facility's needs (e.g., use of most fuel efficient engine such as the Tier 3-certified engine) • Use of the ultra-low sulfur diesel (ULSD) fuel with sulfur content of no more than 0.0015% by weight • Maximum hour of operation is 100 hours per year. Compliance Demonstration • Compliance demonstration for the GHGs emissions (CO_2, CH_4 and N_2O), which are very minimal relative to the GHGs emissions of the RICEs, is established by the BACT analysis and emissions calculations submitted

Emission Units	GHG BACT, BACT emission limits and compliance demonstrations
	with the permit application
Emergency Diesel Generator	GHG BACT • Use of the most efficient emergency diesel generator that meets the facility's needs (e.g., use of most fuel efficient engine such as the NSPS-certified engine) Compliance Demonstration • Compliance demonstration for the GHGs emissions (CO_2, CH_4 and N_2O), which are very minimal relative to the GHGs emissions of the RICEs, is established by the BACT analysis and emissions calculations submitted with the permit application

II. GHG BACT for the three (3) natural gas-fired RICEs

A. BACT Step 1 (Identify Available Control Options)

The following control options, which are identified by Midwest Energy as the most stringent controls for the proposed project, have been considered in Step 1 of GHG BACT for the three (3) RICEs. Details are described in Section 6.5 of the PSD construction permit application. Section 6.5.3.1 explains in detail the option of Carbon Capture and Sequestration (CCS). Table 6-4 of the PSD application summarized the available control options evaluated for the GHG BACT.

A fundamental objective of the proposed project is to utilize pipeline quality natural gas. (The definition of pipeline quality gas is specified in the PSD construction permit.) In comparison to all other potential fuels, natural gas will achieve the lowest emissions of CO_2 and other GHGs. A comparison of emission rate factors for the various fuels is presented in Table 6-5 of the PSD application and shows that natural gas when used as a fuel in stationary sources, typically produces less CO_2 (lbs/MMBTU) than other fuels.

Based on the project design size and objectives, Midwest Energy has determined that RICE technology, firing pipeline quality natural gas and with RICE sizes between 4 to 10 MW, constitutes the most efficient electric generating technology for the project.

Midwest Energy found that CCS is not an available control option to the proposed project. Some specific reasons cited in the application to support that CCS is not an available control option include the following:

1. Current post-combustion CO_2 capture processes such as an amine-type capture process to be used to rapid-response units have never been demonstrated on the exhaust of natural gas-fired RICE at any scale and would still require considerable research and development stage/process; and
2. The exhaust gases from individual RICE will neither be continuous, of large amounts, nor of a high-purity CO_2 concentration (CO_2 concentration will be only about 6% of the gas stream).

B. BACT Step 2 (Eliminate Technically Infeasible Options)

The control options identified in Step 1 of BACT, listed in Table C-3 above, are all integral part of the engine design, thus, technically feasible for the proposed project.

C. BACT Step 3 (Ranking of Controls)

The control options identified in Step 1 of BACT for the proposed project are the most effective control alternative (i.e., the option that achieves the lowest emission level) identified by Midwest Energy.

D. BACT Step 4 (Economic, Energy, and Environmental Impacts)

Because Midwest Energy will utilize all three (3) of the feasible technologies for reducing GHGs from generation of power, no detailed analysis was provided by the facility to compare the available control technologies relative to economic, energy, and environmental impacts.

E. BACT Step 5 (Selecting BACT)

The following is the GHG BACT for the three (3) RICEs:

1. Use of high energy efficiency design and operation technology that includes the use of lean-burn, four-stroke combustion configuration employing spark ignition, use of clean fuels, air-to-fuel ratio control, turbocharger technology, open interface cooling system, and a lube oil cooling system.
2. Use of pipeline quality natural gas only for power generation
3. Good combustion practices in accordance with the manufacturer's recommendation to maintain high energy efficiency/operational design.

F. BACT emission limits and compliance demonstration

The following is the BACT emission limits for the three (3) RICE, during steady-state operation at full-load and during start-up operations:

1. The CO_2 equivalent (CO2e) emissions (or the GHGs CO_2e emissions) from each RICE are limited to the following emissions guaranteed by the manufacturer:

   9,330 lbs/hr during steady-state operation at full load
   6,840 lbs/hr during start-up operation (30 min start-up emissions + 30 min steady-state full load emissions)

2. The CO_2 emissions, not including other GHGs, (for CO_2, mass-basis is equivalent to CO_2e-basis) from each RICE are limited to the following emissions guaranteed by the manufacturer:

   9,320 lb/hr during steady-state operation at full load
   6,832 lb/hr during start-up operation (30 min start-up emissions + 30 min steady-state full load emissions)

3. The CO_2 emissions per power output is limited to the following emissions guaranteed by the manufacturer:
   1.13 lbs/kWh (or 511 g/kWh) based on a 12-month rolling average CO_2 emissions per power output

The following describe the compliance demonstration to the GHG BACT for each RICE:

1. The owner or operator shall keep records of the type and/or specifications of engine installed at proposed station.

2. The owner or operator is limited to firing pipeline quality natural gas only in the three (3) RICEs and shall keep records of the type and/or specifications of the pipeline quality natural gas used. Definition of pipeline quality gas is specified in the PSD construction permit.

3. The owner of operator shall keep records of the good combustion practices done on each RICE, in accordance with the manufacturer's recommendation to maintain efficiency of the engines.

4. The owner or operator shall conduct initial performance testing of CO_2 emissions from each of the three (3) RICE during steady-state operation at full load. Performance testing of other GHGs (CH_4 and N_2O) emissions from the three (3) RICE is not required since emissions from these pollutants are very minimal.

   A. Initial performance testing of each RICE is to demonstrate compliance with 9,320 lb/hr CO_2 during steady-state operation at full load and 6,832 lb/hr CO_2 during start-up (30 min start-up emissions + 30 min steady-state full load emissions) is required.

   B. Subsequent compliance demonstration is the keeping of records of CO_2 emissions per power produced by the facility using the following formula:

      $E = (x * k * y)/ z$

      where,

      $E = CO_2$ emissions per power output (lb/kW-hr)

      x = amount of carbon (C) per cubic foot of natural gas (lb/ft^3), based on a monthly average fuel analysis by the pipeline supplier

      k = 3.667 or the ratio of the molecular weight of CO_2 to C

      y = amount (ft^3) of natural gas burned in the RICEs during the most recent 12-month period; and

z = total power output (kW-hr, gross) from the RICEs during the most recent 12-month period.

5. Compliance demonstration for the other GHGs emissions (CH_4 and N_2O), which are very minimal relative to the GHGs emissions of the RICEs, is established by the BACT analysis and emissions calculations submitted with the permit application.

III. GHG BACT for the Start-up and Shutdown of the three (3) natural gas-fired RICE

Details are described in Section 6.6 of the PSD construction permit application.

Each RICE has potentially 1,095 start-up/shutdown events per engine per year based on long range dispatch model runs for their electrical system. Start-up emissions, on a lb/hr basis, will be higher than the full (100%) load operation during normal steady-state operation because the control devices (i.e., selective catalytic reduction (SCR) system and oxidation catalysts (CO)) cannot operate until the respective catalysts reach certain minimum temperatures. Shutdown emissions, though, occur when catalysts are at proper operating temperatures.

According to Midwest Energy, for the purposes of this permit application, it is assumed that all start-ups are "cold start-ups", which is a very conservative approach as a "cold start-up" has more emissions than a "warm start-up". Midwest Energy expects to have many "warm start-ups" due to the expected daily fluctuations in electrical demand. A "cold start-up" is one which requires about 30 minutes of fired-operation for the SCR and CO catalysts to reach their respective minimum operating temperatures and has higher emissions than a "warm start-up" because it takes less time to reach the proper operating temperature required for the catalyst systems.

A. BACT Step 1 (Identify Available Control Options) and BACT Step 2 (Eliminate Technically Infeasible Options)

Controls that are functional during normal operation are not available to control start-up and shutdown emissions. SCR and CO catalysts require minimum operating temperatures to control emissions. This temperature is not reached until approximately 30 minutes after the unit is turned on. In addition, the air-to-fuel ratio is highly variable until approximately 20% load for the lean-burn combustion. Therefore, there are no technically feasible control technologies for start-up and shutdown emissions from the RICE.

B. BACT Step 3 (Ranking of Controls) and BACT Step 4 (Economic, Energy, and Environmental Impacts)

Because there are no technically feasible control technologies for start-up and shutdown emissions, BACT Step 3 and BACT Step 4 are not applicable.

C. BACT Step 5 (Selecting BACT)

The following is the BACT emission limit for the start-up events of each RICE:

The CO_2 BACT emission limit for each RICE during start-up operation is 6,832 lb/hr (calculated based on 30 min start-up emissions plus 30 min steady-state at full load emissions.)

D. BACT emission limits and compliance demonstration

See II.F above for the emission limit and compliance demonstrations related to the start-up emissions of the RICEs.

IV. GHG BACT for the Natural Gas Dew Point Heater

Details are described in Section 6.7.2 of the PSD construction permit application.

The dew point heater will be fired exclusively on natural gas and is used to pre-heat that fuel to facilitate rapid starts and meet RICE engine manufacturer requirements. The unit is rated at approximately 1.0 MMBtu/hr, and will be fired a total of 8,760 hours per year. The GHG emissions from this unit are estimated to be **518.4 tons CO_2e/yr**. This GHG emission is small when compared with the RICE GHG emissions or the project's total GHG emissions **(approximately 1.08 %).**

A. BACT Step 1 (Identify Available Control Options) and BACT Step 2 (Eliminate Technically Infeasible Options)

The following are the GHG BACT for the dew point heater:

1. Use of clean fuel (exclusive use of pipeline quality natural gas);
2. Good combustion practices in accordance with the manufacturer's recommendation to operate the unit in the most efficient manner possible;
3. Tuning the unit every two (2) years according to the manufacturer's specifications; and
4. Recording of the annual hours of operation and annual fuel use and reporting GHG emissions annually.

B. BACT Step 3 (Ranking of Controls) and BACT Step 4 (Economic, Energy, and Environmental Impacts)

Because Midwest Energy will utilize the most stringent control for reducing the GHG emissions from the dew point heater, no detailed analyses were provided for BACT Step 3 and BACT Step 4.

C. BACT Step 5 (Selecting BACT)

As identified in Step 1 of the BACT, the following are the GHG BACT for the natural gas heater:

1. Use of clean fuel (exclusive use of pipeline quality natural gas);
2. Good combustion practices in accordance with the manufacturer's recommendation to operate the unit in the most efficient manner possible;
3. Tuning the unit every two (2) years according to the manufacturer's specifications; and
4. Recording of the annual hours of operation and annual fuel use and reporting GHG emissions annually.

D. BACT Compliance

Compliance demonstration for the GHGs emissions (CO_2, CH_4 and N_2O), which are very minimal relative to the GHGs emissions of the RICEs, is established by the BACT analysis and emissions calculations submitted with the permit application

V. GHG BACT for the Emergency Diesel Fire Pump

Details are described in Section 6.8.2 of the PSD construction permit application.

The emergency fire pump will be used for no more than 100 hours per year. Consistent with the rationale for the BACT determination for GHG emissions from the RICEs, Midwest Energy believes that BACT for this source involves selection of the most efficient stationary fire pump engine that can meet the project's needs. Midwest Energy has estimated the total GHG emissions from the emergency fire pump at **5.9 tons of CO_2e per year**. This GHG emission is very small when compared with the RICE GHG emissions or the project's total GHG emissions **(approximately 0.012%).**

A. BACT Step 1 (Identify Available Control Options) and BACT Step 2 (Eliminate Technically Infeasible Options)

The following is the GHG BACT for the emergency fire pump:

Use of the most efficient stationary emergency fire pump engine (e.g., use of most fuel efficient engine such as the Tier 3-certified engine)

B. BACT Step 3 (Ranking of Controls) and BACT Step 4 (Economic, Energy, and Environmental Impacts)

Because Midwest Energy will utilize the most stringent control for reducing the GHG emissions from the emergency fire pump, no detailed analyses were provided for BACT Step 3 and BACT Step 4.

C. BACT Step 5 (Selecting BACT)

As identified in Step 1 of the BACT, the following is the GHG BACT for the emergency fire pump:

1. Use of the most efficient stationary fire pump engine (e.g., use of most fuel efficient engine such as the Tier 3-certified engine)
2. Use of the ULSD fuel with sulfur content of no more than 0.0015% by weight
3. Maximum hour of operation is 100 hours per year.

D. BACT Compliance

Compliance demonstration for the GHGs emissions (CO_2, CH_4 and N_2O), which are very minimal relative to the GHGs emissions of the RICEs, is established by the BACT analysis and emissions calculations submitted with the permit application

VI. GHG BACT for the Emergency Diesel Generators

Details are described in Section 6.9.2 of the PSD construction permit application.

The emergency diesel generator (250 kW) will be limited for no more than 100 hours per year. Consistent with the rationale for the BACT determination for GHG emissions from the RICEs, Midwest Energy believes that BACT for this source involves selection of the most efficient stationary emergency generator engine that can meet the project's needs. Midwest Energy has estimated the total GHG emissions from the emergency fire pump at **15.7 tons of CO_2e per year**. This GHG emission is very small when compared with the RICE GHG emissions or the project's total GHG emissions **(approximately 0.033%).**

A. BACT Step 1 (Identify Available Control Options) and BACT Step 2 (Eliminate Technically Infeasible Options)

The following is the GHG BACT for the emergency diesel generator:

Use of the most efficient emergency diesel-fired generator (e.g., use of most fuel efficient engine such as the NSPS-certified engine)

B. BACT Step 3 (Ranking of Controls) and BACT Step 4 (Economic, Energy, and Environmental Impacts)

Because Midwest Energy will utilize the most stringent control for reducing the GHG emissions from the emergency diesel generator, no detailed analyses were provided for BACT Step 3 and BACT Step 4.

C. BACT Step 5 (Selecting BACT)

As identified in Step 1 of the BACT, the following is the GHG BACT for the emergency diesel generator:

1. Use of the most efficient emergency diesel generator (e.g., use of most fuel efficient engine such as the NSPS-certified engine)
2. Maximum hour of operation is 100 hours per year per generator.

D. BACT Compliance

Compliance demonstration for the GHGs emissions (CO_2, CH_4 and N_2O), which are very minimal relative to the GHGs emissions of the RICEs, is established by the BACT analysis and emissions calculations submitted with the permit application.