Permit Summary Sheet

Lacey Randall Generation Facility, LLC.

Proposed Air Quality Construction Permit

Source ID No. 1930036
C-10593

Kansas Department of Health and Environment

Bureau of Air

Permitting Section

January 24, 2014

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PREVENTION OF SIGNIFICANT DETERIORATION (PSD)

PERMIT SUMMARY SHEET

Permit No.: 1930036, C-10593

Source Name: Lacey Randall Generation Facility, LLC

Source Location: Southwest Quarter of Section 17, Township 7 South, Range 33 West
Thomas 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. Thomas County, Kansas, where this construction is taking place, is in attainment for all the criteria pollutants.

II. Project Description

Tradewind Energy, Inc. plans to install up to ten new spark ignition Wartsila four stroke lean burn reciprocating internal combustion engines (RICE) electric generating units (EGUs) plus auxiliary equipment at the Lacey Randall Station (the Project) to be located in Thomas County, Kansas, approximately 3.5 miles northeast of Colby, Kansas. The Project will have a total nominal power output of approximately 94 megawatts (MW) and will be fired by pipeline quality natural gas. The facility will also include a 3 million Btu per hour (MMBtu/hr) gas heater, a 150 horsepower (hp) emergency fire pump, a 324 hp emergency diesel generator, up to 4 circuit breakers, and a 309,000 gallon fuel oil storage tank. The Project is designed to support the expansion of the wind energy resources and the oil/gas exploration in western Kansas.

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. <u>Air Emissions from the Project</u>

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), and hazardous air pollutants (HAPs) from the project were evaluated The potential to emit 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 2-1 and Appendix C of the permit application submitted July 11, 2013, updated December 12, 2013. Emissions of SO_2 and H_2SO_4 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. Estimated Emissions	
Pollutant	Potential-to-emit (PTE)[1] (tons per year)
NO_X [2]	141.57
CO	169.78
SO_2	2.09
VOC	128.69
PM	63.14
PM_{10} and $PM_{2.5}$	100.59
H_2SO_4	0.32
Total HAPs	50.53
Individual Hazardous Air Pollutants (HAPs)[3] - Acetaldehyde - Acrolein - Formaldehyde	 15.56 14.10 9.72
Carbon Dioxide Equivalent (CO_2e) Greenhouse Gases (GHG)[4]: -Carbon Dioxide (CO_2) -Methane (CH_4) -Nitrous Oxide (N_2O) -Sulfur Hexafluoride (SF_6)	409,409.07 408,946.25 186.90 261.97 13.95

Emissions of the EGUs are discussed in Section 4.2.1 of the permit application submitted July 11, 2013 and in Appendix C. Emissions were analyzed at 50, 75, 90, and 100 percent load. Startup emissions were based on a length of 30 minutes per startup, and 14,600 startups per year facility wide. Except as specified, emissions estimates are based on the vendor's guaranteed emission rates with specified emission controls. PM emission estimates, for the purposes of this permit, are based on filterable particulate only. PM emissions estimates are vendor supplied and were submitted on 11/14/13. 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

[1] Potential-to-emit (PTE) means the maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation or the effect it would have on emissions is federally enforceable.

[2] NO_X and VOC emissions for the Project exceed the 40 tons significance threshold. Therefore pursuant to 40 CFR 52.21, the Project is also significant for O_3. Since NO_X and VOCs are surrogates for O_3, BACT for NO_X and VOC will be considered BACT for O_3.

[3] Only the three individual HAPs with the largest PTE have been listed. For detailed HAPs PTE estimates, which include all HAPs, refer to the Permit Application submitted July 11, 2013, Appendix C.

[4] Greenhouse gas emissions are converted to CO_2-based equivalence.

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 4.2.4 through 4.2.8 discuss emission estimates for other facility emission units. The emissions from the fuel gas 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, VOC, NO_X, PM, PM_{10}, and $PM_{2.5}$. SO_2 emissions are 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 309,000 diesel fuel oil storage tank were estimated using EPA TANKS software.

The potential to emit GHGs, NO_X, CO, VOC, 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. NO_x and VOC emissions for the Project exceed the significance threshold. Therefore pursuant to 40 CFR 52.21, the Project is also significant for ozone (O_3). Since NO_x and VOCs are surrogates for O_3, BACT for NO_X and VOC will be considered BACT for O_3. 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 NO_X, CO, VOC, PM, PM_{10}, $PM_{2.5}$ for the 10 EGUs, the emergency fire pump, the diesel fired emergency generator, and the natural gas fired indirect fuel gas heater is presented in Attachment B. KDHE's evaluation of the BACT for greenhouse gases for the same emission units, as well as circuit breakers, 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 NO_X shall not exceed 1.45 lb/hour at all times except during startup (1-hour averaging period). This limitation is less than the NSPS limitation of 1.0 g/hp-hour (approximately 27.6 lb/hour at 100% load), and the NSPS limitation is therefore subsumed in the BACT emission limitation.

2. The emission of CO shall not exceed 2.67 lb/hour at all times except during startup (1-hour averaging period). This limitation is less than the NSPS limitation of 2.0 g/hp-hour (approximately 55.2 lb/hour at 100% load), and the NSPS limitation is therefore subsumed in the BACT emission limitation.

3. The emission of VOC shall not exceed 2.67 lb/hour at all times except during startup (1-hour averaging period). This limitation is less than the NSPS limitation of 0.7 g/hp-hour (approximately 19.3 lb/hour at 100% load), and the NSPS limitation is therefore subsumed in the BACT emission limitation.

4. The emission of PM[5] shall not exceed 1.44 lb/hour at all times, including startup (30-day averaging period).

5. The emission of PM_{10}[6] and $PM_{2.5}$[7] shall not exceed 2.22 lb/hour at all times except during startup (24-hour averaging period).

6. The emission of CO_2e shall not exceed 9330[8] lb/hour at all times except during startup (annual averaging period).

7. The 12-month rolling average CO_2 emissions from the EGUs are limited to no more than 1.08 lb/kWh[9]; the total average EGU emissions for each month is determined as follows:

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

   Where:

   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.

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[5] The term "PM" as used in this permit means that particulate matter (existing as a solid) emitted by a source that can be quantified by analysis under US EPA approved Reference Method 5 as set forth in Appendix A of 40 CFR Part 60.

[6] The term "PM_{10}" as used in this permit means that particulate matter (existing as solid, liquid, and gaseous form) emitted by a source that can be quantified by analysis either by EPA-approved Reference Methods 5 and 202 or by Methods 201A and 202 (with appropriate cyclone-sizing devices appropriate for quantification of PM_{10}), or other such EPA approved test methods.

[7] The term "$PM_{2.5}$" as used in this permit means that particulate matter (existing as solid, liquid, and gaseous form) emitted by a source that can be quantified by analysis either by EPA approved Reference Methods 5 and 202 or by Methods 201A and 202 (with appropriate cyclone sizing devices appropriate for the quantification of $PM_{2.5}$) or other such EPA approved test methods.

[8] The CO_2 emitted is 9320 lb/hour; the remaining 10 lb/hour is the GHG equivalent attributed to methane and nitrous oxides.

[9] 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.

8. The emission of NO_X shall not exceed 11.97 lb/hour during startup (1-hour averaging period).

9. The emission of CO shall not exceed 9.72 lb/hour during startup (1-hour averaging period).

10. The emission of VOCs shall not exceed 4.21 lb/hour during startup (3-hour averaging period).

11. The emission of PM_{10} and $PM_{2.5}$ shall not exceed 2.65 lb/hour during startup (24-hour averaging period).

12. The emission of CO_2e shall not exceed 9,100 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 emission of NO_X shall not exceed 2.98 g/hp-hr.
2. The emission of CO shall not exceed 2.61 g/hp-hr.
3. The emission of VOC shall not exceed 3.00 g/hp-hr.
4. The emissions of PM, PM_{10}, and $PM_{2.5}$ shall not exceed 0.15 g/hp-hr.
5. 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 emission of NO_X shall not exceed 3.00 g/hp-hr.
2. The emission of CO shall not exceed 3.70 g/hp-hr.
3. The emission of VOC shall not exceed 3.00 g/hp-hr.
4. The emissions of PM, PM_{10}, and $PM_{2.5}$ shall not exceed 2.20E-1 g/hp-hr.
5. 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 fuel-gas heater

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

1. The emission of NOX shall not exceed 0.29 lb/hour.

2. The emission of CO shall not exceed 0.25 lb/hour.

3. The emission of VOC shall not exceed 0.016 lb/hour.

4. The emissions of PM, PM_{10}, and $PM_{2.5}$ shall not exceed 0.022 lb/hour.

5. BACT for CO_2e shall be use of clean fuels, and proper maintenance and tuning of the heater.

E. BACT emissions of pollutants from the fuel oil storage tank

The BACT emissions of pollutants from the fuel oil storage tank shall be use of a submerged fill pipe.

VI. <u>Ambient Air Impact Analysis</u>

A. Air Quality Impact Analysis (AQIA) Applicability

1. The proposed facility 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 facility 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 over the baseline concentration in any area.

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

Table 2. Emissions From the Proposed Project and PSD Significant Emission Rates

Pollutant [a]	Project Emissions with Controls (tpy)	PSD Significant Emission Rate (tpy)	Exceeds Significant Emission Rate?
NO_x	141.57	40	Yes
SO_2	2.09	40	No
CO	169.78	100	Yes
PM [b]	63.14	25	Yes
$PM_{2.5}/PM_{10}$	100.59	10/15	Yes
VOC	128.69	40	Yes
H_2SO_4 Mist	0.32	7	No

Table 2. Emissions From the Proposed Project and PSD Significant Emission Rates			
Pollutant [a]	Project Emissions with Controls (tpy)	PSD Significant Emission Rate (tpy)	Exceeds Significant Emission Rate?
CO_2e	409,409	75,000	Yes
Ozone	N/A	40 tpy VOC or 40 tpy NO_x	Yes

[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 only.

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. AERMOD modeling system Version 12345 was used to evaluate the impacts of the following pollutant and averaging times from the proposed project:

   a. 1-hour and annual NO_2;
   b. 1-hour and 8-hour CO;
   c. 24-hour and annual PM_{10};
   d. 24-hour and annual $PM_{2.5}$

3. AERMINUTE Version 11325 was used to process 1-minute ASOS wind data to generate hourly average winds for input to AERMET. AERMET Version 12345 was used to prepare meteorological data for the years 2007-2011.

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 July 11, 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 five (5) different operating scenarios: 100% load, 90% load, 75% load, 50% and "start-up" (worse-case). The "start-up" operating scenario is a combination of emissions rates from 100% load and start-up operations. The emergency diesel-fired generator and emergency fire pump were not modeled together and only modeled for 12 hours per day of operation from 8:00 AM to 8:00 PM. The facility confirmed that the emergency diesel-fired generator and emergency fire pump will not operate at the same time. The following are the detailed description of each operating scenario used by the facility:

   i. 100% load scenario assumes all 10 RICE operate 8,760 hours per year on natural gas at 100% load; one (1) gas heater operates 8,760 hours per year at 100% load; and either one (1) emergency diesel-fired generator operates 100 hours per year at 100% load, or one (1) emergency fire pump operates 100 hours per year at 100% load.

   ii. 90% load scenario assumes all 10 RICE operate 8,760 hours per year on natural gas at 90% load; one (1) gas heater operates 8,760 hours per year at 100% load; and either one (1) emergency diesel-fired generator operates 100 hours per year at 100% load, or one (1) emergency fire pump operates 100 hours per year at 100% load.

   iii. 75% load scenario assumes all 10 RICE operate 8,760 hours per year on natural gas at 75% load; one (1) gas heater operates 8,760 hours per year at 100% load; and either one (1) emergency diesel-fired generator operates 100 hours per year at 100% load, or one (1) emergency fire pump operates 100 hours per year at 100% load.

   iv. 50% load scenario assumes all 10 RICE operate 8,760 hours per year on natural gas at 50% load; one (1) gas heater operates 8,760 hours per year at 100% load; and either one (1) emergency diesel-fired generator operates 100 hours per year at 100% load, or one (1) emergency fire pump operates 100 hours per year at 100% load.

   v. Start-up operating scenario assumes all 10 RICE operate 8,760 hours per year with each hour on natural gas at 100% load for 30 minutes and start-up emissions for 30 minutes; one (1) gas heater operates 8,760 hours per year at 100% load; and either one (1) emergency diesel-fired generator operates 100 hours per year at 100% load, or one (1) emergency fire pump operates 100 hours per year at 100% load.

d. For 1-hour NO_2 NAAQS modeling, intermittent emissions units (emergency diesel-fired generator and emergency fire pump) were not included in the dispersion modeling analysis.

e. KDHE verification runs were done more conservatively, assuming both the emergency diesel-fired generator and emergency fire-pump (except for 1-hour NO_2) can operate at the same time and can run 24 hours per day. KDHE used five (5) years of meteorological data in verifying the dispersion modeling results.

2. Center of the facility

The center of the proposed project is located at the following:
Zone: 14
Easting: 325,182 meters
Northing: 4,367,742 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 (2007 through 2011) of meteorological data. The surface data was obtained from the Goodland Municipal Airport (GLD) meteorological station in Kansas. The upper air data was obtained from the Dodge City Regional Airport (DDC) meteorological station in Kansas. Table 3 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 from the south-southwest. Figure 2 shows a map that includes the proposed Lacey-Randall Generation facility, the GCK and the DDC airport meteorological stations.

Table 3. Meteorological Data Sites					
Station Type	Station Name	WBAN #	Latitude/ Longitude	Elevation (m)	Years of Data
Surface Air Station	Goodland Municipal Airport (GLD), KS	23065	39.3672/ -101.6933	1114.3	2007-2011
Upper Air Station	Dodge City Regional Airport (DDC), KS	13985	37.7711/ -99.9692	787.0	2007-2011

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 shown in Table 4.

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

Table 4. Receptor Spacing Used in Dispersion Modeling of the Proposed Facility

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	1000

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 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.

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.

4. The preliminary modeling results of the worse-case operating scenario from the dispersion modeling runs conducted by the facility are shown in Table 5.

5. The modeled H1H impacts of annual NO_2, 1-hour NO_2, annual PM_{10}, 24-hour PM_{10}, annual $PM_{2.5}$ and 24-hour $PM_{2.5}$ exceed the SIL thresholds. Therefore, refined (cumulative) modeling analyses are required for these pollutants and averaging times.

6. The modeled H1H impacts of 1-hour CO and 8-hour CO fall below SIL thresholds. Therefore, refined (cumulative) modeling analyses are not required for these pollutants and averaging times.

Table 5. Preliminary/Significance Modeling Results [a]

Pollutant	Averaging Period	Modeled Year(s)	UTM Coordinates		Modeled Concentration (Highest, First-Highest, H1H) (μg/m³)	Modeling Significant Impact Level (SIL) (μg/m³)	Pre-application Monitoring Threshold Concentration (μg/m³)
			Easting (meters)	Northing (meters)			
NO_2	Annual	2007	325096.6	4368115.4	1.11	1	14
	1-hour	2007-2011	324800.9	4367779.3	59.15	10 [b]	N/A
CO	1-hour	2009	325286.0	4368110.7	86.01	2000	N/A
	8-hour	2009	325001.9	4368117.7	48.97	500	575
PM_{10}	Annual	2007	325143.9	4368114.2	1.09	1	N/A
	24-hour	2008	325370.0	4367323.5	8.80	5	10
$PM_{2.5}$	Annual	2007	325143.9	4368114.2	1.09	0.3	N/A
	24-hour	2008	325370.0	4367323.5	8.80	1.2	0

[a] From dispersion modeling runs conducted by the facility

[b] Interim SIL established by KDHE until EPA publishes a final SIL. The current EPA recommended SIL is 7.5 μg/m³.

7. Table 5 also shows that the pre-application monitoring threshold was exceeded for $PM_{2.5}$, 24-hour averaging period, therefore, pre-application monitoring for $PM_{2.5}$ is required. Also, since the proposed project would emit more than 40 tons per year of VOCs and 40 tons of per year of NOx (precursors of ozone) as shown in Table 1, pre-application monitoring for ozone is also required. TradeWind sent a document on October 1, 2013 to KDHE requesting that the pre-construction monitoring for $PM_{2.5}$ and ozone be fulfilled with the existing representative KDHE monitors, specifically the Cedar Bluff (20-195-0001) monitors, which measure both the ambient air concentration of $PM_{2.5}$ and ozone. TradeWind discussed in the permit application and supporting documentation the reasons why the existing monitor is a representative monitor for $PM_{2.5}$ and ozone. KDHE has approved the use of existing monitors in the region for 24-hour $PM_{2.5}$ and for ozone monitoring.

8. Figures 3 through 8 show the H1H modeled impacts isopleths and the significant impact areas (SIA), as verified by the KDHE dispersion modeling runs, for the annual NO_2, 1-hour NO_2, annual PM_{10}, 24-hour PM_{10}, annual $PM_{2.5}$, and 24-hour $PM_{2.5}$, respectively.

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 runs conducted by the facility) are shown in Table 6.

3. Table 7 shows the receptor grid size, and the nearby sources used in the NAAQS modeling analysis.

Table 6. NAAQS Modeling Results [a]

Pollutant	Averaging Period	Modeled year(s)	UTM Coordinates		Modeled Concentration (μg/m³) [b]		Background concentration (μg/m³) [c]	Total concentration (μg/m³)	NAAQS Standard (μg/m³)
			Easting (meters)	Northing (meters)					
NO_2	Annual	2008	322750	4362500	590.54	H1H	7.50	598.04	100.00
	1-hour	2007-2011	322750	4362500	1,095.68	H8H	49.00	1,144.68	188.70
PM_{10}	Annual								Revoked [d]
	24-hour	2007-2011	322750	4362500	150.31	H6H	89.00	239.31	150.00
$PM_{2.5}$	Annual	2008	322750	4362500	20.35	H1H	7.00	27.35	12.00
	24-hour	2007-2011	322750	4362500	156.37	H1H	17.00	173.37	35.00

[a] From dispersion modeling runs conducted by the facility
[b] H1H = Highest, First-Highest; H8H = Highest, Eighth-Highest; H6H = Highest, Sixth-Highest
[c] Background concentrations provided by KDHE
[d] Annual PM_{10} NAAQS of 50 μg/m3 was revoked on October 17, 2006

Table 7. Receptor Grid Size, Radius Selected for Nearby Sources, and Number of Nearby Sources Used in the NAAQS Modeling Analysis

Pollutant	Receptor Grid Size	Radius Selected for Nearby Sources From Center of the Facility (km)	Number of Nearby Sources
Annual NO_2	50 km by 50 km grid	50	10[a]
1-hour NO_2	50 km by 50 km grid	50	12[b]
24-hour PM_{10}	7 km by 7 km grid	50	15
Annual $PM_{2.5}$	7 km by 7 km grid	50	11
24-hour $PM_{2.5}$	7 km by 7 km grid	50	11

[a] One of the nearby sources is the combined emissions from six (6) generators (Units 3, 4, 5, 6, 7, and 8) from Colby Municipal Power Plant
[b] Three (3) generators (Units 3, 4, and 5) for emergency use only from Colby Municipal Power Plant were excluded from 1-hour NO_2 modeling.

4. The MAXDCONT option on AERMOD was used to determine the contribution of each user-defined source group to any modeled violation to the NAAQS, paired in time and space. The MAXDCONT option in AERMOD is only applicable for 1-hour NO_2, 24-hour $PM_{2.5}$ and 1-hour SO_2. The MAXDCONT option will not work with separate meteorological data files for each year (Addendum: User's Guide for AMS/EPA Regulatory Model-AERMOD, EPA-454/B-03-001, September 2004).

5. The proposed project's contributions were compared to the SIL to determine whether the project causes or contributes to any of the modeled violations of the NAAQS (EPA Memorandum: Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard, March 1, 2011).

6. For annual NO_2 impacts:

    a. The Tier 2 approach was used to determine the annual NO_2 impacts. This was done was multiplying Tier 1 (assume a total conversion of NO to NO_2) estimate(s) by an empirically derived NO_2/NO_X value of 0.75 (annual national default).

    b. Figure 9 shows the isopleths of annual NO_2 refined/NAAQS modeling run as verified by KDHE based on the Highest, First-Highest (H1H) modeled impact.

    c. There are five (5) receptors with modeled impacts that exceed the annual NO_2 NAAQS. The contributions of the proposed project to the exceedances are below the annual NO_2 SIL of 1.0 $\mu g/m^3$. Therefore, the proposed Lacey Randall Generation facility does not significantly cause or contribute to a violation of annual NO_2 NAAQS.

7. For 1-hour NO_2 impacts:

    a. The Tier 3 (Ozone Limiting Method, OLM) approach was used to determine the 1-hour NO_2 impacts. A formal request to use the Tier 3 (OLM) analysis was submitted to EPA Region 7 by the facility.

    b. Figure 10 shows the isopleths of 1-hour NO_2 refined/NAAQS modeling run conducted by KDHE based on the Highest, Eighth-Highest (H8H) modeled impact.

    c. There are 34 receptors with modeled impacts that exceed the 1-hour NO_2 NAAQS. The contributions of the proposed project to the exceedances are below EPA's 1-hour NO_2 SIL of 7.5 $\mu g/m^{3,}$ which is more conservative than the KDHE SIL of 10 $\mu g/m^3$. Therefore, the proposed Lacey Randall Generation facility does not significantly cause or contribute to a violation of 1-hour NO_2 NAAQS.

8. For 24-hour PM_{10} impacts:

   a. Figure 11 shows the isopleths of 24-hour PM_{10} refined/NAAQS modeling run as verified by KDHE based on the Highest, Six-Highest (H6H) modeled impact.

   b. There are two (2) receptors with modeled impacts that exceed the 24-hour PM_{10} NAAQS. The contributions of the proposed project to the exceedances are below the 24-hour PM_{10} SIL of 5.0 $\mu g/m^3$. Therefore, the proposed Lacey Randall Generation facility does not significantly cause or contribute to a violation of 24-hour PM_{10} NAAQS.

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

   a. Figure 12 shows the isopleths of annual $PM_{2.5}$ refined/NAAQS modeling run as verified by KDHE based on the H1H modeled impact.

   b. There are two (2) receptors with modeled impacts that exceed the annual $PM_{2.5}$ NAAQS. The contributions of the proposed project to the exceedances are below the 24-hour PM_{10} SIL of 0.3 $\mu g/m^3$. Therefore, the proposed Lacey Randall Generation facility does not significantly cause or contribute to a violation of 24-hour PM_{10} NAAQS.

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

   a. Figure 13 shows the isopleths of 24-hour $PM_{2.5}$ refined/NAAQS modeling run as verified by KDHE based on the H1H modeled impact.

   b. There are 18 receptors with modeled impacts that exceed the 24-hour $PM_{2.5}$ NAAQS. The contributions of the proposed project to the exceedances are below the 1-hour SIL 24-hour $PM_{2.5}$ of 1.2 $\mu g/m^3$. Therefore, the proposed Lacey Randall Generation facility does not significantly cause or contribute to a violation of 24-hour $PM_{2.5}$ NAAQS.

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 8 shows the PSD increment for NO_2, 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 9 shows the major source and trigger dates for $PM_{2.5}$, PM_{10}, and NO_2.

Table 8. PSD Increment for Class II Areas		
Pollutant	Averaging period	PSD increment (maximum allowable increase) for Class II area ($\mu g/m^3$)
NO_2	Annual	25
PM_{10}	24-hour	30
	Annual	17
$PM_{2.5}$	24-hour	9
	Annual	4

Table 9. Major Source Baseline Date and Trigger Dates For NO_2, PM_{10} and $PM_{2.5}$ [a]		
Pollutant	Major Source Baseline Date	Trigger Date
NO_2	February 8, 1988	February 8, 1988
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. KDHE reviewed its list of PSD applications received and/or permits issued in Kansas since about 1976. It was determined that there are no records of any PSD applications received and/or issued in Thomas County (where the proposed facility will be located) and its surrounding counties, namely: Cheyenne, Sherman, Wallace, Logan, Gove, Sheridan, Decatur, and Rawlins. Thus, minor source baseline dates are yet not established in the said counties.

3. The proposed Lacey Randall Generation facility will establish the minor source baseline dates for $PM_{2.5}$, PM_{10}, and NO_2 and will be the first PSD increment consuming source in Thomas 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).

4. The PSD permit application for this facility was deemed complete by KDHE on November 22, 2013.

5. Table 10 shows the maximum PSD increment consumption from the proposed project from the dispersion modeling runs conducted by the facility for the time period modeled. EPA has not established a 1-hour Class II maximum allowable increment for NO_2 or CO. Therefore, no calculation of the potential consumption of such increment is possible.

6. Figures 14 and 15 show that the modeled concentrations of annual NO_2 and annual PM_{10} exceed the significant ambient impact of 1.0 $\mu g/m^3$ in Thomas County. The NO_2 and PM_{10} minor source baseline dates are established in Thomas County, Kansas on November 22, 2013.

7. Figure 16 shows that the modeled concentrations of annual $PM_{2.5}$ exceeds the significant ambient impact of 0.3 $\mu g/m^3$ in Thomas County. The $PM_{2.5}$ minor source baseline date is established in Thomas County, Kansas on November 22, 2013.

Table 10. PSD Increment Modeling Results [a]

Pollutant	Averaging Period	Modeled year(s)	UTM Coordinates		Modeled Concentration ($\mu g/m^3$) [b]		PSD increment for Class II areas ($\mu g/m^3$)	Maximum Increment consumption (%) [c]
			Easting (meters)	Northing (meters)				
NO_2	Annual	2007	325096.6	4368115.4	1.11	H1H	25	4.44
	1-hour	No available PSD increment						
PM_{10}	Annual	2007	325143.9	4368114.2	1.09	H1H	17	6.41
	24-hour	2008	325370.0	4367323.5	7.76	H2H	30	25.9
$PM_{2.5}$	Annual	2007	325143.9	4368114.2	1.09	H1H	4	27.2
	24-hour	2008	325370.0	4367323.5	7.76	H2H	9	86.2

[a] From dispersion modeling runs conducted by the facility
[b] H1H = Highest, First-Highest; H2H = Highest, Second-Highest
[c] The proposed Lacey Randall Generation facility will be the first PSD increment consuming source in Thomas County.

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

Please refer to Section 7.9 of the PSD permit application to review an analysis of the secondary $PM_{2.5}$ formation from the proposed project.

KDHE generally follows the March 23, 2010 Stephen Page memo, Modeling Procedures for Demonstrating Compliance with PM2.5 NAAQS.

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 of the following information, please see Section 8.0 of the PSD permit application.

i. Section 8.1 for Construction Impacts:

Construction at Lacey Randall Station 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 Thomas 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 nitrogen oxides, Section 2.2.2 for the synergistic effects of pollutants, Section 8.2.3 for the effects of particulate matter, Section 8.2.3 for the effects of carbon monoxide, Section 8.2.4 for the effects of carbon monoxide, and Section 8.2.5 for the effect of carbon dioxide on vegetation.

The general land use in the vicinity of Lacey Randall Station is irrigated row cropland and dry-land farming. Common crops produced in this area include wheat (*Triticum aestivum*), corn (*Zea mays*), grain sorghum (*Sorghum bicolor*), alfalfa (*Medicago sativa*), and sunflower (*Helianthus annuus*). Trees are generally uncommon but may occur in hedgerows and along riparian corridors. These species include Siberian elm (*Ulmus pumila*), hackberry (*Celtis occidentalis*), honey locust (*Gleditsia triancanthous*), plum (*Prunus* spp.), black willow (*Salix nigra*), sandbar willow (*Salix interior*), eastern red cedar (*Juniperus virginiana*), cottonwood (*Populus deltoides*), and, mulberry (*Morus* sp.). Remnants of native shortgrass prairie may occur near Lacey Randall Station. Common grasses in this community include blue-grama (*Bouteloua gracilis*), buffalograss (*Bouteloua dactyloides*), alkali sacaton (*Sporobolus airoides*), and western wheatgrass (*Pascopyrum smithii*).

The maximum annual and 1-hour NO_2 modeled values for the proposed project are 1.5 and 59.15 $\mu g/m^3$, respectively. These levels are low, so it is highly unlikely that NO_2 emissions will impact vegetation adjacent to or surrounding Lacey Randall Station.

The maximum PM_{10} and $PM_{2.5}$ 24-hour modeled values for the proposed project are 8.8 $\mu g/m^3$ and 8.8 $\mu g/m^3$, respectively. This level is low, so it is highly unlikely that PM_{10} and $PM_{2.5}$ emissions will impact vegetation adjacent to Lacey Randall Station.

CO and CO_2 are not known to injure plants.

iii. Section 8.3 for Soil Impacts:

Four (4) soil types are mapped at, or in the immediate vicinity of, the project site.

They include:

a. Keith silt loam, 0 to 1 percent slopes
b. Keith silt loam, 1 to 3 percent slopes
c. Ulysses silt loam, 1 to 3 percent slopes
d. Ulysses silt loam, 3 to 6 percent slopes

Sulfates and nitrates resulting from SO2 and NO2 deposition on soil can be both beneficial and detrimental to soils depending on their composition. However, given the low expected deposition from the engines, due to considerable lower emissions than the NAAQS, operation of the RICE should not materially affect the soils on-site or in the immediate vicinity.

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

The proposed project is expected to increase employment in the area. The building phase will last approximately one (1) year. Construction employment is expected to peak at approximately 150 skilled construction jobs. Projected employment, reflecting full-time jobs directly tied to the operation of Lacey Randall Station is estimated to be 5 people at the facility. 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 at Lacey Randall Station, increased vehicular traffic is expected. However, these activities are not expected to significantly impact air quality.

The construction work at Lacey Randall Station may temporarily increase the number of people residing in the area. After construction is completed, 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 an impact on the air quality in the area.

Adding additional electricity to the grid in this area may increase industrial growth. However, it is unknown how increasing available electrical power in this area may affect future industrial growth.

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 updated PSD permit application.

a. Section 8.5.1 for Class I Area Analysis:

After reviewing recent Federal Land Manager (FLM) guidance for proposed major sources, a determination was made to perform an assessment of air quality impacts at Class I areas if these areas are located within approximately 300 kilometers of the proposed facility. Because there are no Class I areas that are within 300 kilometers of the proposed project, no assessment of air quality impacts at Class I areas was performed for this project.

b. Section 8.5.2 for Class II Area Analysis:

A visibility analysis was performed for Scott State Park located approximately 80 kilometers south of the proposed project near Scott City, Kansas.

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. The first-level VISCREEN model was performed for the proposed project at Lacey Randall Station. The inputs into the model included particulate matter, NOx, primary NO_2, soot, and primary sulfate (SO_4). Annual particulate and NOx emissions were calculated for each operating scenario. The maximum annual particulate emission rate of 100.59 tons per year occurs when the units operate 8,760 hours per year and the maximum NOx emission rate of 141.57 tons per year occur when the units operate for 8,760 hours per year. These maximum rates were used in the VISCREEN analysis.

The results of the first-level VISCREEN model are provided in Appendix H of the PSD permit application. The visual results are within the Class I area screening criteria for Scott State Park, which is a Class II area located approximately 80 kilometers from Lacey Randall Station.

I. Summary and Conclusions for the Ambient Air Impact Analysis

1. The modeled H1H impacts of annual NO_2, 1-hour NO_2, annual PM_{10}, 24-hour PM_{10}, 24-hour $PM_{2.5}$ and annual $PM_{2.5}$ exceed the SIL thresholds. Therefore, refined (cumulative) modeling analyses are required for these pollutants and averaging times.

2. The pre-application monitoring threshold was exceeded for $PM_{2.5}$, 24-hour averaging period. Also, the proposed project would emit at least 100 tons per year of VOCs (precursor of ozone), which triggers pre-application monitoring requirements for ozone. KDHE has approved the use of existing monitors in the region for 24-hour $PM_{2.5}$ and ozone.

3. The contributions of the proposed project to the modeled NAAQS exceedances are below the SIL values. Therefore, the proposed Lacey Randall Generation facility does not significantly cause or contribute to any NAAQS violations of annual NO_2, 1-hour NO_2, 24-hour PM_{10}, annual $PM_{2.5}$ and 24-hour $PM_{2.5}$ NAAQS.

4. The proposed Lacey Randall Generation Facility will establish the minor source baseline date for $PM_{2.5}$, PM_{10}, and NO_2 and will be the first PSD increment consuming source in Thomas County. The PSD permit application for this facility was deemed complete by KDHE on November 22, 2013. The NO_2, PM_{10} and $PM_{2.5}$ minor source baseline dates are established in Thomas County, Kansas on November 22, 2013.

5. Increment modeling results indicated maximum increment consumption as follows: 4.44% for annual NO_2, 6.41% for annual PM_{10}, 25.9% for 24-hour PM_{10}, 27.2% for annual $PM_{2.5}$, and 86.2% for 24-hour $PM_{2.5}$.

6. KDHE concurs that TradeWind Energy had sufficiently demonstrated that the proposed Lacey Randall Generation facility does not cause or contribute to a violation of any NAAQS or PSD increment; and that the proposed project has no adverse impact on visibility; vegetation, soils and animals; and in industrial, commercial and residential growth.

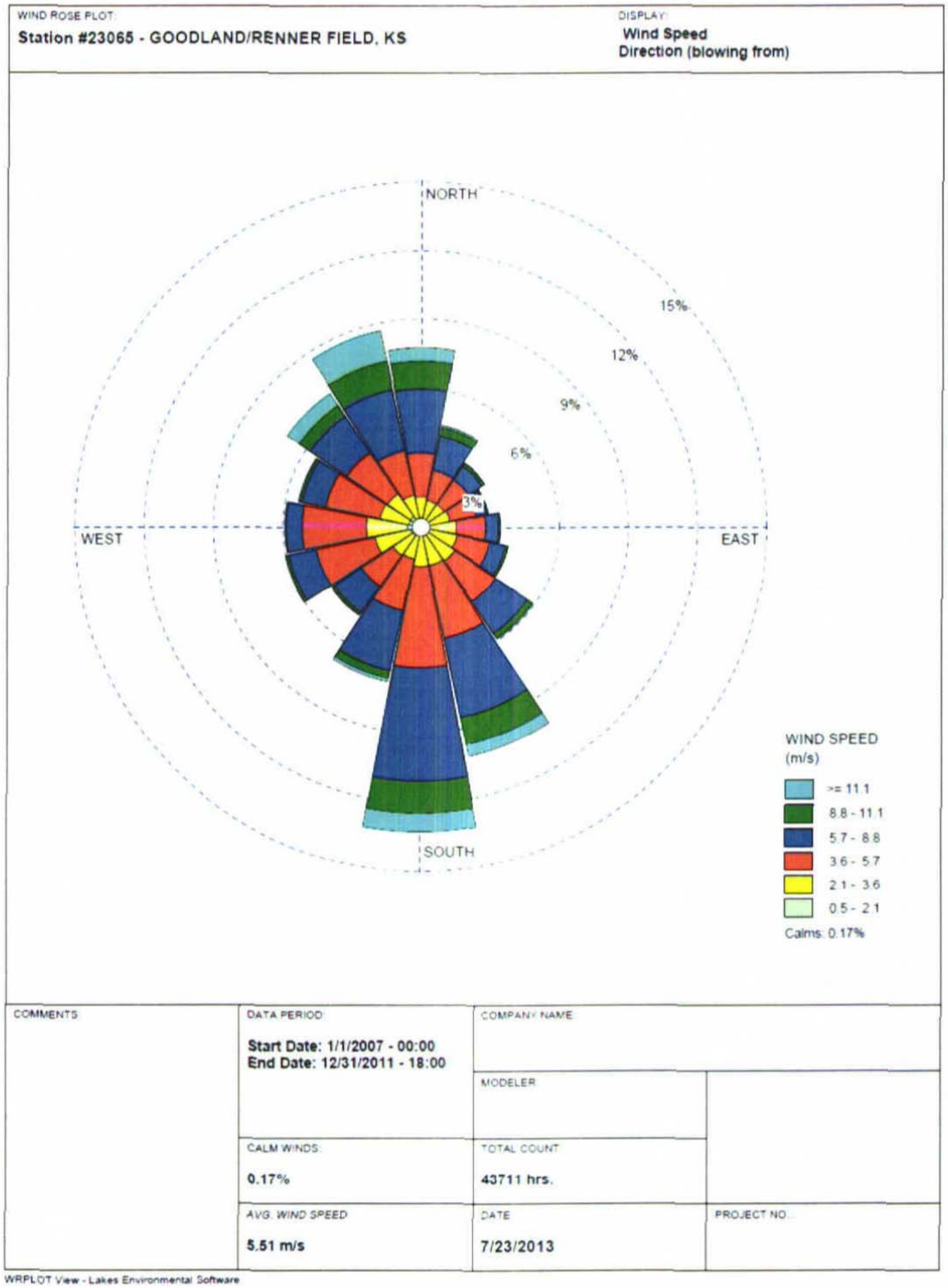

Figure 1. Wind Rose for Years 2007 to 2011

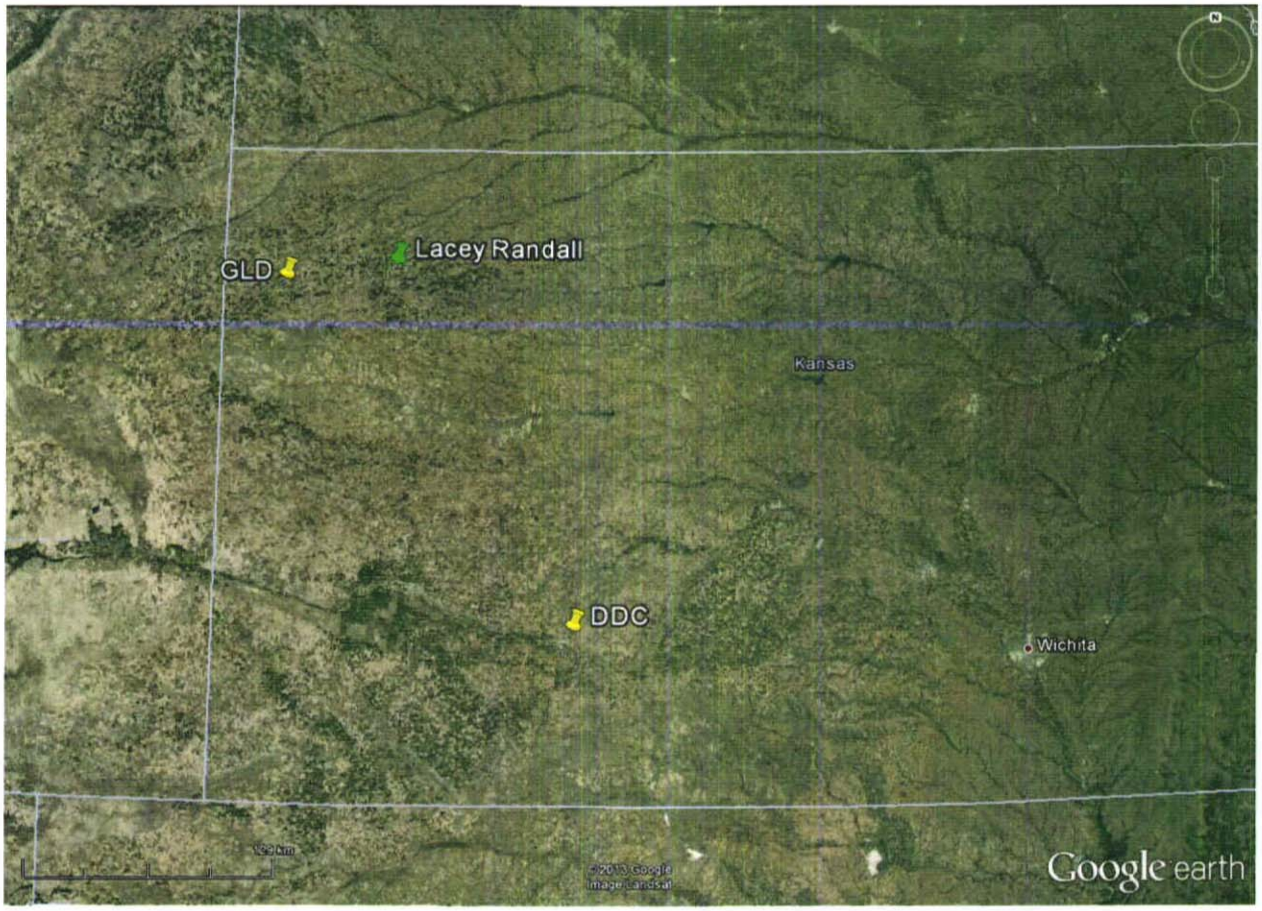

Figure 2. Map showing the Lacey Randall Generation Facility in Thomas County in Kansas, the Goodland Municipal Airport (GLD) and the Dodge City Regional Airport (DDC) meteorological stations in Kansas.

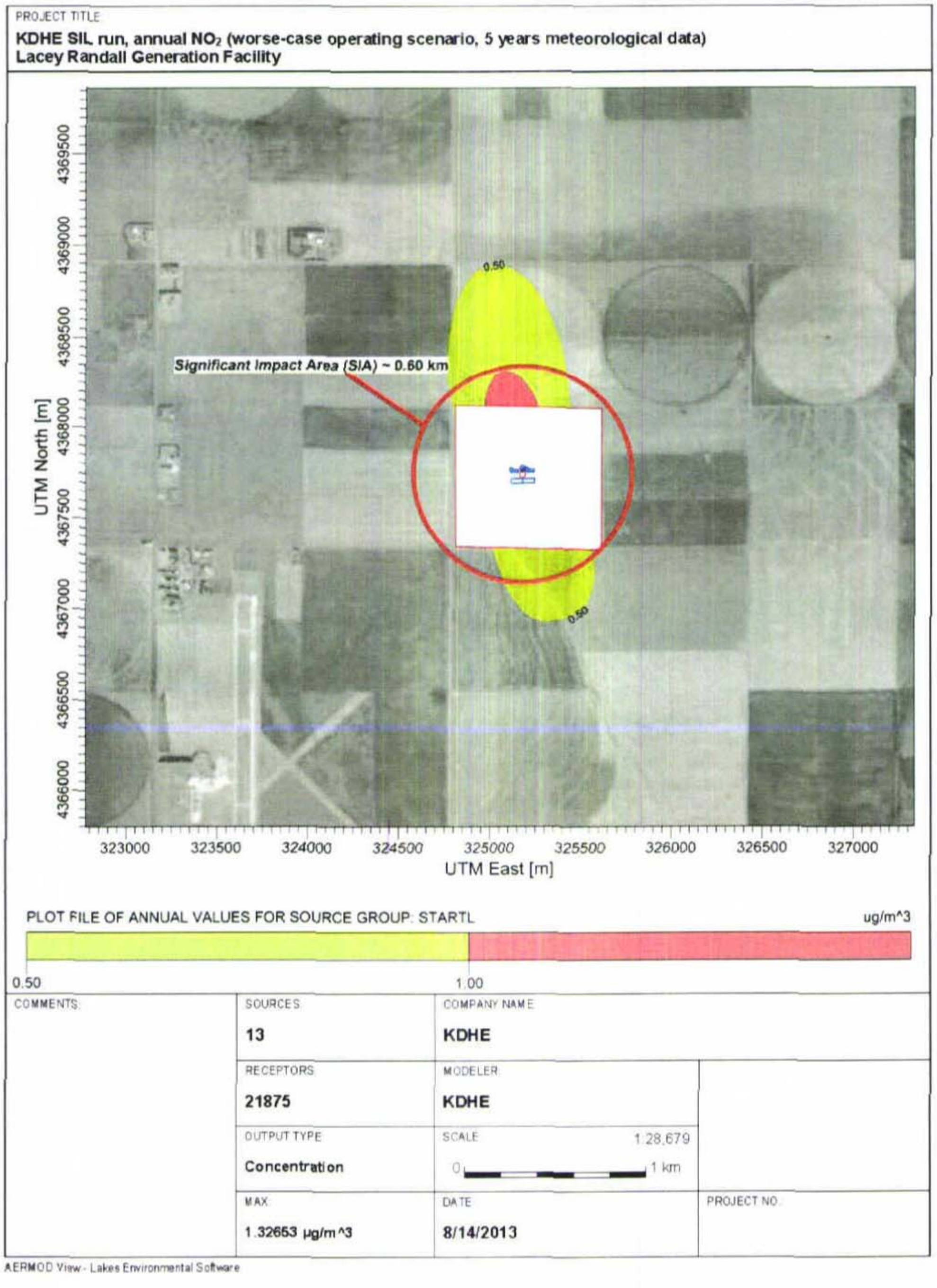

Figure 3. SIL Modeling Isopleths for Annual NO_2

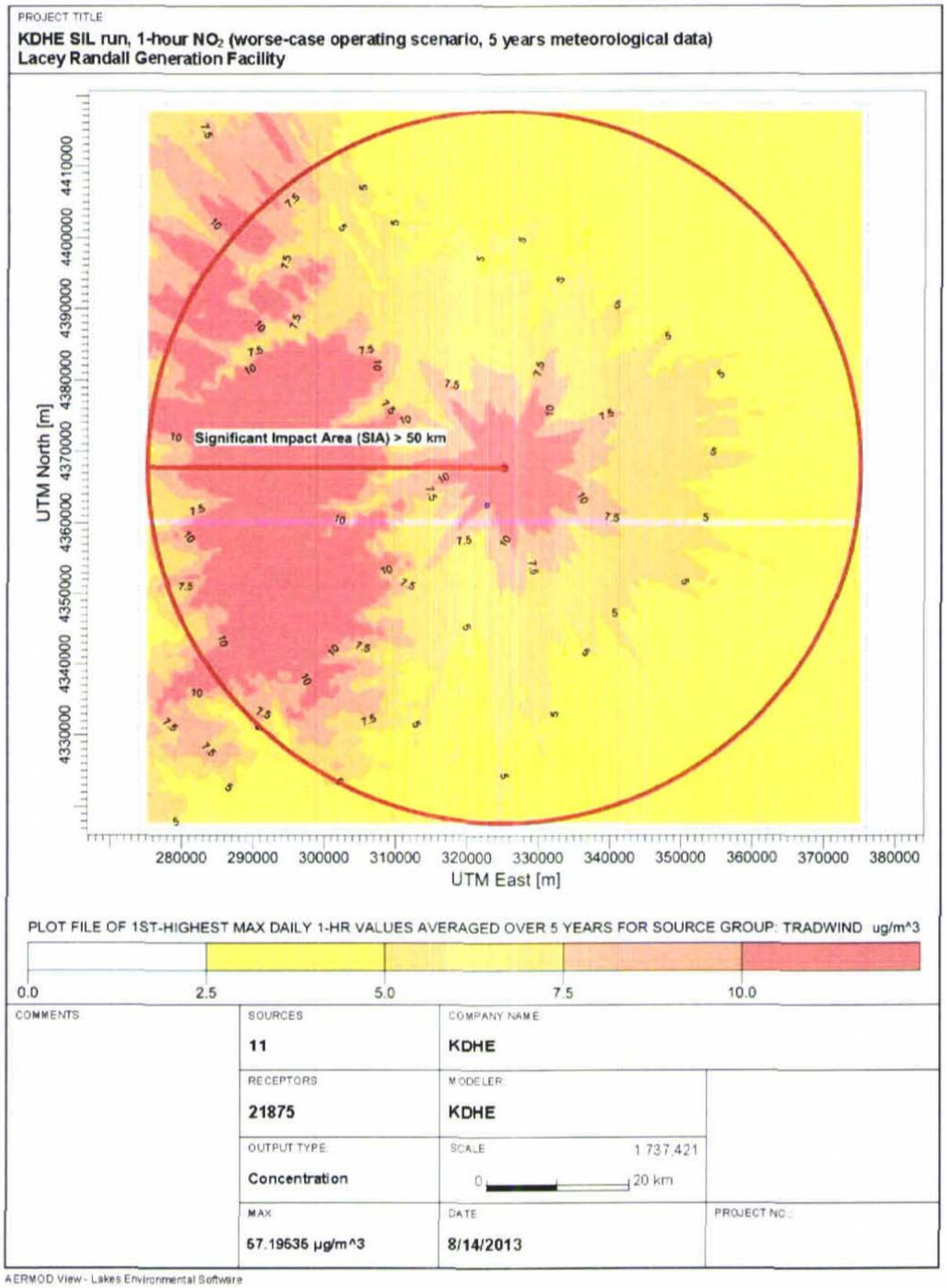

Figure 4. SIL Modeling Isopleths for 1-hour NO_2

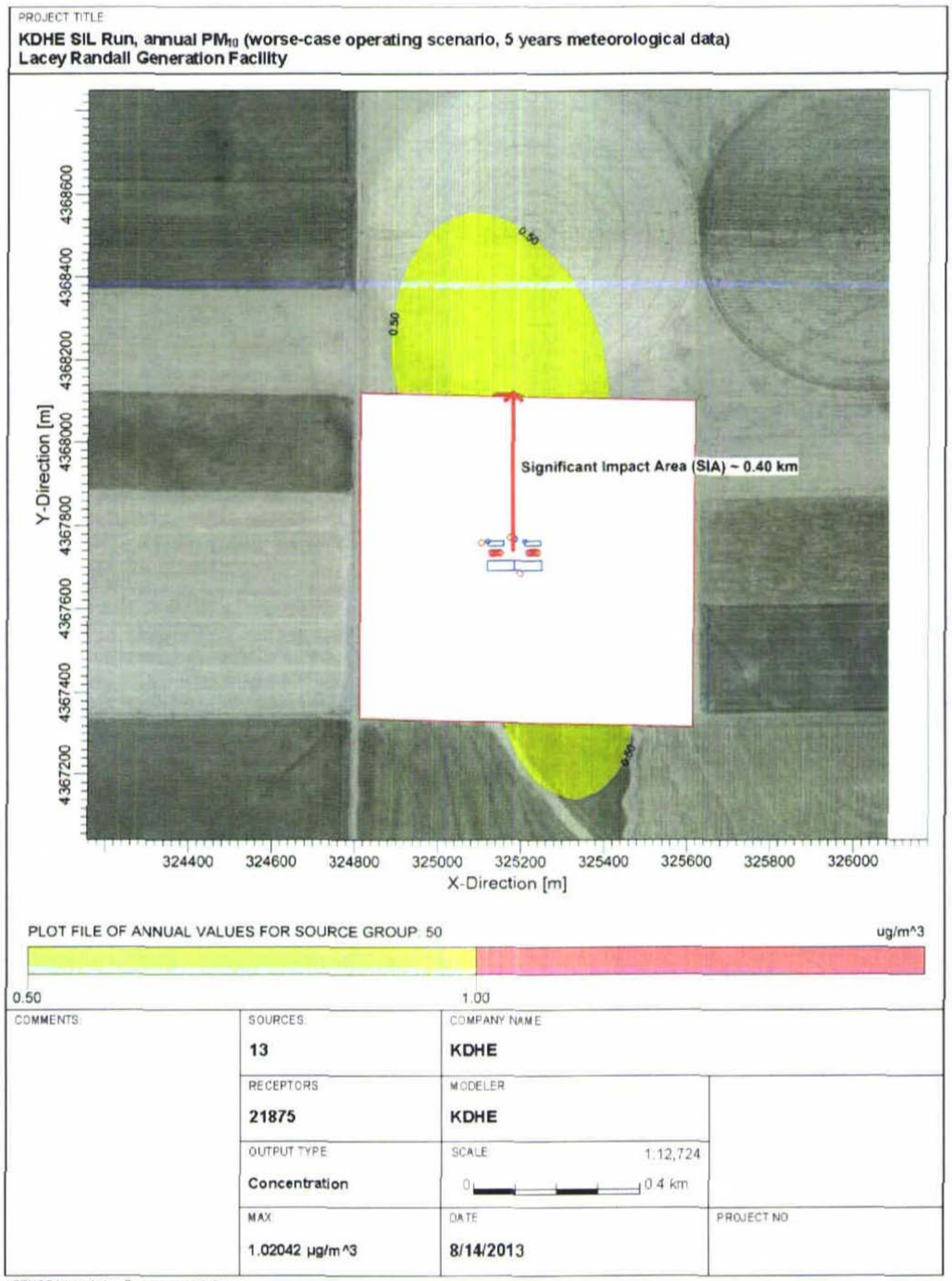

Figure 5. SIL Modeling Isopleths for annual PM_{10}

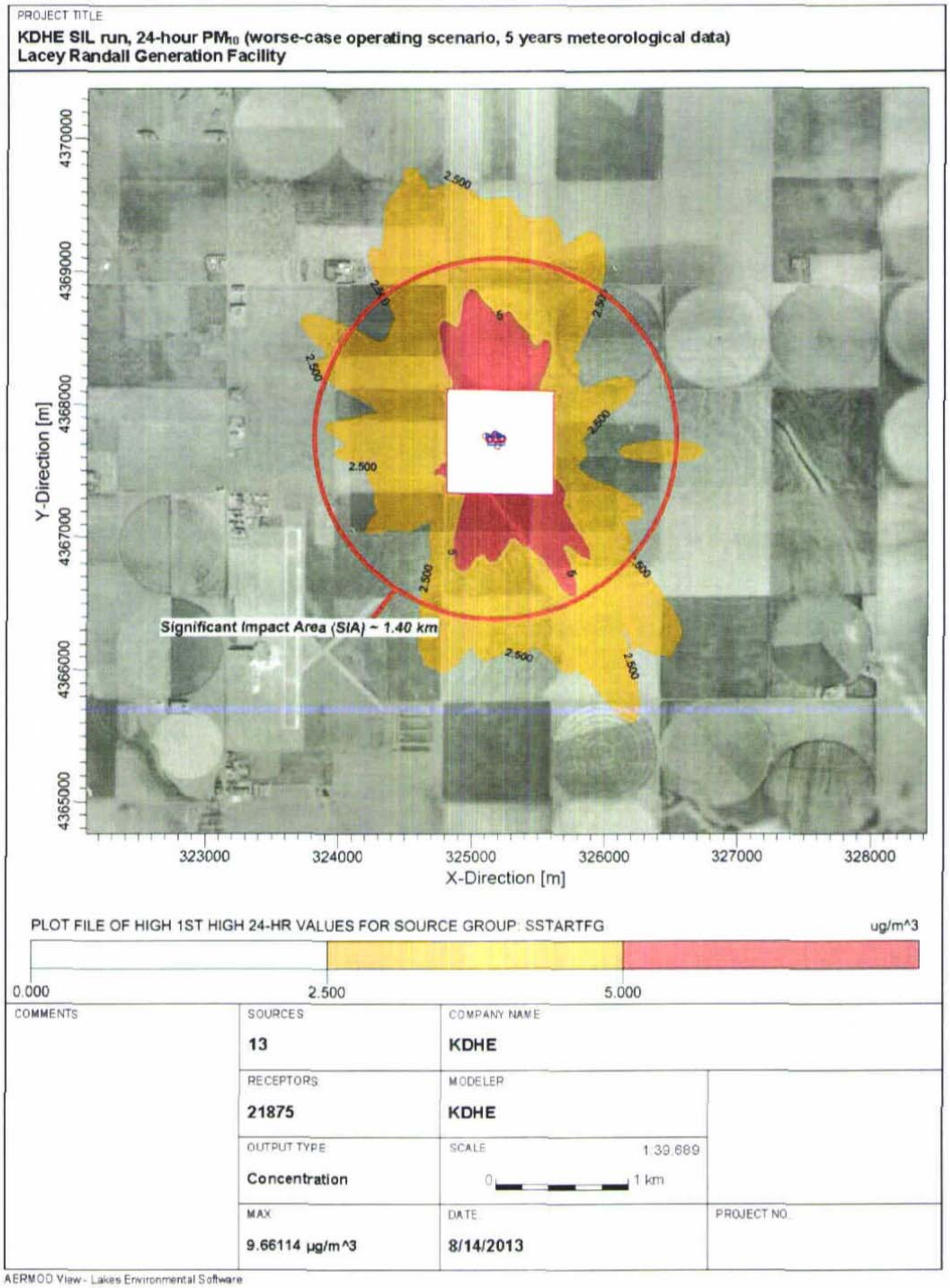

Figure 6. SIL Modeling Isopleths for 24-hour PM_{10}

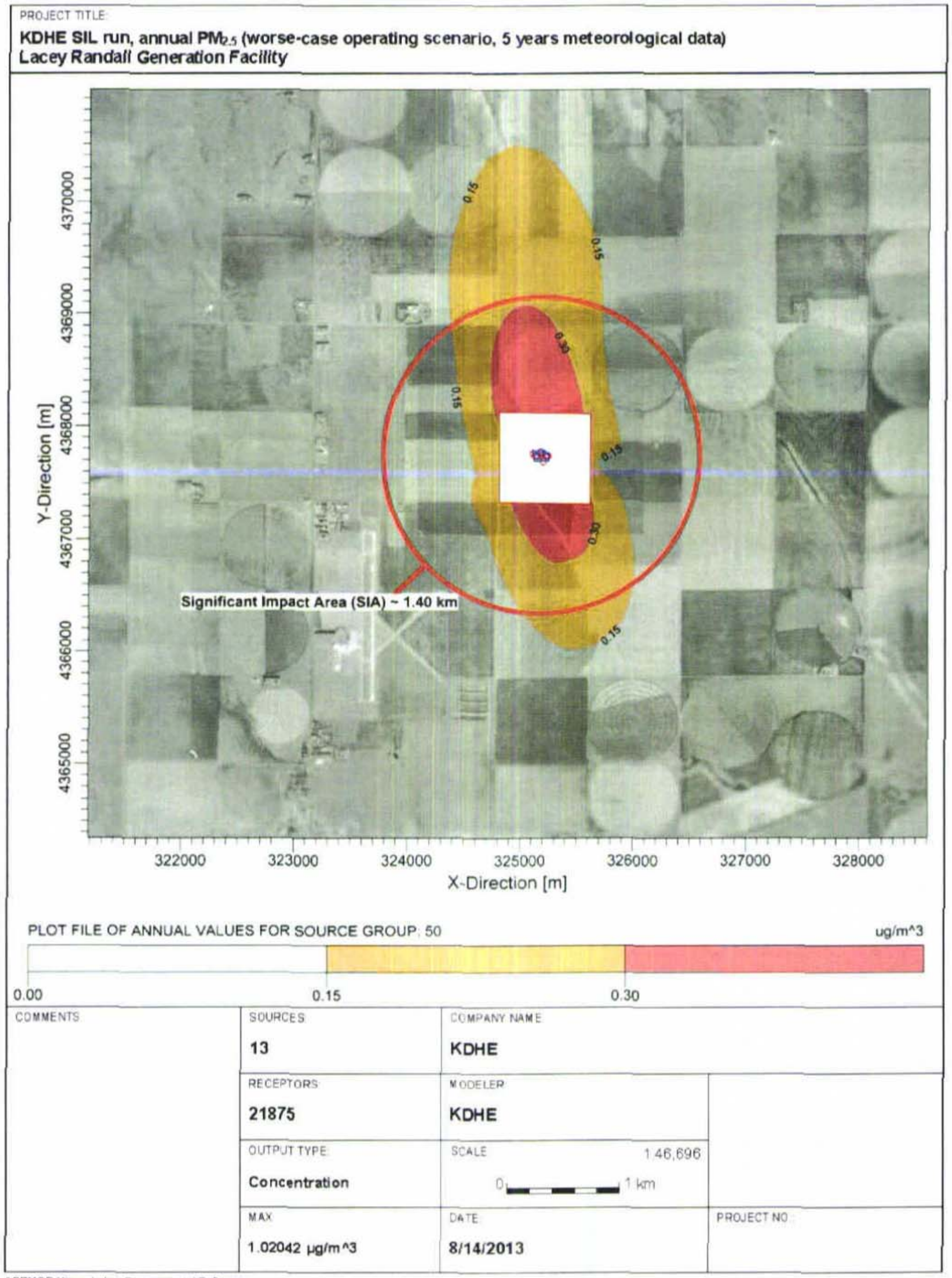

Figure 7. SIL Modeling Isopleths for annual PM $_{2.5}$

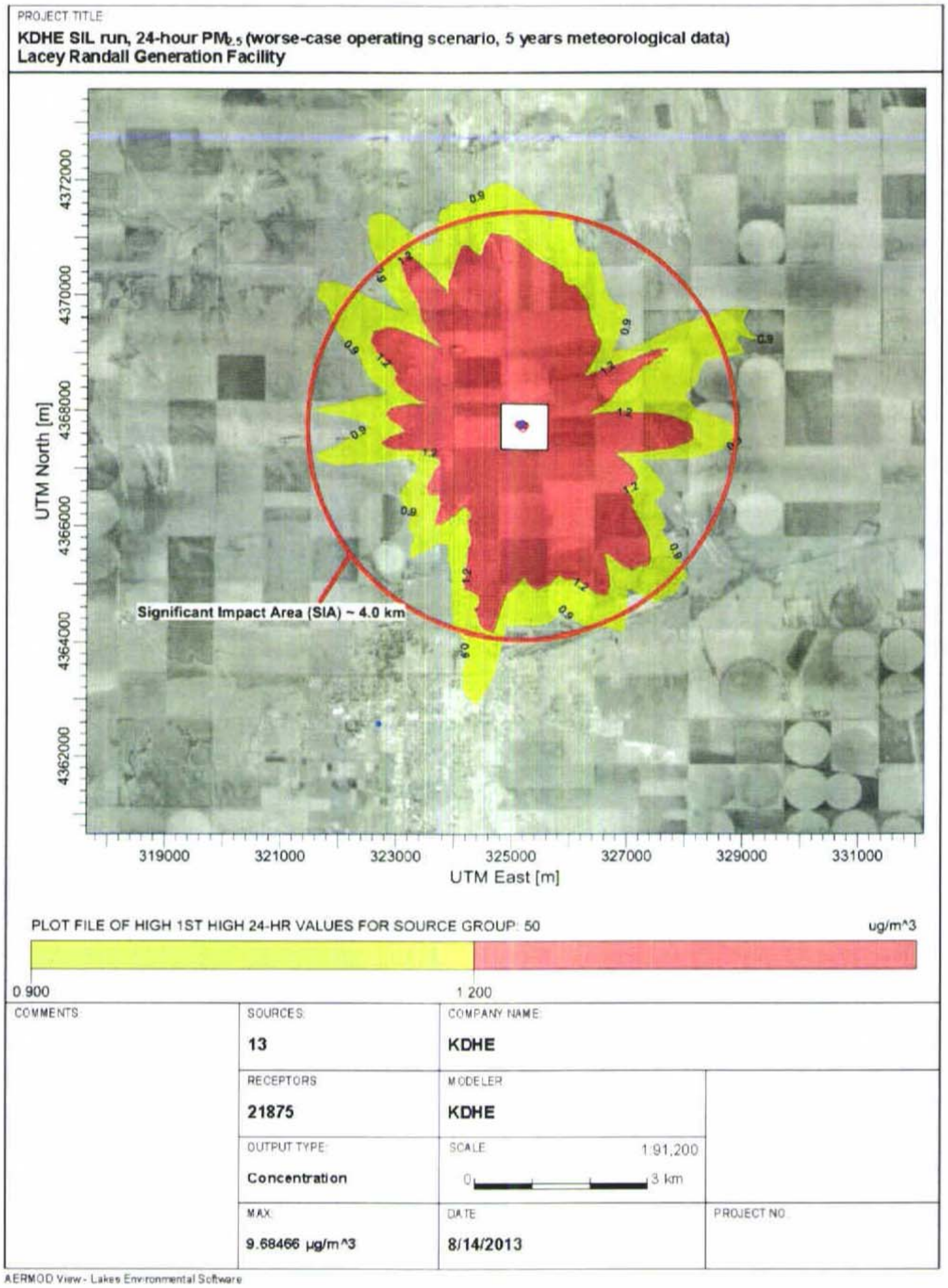

Figure 8. SIL Modeling Isopleths for 24-hour $PM_{2.5}$

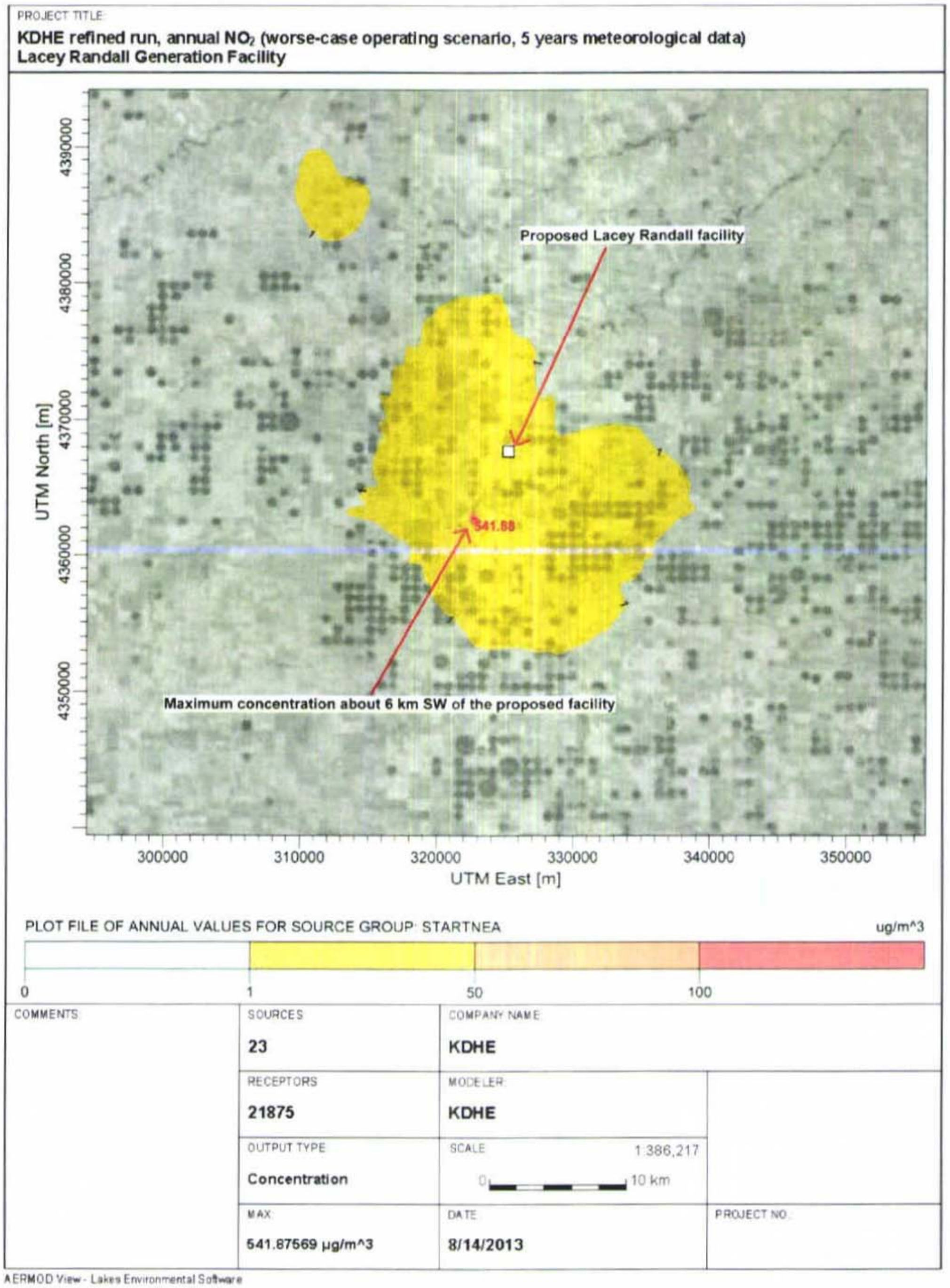

Figure 9. Refined Modeling Isopleths for annual NO_2 NAAQS Compliance

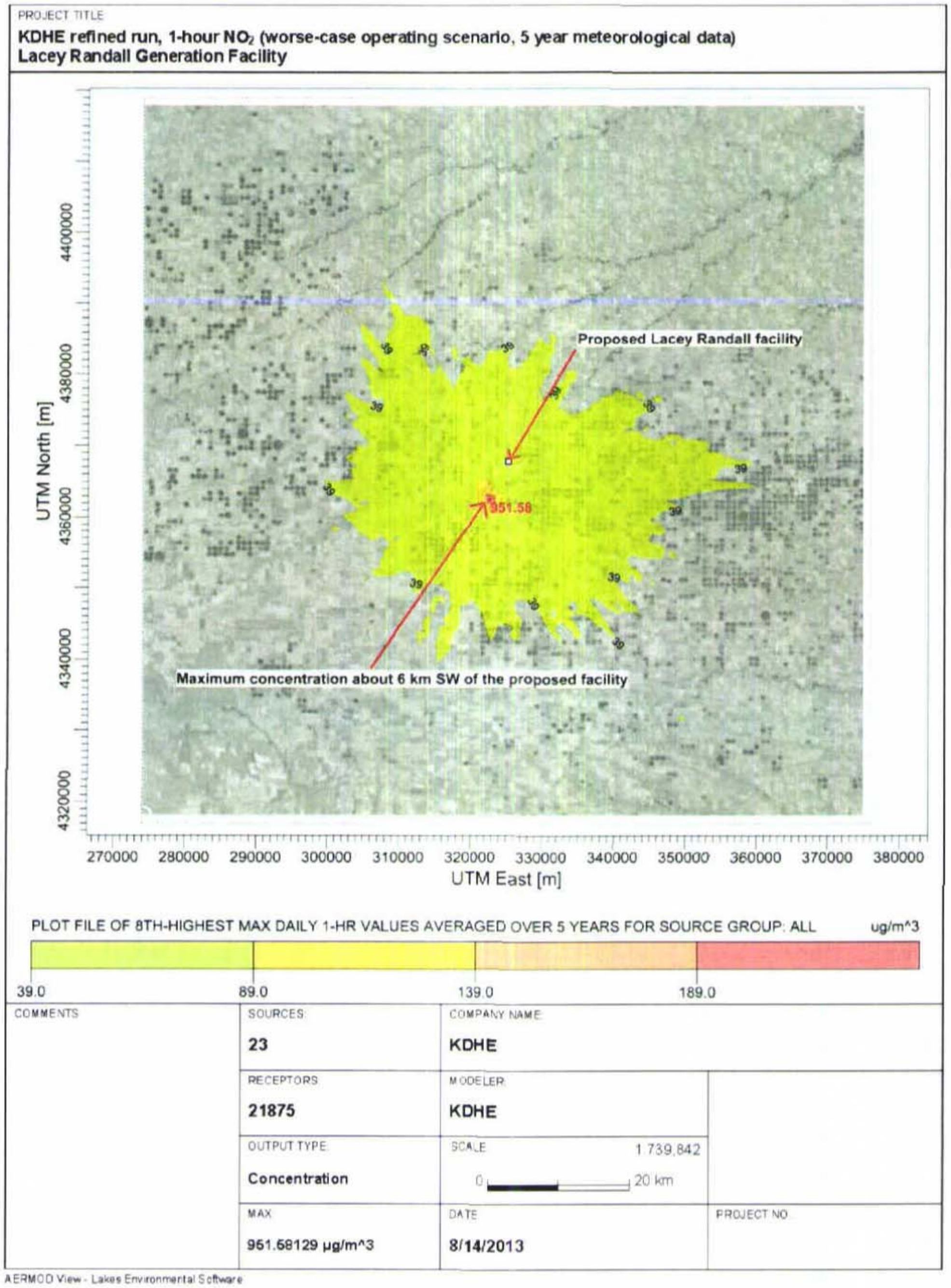

Figure 10. Refined Modeling Isopleths for 1-hour NO_2 NAAQS Compliance

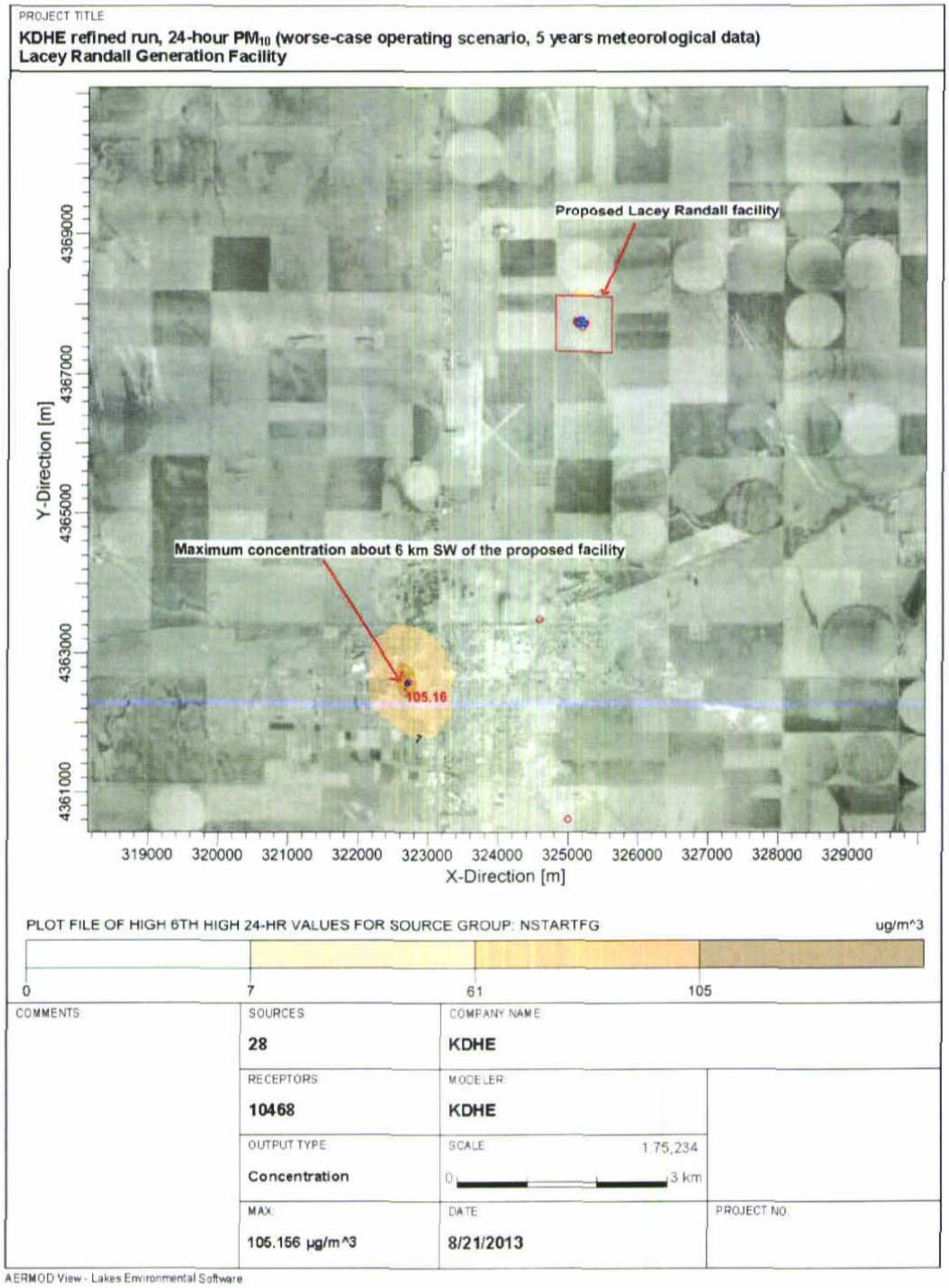

Figure 11. Refined Modeling Isopleths for 24-hour PM_{10} NAAQS Compliance

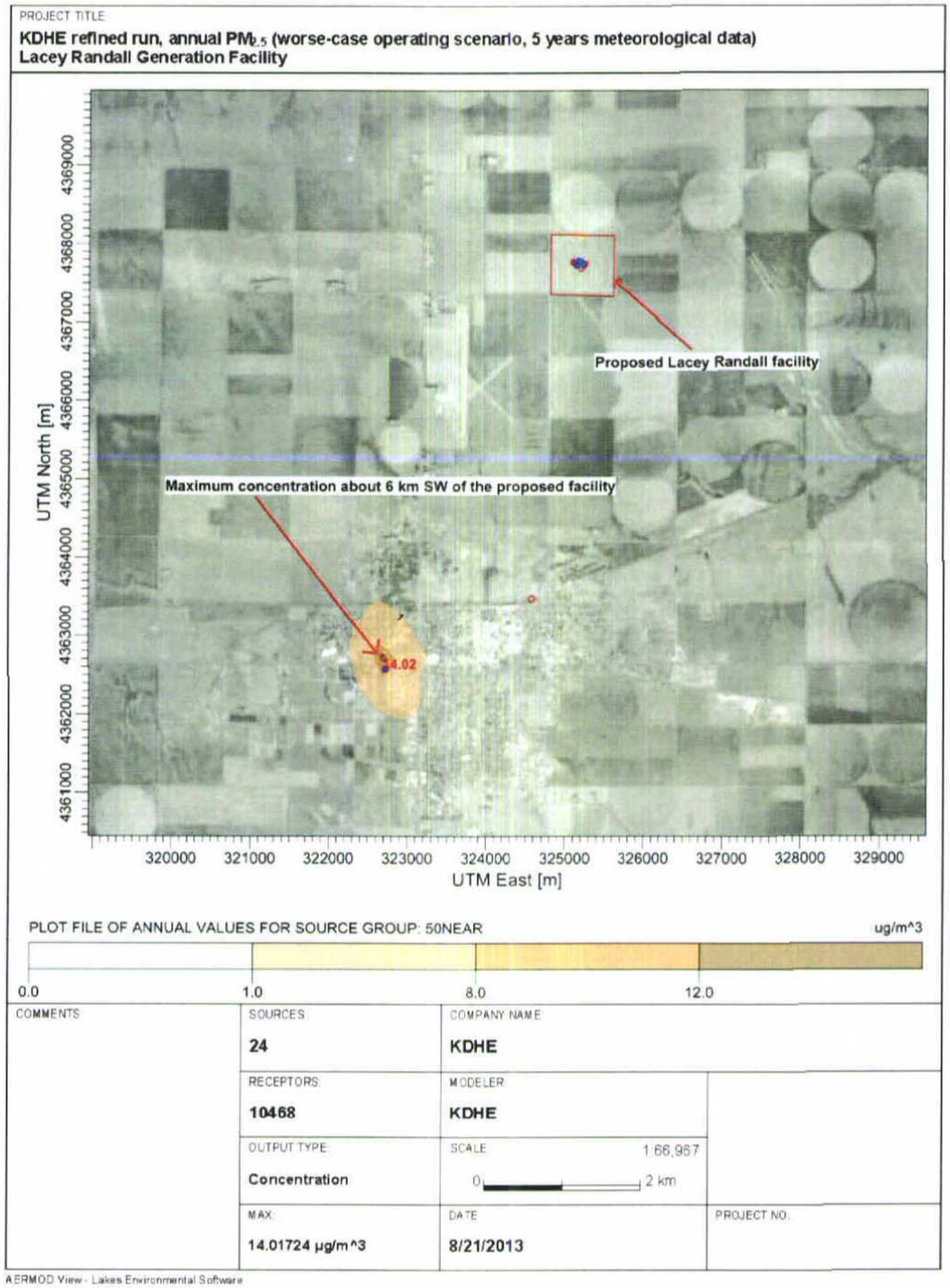

Figure 12. Refined Modeling Isopleths for annual $PM_{2.5}$ NAAQS Compliance

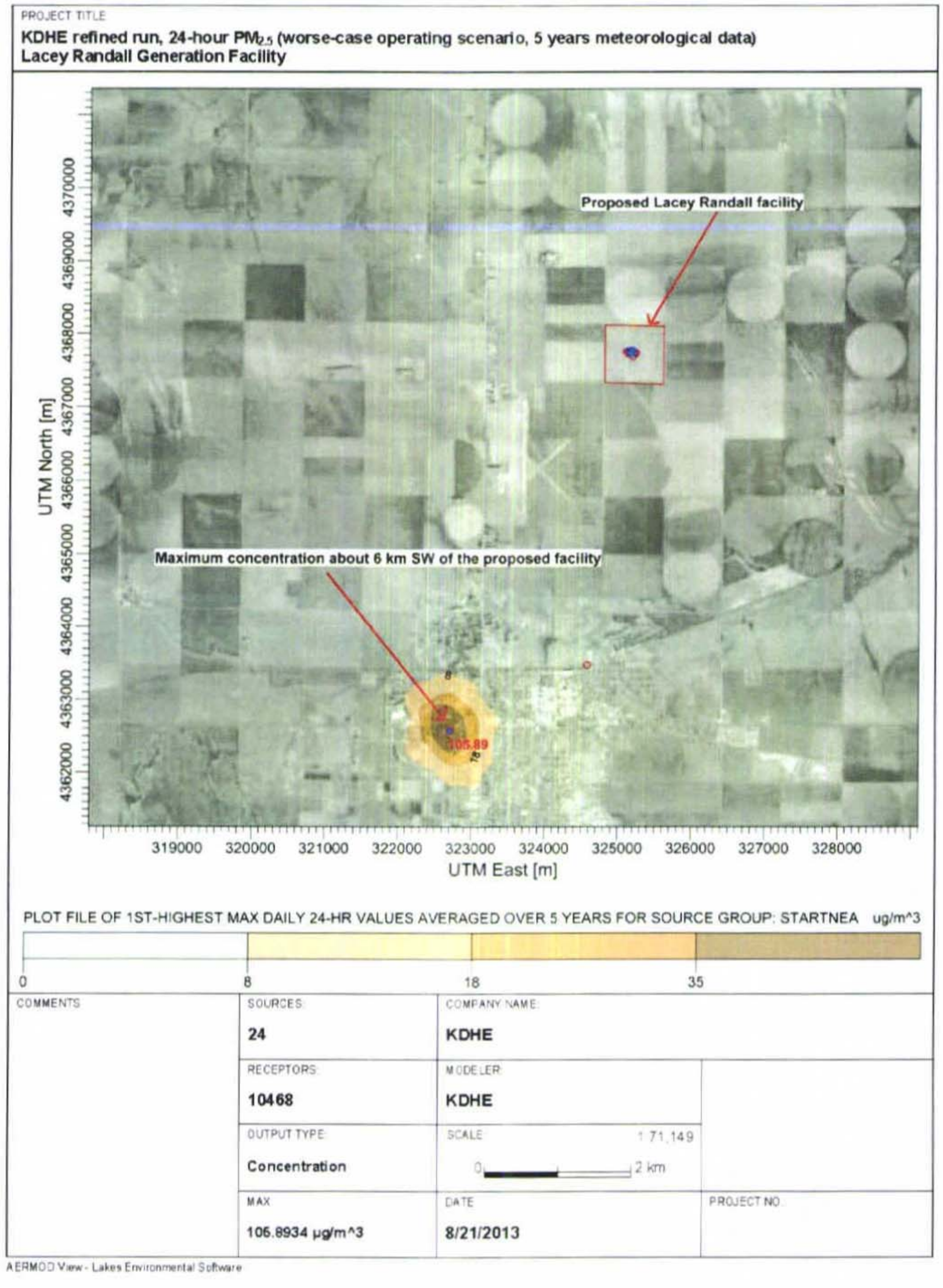

Figure 13. Refined Modeling Isopleths for 24-hour $PM_{2.5}$ NAAQS Compliance

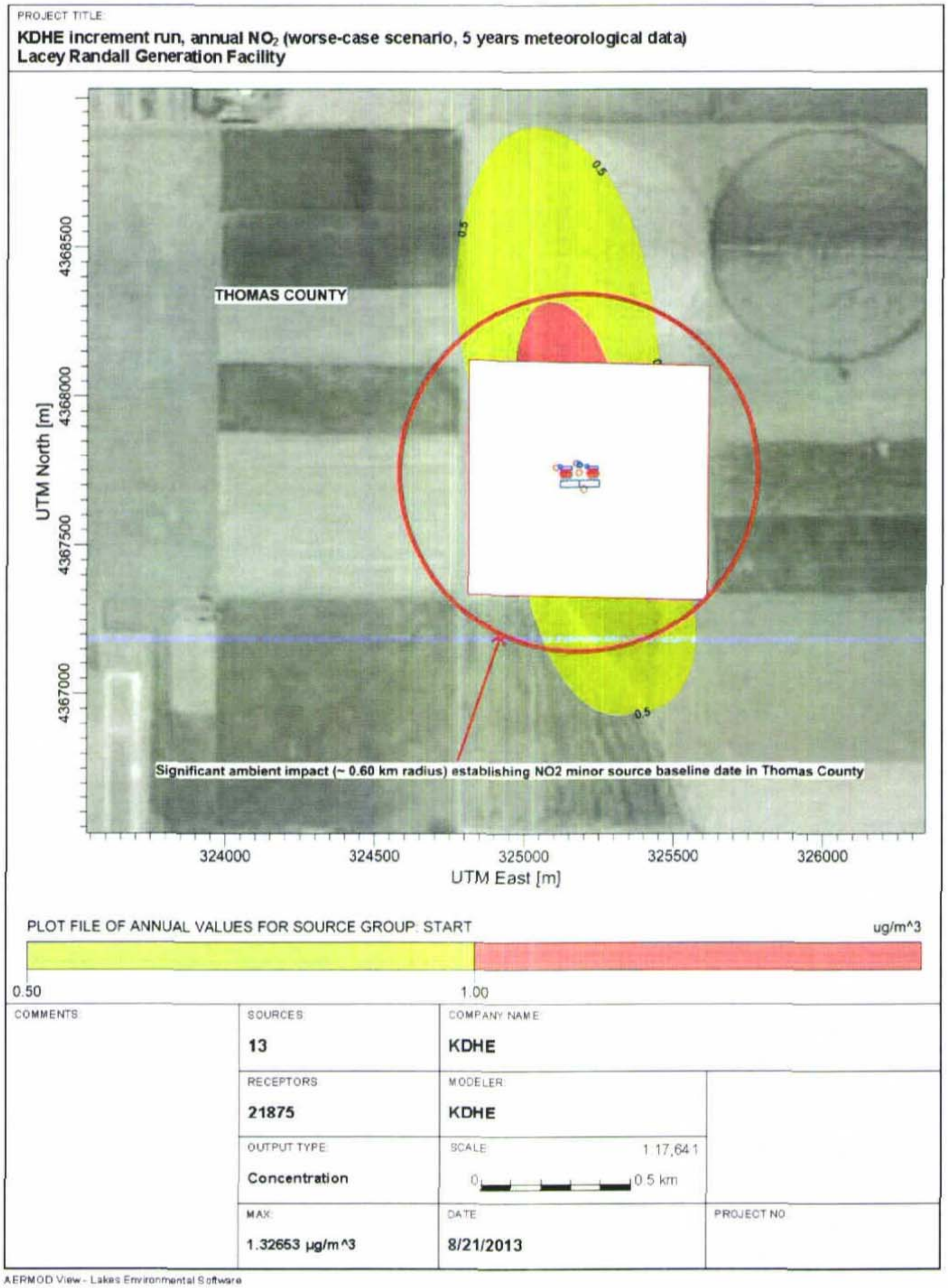

Figure 14. PSD Increment Modeling Isopleths for Annual NO_2

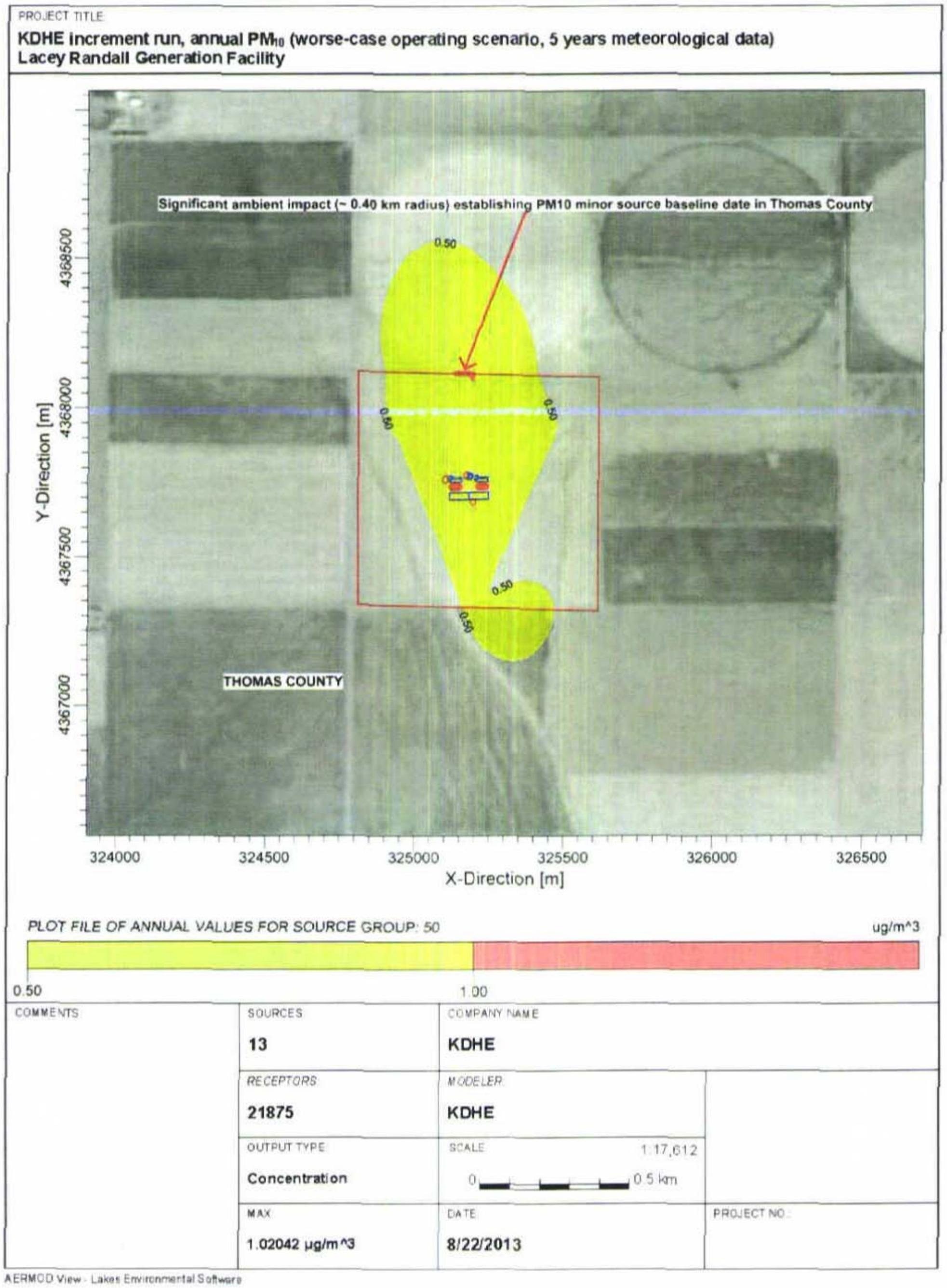

Figure 15. PSD Increment Modeling Isopleths for Annual PM_{10}

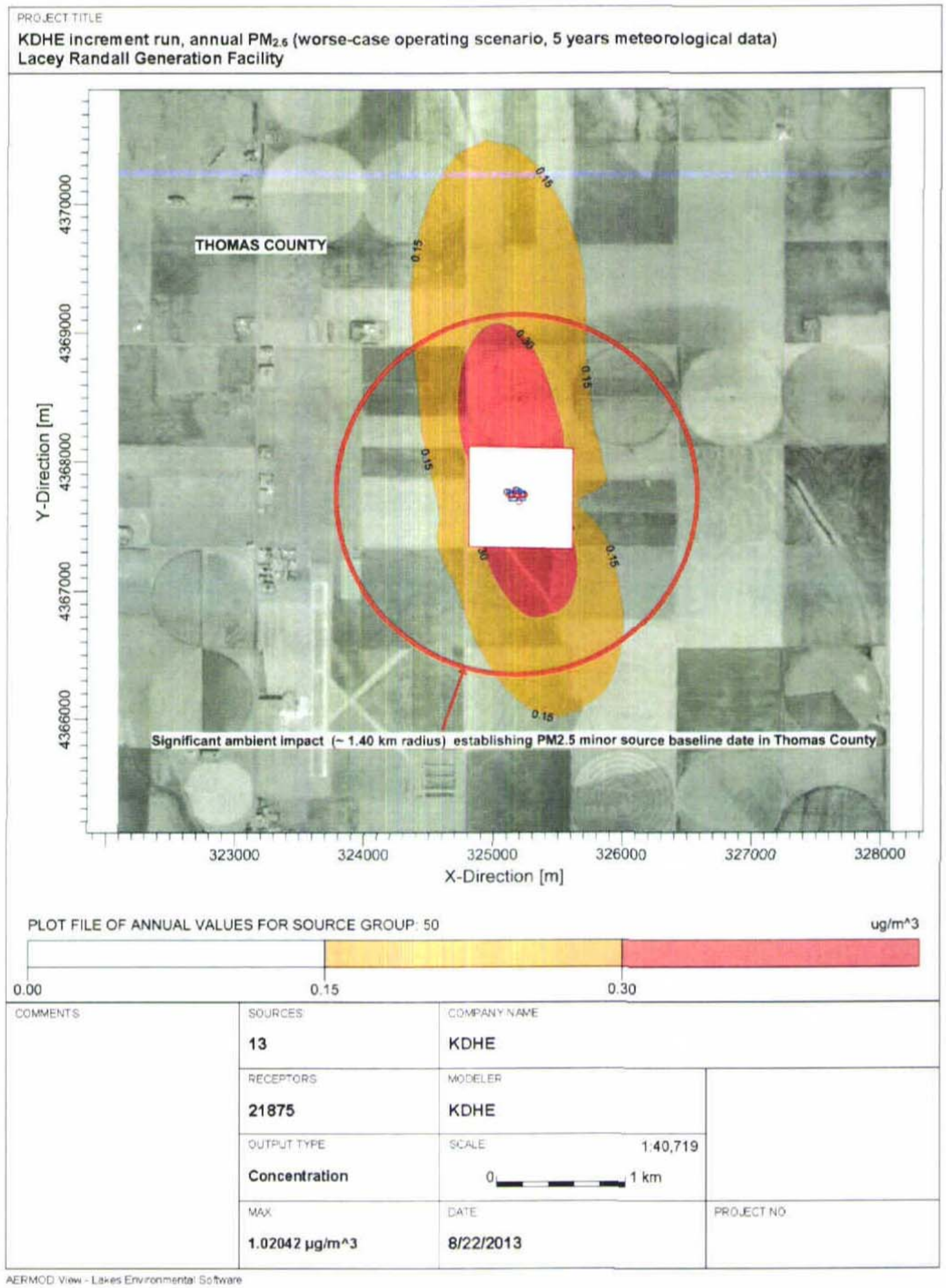

Figure 16. PSD Increment Modeling Isopleths for annual $PM_{2.5}$

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 Lacey Randall Generation Facility, LLC Proposed NO_x, CO, VOC, PM, PM_{10}, $PM_{2.5}$ BACT Options

Lacey Randall Generation Facility, LLC evaluated the BACT options to control emissions from the Wartsila four stroke lean burn reciprocating internal combustion engine electric generating units (EGUs), the fuel gas heater, the emergency fire pump, the emergency diesel generator, and a diesel fuel storage tank. 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. NO_x BACT for the EGUs

NO_x control methods considered included non-selective catalytic reduction (NSCR), selective catalytic reduction (SCR), and lean-burn combustion.

NSCR uses the residual hydrocarbons and CO in the rich-burn engine exhaust as a reducing agent for NO_x. In an NSCR, hydrocarbons and CO are oxidized by O_2 and NO_2. The excess hydrocarbons, CO, and NO_x pass over a catalyst that reduces NO_x to N_2. Lean burn engines cannot be retrofitted with NSCR because of the reduced exhaust temperatures. Because lean burn engines cannot be fitted with NSCR, NSCR is not technically feasible for application to the EGUs.

SCR is a post combustion technology that employs ammonia in the presence of a catalyst to convert NO_x to nitrogen and water. The function of the catalyst is to lower the activation energy of the NO_x decomposition reaction. Technical factors related to this technology include the catalyst reactor design, optimum operating temperature, sulfur content of the fuel, de-activation due to aging, ammonia slip (ammonia that is left unreacted and exits the stack) emissions, and the design of the ammonia injection system. SCR represents state of the art controls for NO_x removal from this type of engine. SCRs are commercially available and have been used on similar engines. Therefore, SCR is technically feasible.

The EGUs used in this project are lean burn four stroke engines. These engines are also characterized as clean burn engines. The engines operate with air to fuel ratios between 20:1 and 50:1. Engines operating at high air to fuel ratios (greater than 30:1) may require combustion modification to promote stable combustion with the high excess air. These units are designed with a turbo charger, which is used to force more air into the combustion chamber. Lean burn engines typically have lower NO_x emissions than rich burn engines. Lean burn combustion with clean burn technology is standard on this type of engine, and is therefore a technically feasible option.

Please refer to the BACT analysis presented in Section 6 of the permit application for a more thorough evaluation of possible BACT.

KDHE reviewed the EPA's RACT/BACT/LAER Clearinghouse (RBLC) and other recently issued permits. Data indicated that recent installation of similar units utilized lean burn combustion with clean burn technology and SCR for the best controlled units. The PSD regulations require BACT, which requires the source to evaluate the control options for economic feasibility along with the impact on environment and energy use. If the top control is not chosen, an economic analysis to determine capital and annual control costs in terms of cost-effectiveness (i.e. dollars per ton of pollutant removed) of each control system will be conducted. The top control has been selected as BACT. The maximum emission reduction technically feasible control applied to this type of engine is SCR with lean burn combustion. Therefore, BACT for control of NO_x emissions from the EGUs is lean burn combustion with clean burn technology and SCR.

Emission rates from the RBLC were considered for engines in a comparable size range and located in attainment areas. Emission rates from similar units were in the range 0.05 g/bhp-hr and higher. Engine design differences between manufacturers account for variation between emission rates achievable for different engines. The BACT limit for NO_x is 1.45 lb/hr for steady state operation, based on vendor guarantees, which equates to 0.05 g/hp-hr for steady state operation. The BACT emission rate averaging period is 1 hour.

II. CO BACT for the EGUs

The technically feasible technologies identified for reducing CO emissions are oxidation catalyst and combustion controls. The standard technology for reducing CO emissions is to follow good combustion practices by monitoring the combustion process through the air to fuel ratio. Review of the RBLC indicates combustion control or oxidation catalyst as the most prevalent technologies.

Oxidation catalysts are a post-combustion technology which uses excess air present in the engine exhaust to oxidize CO to CO_2. Products of combustion are introduced into a catalyst bed, with the optimal temperature range of 700°F to 1100°F. The addition of the catalyst bed onto the engine exhaust creates a pressure drop, resulting in back pressure to the engine. This has the effect of reducing the efficiency of the engine and the power generating capabilities.

Please refer to Section 6 of the permit application, and Appendix D, for additional information.

Oxidation catalysts come as standard equipment for these engines, and also represent the highest level of control for CO. Therefore, oxidation catalysts are BACT for these engines.

The facility has proposed, and KDHE has concurred with, a BACT emission level of 2.67 lb/hr based on guarantees from the equipment vendor. This rate is comparable to similar units in RBLC and is therefore considered BACT. The BACT emission rate averaging period is 1 hour.

III. VOC BACT for the EGUs

Similar to CO, VOC emissions result from incomplete combustion. VOC emissions occur when some gas remains unburned or is only partially burned during the combustion process. The technically feasible technologies identified for reducing VOC emissions from the EGUs are the same as those identified for CO control: an oxidation catalyst and combustion control. As discussed for CO BACT, oxidation catalysts come as standard equipment for these engines, and also represent the highest level of control for VOC. Therefore, oxidation catalysts are BACT for these engines.

The facility has proposed and KDHE has concurred with a BACT emission level of 2.67 lb/hr based on guarantees from the equipment vendor. The BACT emission rate averaging period is 1 hour.

IV. $PM/PM_{10}/PM_{2.5}$ 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 1.44 lb/hr for PM, based on manufacturer's data. PM emission estimates, for the purposes of this permit, are based on filterable particulate only. BACT limits for PM_{10} and $PM_{2.5}$ are based on an estimated maximum rate of 2.22 lb/hour, and include both filterable and condensable particulate matter. The PM BACT emission rate averaging period is 30 days. The PM_{10} and $PM_{2.5}$ BACT emission rate averaging period is 24 hours.

V. Startup 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. Therefore, there are no technically feasible control technologies for start-up 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 NO_x is 11.97 lb/hour, the BACT emission limit for CO is 9.72 lb/hour, the BACT emission limit for VOCs is 4.21 lb/hour, and the BACT emission limit for PM_{10} and $PM_{2.5}$ is 2.65 lb/hour. The averaging periods for the BACT emission rate for each pollutant are the same as for normal operation.

VI. NOx BACT for the Fuel Gas Heater

NO_x emission reduction controls available include SCR and dry low NO_x burners. SCR is technically feasible, but would result in cost per ton of NO_x removed of $77,197, and would therefore not be economical. Refer to Appendix E of the permit application for the complete economic analysis. Dry low NO_x burners are standard equipment and are considered BACT for this heater. The emission limit of 0.29 lb/hr is the BACT limit.

VII. CO, VOC, PM, PM_{10}, and $PM_{2.5}$ BACT for the Fuel Gas Heater

BACT control for these pollutants consists of good combustion practices. The associated BACT limits are as follows: The BACT emissions limit for CO is 0.25 lb/hr, the BACT emission limit for VOC is 0.016 lb/hr, the BACT emission limit for PM, PM_{10}, and $PM_{2.5}$ is 0.022 lb/hr. BACT limits exclude startup, shutdown, and malfunction.

VIII. NOx, CO, VOC, PM, PM_{10}, and $PM_{2.5}$ BACT for the Emergency Diesel Generator

These units 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 associated BACT limits are as follows: The BACT emissions limit for NO_x is 2.98 g/hp-hr, the BACT emissions limit for CO is 2.61 g/hp-hr, the BACT emission limit for VOC is 3.00 g/hp-hr, the BACT emission limit for PM, PM_{10}, and $PM_{2.5}$ is 0.15 g/hp-hr. BACT limits exclude startup, shutdown, and malfunction.

IX. NOx, CO, VOC, PM, PM_{10}, and $PM_{2.5}$ BACT for the Emergency Fire Pump

These units 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 associated BACT limits are as follows: The BACT emissions limit for NO_x is 3.0 g/hp-hr, the BACT emissions limit for CO is 3.7 g/hp-hr, the BACT emission limit for VOC is 3.0 g/hp-hr, the BACT emission limit for PM, PM_{10}, and $PM_{2.5}$ is 0.22 g/hp-hr. BACT limits exclude startup, shutdown, and malfunction.

X. VOC BACT for the Diesel Fuel Tank

BACT for the diesel fuel storage tank is use of a submerged fill pipe.

Attachment C

Kansas Department of Health and Environment's Evaluation of Lacey Randall Generation Facility, LLC
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 TradeWind Energy, Inc. (TradeWind) 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 Lacey Randall Generation Facility, a power generation plant with a total nominal power output of approximately 94 megawatts (MW).

TradeWind Energy is proposing to install and operate ten (10) 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) 3-MMBTU/hr natural gas heater, one (1) emergency diesel fire pump engine (with 150 hp power output), one (1) emergency diesel generator (with 324 bhp power output), and four (4) circuit breakers, to be located at the proposed Lacey Randall Generation Facility in Thomas County, Kansas, approximately 3.5 miles northeast of Colby, Kansas.

For more details, please refer to the Prevention of Significant Deterioration Air Construction Permit Application by TradeWind received by KDHE on July 11, 2013, updated December 12, 2013.

The potential maximum GHG emission estimates from the proposed facility 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.

KDHE has reviewed and concurs with the GHG BACT and BACT emission limits, as summarized in Table C-3.

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

Emission Unit/Process	Carbon dioxide (CO_2), CO_2 equivalent, facility-wide [a]	Methane (CH_4), CO_2 equivalent, facility-wide [a]	Nitrous Oxide (N_2O), CO_2 equivalent, facility-wide [a]	Sulfur Hexaflouride (SF_6), CO_2 equivalent, facility-wide [a]	All GHGs CO_2 equivalent, facility-wide [a]	Contri-bution, %
	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	
Natural gas-fired RICE (steady-state operation at 100 % load)	374,207.2	170.6	261.0	0	374,638.92	99.6
Start-up emissions from natural gas-fired RICE [b]	33,178.9	15.5	No data available	0	33,194.45	
Natural Gas Heater	1,537.4	0.73	0.86	0	1,538.97	0.4
Emergency Diesel Generator	15.5	0.01	0.04	0	15.55	
Emergency Diesel Fire Pump	7.2	0.01	0.02	0	7.22	
Circuit breaker [c]	0	0	0	13.95	13.95	
TOTAL	**408,946.25**	**186.89**	**261.97**	**13.95**	**409,409**	

[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, SF_6 = 22,800; Consisting of ten (10) natural gas-fired RICEs, one (1) natural gas heater, one (1) emergency diesel generator, one (1) emergency diesel fire pump, and four (4) circuit breakers.

[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 14,600 start-up and shutdown events per year total for 10 engines (or 1,460 start-up and shutdown events per year per engine)

[c] assuming 0.5% leakage per year

Table C-2. Potential maximum greenhouse gas (GHG) emissions from the proposed facility (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]		Sulfur Hexaflouride (SF_6), per circuit breaker [a]		All GHGs, CO_2 equivalent, per unit [b]	
Natural gas-fired RICE (steady-state operation at 100 % load)	9,320.00	lbs/hr	0.17	lbs/hr	0.02	lbs/hr	0		**9,330**	lbs/hr
Start-up emissions from natural gas-fired RICE [c]	4,430.00	lbs/start-up	0.09	lbs/start-up	No data available		0		**9,100**	lbs/hr
Natural Gas Heater	351.00	lbs/hr	6.61E-03	lbs/hr	6.61E-04	lbs/hr	0		**351**	lbs/hr
Emergency Diesel Generator	310.00	lbs/hr	1.26E-02	lbs/hr	2.52E-03	lbs/hr	0		**311**	lbs/hr
Emergency Diesel Fire Pump	144.00	lbs/hr	5.83E-03	lbs/hr	1.17E-03	lbs/hr	0		**144**	lbs/hr
Circuit breaker [d]	0		0		0		0.306	lbs/yr	**3.49E-05**	lb/hr
TOTAL									**19,238**	lbs/hr

[a] Mass-based emissions

[b] CO_2e-based emissions; Global Warning Potentials (GWP) used are as follows: $CO_2 = 1$, $CH_4 = 25$, $N_2O = 298$, $SF_6 = 22{,}800$; Consisting of ten (10) natural gas-fired RICEs, one (1) natural gas heater, one (1) emergency diesel generator, one (1) emergency diesel fire pump, and four (4) circuit breakers.

[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 14,600 start-up and shutdown events per year total for 10 engines (or 1,460 start-up and shutdown events per year per engine).

[d] assuming 0.5% leakage per year

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, spark ignition, natural gas-fired RICE (with air-to-fuel ratio control, turbocharger, an open interface cooling system and a lube oil cooling system) • Use of clean fuel such that only pipeline quality natural gas will be used 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 from each RICE are limited to the following emissions guaranteed by the manufacturer: **9,330 lb/hr** during steady-state operation at full load **9,100 lb/hr** *during start-up operation* (30 *min* start-up emissions + 30 min steady-state full load emissions) • 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 **9,090 lb/hr** during start-up *operation (30 min start-up emissions* + 30 min steady-state full load emissions) • The CO_2 emissions per power output is limited to the following emissions guaranteed by the manufacturer: **1.08 lbs/kWh (or 491 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 the proposed station. • The owner or operator is limited to firing pipeline quality natural gas only in the 10 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 for each RICE, in accordance with the manufacturer's recommendations to maintain efficiency of the engines. • Initial performance testing of each RICE to demonstrate compliance with **9,320 lb/hr** CO_2 during steady-state operation at full load and **9,090 lb/hr** CO_2 during start-up is required. • Subsequent compliance demonstration is the recordkeeping 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/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

Emission Units	GHG BACT, BACT emission limits and compliance demonstrations
	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 Heater	GHG BACT • Use of clean fuel (exclusive use of pipeline quality natural gas) • Good combustion practices in accordance with the manufacturer's recommendation (e.g., tuning the unit every two (2) years according to the manufacturer's specifications) 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 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 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
Circuit breakers	GHG BACT • State-of-the-art enclosed-pressure SF6 circuit breakers with a guaranteed loss rate of 0.5% by weight or less by year; • Density monitor alarm system; and • Develop and implement a written LDAR program. Compliance Demonstration • Compliance demonstration for the SF_6 emissions, which is 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 10 natural gas-fired RICEs

A. BACT Step 1 (Identify Available Control Options)

The following control options, which are identified by TradeWind as the most stringent controls for the proposed project, have been considered in Step 1 of GHG BACT for the 10 RICEs. Details are described in Section 6.8 of the PSD construction permit application. Section 6.8.3.1 explains in detail the option of Carbon Capture and Sequestration (CCS). Table 6-10 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 6-11 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, TradeWind 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.

TradeWind 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 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 not be continuously in large amounts and are not of 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 TradeWind.

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

Because TradeWind will utilize the most stringent control for reducing the GHG emissions, no detailed analysis was provided by the facility to compare the available and feasible control technologies in terms of economic, energy, and environmental impacts.

E. BACT Step 5 (Selecting BACT)

The following is the GHG BACT for the 10 RICEs:

1. Use of high energy efficiency design and operation technology that includes the use of lean-burn, four-stroke, spark ignition, natural gas-fired RICE (with air-to-fuel ratio control, turbocharger, an open interface cooling system and a lube oil cooling system).

2. Use of clean fuel such that only pipeline quality natural gas will be used 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 10 RICE, during steady-state operation at full-load and during start-up operations:

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

   9,330 lb/hr during steady-state operation at full load; and
   9,097 lb/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 CO2, mass-basis is equivalent to CO2e-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; and
9,090 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:
1.08 lbs/kWh (or 491 g/kWh) based on a 12-month rolling average CO_2 emissions per power output.

The following describes the compliance demonstration of 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 10 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 for 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 10 RICE during steady-state operation at full load. Performance testing of other GHGs (CH_4 and N_2O) emissions from the 10 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 9,090 lb/hr CO_2 during start-up 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 (CH4 and N2O), 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 10 natural gas-fired RICE

Details are described in Section 6.9 of the PSD construction permit application.

Each RICE has potentially 1,460 start-up/shutdown events per engine per year. 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) cannot operate until the respective catalysts reach certain minimum temperatures. Shutdown emissions, though, occur when catalysts are at proper operating temperatures.

According to TradeWind, 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". TradeWind 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 oxidation 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 9,090 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 Heater

Details are described in Section 6.10.5 of the PSD construction permit application.

The gas 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 3.0 MMBtu/hr, and will be fired a total of 8,760 hours per year. The GHG emissions from this unit are estimated to be **1,539 tons CO_2e/yr**. This GHG emission is small **(approximately 0.376% only)**, when compared with the RICE GHG emissions or the project's total GHG emissions.

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

The following are the GHG BACT for the fuel-gas heater:

1. Use of clean fuel (exclusive use of pipeline quality natural gas); and
2. Good combustion practices in accordance with the manufacturer's recommendations (e.g., tuning the unit every two (2) years according to the manufacturer's specifications).

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

Because TradeWind will utilize the most stringent control for reducing the GHG emissions from the natural gas heater, no detailed analysis was 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); and
2. Good combustion practices in accordance with the manufacturer's recommendations (e.g., tuning the unit every two (2) years according to the manufacturer's specifications).

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 Fire Pump

Details are described in Section 6.11.5 of the PSD construction permit application.

The emergency fire pump will be used no more than 100 hours per year. Consistent with the rationale for the BACT determination for GHG emissions from the RICEs, TradeWind believes that BACT for this source involves selection of the most efficient stationary fire pump engine that can meet the project's needs. TradeWind has estimated the total GHG emissions from the emergency fire pump at **7.2 tons of CO_2e per year**.

This GHG emission is very small **(approximately 0.002% only)** when compared with the RICE GHG emissions or the project's total GHG emissions.

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 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 TradeWind will utilize the most stringent control for reducing the GHG emissions from the emergency fire pump, no detailed analysis was 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; and
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 6.12.5 of the PSD construction permit application.

The emergency diesel generator (324-hp) will be limited to no more than 100 hours per year. Consistent with the rationale for the BACT determination for GHG emissions from the RICEs, TradeWind believes that BACT for this source involves selection of the most efficient stationary emergency generator engine that can meet the project's needs. TradeWind has estimated the total GHG emissions from the emergency fire pump at **15.6 tons of CO_2e per year**. This GHG emission is very small **(approximately 0.004% only)** when compared with the RICE GHG emissions or the project's total GHG emissions.

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 TradeWind will utilize the most stringent control for reducing the GHG emissions from the emergency diesel generator, no detailed analysis was 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); and
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.

VII. GHG BACT for the Circuit Breakers

Details are described in Section 6.13 of the PSD construction permit application.

Sulfur hexafluoride (SF_6) is a very potent GHG with a global warming potential (GWP) of 22,800. SF_6 is a gaseous dielectric used in circuit breakers and circuit switchers. The project will have a maximum of four (4) circuit breakers that will contain small amounts of SF_6. Leakage is expected to be minimal, and is expected to occur only as a result of circuit interruption and at extremely low temperatures.

Emissions of SF_6 from the circuit breakers are listed in Tables C-1 and C-2 above. SF_6 emissions are based on a maximum leakage rate of 0.5% per year, based on vendor guarantees, to calculate the annual potential-to-emit emissions. Based on the calculations for all four (4) circuit breakers, the maximum CO_2e emission is **13.95 tons per year**. This GHG emission is very small **(approximately 0.004% only)** when compared with the RICE GHG emissions or the project's total GHG emissions.

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

The following control options are identified by TradeWind. For the discussion on the technical feasibility of the controls, refer to the BACT document for the circuit breakers in Section 6.13.1.3.

1. Use state-of-the-art SF_6 technology with leak detection systems to limit fugitive emissions. This option is technically-feasible.
2. Substitution of another, non-greenhouse-gas substance for SF_6 such as the use of a different dielectric oil or compressed air (air-blast) circuit breaker as the dielectric material in the breakers. This option is not technically-feasible.
3. Use an emerging technology to replace SF_6 with a material that has similar dielectric and arc-quenching properties, but without the drawbacks of oil and air-blast breakers. This option is not technically-feasible.
4. Develop and implement a Leak Detection and Repair (LDAR) program, similar to NSPS, Subpart Wa (40 CFR 60.480a through 60.489a). This option is technically-feasible.

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

TradeWind will utilize the use state-of-the-art SF_6 technology with leak detection systems to limit fugitive emissions and the LDAR program. Because TradeWind will utilize the most stringent controls for reducing the GHG emissions from the circuit breakers, no detailed analysis was provided for BACT Step 3 and BACT Step 4.

C. BACT Step 5 (Selecting BACT)

As identified in Steps 1 through 3 of the BACT, the following is the GHG BACT for the circuit breakers:

1. State-of-the-art enclosed-pressure SF_6 circuit breakers with a guaranteed loss rate of 0.5% by weight or less by year;
2. Density monitor alarm system; and
3. Develop and implement a written LDAR program.

D. BACT Compliance

The following describes the compliance demonstration to the GHG BACT for the circuit breakers:

1. In place of direct monitoring of the fugitive SF_6 emissions, surrogate monitoring through measuring the amount of SF_6 lost and using a conversion factor to assess annual SF_6 fugitive emissions in terms of CO_2e.
2. Implement a density monitor alarm system with threshold of 10 %, that is, the alarm will alert controllers when the circuit breakers lose 10 % of its SF_6. In the event of an alarm, TradeWind will investigate the event and take any necessary corrective action to address any problems.
3. TradeWind will provide a copy of the LDAR program and documentation regarding observations and/or repairs made in accordance with the LDAR program to KDHE upon request.