Air Quality Impact Analysis Review

Abengoa Bioenergy Biomass of Kansas, LLC
Air Quality Construction Permit Application

Source ID No. 1890231
C-9600

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

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Table of Contents

Topic **Page**

I. Introduction 1

II. Facility Description 3

III. Air Quality Impact Analysis Applicability 7

IV. Model Selection 8

V. Model Inputs 10

VI. Significance Determination 14

VII. Refined Analysis Results 16

VIII. Visibility Impacts 20

IX. Conclusions 21

Tables

Table 1. Emissions From the Proposed Project and PSD Significant Emission Rates 7

Table 2. Meteorological Data Sites 11

Table 3. Receptor Spacing for Significant Impact Modeling for the Proposed Facility 13

Table 4. Significance Determination Table 14

Table 5. Radius of Impact for SIL 16

Table 6. NAAQS Compliance Demonstration 17

Table 7. Holcomb Expansion Project Increment Consumption 18

Table 8. All Source Cumulative Increment Consumption 19

Figures

Figure 1. Wind Rose for Years 2006 to 2010 11

Figure 2. Map of Abengoa Bioenergy Biomass of Kansas Facility and the Garden City and Dodge City Meteorological Stations 12

I. Introduction

Abengoa Bioenergy Biomass of Kansas, LLC (ABBK) submitted a prevention of significant deterioration (PSD) construction permit application to install and operate a biomass to ethanol manufacturing and biomass to power cogeneration (CoGen) facility near Hugoton, Kansas.

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

The original PSD air quality construction permit application was submitted to the Kansas Department of Health and Environment (KDHE) on July 21, 2008 for a traditional grain-to-ethanol production process, enzymatic hydrolysis (EH) ethanol production process and gasification process (syngas production). An Air Quality Modeling Protocol supplement (Supplement No. 1) was received by KDHE in October 2008. KDHE provided comments on this Air Quality Modeling Protocol on November 20, 2008. Subsequently, ABBK provided a supplement to this protocol on January 16, 2009.

A Best Available Control Technology (BACT) analysis supplement (Supplement No. 2) was also submitted in October 2008 to address the KDHE August 18, 2008 letter requesting clarification and/or additional information regarding the BACT analysis provided in the July 21, 2008 application.

A draft AQIA (Supplement No. 3) was submitted to KDHE in November 2008. An amendment to the July 21, 2008 PSD air quality construction permit application was submitted to KDHE in April 2009 (Supplement No. 4) due to changes to the facility design. These changes included the addition of the CoGen plant. A revised AQIA (Supplement No. 5) and a PSD Class II and Sensitive Areas Visibility Assessment (Supplement No. 6) were also submitted to KDHE in May 2009 and August 2009, respectively.

Subsequent changes to the facility's design in September 2009 required significant revision to the air quality construction permit application; therefore, a complete new application was prepared and submitted to KDHE in January 2010. The changes to the facility design consist primarily of the removal of the traditional grain-to-ethanol production process, removal of the gasification process (syngas production), and an increase in the output capacities of the EH and CoGen plants.

On October 22, 2010 KDHE received a new version of the Ambient Air Quality Impact Assessment Protocol. This document was updated on February 14, 2011. The February 2011 AQIA update includes the results from the October 2010 AQIA, as well as updated results from modeling analyses performed in February 2011.

A 2011 redesign of the project was required to satisfy U.S. Department of Energy (DOE) partnership criteria and the February 21, 2011 National Emission Standards for Industrial, Commercial, and Institutional Boilers and Process Heaters standards. This modification includes the use of a biomass-fired stoker boiler instead of the bubbling fluidized bed (BFB) boiler considered in the previous application. SO_2 emissions will also increase due to a redesign in a process stream that will be redirected from the wastewater treatment system to the biomass-fired boiler. These changes required a new permit application and modeling demonstration. Different components of the modeling analysis were received throughout April, May and June of 2011. On July 1st, 2011 KDHE received a revised AQIA dated June 2011 with modeling files for the new facility design. The BACT analysis for the biomass boiler was revised to include selective catalytic reduction (SCR) for NO_2 control, and a final supplement and update to the AQIA dated August 2011 was submitted. KDHE received this update on August 4, 2011.

Dispersion modeling for this project includes a demonstration of compliance with NAAQS published recently by the Environmental Protection Agency (EPA). The NAAQS for 1-hour NO_2 was published on February 9, 2010, with an effective date of April 12, 2010. The NAAQS for 1-hour SO_2 was published in the Federal Register on June 22, 2010, with an effective date of August 23, 2010. With these new final rules, EPA did not issue significant impact levels (SILs), significant monitoring concentrations, increment, post processors and other implementation guidance and tools that are needed for a dispersion modeling analysis. Thus, KDHE and other permitting agencies have developed interim SILs for 1-hour NO_2 NAAQS and 1-hour SO_2 NAAQS. The KDHE-established interim SILs are to be valid until the EPA promulgated SILs are effective and adopted in the Kansas air quality regulations. Guidance was issued by EPA for NO_2 and SO_2 1-hour interim SILs on June 29, 2010 and August 23, 2010. Abengoa modeled 1-hour NO_2 and 1-hour SO_2 based on the EPA recommended interim SILs. Since these are more stringent than the KDHE interim SILs, KDHE deems this demonstration to be acceptable.

On October 20, 2010, the EPA published final SIL values in the Federal Register for 24-hour and annual $PM_{2.5}$ NAAQS, with an effective date of December 20, 2010. These $PM_{2.5}$ SILs will have to be incorporated in the Kansas Air Regulations before they become effective in Kansas. Abengoa has agreed to conduct modeling using these new standards. Since these are more stringent than KDHE interim SILs, KDHE deems this demonstration to be acceptable.

II. Facility Description

ABBK intends to install and operate a biomass to ethanol manufacturing and biomass to power cogeneration (CoGen) facility near Hugoton, Kansas. The biomass to ethanol manufacturing facility, employing an enzymatic hydrolysis alcohol production process, will utilize cellulosic feedstocks (biomass) such as wheat straw, milo (sorghum) stubble, corn stover, switchgrass, and opportunity feedstocks that are locally available. The cogeneration plant will utilize the same cellulosic feedstocks used in the enzymatic hydrolysis ethanol manufacturing plant, as well as enzymatic hydrolysis residuals (including lignin-rich stillage cake and thin stillage syrup), particles collected during biomass grinding, non-condensable gases (NCG) vent streams, and wastewater treatment sludge and biogas, as they are available. Natural gas will be used during start-up periods as required per manufacturer recommendations, as well as during periods when there is a reduction or failure in the solid fuel feedrate.

Nominal production for the enzymatic hydrolysis alcohol production process is based on a designed production rate of 23,300,000 gallons per year (23.3 MMgpy) anhydrous ethanol. For permitting purposes, the enzymatic hydrolysis ethanol production process is based on a 20% increase in plant efficiency and a production schedule of 365 days per year, which results in a maximum annual anhydrous ethanol production of 30,000,000 gallons per year (30 MMgpy) anhydrous ethanol. The anhydrous ethanol is then denatured prior to shipment offsite, resulting in a total denatured nominal production rate of 23.8 MMgpy, and a maximum denatured potential production rate of 31.6 MMgpy.

The cogeneration plant will employ one water-cooled vibrating grate (stoker) boiler. The boiler will be capable of producing 325,000 pounds per hour of 920 pound-force per square inch gauge (psig) / 750 ^{o}F steam. The high pressure steam will supply a single condensing-extraction steam turbine generator nominally rated at 22 Megawatts of electricity (MWe). Electrical power will be supplied to the facility and power sales to the grid are not foreseen at this time. The stoker boiler's design heat input is 500 million British thermal units per hour (MMBtu/hr). The stoker boiler is capable of burning a combination of raw biomass (consisting of corn stover, wheat straw, milo (sorghum) stubble, switchgrass, and other opportunity feedstocks that are available), enzymatic hydrolysis residuals (including lignin-rich stillage cake and thin stillage syrup), particles collected during biomass grinding, NCG vent streams, wastewater treatment sludge and biogas. Natural gas will be used during start-up periods as required per manufacturer recommendations. The stoker boiler will also be capable of firing on natural gas during normal operations as needed at a limited capacity, as well as firing on a combination of natural gas, liquid fuel (i.e. enzymatic hydrolysis thin stillage syrup) and biogas in the event of a solid fuel failure. The cogeneration process will utilize up to 812 dry tons/day of fuel feedstock.

The proposed facility location is one mile west of the City of Hugoton, in Stevens County, Kansas in Section 18, Township 33S, Range 37W. The portion of Section 18 that will be developed includes the area north of the Cimarron Valley Railroad right-of-way, which consists of approximately 385 acres. The property is currently used as row-cropped agricultural land and is adjoined by grain elevators, an asphalt plant, an industrial park, and the Hugoton Municipal Airport to the south; a golf course and agricultural land to the west; two residences to the northwest; agricultural cropland to the north; and the City of Hugoton to the east.

Stevens County is located in southwest Kansas and is designated as attainment or unclassifiable/attainment for particulate matter (PM), particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}), particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$), nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), and volatile organic compounds (VOCs). Attainment areas are where the air quality meets or is better than the National Ambient Air Quality Standards (NAAQS).

There are no Federal Prevention of Significant Deterioration (PSD) Class I areas located within 100 kilometers (km) of the proposed facility. The nearest Federal PSD Class I Area is the Great Sand Dunes in southeastern Colorado, located approximately 370 km (230 miles) west of the proposed facility location. There is one potential Class II area of concern within 50 km (31 miles) to the proposed facility. The Cimarron National Grasslands, one of twenty National Grasslands administered by the U.S. Department of Agriculture (USDA) Forest Service is located within Morton and Stevens Counties in southwestern Kansas, approximately 24 km (15 miles) west of the proposed facility location. The Cimarron National Grasslands consist of 437.8 km^2 (108,175 acres) of protected grasslands.

The proposed facility will employ two different biomass processes to produce ethanol, crude lignin, soil amendment ash, and power. These two processes include the following:

- Biomass-to-Ethanol: Enzymatic Hydrolysis Ethanol Production Process (EH Plant); and
- Biomass-to-Power: Cogeneration Process (CoGen Plant).

There are two types of emissions associated with the proposed facility, including point source emissions and fugitive emissions. Point source emissions are those emissions that are emitted from a stack or vent in the EH Plant and the CoGen Plant. Fugitive emissions are those emissions that are not emitted through a stack or vent and were treated as either area or volume sources. Fugitive sources modeled include paved roads, biomass laydown roads, storage piles, and grinding and handling activities. A detailed description of the emissions sources is included in Section 3.0 and Appendix B from the Ambient Air Quality Impact Assessment dated June 2011.

In addition to normal operating conditions, alternate operating scenarios are considered in the modeling analysis.

For haul roads the typical scenario assumes that truck traffic associated with shipping and receiving occurs from 6:00 AM to 6:00 PM only. Typical and alternate scenarios were modeled for the 24-hour PM_{10} and $PM_{2.5}$ compliance demonstrations. In the typical scenario the unpaved biomass storage area roads were modeled based on the areas being active constantly and paved roads being active from 6:00 AM to 6:00 PM. Scenarios performed for paved truck traffic include the following:

- **Scenario 1**- Truck traffic associated with shipping and receiving occurs from 6:00 AM to 6:00 PM only.
- **Scenario 2**- 90% of the truck traffic associated with shipping and receiving occurring from 6:00 AM to 6:00 PM and 10% of the truck traffic occurring from 6:00 PM to 6:00 AM.
- **Scenario 3**- 80% of the truck traffic associated with shipping and receiving occurring from 6:00 AM to 6:00 PM and 20% of the truck traffic occurring from 6:00 PM to 6:00 AM.
- **Scenario 4**- 70% of the truck traffic associated with shipping and receiving occurring from 6:00 AM to 6:00 PM and 30% of the truck traffic occurring from 6:00 PM to 6:00 AM.

Based on the 24-hour $PM_{10}/PM_{2.5}$ averaging period modeling results, the worst-case paved haul road traffic scenario was identified as Scenario 4 in which 70% of the truck traffic associated with shipping and receiving occurs from 6:00 AM to 6:00 PM and 30% of the truck traffic occurs from 6:00 PM to 6:00 AM. Annual $PM_{10}/PM_{2.5}$ emissions from all haul roads were modeled based on this scenario. In all scenarios the unpaved roads were modeled as active constantly.

Shipping and receiving operations directly related to truck traffic include seven sources, namely: the wood residues receiving via rail; the dirt/fines load-out from silo; the ash pellets load-out from silo; the ash pellets storage pit loading and load-out; the wood residues storage pile loading; the dirt load-out silo spout; and the ash pellets load-out silo spout. These sources were modeled based on the hours of operation specified for the paved roads scenarios.

The firewater pump engine (EP-06001) is an emergency unit which normally operates a maximum of 1 hour per day for testing purposes, and not more than 100 hours per year to comply with the NSPS, 40 CFR Part 60, Subpart IIII, *Compression Ignition Internal Combustion Engines*. The facility shall limit the firewater pump engine operations such that it will not be operated at any time that the Flare is operating except in the event of a facility emergency. Per EPA's Memorandum, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO2 NAAQS,* published March 1, 2011 reviewing authorities have discretion to exclude intermittent emission sources (i.e., emergency generators) from modeling demonstrations for the 1-hour NO_2 and 1-hour SO_2 averaging periods. Accordingly, KDHE granted the exclusion of the fire water pump from the 1-hour NO_2 and 1-hour SO_2 modeling demonstrations. The Firewater Pump Engine was included in the SIL modeling analysis for both the 1-hour NO_2 and 1-hour SO_2 to assess the potential worst-case impacts from the source. For all other pollutants and averaging periods, the Firewater Pump Engine was included in the SIL, and if necessary, NAAQS and PSD Class II Increment analyses.

The biomass-fired boiler is expected to operate at various loads based on the facility's steam needs. The boiler will be operated during normal operation within the vendor's specified operating ranges to maximize fuel-to-energy conversion and control efficiencies. For the purposes of the modeling the boiler at various loads, the following scenarios were modeled:

1. 141 MMBtu/hr
2. 236 MMBtu/hr
3. 353 MMBtu/hr
4. 471 MMBtu/hr
5. 500 MMBtu/hr

For Abengoa's complete description of the modeled operating scenarios, refer to Section 3.0 and Appendix B from the Ambient Air Quality Impact Assessment dated June 2011, and to the memo and attached data submitted by e-mail on August 3, 2011.

III. Air Quality Impact Analysis (AQIA) Applicability

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

1) any NAAQS in any air quality control region; or
2) any applicable maximum allowable increase of $PM_{2.5}$, PM_{10}, SO_2, or NO_2 over the baseline concentration in any area (increment).

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

Table 1. Emissions From the Proposed Project and PSD Significant Emission Rates

Pollutant	Project Emissions with controls (tpy)	Significant Emission Rate (tpy)	PSD Review Required
NO_x	668.5	40	Yes
SO_2	483.4	40	Yes
PM	130.5	25	Yes
PM_{10}	118.6	15	Yes
$PM_{2.5}$	81.2	10	Yes
CO	519.5	100	Yes
VOC	29.0	40	No
Ozone	N/A	40 tpy VOC or 40 tpy NO_x	Yes

IV. Model Selection

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 nearfield 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."*

Based on the proposed facility emissions, the following pollutants must be evaluated as part of the AQIA: nitrogen oxides (NO_x) as nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter with an aerodynamic diameter less than or equal to ten microns (PM_{10}), particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), and carbon monoxide (CO). The AQIA does not evaluate VOCs as there is currently no EPA approved methodology for evaluating the 8-hour ozone standard.

The AERMOD modeling system, Version 11103, was used to evaluate the impacts of the following emissions that will result from the proposed facility:

- 1-hour, annual NO_2;
- 1-hour, 3-hour, 24-hour, and annual SO_2;
- 1-hour and 8-hour CO.

The AERMOD modeling system, Version 09292, was used by Abengoa to evaluate the impacts of the following emissions that will result from the proposed facility:

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

Abengoa performed a comparison analysis between AERMOD Version 11103 and Version 09292 for the following scenarios:

- FWP471 for 24-hour PM10, annual PM_{10} and annual $PM_{2.5}$;
- AB471 for 24-hour $PM_{2.5}$.

The analysis showed no difference in results. KDHE evaluated these pollutants and averaging periods with AERMOD Version 11103. KDHE results were consistent with the results obtained by the facility.

AERMAP Version 11103 was used to assign elevations. AERMET Version 11059 was used to prepare meteorological data, which was provided by KDHE to Abengoa for the years 2006-2010. AERMINUTE Version 11059 was used to processes 1-minute ASOS wind data to generate hourly average winds for input to AERMET in Stage 2.

Unless otherwise noted in this document and/or in the facility's modeling analyses, regulatory default options in the AERMOD model were utilized for this air quality impact analysis. The facility utilized the non-regulatory default option for the following:

1) parallel processing for PM_{10}, $PM_{2.5}$, and 1-hour NO_2;
2) AERMOD Version 09292 instead of AERMOD Version 11103 for modeling PM_{10} and $PM_{2.5}$; and
3) the Plume Volume Molar Ratio Method (PVMRM) method for modeling 1-hour NO_2.

The facility submitted requests for approval of the items above to EPA Region 7. The use of non-regulatory model options is described in Section 3.10 of the Ambient Air Quality Impact Assessment dated June 2011. Correspondence concerning non-regulatory model options can be reviewed in Appendix A of the Ambient Air Quality Impact Assessment dated June 2011.

V. Model Inputs

A. Source Data

The emission rates, point locations, and stack parameters for the emission sources used in the model were based on the data presented in the permit application. Facility point, area, and volume source information are described in Appendix B from the Ambient Air Quality Impact Assessment dated June 2011.

B. Urban or Rural

The area is deemed "rural" for air modeling purposes.

C. Terrain

The proposed project was modeled using the Elevated Terrain Mode. AERMAP processor was used by the applicant to process the National Elevation Data (NED) files from the USGS to interpolate elevations at each receptor. The AERMAP processor was used to process the NED files and generate source, building, and receptor heights and hill height scales as applicable.

D. Meteorological Data

Five consecutive years of meteorological data considered representative of the climatology and topography for the proposed facility location was used in the AQIA. AERMET, the meteorological data pre-processor for the AERMOD modeling system, extracts and processes data in order to calculate the boundary layer parameters that are ultimately necessary for the calculation of pollutant concentrations within the atmosphere. The surface and upper air measurements used for this analysis were for the years from 2006 to 2010. The upper air data was from the Dodge City station, WBAN# 13985 and the surface air data was from the Garden City National Weather Station (NWS), WBAN #23064. Information on these stations is shown in Table 2 below and a wind rose for the cumulative five-year period is provided in Figure 1.

Table 2. Meteorological Data Sites					
Station Type	**Station Name**	**WBAN #**	**Latitude/Longitude**	**Elevation [m]**	**Years of Data**
Surface Air Station	Garden City (GCK)	23064	37.933 / -100.733	878.4	2006-2010
Upper Air Station	Dodge City (DDC)	13985	37.767 / -99.967	787.0	2006-2010

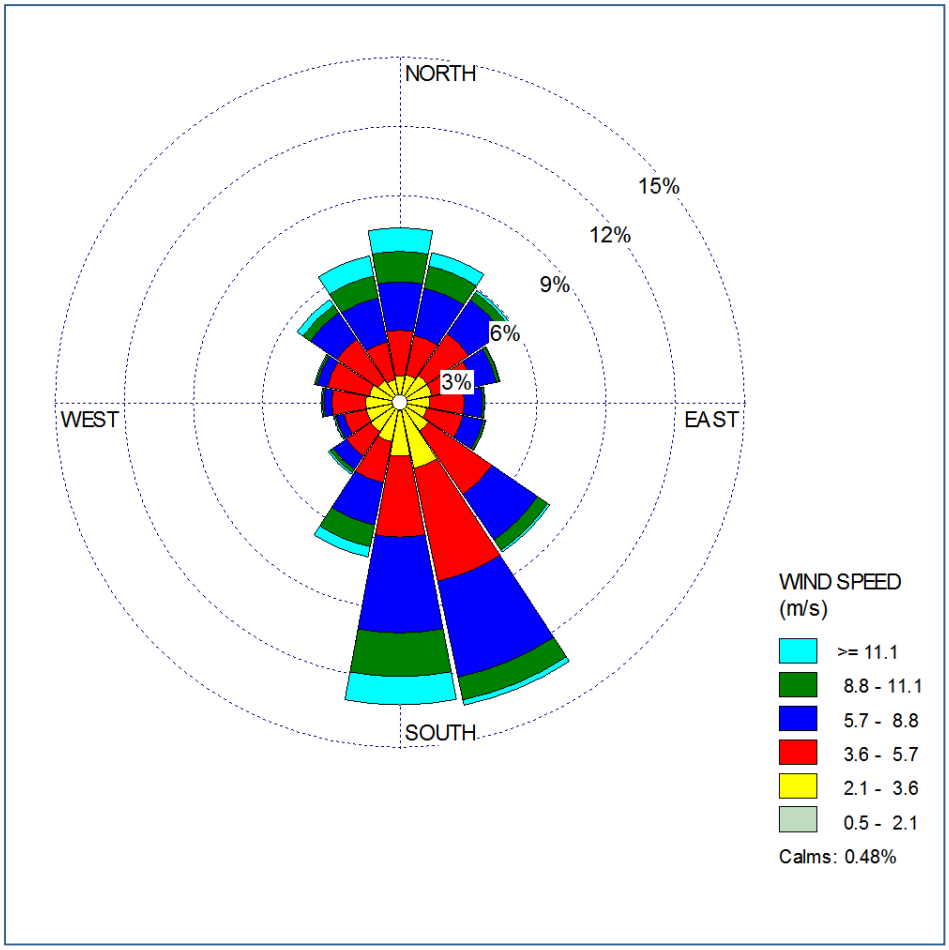

Figure 1. Wind Rose for Years 2006 to 2010

Figure 2. Map of Abengoa Bioenergy Biomass of Kansas Facility and the Garden City (GCK) and Dodge City (DDC) Meteorological Stations

The surface characteristics for use with the AERMET program were determined using AERSURFACE. Evaluation of a comparison of the surface characteristics surrounding the Garden City Airport and the ABBK site indicates that the Garden City Airport data are representative of the application site.

E. Building Downwash

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

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

  $Hg = H + 1.5L$

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

For emissions released below GEP height, it is necessary to include the potential effect of plant buildings on the dispersion of emissions. Building downwash was calculated using

the Building Profile Input Program (BPIP) with plume rise model enhancements (PRIME).

F. Receptors

AERMOD estimates ambient concentrations using a network of points, called receptors, throughout the region of interest. The model uses emissions and weather information to estimate ambient pollutant concentrations at each receptor location. Model receptors are typically placed at locations that reflect the public's exposure to the pollutant. Receptors were placed at 50 meter spacing along the proposed facility's fenceline. The minimum receptors for significant impact modeling for the proposed facility consisted of a multi-tiered grid as shown in Table 3. More dense grid spacing was used for portions.

Table 3. Receptor Spacing for Significant Impact Modeling for the Proposed Facility

Distance From Facility Boundary (meters)	Receptor Spacing (meters)
Fenceline to 200	50
200 to 2,000	100
2,000 to 5,000	250
5,000 to 10,000[1]	500
10,000 to 50,000[2]	1000

Screening modeling resulting in a significant impact for any receptors at or beyond the facility fenceline requires a full impact analysis. The screening model radius of impact (ROI) was determined by first finding the distance to the farthest receptor showing a concentration greater than the SIL. This distance is then added to 50 kilometers and the area within this radius from the center of the facility is considered to be the ROI.

[1] Used only if impact > SIL extended beyond 5 km.
[2] Used only if impact > SIL extended beyond 10 km.

VI. Significance Determination

A facility that proposes to emit any pollutant above the PSD significant emission rate thresholds must submit an ambient air quality impact analysis. In order to determine if a full impact model analysis and/or ambient air monitoring is necessary, a facility must complete a preliminary modeling analysis. The preliminary analysis includes only the proposed source or modification so it can be determined if a significant modeled impact will take place. For each pollutant that the model predicts the high first high concentration to be below the SIL threshold, no further analysis is necessary for that pollutant. The SILs and pre-application monitoring thresholds for applicable pollutants and ABBK results from the preliminary analysis are shown in Table 4.

Table 4. Significance Determination Table

Pollutant	Averaging Period	Maximum Predicted Concentration ($\mu g/m^3$)	Modeling Significant Impact Level (SIL) ($\mu g/m^3$)	Exceeds SIL?	Pre-application Monitoring Threshold Concentration ($\mu g/m^3$)	Exceeds Monitoring Threshold?
NO_2	Annual	2.33	1	Yes	14	No
	1-hour	20.49	10[3]	Yes	N/A	N/A
CO	8-hour	22.33	500	No	575	No
	1-hour	37.00	2000	No	N/A	N/A
SO_2	Annual	1.24	1	Yes	N/A	N/A
	24-hour	11.70	5	Yes	13	No
	3-hour	24.15	25	No	N/A	N/A
	1-hour	23.77	10[3]	Yes	N/A	N/A
PM_{10}	Annual (standard revoked by EPA)	7.05	1	Yes	N/A	N/A
	24-hour	32.61	5	Yes	10	Yes
$PM_{2.5}$	Annual	2.18	0.3	Yes	N/A	N/A
	24-hour	8.31	1.2	Yes	4	Yes
Ozone	N/A	N/A	N/A	N/A	>100 tpy VOC or NO_x emissions	Yes

The scenarios with maximum modeled concentrations are as follows:

- A boiler load of 471 MMBtu/hr for the 1-hour and annual NO_2 averaging periods.
- A boiler load of 471 MMBtu/hr for the for the CO 1-hour and 8-hour averaging periods.

[3] Interim SIL established by KDHE until EPA publishes a final SIL.

- A boiler load of 471 MMBtu/hr for the SO_2 1-hour, 3-hour, 24-hour and annual averaging periods.
- A boiler load of 141 MMBtu/hr with the fire water pump operational and the flare pilot on for the 24-hour PM_{10} averaging period during Scenario 4.
- A boiler load of 471 MMBtu/hr with the fire water pump operational and the flare pilot on for the annual PM_{10} averaging period during Scenario 4.
- A boiler load of 141 MMBtu/hr with the fire water pump operational and the flare pilot on for the 24-hour and annual $PM_{2.5}$ averaging periods during Scenario 4.

The modeled impacts for the proposed facility fall below the modeling SIL for the 8-hour CO, 1-hour CO, and 3-hour SO_2 averaging periods.

A full impact analysis was conducted for the annual NO_2, 1-hour NO_2, 1-hour SO_2, 24-hour SO_2, annual SO_2, annual PM_{10} (standard has been revoked), 24-hour PM_{10}, annual $PM_{2.5}$, and 24-hour $PM_{2.5}$ averaging periods. All applicable operating scenarios with maximum predicted impacts determined in the significant impact analysis, as described above, were analyzed in the full impact analysis.

Dispersion modeling for this project includes a demonstration of compliance with NAAQS published recently by the EPA. The NAAQS for 1-hour NO_2 was published on February 9, 2010, with an effective date of April 12, 2010. The NAAQS for 1-hour SO_2 was published in the Federal Register on June 22, 2010, with an effective date of August 23, 2010. With these new final rules, EPA did not issue significant impact levels, significant monitoring concentrations, increment, post processors and other implementation guidance and tools that are needed for a dispersion modeling analysis. Thus, KDHE and other permitting agencies have developed interim SILs for 1-hour NO_2 NAAQS and 1-hour SO_2 NAAQS. KDHE interim SILs will be used for the 1-hour NO_2 and 1-hour SO_2 modeling analyses until new SILs are finalized by EPA and adopted in Kansas air quality regulations.

On October 20, 2010, the EPA published new SIL values in the Federal Register for 24-hour and annual $PM_{2.5}$ NAAQS, with an effective date of December 20, 2010. The new SIL values were used in the $PM_{2.5}$ modeling analysis.

The modeled impacts for the proposed project exceed the pre-application ambient monitoring thresholds for 24-hour PM_{10}, 24-hour $PM_{2.5}$, and ozone. The ozone ambient monitoring threshold is exceeded because expected emissions of NO_x exceed 100 tons per year. As approved by KDHE, in lieu of pre-application ambient monitoring data, the facility will use representative monitoring data for these pollutants from state monitoring sites located at Cedar Bluff (Trego County) for ozone and $PM_{2.5}$, and Dodge City for PM_{10}.

VII. Refined Analysis Results

Refined 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.

KDHE supplied emission sources within the following distances from the facility to ABBK for the full impact analysis as shown in Table 5.

Table 5. Radius of Impact for SIL

Pollutant	ROI Based on H1H	Radius of Impact + 50 km
24-hour $PM_{2.5}$	5350 m	55 km
Annual $PM_{2.5}$	2350 m	52 km
24-hour PM_{10}	20,000 m [4]	70 km [5]
Annual PM_{10} (Standard has been revoked)	2250 m	52 km
1-hour NO_2	50,000 m [6]	100 km [7]
Annual NO_2	2,000 m	52 km
1-hour SO_2	50,000 m [6]	100 km [7]
24-hour SO_2	3250 m	53 km
Annual SO_2	1200 m	51 km

KDHE prepared the nearby source inventories using information available through the KDHE emission inventory database and the facility files. 40 CFR Part 51 Appendix W procedures were followed. The list of nearby sources with source parameters and emission rates can be found in Appendix D from the Ambient Air Quality Impact Assessment dated June 2011 and in Appendix B from the Updated Ambient Air Quality Impact Assessment Supplement dated August 2011.

The significant impact area plus 50 kilometers also extended into Oklahoma, Colorado, and Texas for some pollutants. The Colorado Department of Public Health and Environment, the Oklahoma Department of Environmental Quality, and the Texas Commission on Environmental Quality provided the nearby source information for those sources in their states that met the specified criteria and were located within the radius of impact plus 50 kilometers. These sources are also included in Appendix D from the Ambient Air Quality Impact Assessment dated June 2011. The nearby sources supplied by KDHE for 1-hour NO_2 was revised to include those sources within a 20 km radius from the proposed facility, as provided for in Appendix W Section

[4] Abengoa's grid extended to 20 km. KDHE modeling with a 40 km grid confirmed no SIL exceedances beyond 20 km used.
[5] Nearby sources were provided to 51 km, consistent with Appendix W Section 8.2.3.b.
[6] AERMOD is expected to be valid to 50 km.
[7] Distance reviewed for 1-hour NO_2 refined modeling analysis was based on a total of 100 km, based on collection of nearby sources to 100 km and receptors to 50 km due to limitations of AERMOD beyond 50 km.

8.2.3.b., and is included in Appendix B from the Updated Ambient Air Quality Impact Assessment Supplement dated August 2011.

ABBK used the NAAQS inventories for the increment analyses for all pollutants except for 24-hour PM_{10}. The nearby source data used is available in Appendix D from the Ambient Air Quality Impact Assessment dated June 2011. After KDHE's review it was determined that the Seaboard Foods, LLC feed mill located immediately adjacent to and south of the ABBK was not a PM_{10} increment consuming source and that it could be excluded from the increment analysis for the 24-hour PM_{10} averaging period.

Limited receptor grids were used in the refined analyses based on the SIA and/or receptors that exceeded the SIL in the SIA analysis.

The background concentrations were provided by KDHE. Background concentrations prepared by KDHE can be found in Attachment D of the Ambient Air Quality Impact Assessment dated June 2011.

Table 6 summarizes the results from the refined analysis and includes the total concentration compared to the NAAQS for each pollutant for which a refined analysis was conducted.

Table 6. NAAQS Compliance Demonstration

Pollutant	Averaging Period	Modeled Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
PM_{10}	24-hour (H6H)	31.47	89	120.47	150
	Annual (H1H)	7.55	22	29.55	50
$PM_{2.5}$	24-hour (H1H)	22.87	17	**39.87**	**35**
	Annual (H1H, 3 yr average)	2.31	7	9.31	15
NO_2	1-hour (H8H, 5 yr average)	471.54	49	**520.54**	**188.7**
	Annual (H1H)	25.95	7.5	33.45	100
SO_2	1-hour (H4H, 5 yr average)	51.23	8.9	60.13	196
	24-hour (H2H)	15.97	5.8	21.77	365
	Annual (H1H)	1.24	0.0	1.24	80

NAAQS exceedances were modeled in the 24-hour $PM_{2.5}$ compliance demonstration. The maximum predicted impact was 22.87 μg/m^3, for a total concentration of 39.87 μg/m^3 when background is included. This value exceeds the NAAQS of 35 μg/m^3. Abengoa performed a temporal and spatial contribution analysis for the 3 receptors that exceeded the NAAQS, and demonstrated that this project does not contribute significantly to any modeled NAAQS exceedance. NAAQS exceedances due to other sources will be addressed separately from this permit.

NAAQS exceedances were modeled in the 1-hour NO_2 compliance demonstration. The maximum predicted impact was 643.42 μg/m^3, for a total concentration of 692.42 μg/m^3 when background is included. This value exceeds the NAAQS of 188.7 μg/m^3. Abengoa performed a temporal and spatial contribution analysis for the more than 11,000 receptors that exceeded the NAAQS, and demonstrated that this project does not contribute significantly to any modeled NAAQS exceedance. NAAQS exceedances due to other sources will be addressed separately from this permit.

The analyses indicated that concentration levels of all pollutants resulting from the proposed project, when combined with other sources, would not cause or contribute to an exceedance of the NAAQS.

Model runs were conducted to demonstrate that the allowable increments were not exceeded for each pollutant and averaging period. The contributions from the proposed project were modeled, as well as total increment consumed by all sources that received a permit after the minor source baseline date for each applicable pollutant and averaging period.[8] The highest second high concentration was used for the short term averaging periods (1-hour, 3-hour, and 24-hour), except for 24-hour $PM_{2.5}$, which was compared to the H1H per EPA's memo by Stephen Page dated March 23, 2010. The highest first high concentrations were used for comparison with the annual averaging period. The results are summarized in Tables 7 and 8:

Table 7. ABBK Expansion Project Increment Consumption

Pollutant	Averaging Period	Modeled Concentration (μg/m^3)	Class II Increment (μg/m^3)	% of Increment
NO_2	Annual (H1H)	2.33	25	9.3
PM_{10}	Annual (H1H)	7.05	17	41.5
	24-hour (H2H)	27.45	30	91.5
$PM_{2.5}$	Annual (H1H)	2.18	4	54.5
	24-hour (H1H)	8.31	9	92.3
SO_2	Annual (H1H)	1.24	20	6.2
	24-hour (H2H)	9.75	91	10.7
	3-hour (H1H)	20.84	512	4.1

[8] In most cases, the facility conservatively used the NAAQS inventory rather than requesting a separate increment inventory.

Table 8. All Source Cumulative Increment Consumption				
Pollutant	**Averaging Period**	**Modeled Concentration ($\mu g/m^3$)**	**Class II Increment ($\mu g/m^3$)**	**% of Increment**
NO_2	Annual (H1H)	**25.95**	**25**	**103.8**
PM_{10}	Annual (H1H)	7.16	17	42.12
	24-hour (H2H)	27.52	30	91.73
$PM_{2.5}$	Annual (H1H)	2.30	4	57.50
	24-hour (H1H)	**22.87**	**9**	**254.11**
SO_2	Annual (H1H)	1.77	20	8.85
	24-hour (H2H)	15.97	91	17.55

EPA has not established a 1-hour Class II maximum allowable increment for NO_2 or SO_2. Therefore, no calculation of the potential consumption of such increment is possible.

A cumulative increment consumption analysis was not performed for 3-hour SO_2 since the modeled concentration was below the significance threshold.

Allowable increment for all sources was exceeded for annual NO_2. The maximum predicted concentration was 25.95 $\mu g/m^3$, compared to the allowable increment of 25 $\mu g/m^3$. Abengoa performed a temporal and spatial contribution analysis for the 12 receptors that exceeded the increment, and demonstrated that this project does not contribute significantly to any modeled increment exceedance. Increment exceedances due to other sources will be addressed separately from this permit.

Allowable increment for all sources was exceeded for 24-hour $PM_{2.5}$. The maximum predicted concentration was 22.87 $\mu g/m^3$, compared to the allowable increment of 9 $\mu g/m^3$. Abengoa performed a temporal and spatial contribution analysis for the 10 receptors that exceeded the increment, and demonstrated that this project does not contribute significantly to any modeled increment exceedance. Increment exceedances due to other sources will be addressed separately from this permit.

The analyses indicated that concentration levels of all pollutants resulting from the proposed project, when combined with other sources, would comply with applicable PSD Class II increments.

VIII. Visibility Impacts

The PSD regulations require the applicant to provide an analysis of impairment to visibility that will occur as a result of the source and growth associated with the source [40 CFR 52.21(o)(1)]. There are no Federal Class I areas located within 100 km of the proposed facility. The nearest Federal Class I Area is the Great Sand Dunes in southeastern Colorado, located approximately 370 km (230 miles) west of the proposed facility location. There is one potential Class II area of concern within 50 km (31 miles) to the proposed facility. The Cimarron National Grasslands is located within Morton and Stevens Counties in southwestern Kansas, approximately 24 km (15 miles) west of the proposed facility location. All sources at the proposed facility are expected to operate in compliance with applicable opacity restrictions. However, KDHE requested that a visibility analysis be performed on the Class II area, as required by 40 CFR 52.21(o)[9], to demonstrate that no significant deterioration of visibility will result from the operation of the proposed facility. In addition to the Class II area, KDHE also identified one sensitive area, Hugoton Municipal Airport, to be included in the visibility analysis.

A Class II visual impairment screening analysis was conducted on the Cimarron National Grasslands to provide a conservative indication of the perceptibility of plumes from the proposed facility. This analysis was performed in accordance with the EPA's workbook, *Workbook for Plume Visual Impact Screening and Analysis*, using the VISCREEN model. This type of visibility impairment analysis and the use of VISCREEN are typical for assessments in Federal Class I areas where visibility preservation is a factor in the permit approval process. However, since an applicable Class II visibility model is not available, this model and methodology for Class I areas as outlined in the EPA workbook were used.

The VISCREEN model is designed to determine whether a plume from a facility may be visible from a given vantage point. The primary variables that affect whether a plume is visible or not at a certain location are the quantity of emissions, the types of emissions, the relative location of the emission source and the observer, and the background visibility range.

The Level 2 VISCREEN analysis results indicated no expected adverse impacts at Cimarron National Grasslands. The level 2 analysis indicated potential impacts for Hugoton Municipal Airport. Therefore, a sun angle analysis was performed for Hugoton Municipal Airport. The results of the sun angle analysis indicated minimal visibility impacts at Hugoton Municipal Airport. No criteria have been established for Class II areas.

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[9] See also the New Source Review Workshop Manual, DRAFT 1990, p.D-5, Section II.D.

IX. Conclusions

The results of the modeling analysis are summarized in the Ambient Air Quality Impact Assessment dated June 2011 and the Updated Ambient Air Quality Impact Assessment Supplement dated August 2011. Evaluation of the facility potential emissions indicated that emissions of NO_2, SO_2, CO, $PM_{2.5}$, and PM_{10} are expected. The AQIA does not evaluate VOCs as there is currently no EPA approved methodology for evaluating the 8-hour ozone standard.

The AERMOD Modeling System was used to determine predicted ground level concentrations.

The results of the initial significant impact modeling indicated that refined modeling was required for 1-hour SO_2, 24-hour SO_2, annual SO_2, 1-hour NO_2, annual NO_2, 24-hour PM_{10}, annual PM_{10}, 24-hour $PM_{2.5}$, and annual $PM_{2.5}$.

The analyses indicated that concentration levels of all pollutants resulting from the proposed project, when combined with other sources, would not significantly cause or contribute to an exceedance of the NAAQS.

The analyses indicated that concentration levels of all pollutants resulting from the proposed project, when combined with other increment consuming sources, would comply with PSD Class II increments.

The analyses indicated that visibility impacts were within allowable criteria.