PREVENTION OF SIGNIFICANT DETERIORATION (PSD)

PERMIT SUMMARY SHEET

Permit No.: 1730309 C-13362

Source Name: Spirit AeroSystems, Inc.

Source Location: 3801 South Oliver Street
Wichita, Sedgwick County, Kansas 67210

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. Sedgwick County, Kansas, where this construction is taking place, is in attainment for all the criteria pollutants.

II. Project Description

Spirit AeroSystems, Inc. (Spirit) operates an aerospace parts and assemblies manufacturing facility located at and around the intersection of South Oliver Street and East MacArthur Road in Wichita, Kansas. Spirit is proposing to expand the production rate of its 737 production line from 31 to 57 airplane fuselages per month (APM).

Spirit was issued a permit (C-9905) on February 22, 2012 to construct an expansion of the 737 production line from 31 to 42 APM via a debottlenecking of the assembled fuselage paint booth, CAMO I Paint Area (EU-2309K-P1). This debottlenecking was accomplished through the construction and operation of a separate paint booth handling that do the same work as CAMO I Paint Area, identified as the North Plant 2 Booth (EU-2297F-B7) along with other assembly and fabrication emission units.

Spirit was then issued subsequent updated version of this permit (C-10497) on September 10, 2012 when the design of the expansion required installation of new sludge dryers to handle waste from the tank line. A second permit revision (C-10691) was issued on November 19, 2012 when a second regenerative thermal oxidizer (RTO) for the CAMO I Paint Area was installed. The third permit revision (C-11237) was issued on May 17, 2013 when an additional carbon adsorption system for emission control of the chemical milling maskant spray booth was needed.

At the time of issuance for this permit and subsequent updates, Spirit was considering plans to expand the 737 fuselage production further. Since this further expansion was not an economic reality at the time of the 31 to 42 APM expansion and no specific design plans were completed, Spirit could not permit this further expansion.

Spirit is now planning to produce 737 fuselages at a further expanded rate of 57 APM. Since plans for this further expansion were documented in 2012 but not finalized or acted upon until now, Spirit is permitting this expansion from current fuselage production rate of 42 to 57 APM in combination with the originally permitted expansion of 31 to 42 APM. This makes the effective 737 fuselage rate increase for this Prevention of Significant Deterioration permit from 31 to 57 APM (the Project).

The modifications Spirit made to increase their 737 airplane fuselage production from 31 to 42 APM are accounted for in the May 17, 2013 construction permit (C-11237) and include two (2) regenerative thermal oxidizers (RTOs) to control volatile organic compound (VOC) emissions from the existing CAMO I booth (EU-2309K-P1) and one (1) RTO to control VOC emissions from a new North Plant 2 Booth (EU-2297F-B7). Other equipment installed as part of the original expansion (from 31 to 42 APM) includes 2 chord trimmers, an extrusion mill, two hi-speed mills, a 6-axis mill, a trim and drill machine, a cooling tower, two sludge dryers, and an additional carbon adsorption system (CAS) in parallel with the existing CAS to the Manufacturing Process Facility (MPF) Spray Maskant Operation.

In addition to the existing emission units, Spirit is proposing to install and operate an additional trim and drill machine, a new robotic drill, a clean-up sanding booth, and a combination spray booth/oven (Spoven) to reach the targeted 57 APM for the Project. The last modification Spirit proposes for the Project is a material substitution for the current primer used in the CAMO I Paint Area (EU-2309K-P1) and the North Plant 2 Booth (EU-2297F-B7). The current primer is designated BMS 10-11 Type 1 Grade E. The substitute primer formulation is designated BMS 10-11 Type 1 Grade A. This operation change will result in increased volatile organic compound (VOC) and certain hazardous air pollutant (HAP) emissions.

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 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 (PSD) 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. 28-19-750. Maximum Achievable Control Technology, which adopts by reference 40 CFR Part 63, National Emission Standards for Hazardous Air Pollutants. The facility is subject to 40 CFR Part 63 Subpart GG, *National Emissions Standards for Aerospace Manufacturing and Rework Facilities*. The two natural gas-fired sludge dryers and the oven of the Spoven are subject to 40 Part 63, Subpart DDDDD, *National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters*.

IV. Air Emissions from the Project:

Emissions of volatile organic compounds (VOCs), particulate matter (PM), PM with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}), PM with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$), oxides of nitrogen (NO_X), sulfur dioxide (SO_2), carbon monoxide (CO), lead, greenhouse gases (GHGs) as carbon dioxide equivalent (CO_2e), and hazardous air pollutants (HAPs) from the Project were evaluated.

The Project constitutes a major modification under 40 CFR 52.21, which is adopted by reference in K.A.R. 28-19-350, because it results in a PSD significant emission rate of 40 tons per year of VOC. Emissions of PM, PM_{10}, $PM_{2.5}$, NO_X, SO_2, CO, lead, and GHGs were below the PSD significant emission rates.

The estimated emission for each air pollutant from the Project is listed in Table 1 of the permit application and in the electronic copy of the Excel file “Spirit 737 Expansion Booth and RTO Calcs 57APM FINAL.xlsx” submitted to the Kansas Department of Health and Environment (KDHE) on March 24, 2016. The latest revision was submitted to KDHE via email as Excel file “Spirit 737 Expansion Booth and RTO Calcs 57APM VOC Spec (rev7.6.16).xlsx” on July 6, 2016.

Table 1. Estimated Emissions from The Project.

Pollutant	The Project	Facility-Wide	
	Total Emission Increase (tons per year)	Contemporaneous Emission Change (tons per year)	Net Emission Change (tons per year)
VOC[1]	97.14	11.37	108.50
PM	20.94		20.94
PM_{10}	12.98		12.98
$PM_{2.5}$	9.02		9.02
NO_X	20.51		20.51
SO_2	0.07		0.07
CO	9.26		9.26
Lead	5.51×10^{-5}		5.51×10^{-5}
Total HAPs	87.78		87.78
Individual Hazardous Air Pollutants (HAPs)[2]			
-Perchloethylene	58.77		58.77
-Toluene	21.06		21.06
-Xylene	3.83		3.83
Carbon Dioxide Equivalent (CO_2e) Greenhouse Gases (GHG)[3]:	14,652.70		14,652.70
-Carbon Dioxide (CO_2)	14,625.35		14,625.35
-Methane (CH_4)	6.34		6.34
-Nitrous Oxide (N_2O)	21.02		21.02

[1] VOC emissions for the Project exceed the 40 tons per year significance threshold. Therefore pursuant to 40 CFR 52.21, the Project is also significant for O_3. Since VOC is one of the surrogates for O_3, BACT for VOC will be considered BACT for O_3.

[2] Only the three individual HAPs with the largest PTE have been listed, which account for 95% of total HAPs. For detailed HAPs PTE estimates, which include all HAPs, refer to the permit application attachment, Excel file "Spirit 737 Expansion Booth and RTO Calcs 57APM FINAL.xlsx", submitted on March 24, 2016; and revised as Excel file "Spirit 737 Expansion Booth and RTO Calcs 57APM VOC Spec (rev7.6.16).xlsx", submitted on July 6, 2016.

[3] Greenhouse gas emissions are converted to CO_2-based equivalent emissions.

Emissions of PM, PM_{10}, and $PM_{2.5}$ from the Fabrication and Assembly sources were submitted to KDHE via email as Excel file "Spirit 737 Expansion Fab and Assembly Calcs 57APM.xlsx" on April 12, 2016. The latest revision was submitted to KDHE via email as Excel file "Spirit 737 Expansion Fab and Assembly Calcs 57APM r3 (sent 5.13.2016).xlsx" on May 13, 2016. Emissions of PM, PM_{10}, and $PM_{2.5}$ from the Project were below the PSD significant emission rates based from Emission Netting calculations.

Emissions of PM, PM_{10}, and $PM_{2.5}$, SO_2, CO, NO_X, VOC, and CO_2e from the two natural gas-fired sludge dryers were submitted to KDHE via email as Excel file "Spirit Sludge Dryers Emissions Calcs.xlsx" on June 30, 2016. The latest revision was submitted to KDHE via email as Excel file "Spirit Sludge Dryers Emissions Calcs (rev7.6.16).xlsx" on July 6, 2016.

SO_2 emissions are based on the sulfur content of pipeline quality natural gas[4]. GHG emissions are based on vendor data for CO_2, methane, and nitrous oxide and were calculated using 40 CFR Part 98 (EPA Mandatory Greenhouse Gas Reporting Rule) emission factors, the appropriate CO_2 equivalency ratio applied, and summed to obtain total GHGs, or CO_2e. Emissions for other pollutants are based on AP-42 emission factors and vendor data.

VOC emissions for the Project exceed the significance threshold under K.A.R. 28-19-350. Therefore pursuant to 40 CFR 52.21, the Project is also significant for ozone (O_3). Since VOCs are surrogates for O_3, BACT for 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 impact analysis, and additional impact analysis upon soils, vegetation, and visibility.

V. <u>Air Emission Unit Technical Specifications</u>

Table 2 showed the corresponding control device for each emission unit, the pollutant being controlled, and the control and capture efficiency of individual control device. It also listed which emission units or control devices are new or existing, and which are BACT add-on control devices. BACT is only applied to VOC emission units that are new or existing and undergo physical or operational change (modified) resulting in increased emissions such as the North Plant 2 Booth, sludge dryers, and the combination spray

[4] Pipeline quality natural gas means a naturally occurring fluid mixture of hydrocarbons (e.g., methane, ethane, or propane) produced in geological formations beneath the Earth's surface that maintains a gaseous state at standard atmospheric temperature and pressure under ordinary conditions and which is provided by a supplier through a pipeline. Pipeline quality natural gas must either be composed of at least 70 percent methane by volume or have a gross calorific value between 950 and 1,100 Btu per standard cubic foot. The H_2S content shall be less than 4 ppm per 100 cubic feet of gas.

Table 2. Air Emission Units and Control Devices Technical Specifications.

Emission Unit	Emission Unit ID	Control Device	Control Device ID	New or Existing?	BACT?	Pollutant Controlled	Control and Capture Efficiency
CAMO I Paint Area	EU-2309K-P1	Regenerative Thermal Oxidizer	CE-2309K-P1FN	Existing	No	VOC	99%
CAMO I Paint Area	EU-2309K-P1	Regenerative Thermal Oxidizer	CE-2309K-P1FS	Existing	No	VOC	99%
CAMO I Paint Area	EU-2309K-P1	Fabric Filters	CE-FILTER3	Existing	No	PM & IHAPs[5]	96.90%
North Plant 2 Booth	EU-2297F-B7	Regenerative Thermal Oxidizer	CE-2297F-B7F	Existing (Modified)	Yes – ECEs[6] only	VOC BACT	48.9%
North Plant 2 Booth	EU-2297F-B7	Fabric Filters	CE-2297F-B7	Existing (Modified)	No	PM & IHAPs	96.90%
Chord Trimmer	EU-3193G-PM31	Cyclone/Filter Unit	CE-3193G-PM31	Existing	No	PM	99%
Chord Trimmer	EU-3193G-PM32	Cyclone/Filter Unit	CE-3193G-PM32	Existing	No	PM	99%
Modig WZY Model Extrusion Mill	EU-3193G-PM33	Fabric Filter	CE-3193G-PM33	Existing	No	PM	99%
Makino A7 MAG7 Model High Speed Mill	EU-2280J-PM49	Cyclone/Filter Unit	CE-2280J-PM49	Existing	No	PM	99%
Makino A7 MAG7 Model High Speed Mill	EU-2280J-PM50	Cyclone/Filter Unit	CE-2280J-PM50	Existing	No	PM	99%

[5] Inorganic Hazardous Air Pollutants (IHAPs)

[6] Emission Control Enclosures or ECEs

Emission Unit	Emission Unit ID	Control Device	Control Device ID	New or Existing?	BACT?	Pollutant Controlled	Control and Capture Efficiency
Mazak Vortex 6-axis Mill	EU-2280J-PM51	Cyclone/Filter Unit	CE-2280J-PM51	Existing	No	PM	99%
Trim and Drill Machine with 40-foot T-slot/40-foot Pogo	EU-2280J-PM52	Fabric Filter	CE-2280J-PM52	Existing	No	PM	99%
MPF Spray Maskant Operation	EU-2278M-MSK	Regenerative Carbon Adsorption System	CE-CARBON2	Existing	No	Perchloroethylene	95%
Trim and Drill machine with 40-foot T-slot/40-foot Pogo	EU-2280J-PM53	Fabric Filter	CE-2280J-PM53	New	No	PM	99%
Robotic Drill	IA-3187S-PM22	None	None	New	No	None	None
Clean-up Sanding Booth	IA-3187S-PM23	Fabric Filter	CE-3187S-PM23	New	No	PM	99%
Sludge Dryers	EU-55028-PM4 EU-55028-PM5	None	None	New	Yes	VOC BACT[7]	None
Combination of Spray Booth and Oven (IPB4 Spoven)	EU-3187S-B4	Fabric Filter	CE-3187S-B4	New	Yes – VOC only	PM & IHAPs VOC BACT[8]	None

[7] VOC BACT is compliance with 40 CFR Part 63 Subpart DDDDD, pipeline quality natural gas and good combustion practices.

8 VOC BACT is compliance with 40 CFR Part 63 Subpart GG, pipeline quality natural gas and good combustion practices.

booth/oven (IPB4 Spoven). Other control devices were not included as BACT because they were for emission units that have been debottlenecked. BACT was not applied to PM emissions because PM emissions for the Project did not exceed the PSD significant emission rate.

VI. Best Available Control Technology (BACT)

BACT requirements apply to each individual new or modified affected emissions unit and pollutant emitting activity at which a new emissions increase would occur[9]. 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 VOC for the North Plant 2 Booth, the IPB4 Spoven booth and oven, and the two natural gas-fired sludge dryers is presented in **Attachment B**.

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

A. BACT emissions of pollutants from the North Plant 2 Booth (EU-2297F-B7) shall be no greater than limitations specified below. 40 CFR Part 63 Subpart GG requirements are included in a separate section of the PSD permit.

   1. BACT emissions of VOCs shall not exceed 2.15 lb/hour (6.01 ppm) and shall apply at all times, including startup and shutdown (1-hour averaging period) for Operation 2 (interior coating of fuselage) that uses Emission Control Enclosures (ECEs) and regenerative thermal oxidizer (RTO) in the North Plant 2 Booth. The RTO for the ECEs is sized for a 25,000 scfm exhaust flow.

   2. The BACT for VOC for Operation 2 in the North Plant 2 Booth shall be the use of ECEs with an RTO and compliance with 40 CFR Part 63 Subpart GG.

   3. The BACT for VOC for Operation 1 (exterior coating of fuselage) in the North Plant 2 Booth shall be compliance with 40 CFR Part 63 Subpart GG.

[9] U.S. EPA. 1990. New Source Review Workshop Manual: Prevention of Significant Deterioration and Nonattainment Area Permitting. *https://www.epa.gov/sites/production/files/2015-07/documents/1990wman.pdf*.

B. BACT emissions of pollutants from the IPB4 Spoven *booth* (EU-3187S-B4) shall be no greater than limitations specified below. 40 CFR Part 63 Subpart GG requirements are included in a separate section of the PSD permit.

1. BACT emissions of VOCs shall not exceed 1.34 lb/hour (2.34 ppm) and shall apply at all times, including startup and shutdown (1-hour averaging period).

2. The BACT for VOC shall be the compliance with 40 CFR Part 63 Subpart GG.

C. BACT emissions of pollutants from the IPB4 Spoven *oven* (EU-3187S-B4) shall be no greater than limitations specified below. 40 CFR Part 63 Subpart DDDDD requirements are included in a separate section of the PSD permit.

1. BACT emissions of VOC shall not exceed 0.0054 lb/MMBtu (5.5 lb/MMscf) and shall apply at all times, including startup and shutdown.

2. The BACT for VOC shall be the use of pipeline quality natural gas and good combustion practices.

D. BACT emissions of pollutants from any natural gas-fired sludge dryer (EU-55028-PM4 or EU-55028-PM5) shall be no greater than limitations specified below. 40 CFR Part 63 Subpart DDDDD requirements are included in a separate section of the PSD permit.

1. BACT emissions of VOC shall not exceed 0.0054 lb/MMBtu (5.5 lb/MMscf) and shall apply at all times, including startup and shutdown.

2. The BACT for VOC shall be the use of pipeline quality natural gas and good combustion practices.

E. The North Plant 2 Booth shall be limited to 7,104 hours of operation per year, which equate to VOC emissions of 24.48 tons per year.

F. The IPB4 Spoven booth and oven shall be limited to 4,000 hours of operation per year, which equate to a total VOC emissions of 2.74 tons per year (2.68 tpy for the booth and 0.06 tpy for the oven).

VII. Ambient Air Impact Analysis

The owner or operator of a proposed source (new source or modification of a source), must demonstrate that the allowable emission increases from the proposed source, in conjunction with all other applicable emissions increases or reductions, would not cause or contribute to a violation of any national ambient air quality standard (NAAQS) or any applicable maximum allowable increase (increment) over the baseline concentration in any area.

A. Ozone NAAQS Analysis

Spirit AeroSystems, Inc. (Spirit) is proposing an expansion of their 737 production line from 42 airplane fuselages per month (APM) to 57 APM. Spirit has no existing PSD permit, however, the facility is currently considered a major source for PSD because the actual VOC emissions are greater than 250 tons per year based on 2015 emissions inventory. Since the proposed expansion project has a significant emission rate (SER) of more than 40 tons per year (tpy) of VOC, Spirit must demonstrate that the proposed increase in VOC (a precursor of ozone) will not cause or contribute to an exceedance of the current 70 ppb ozone NAAQS. EPA has not established a Class II maximum allowable increment for VOC or ozone, therefore, no calculation of the potential consumption of such increment is possible.

Ground level ozone (or ozone, also referred to as tropospheric ozone) is mainly produced close to the ground where people live. Ozone is an air pollutant that can cause lung damage in healthy people and can have severe effects on sensitive groups like children, elderly and people with respiratory diseases, like asthma and emphysema. The ozone standard is designed to protect the most sensitive groups in our population.

Ozone is not directly emitted but is formed from the photochemical interactions of VOCs and NO_X. Equation 1 below is a simplified equation of ozone formation.

$$NO_X + VOCs + Heat + Sunlight = Ozone \qquad \textbf{(Equation 1)}$$

Ozone is formed when NO_X and VOCs from sources such as vehicle exhaust, paint, solvents, gasoline vapors and industrial processes react with heat and sunlight. Ozone is formed only during daylight hours under appropriate weather conditions. Thus, ozone concentrations vary depending on different factors such as time of the day and location.

KDHE reviewed five (5) different approaches to determine if the 8-hour ozone NAAQS of 70 ppb will not be exceeded by the emissions from the proposed Spirit 737 expansion project. These approaches include the following:

1. Determining the current strategies and programs related to ozone precursors reduction in the area
2. The 5-year trend of 4th highest 8-hour ozone readings at three (3) ozone monitors located in the area
3. The contribution of different sources (onroad, non-road, non-point, and point) of the main ozone precursors and comparison of Spirit's net VOC and NO_X emissions to the overall VOC and NO_X emissions inventory in the Wichita MSA
4. Determining if the project is located in a NO_X-limited or a VOC-limited area.
5. Determining the types of VOCs (VOC speciation) and the reactivity of each type from selected presentative stacks and use this information as a screening tool using AERMOD

1. <u>Current strategies and programs</u>

Spirit is located in Sedgwick County, which is part of the Wichita Metropolitan Statistical Area (MSA). The Wichita MSA includes Butler, Harvey, Sedgwick, and Sumner Counties (Figure 1).

The Wichita MSA is taking proactive steps to avoid exceeding the 8-hour ozone NAAQS by participating in the voluntary EPA program called Ozone Advance Program. Since ozone standard is expected to be reevaluated and change again in the next coming years, it is a good strategy to have collaborative efforts from all sectors of the community.

The Wichita MSA Program is called Ozone Advance Path Forward, which is a collaborative effort between EPA, KDHE and Wichita MSA to encourage expeditious reductions in ozone levels in order to ensure protection of human health and to remain in attainment designation with regard to the ozone standards. The Ozone Advanced Path Forward lists strategies and first steps in an effort to reduce ozone-forming emissions for the health and quality of life of residents in the Wichita MSA. The City of Wichita has designated the Air Quality Improvement Task Force (AQITF) to lead the creation and implementation of the Path Forward Program.

For more details about the Ozone Advance Path Forward, please go to: *https://www.wichita.gov/Government/Departments/PWU/EnvironmentDocuments/Wichita%20MSA%20Ozone%20Advance%20Path%20Forward,%204-24-14.pdf*

https://www.wichita.gov/Government/Departments/PWU/EnvironmentDocuments/COW%20Ozone%20Action%20Plan,%209-25-14.pdf

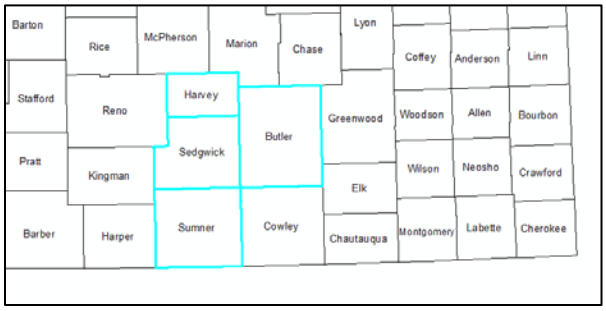

Figure 1. The Wichita MSA consists of Butler, Harvey, Sedgwick, and Sumner Counties.

2. <u>5-year trend of the 8-hour ozone readings</u>

The purpose of this assessment is to determine if ozone readings at the monitoring stations in Wichita MSA are decreasing or not. This is valuable data that will be used in the permitting review of the proposed expansion project.

Ozone is being monitored at three locations in the Wichita MSA, namely Peck Station at the Sedgwick and Sumner County line; Wichita Health Department Station in central Wichita; and Sedgwick Station in northwest Sedgwick County (Figure 2).

The 4th highest 8-hour ozone readings from the three stations from 2011 to 2015 were plotted to determine the 5-year ozone trend. Figure 3 shows that there is a decreasing ozone trend. The 3-year average of the 4th highest 8-hour ozone is shown in Table 3 and is currently below the 70 ppb 8-hour ozone standards.

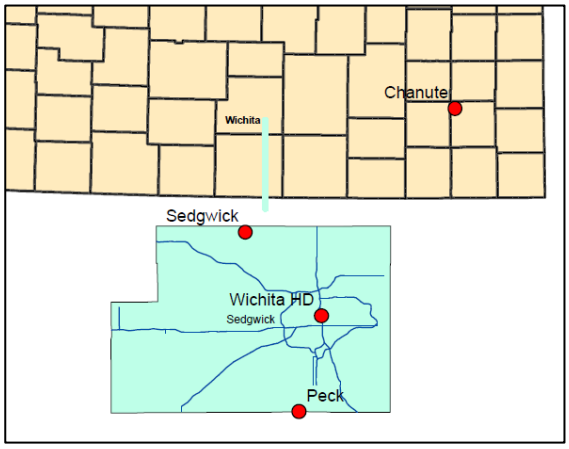

Figure 2. Ozone monitoring stations in the Wichita MSA: Peck, Wichita Health Department and Sedgwick stations.

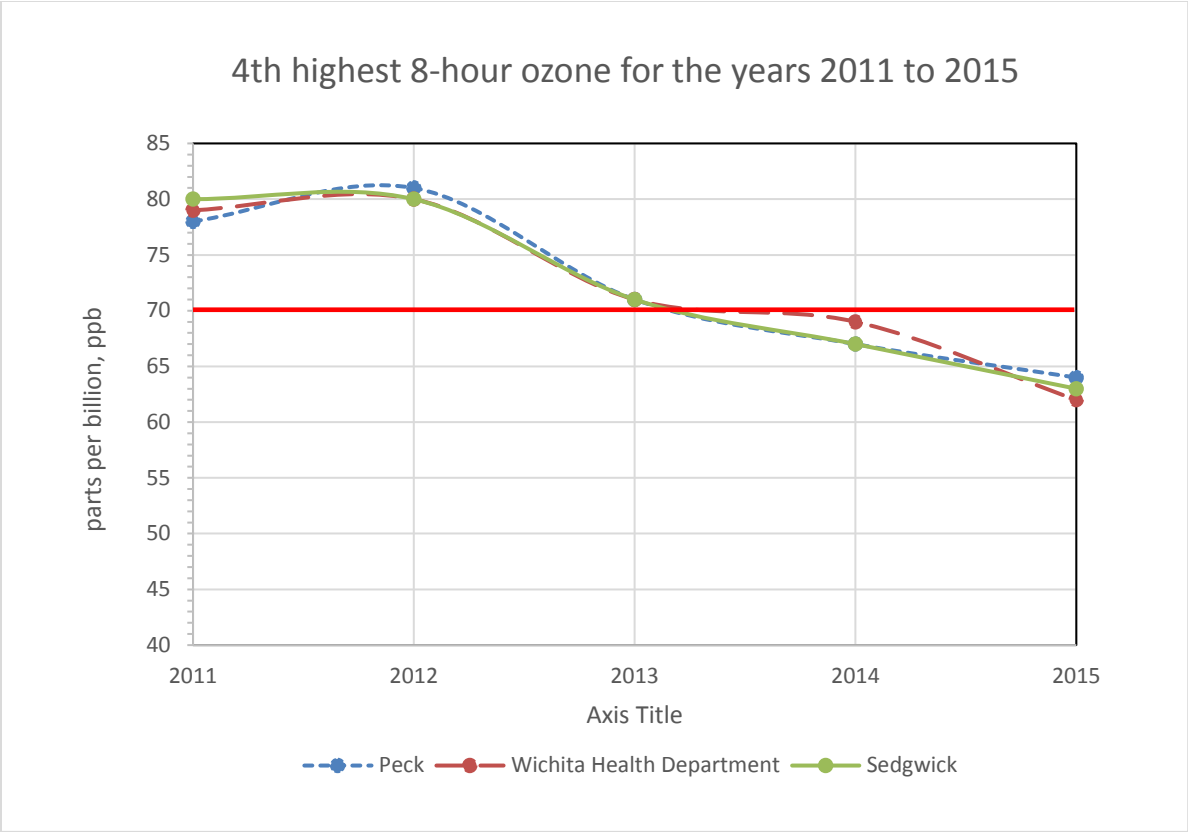

Figure 3. The 4th highest 8-hour ozone readings from three ozone monitoring stations from 2011 to 2015.

Table 3. The 3-year average of the 4th highest 8-hour ozone is currently below the 70 ppb 8-hour ozone standards.

Ozone Monitors in Wichita MSA	ppb, 2013	ppb, 2014	ppb, 2015	3-year average of the 4th highest 8-hour ozone reading, ppb
Peck	71	67	64	67
Wichita Health Department	71	69	62	67
Sedgwick	71	67	63	67

3. <u>Contribution of different sources (onroad, non-road, non-point, point) to ozone's main precursors (NO_X and VOCs) and comparison of Spirit's net VOC emissions to the overall VOC emissions inventory in the Wichita MSA</u>

Volatile organic compounds (VOCs) and nitrogen oxides (NO_X) are two major precursors of ground ozone formation. The contribution of different sources of the VOC and NO_X emissions were reviewed. The emissions data were obtained from EPA's National Emissions Inventory (NEI) (prepared every three years by EPA). Figures 4 and 5 show pie charts of VOC and NO_X NEI, respectively, for the years 2005, 2008 and 2011. Figures 6 and 7 show bar charts of VOC and NO_X NEI, respectively, for the years 2005, 2008 and 2011.

The following are the description of each source categories used in the graphs.

Onroad Mobile Sources: include motorized vehicles that are normally operated on public roadways for transportation of passengers or freight. This includes passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks and buses.

Nonroad Mobile Sources: include aircraft, locomotives and other nonroad engines and equipment such as lawn and garden equipment, construction equipment, engines used in recreational activities and portable industrial, commercial and agricultural engines.

Nonpoint Sources: include any stationary sources not required to have emission permits. The term refers to smaller and more diffuse sources within a relatively small geographic area.

Point Sources: include large, stationary emissions sources that can be located on a map.

Figures 4 and 6 show that for VOC emissions, nonpoint source category is the highest contributor ranging from 55% (2005) to 77% (2011). The lowest contributor to VOC emissions is the point source category with emissions ranging from 6% (2011) to 10% (2005). Figures 5 and 7 show that for NO_X emissions, onroad mobile source category is the highest contributor ranging from 35% (2005) to 47% (2008). The lowest contributor to NO_X emissions is the point source category with emissions ranging from 11% (2008) to 18% (2005).

Spirit's net VOC emissions increase for the proposed project is 108.50 tons per year. This change is about 3% of the 2011 point source category VOC emissions (3,556 tons); and only about 0.2% of the 2011 all source category VOC emissions (62,021 tons). NO_X emissions increase from this project are below the SER and are not subject to PSD permitting requirements. If we assume ozone concentration is proportional to VOC emissions only (this is conservative), then 0.2% increase in total VOC emissions would also increase ozone by 0.2%, with a design value of (67 ppb)(1.002) = 67.13 ppb, which is still below the 70 ppb 8-hour ozone standard.

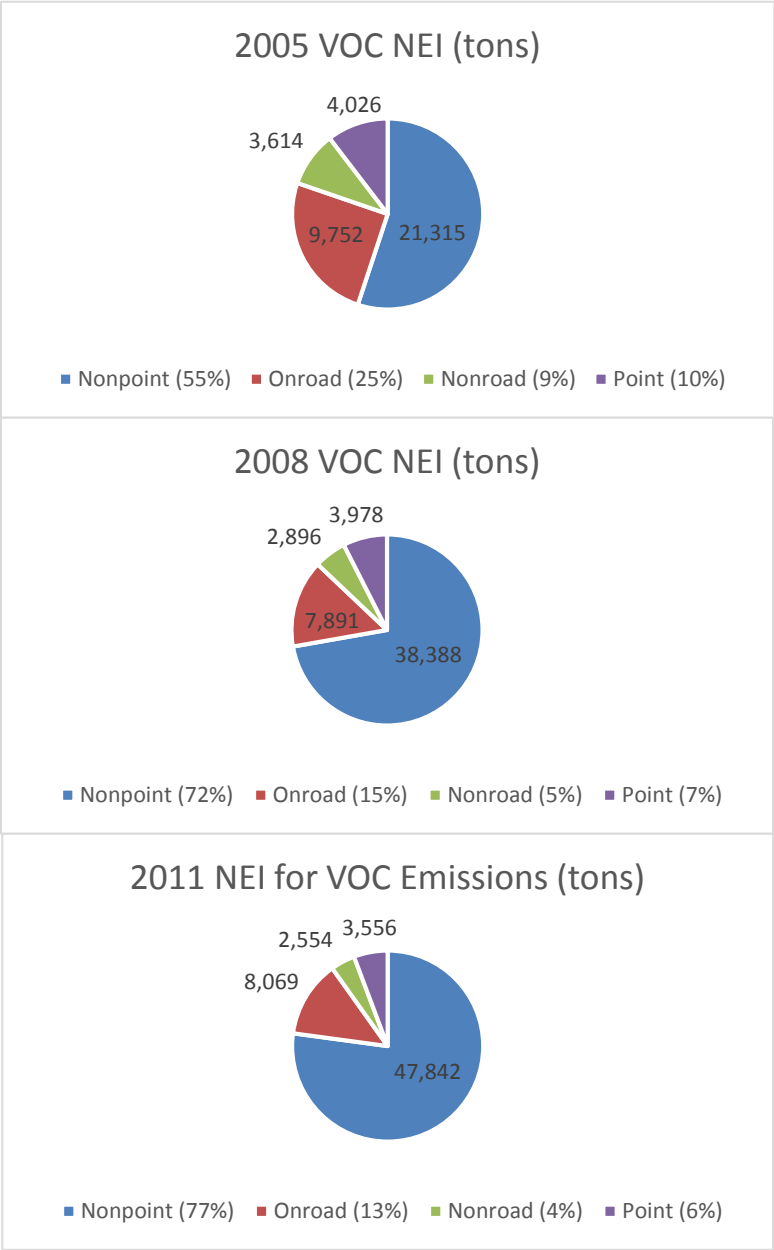

Figure 4. VOC NEI for the years 2005, 2008 and 2011.

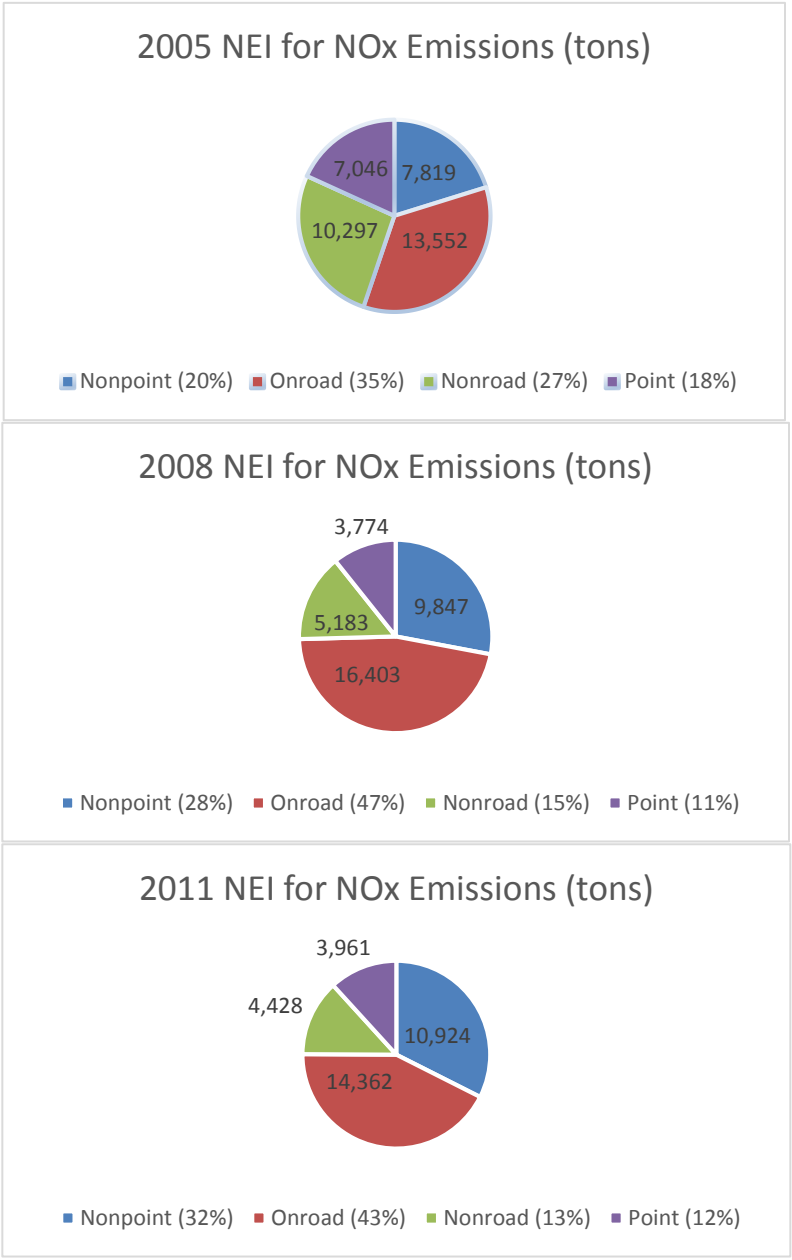

Figure 5. NO_X NEI for the years 2005, 2008 and 2011.

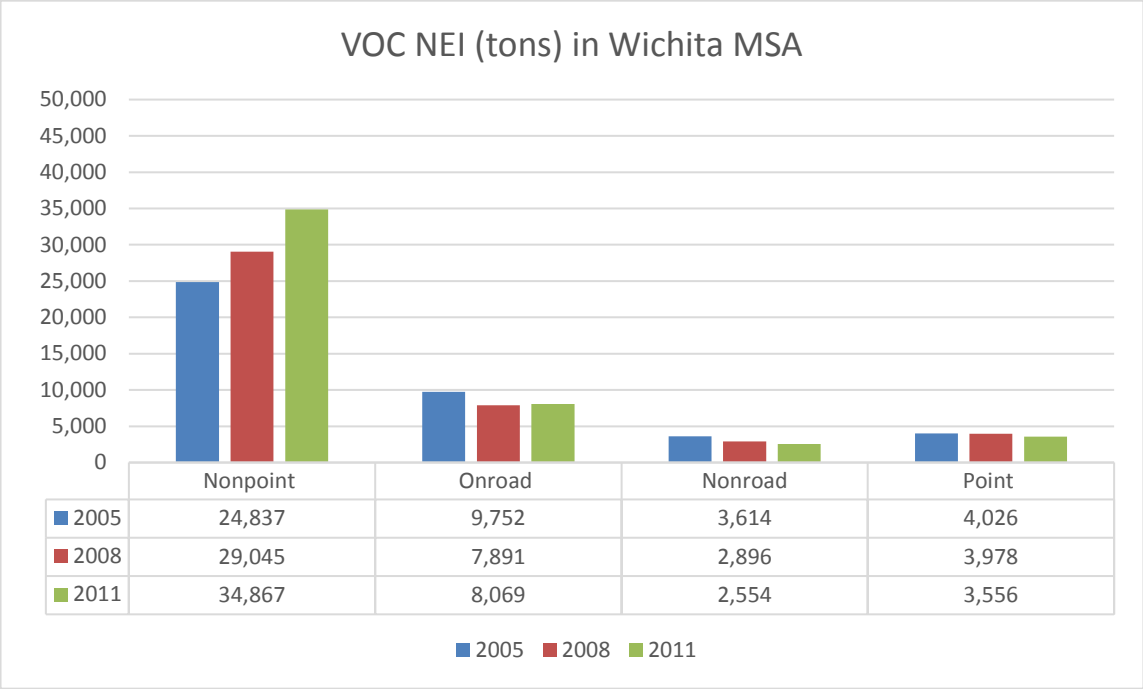

Figure 6. VOC NEI for the years 2005, 2008 and 2011.

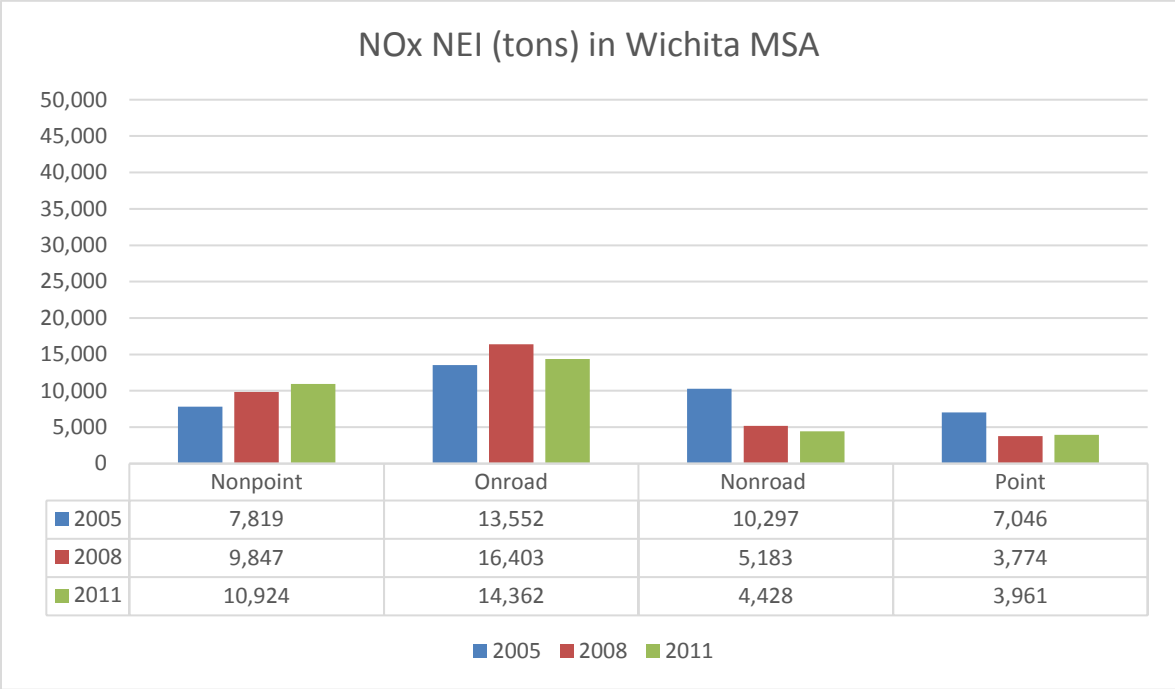

Figure 7. NO_X NEI for the years 2005, 2008 and 2011.

4. <u>Determination if the Project Area is NO_X Limited and VOC Limited:</u>

The rate of ozone production can be limited by either VOCs or NO_X. In general, a VOC to NO_X ratio of 8 to 1 is often cited as an approximate decision point for determining the relative benefits of NO_X versus VOC controls (Figure 8). At low VOC to NO_X ratios (< 4 to 1), an area is considered to be VOC-limited and VOC reductions will be most effective in reducing ozone. At high VOC to NO_X ratios (> 15 to 1), an area is considered NO_X limited, and VOC controls may be ineffective. When VOC to NO_X ratios are at intermediate levels (4 to 15), a combination of VOC and NO_X reductions may be warranted (Source: TCEQ-APDG 6232v2, Draft 06/2014, Air Quality Guidelines, Appendix Q – Conducting an Ambient Ozone Impact Analysis).

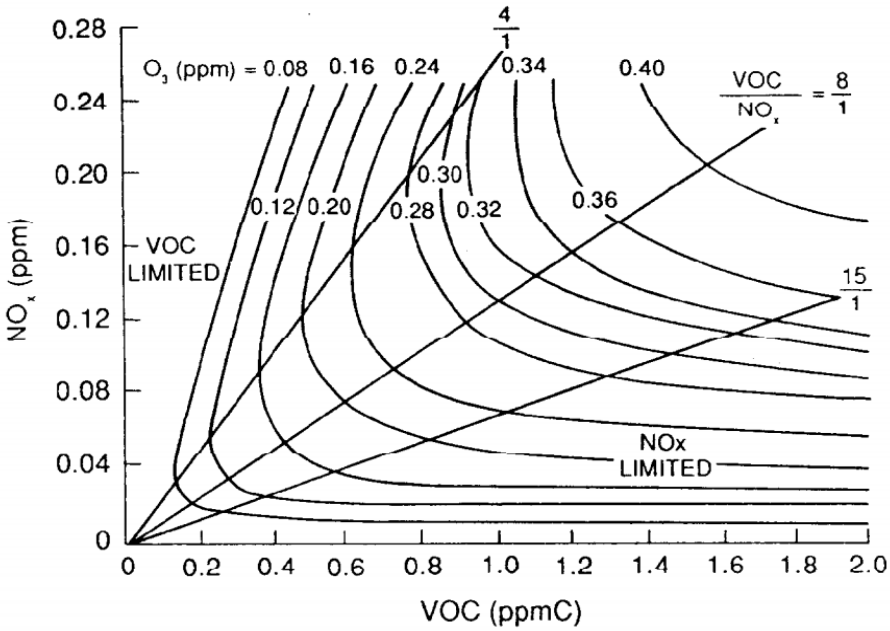

Figure 8. Isopleths developed from EPA's Empirical Kinetic Modeling Approach (EKMA) to illustrate VOC/NO_X ratios (NRC, 1991). (Source: EPA-454/R-96-006, Chapter 4, November 1996).

The VOC-to-NO_X ratios were calculated based on Texas Commission on Environmental Quality guidelines (TCEQ-APDG 6232v2, Draft 06/2014, Air Quality Guidelines, Appendix Q – Conducting an Ambient Ozone Impact Analysis). The total VOC and NO_X emissions in tpy used in the VOC-to-NO_X ratio calculations included all sectors (nonpoint, onroad, nonroad and point sources) in Sedgwick County for the year 2011. Table 4 shows the estimated VOC-to-NO_X ratio of the project county and the project site. This is only an estimate of the VOC-to-NO_X ratio.

Table 4. Estimated VOC-to-NO_X ratio of the project county and the project site.

Location	VOC-to-NO_X ratio	Determination	Emissions reductions/controls
Project County (Sedgwick)	4:1	Intermediate levels (4 to 15)	Combination of VOC and NO_X reductions may be warranted
Project Site (SpiritAerosystems)	16:1	NO_X-limited	VOC controls may be ineffective

5. <u>Determining the VOC speciation and reactivity from selected stacks and use it as input in the screening modeling using AERMOD</u>

It has been recognized that different types of VOCs emitted into the atmosphere react at different rates to form ozone; some are highly reactive, while others are not so reactive. Thus, the VOC speciation and reactivity analysis was considered in the evaluation process of the proposed 737 expansion project.

VOCs from stacks representing the new and the modified emission sources of the proposed 737 project were considered. The VOC speciation was done by the facility by identifying different types of VOCs emitted from the representative stacks. The emission rate (g/hr) of each type of VOC was determined. The reactivity factors (RF) (g ozone/g VOC) available in EPA's 40 CFR Part 59 National Volatile Organic Compound Emission Standards for Aerosol Coatings (March 9, 2012) were used to estimate the amount of virtual ozone being emitted at each representative stack (see Equation 2 below). Table 5 shows the estimated total virtual ozone emissions for each stack. Figure 9 shows the estimated locations of representative stacks at the facility.

$$Ozone\ Emission\ Rate\ \left(\frac{g}{hr}\right) = \left[VOC1\ \left(\frac{g}{hr}\right) * RF1\ \left(\frac{g\ Ozone}{g\ VOC}\right)\right] + \left[VOC2\ \left(\frac{g}{hr}\right) * RF2\ \left(\frac{g\ Ozone}{g\ VOC}\right)\right] + \left[VOC3\ \left(\frac{g}{hr}\right) * RF3\ \left(\frac{g\ Ozone}{g\ VOC}\right)\right] + \cdots + \left[VOCn\ \left(\frac{g}{hr}\right) * RFn\ \left(\frac{g\ Ozone}{g\ VOC}\right)\right]$$ **(Equation 2)**

Where,

VOC1, VOC2, VOC3, VOCn are emission rates (g/hr) of different speciated VOCs

RF1, RF2, RF3, RFn are reactivity factors (g ozone/g VOC) of each speciated VOC

Table 5. Estimated total ozone emissions for each stack.

Stacks	Virtual ozone emission rates (g/hr)	Virtual ozone emission rates (g/sec)
CAMO1 RTO (North)	41.45	0.01
CAMO1 RTO (South)	41.45	0.01
CAMO1 Booth	825.97	0.23
North Plant 2 RTO	110.80	0.03
North Plant 2 Booth	9929.97	2.76
MPF	793.06	0.22
IPB4	1768.96	0.49

Using AERMOD as the screening tool, the virtual ozone emission rates in g/sec on Table 5 (calculated using the reactivity factors) were used to determine the modeled concentration of ozone. **Please note that this method is experimental and is not an EPA recommended method.** The assumption was the complex photochemistry was already completed and the ozone was already formed; therefore, there are no estimated impacts of additional ozone formation or any ozone destruction. The ozone emissions from the representative stacks were modeled using a time period from 10 AM to 5 PM to represent the hottest 8 hours during each day. Five buildings at the facility were selected to represent building downwash. Table 6 shows the 4th highest 8-hour ozone modeled concentration for each year modeled. Using the latest available year (2015) for ozone background concentration at Wichita Health Department met station, the total concentration (modeled concentration plus

background concentration) for each year is below the 70 ppb ozone NAAQS. Again, the method used in the screening modeling is an experimental approach and was not evaluated or recommended by EPA.

Table 6. 4th highest 8-hour ozone modeled concentration for each year modeled.

Year	4th highest 8-hour ozone modeled concentration, ug/m3	4th highest 8-hour ozone modeled concentration, ppb	2015 Ozone Background (Wichita Health Department met station), ppb	Total concentration, ppb
2011	7.3	3.7	62	65.7
2012	6.9	3.5	62	65.5
2013	7.3	3.7	62	65.7
2014	6.9	3.5	62	65.5
2015	7.2	3.7	62	65.7

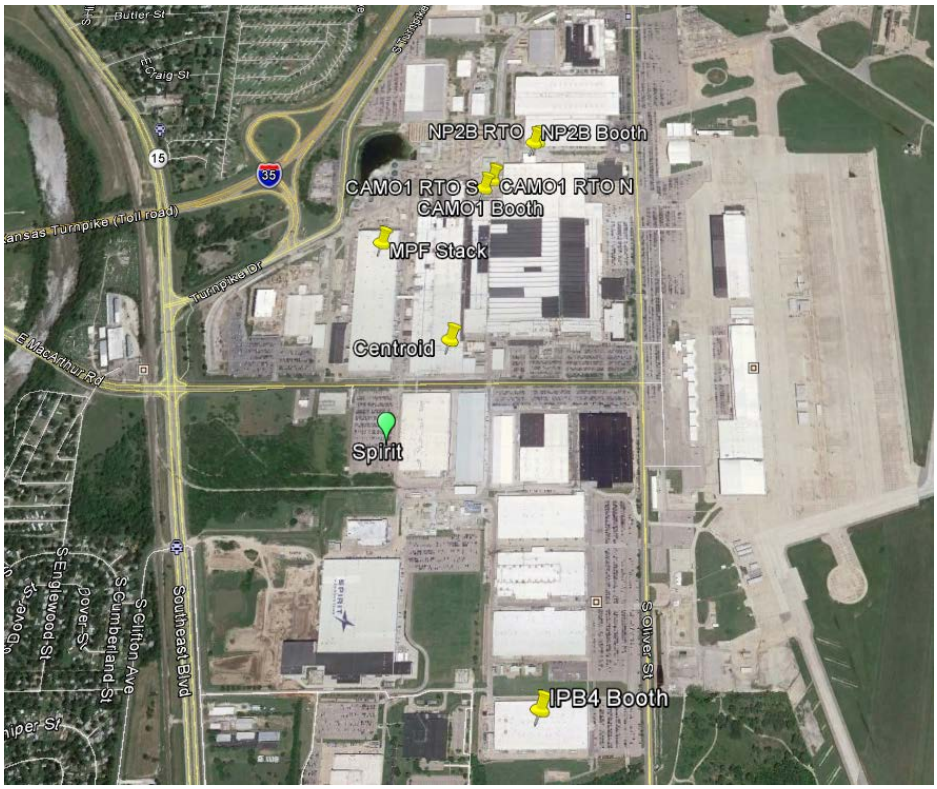

Figure 9. Representative stacks at the facility that were used in the screening modeling.

Summary and Conclusion

KDHE reviewed five (5) different approaches to determine if the 8-hour ozone NAAQS of 70 ppb will not be exceeded by the proposed Spirit expansion project.

The first approach was the determination of the current strategies and programs related to the reductions of ozone precursors in the area. The Wichita MSA is taking proactive steps to avoid exceeding the 8-hour ozone NAAQS by participating in the voluntary EPA program called Ozone Advance Program.

The second approach was the evaluation of the 5-year trend of 4th highest 8-hour ozone readings at three (3) ozone monitors located in the area. The graph shows that there is a decreasing trend.

The third approach was the review of the contribution of different sources of the VOC and NO_X emissions and comparison of Spirit's net VOC emissions to the overall VOC emissions inventory in the Wichita MSA. For the VOC emissions (Figures 4 and 6), nonpoint source category is the highest contributor ranging from 55% (2005) to 77% (2011). The lowest contributor to VOC emissions is the point source category with emissions ranging from 6% (2011) to 10% (2005). The Spirit's net VOC emissions increase for the proposed project is 108.50 tons per year. This change is about 3% of the 2011 point source category VOC emissions (3,556 tons); and only about 0.2% of the 2011 all source category VOC emissions (62,021 tons).

The fourth approach is determining if the project is located in a NO_X-limited or a VOC-limited area. This is only an estimate of the VOC-to-NO_X ratio.

The fifth approach is determining the types of VOCs (VOC speciation) and associative reactivity. Selected representative stacks were used in screening modeling using AERMOD. Using the latest available year (2015) for ozone background concentration at the Wichita Health Department met station, the total concentrations (modeled concentration plus background concentration) for each year, for five years, are below the 70 ppb ozone NAAQS. The screening modeling used is an experimental approach and not evaluated or recommended by EPA.

Based on tools and information available, KHDE considers the project emissions to have impacts within the allowable range and is approving the proposed 737 expansion project.

B. Pre-construction Monitoring

The purpose of pre-construction monitoring or identifying a representative monitor is to determine the background concentration of a pollutant at a project site. The background concentration includes natural sources, sources not included in the model, and unidentified sources (e.g. regional transport).

According to EPA's "Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)[10]," additional pre-construction monitoring is not required when data supplied from an existing monitoring network meets EPA's requirements for representativeness. The monitors in Kansas' network were evaluated for representativeness.

There are three ozone monitors in the Wichita area. According to the State of Kansas 5-Year Ambient Air Monitoring Network Assessment, "Wichita Health Department is the urban center site located in downtown Wichita; Peck monitor is located to the south-southwest of the Wichita Health Department monitor, measuring regional O_3 transport into Wichita; and the Sedgwick monitor is located to the northwest of Wichita measuring O_3 concentration after the air parcel travels through the city." Since the Health Department monitor is in the urban center, similar to Spirit, and is the closest to the facility, this area monitor is the most representative of Spirit's location.

Other monitors in urban areas in Kansas were also evaluated. The monitor in Leavenworth is located on the far western side of town, and is surrounded by farmland to the west and residential homes to the east. Heritage Park monitor is located in the south Kansas City area, surrounded by a park and residential homes. The JFK monitor is located in the Kansas City, Kansas urban core, and the surrounding area does not include industrial use. These monitors were rejected because the land use is not similar to the area surrounding Spirit.

Therefore, Spirit has requested approval to use the data from the ozone monitor at the Wichita Health Department because this data is representative of the existing ambient air in the proposed project location. Per EPA guidance, three items need to be considered when determining whether the monitoring data is representative: monitor location, quality of the data, and currentness of the data. Similar topography, meteorology, and land-use are also included in this analyses.

[10] U.S. EPA. 1987. Ambient Air Monitoring Guidelines for Prevention of Significant Deterioration (PSD). EPA-450/4-87-007. May 1987. *https://www.epa.gov/sites/production/files/2015-07/documents/monguide.pdf*.

1. Monitor location

The existing monitoring data should be representative of three areas: the location of the maximum air pollutant concentration from the proposed source; the location of the maximum air pollutant concentration from existing sources; and the location of the maximum impact area. The Wichita Health Department is located approximately 7.7 km and slightly northwest from Spirit, see Figure 10.

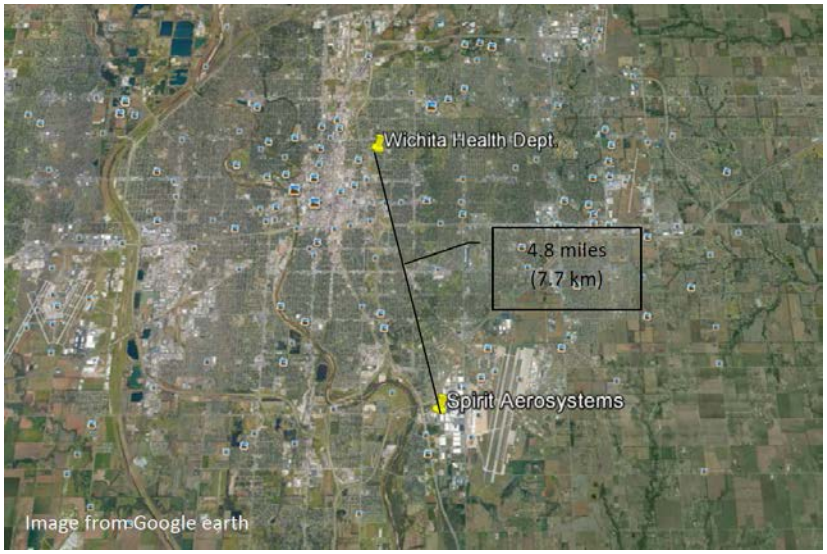

Figure 10. Facility and Monitor Locations.

Maximum ozone concentrations from existing sources are captured by the Health Department monitor since the wind is predominantly from the south, and most industry in the city is located in two areas: directly southeast of the monitor in Old Town Wichita; and the area surrounding Spirit, directly south of the monitor. A wind rose from the Western Regional Climate Center[11] for the Wichita area in 2012 is shown in Figure 11 below. Several wind roses over the years all display similar patterns, the wind is predominantly from the south.

Since the Health Department monitor is located near the proposed project, and is located upwind of the facility, KDHE considers this location to be representative.

[11] *www.wrcc.dri.edu*. Note: the latest data for the Wichita area is from 2012.

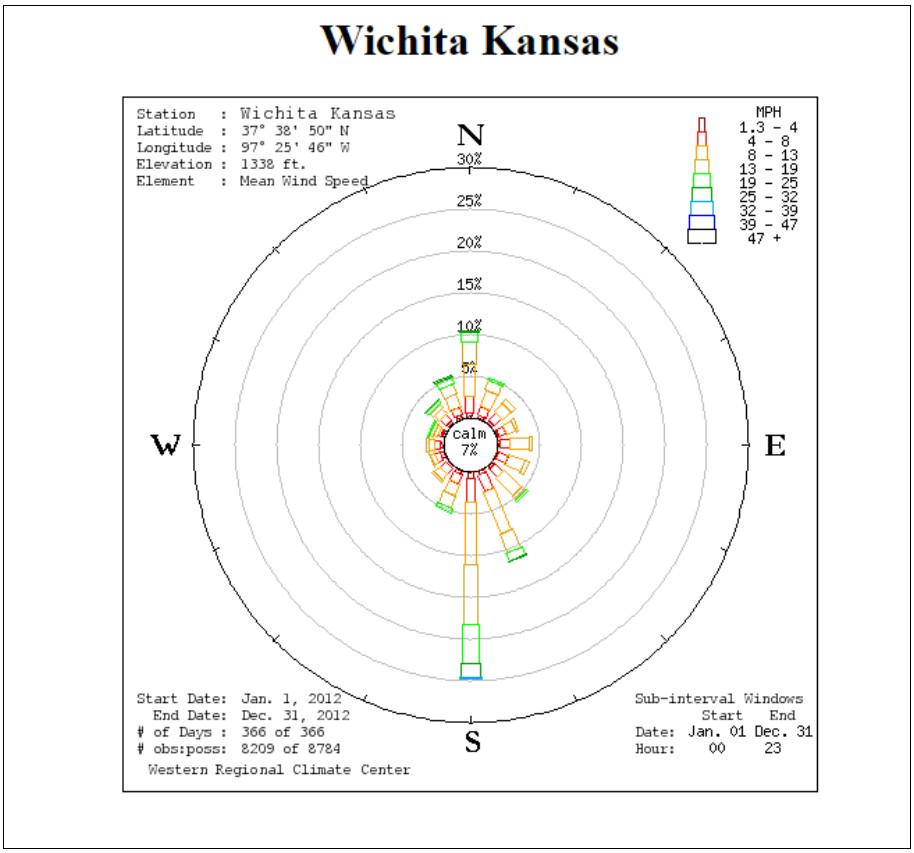

Figure 11. Wind Rose.

Data Quality

Ozone data from the Wichita Health Department monitor for 2012-2014 was reviewed for quality assurance and used in the State of Kansas 5-Year Ambient Air Monitoring Network Assessment.

Currentness of Data

The Wichita Health Department monitor has data from the three year period preceding the permit application and fulfils the currentness requirement.

Topography

Both areas contain multisource emissions, are located in urban areas, and are located in basically flat terrain. Spirit is located at an elevation of 1,350 feet and the Health Department is located at an elevation of 1,320 feet.

Meteorology
Since the two locations are near of each other and in the same urban area, they experience the same weather.

Land Use
The land uses surrounding Spirit and the monitor are shown in Figures 12 and 13 below.

Figure 12. Spirit AeroSystems.

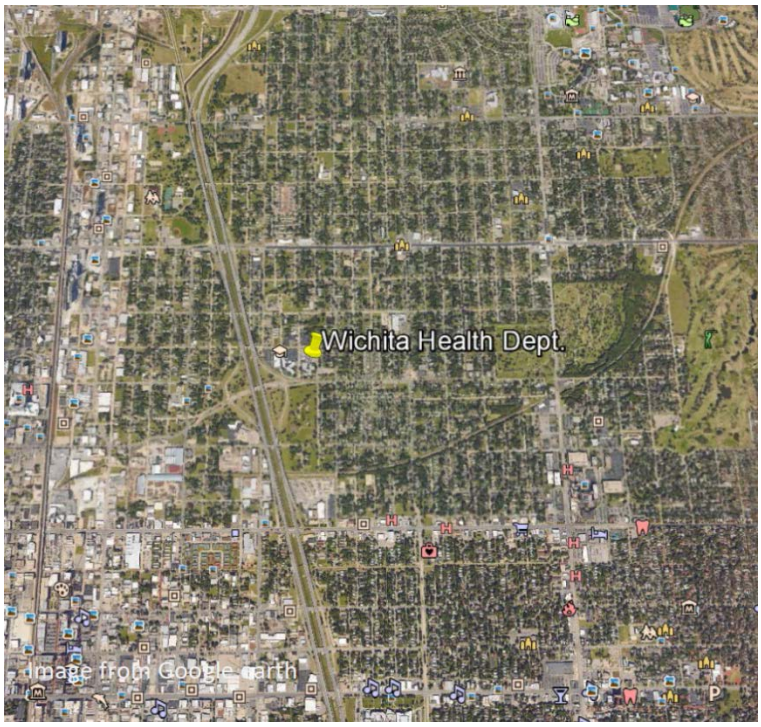

Figure 13. Wichita Health Department Ozone Monitor.

Both areas are a mix of industrial and residential use. Spirit is located next to McConnell Air Force Base and the Health Department is directly northwest of Old Town Wichita, a mix of residential, industrial and commercial uses.

Conclusion

Spirit requests that preconstruction monitoring be fulfilled with the existing ozone monitor located at the City of Wichita's Health Department. KDHE approves the use of the ozone monitor located at the City of Wichita's Health Department as representative for Spirit's preconstruction monitoring.

C. Additional Impact Analysis

In accordance with 40 CFR 52.21(o), Spirit analyzed the potential impairment to visibility, soils, and vegetation in the area that would occur as a result of the project, as well as the air quality impact projected for the area as a result of general commercial, residential, industrial, and other growth associated with the project.

40 CFR 52.21(p)(3) requires a visibility analysis if the project is located close to a Class I area. Although there are no Class I areas located within 300 km of Spirit, the potential for visibility impairment is discussed below.

1. Visibility, Vegetation and Soil Impacts

As required by the Clean Air Act (CAA) amendments of 1990, EPA established secondary national ambient air quality standards (NAAQS) for pollutants to provide protection against decreased visibility and damage to animals, crops, vegetation, and buildings. EPA's New Source Review Workshop Manual states "For most types of soil and vegetation, ambient concentrations of criteria pollutants below the secondary national ambient air quality standards (NAAQS) will not result in harmful effects."[9] Only the VOC emissions from the project are subject to PSD review and VOC is regulated as a precursor to ozone. On October 1, 2015, EPA revised the primary and secondary ozone standards to 70 parts per billion (ppb).[12]

Ozone can affect vegetation through the direct exposure of plant to gaseous pollutants in the ambient air. Effects of ozone can be classified as acute or chronic. Acute effects result from short-term exposures to relatively high concentrations while chronic effects result from exposure to lower concentrations for months to several years. Ozone also affects soil fertility by inhibiting plants' ability to metabolize carbon dioxide, which results in less carbon in the soil. Reduced carbon results in fewer soil microbes, and therefore, reduced microbial activities that are a function of soil fertility.

[12] U.S. EPA. 2015. National Ambient Air Quality Standards for Ozone; Final Rule. 80 FR 65292. *https://www.gpo.gov/fdsys/pkg/FR-2015-10-26/pdf/2015-26594.pdf*

A study done by Kirk Baker estimates ozone impacts from hypothetical sources across the central and eastern U.S.[13] One hypothetical location is in south central Kansas, very close to the actual location of Spirit. The study predicts a maximum daily 8-hour ozone peak impact of 0.1 ppb for an emission source of 500 tpy of VOCs. Additionally, modeling done for a permit application close to Oklahoma City for a facility with VOC emissions of 600 tpy found a maximum ozone increase of 0.1 ppb.[14] A qualitative analysis of an ozone impact from emissions of 108 tpy estimates an increase of 0.02 ppb (0.1/500*(108)). An increase of 0.02 ppb of ozone is insignificant and unlikely to adversely affect vegetation in the area.

Assuming maximum impact of 0.1 ppb, and using as background the 3-year average of the 4th highest 8-hour ozone readings in the Wichita MSA ozone monitors, the maximum ozone levels in the area are still protective of soils and vegetation, see table below.

Table 8. Comparison of Background Ozone and Hypothetical Impacts.

Monitor in Wichita MSA	Background (ppb)	Maximum Hypothetical Project Impact	Background + Hypothetical Impact (ppb)	Secondary Ozone NAAQS (ppb)	Less Than NAAQS?
Peck	67	0.1	67.1	70	Yes
Health Dept.	67		67.1		Yes
Sedgwick	67		67.1		Yes

For visibility impairment, only some specific VOC species react to form secondary organic aerosols (SOAs). SOAs are a major component of fine particle pollution ($PM_{2.5}$), the main cause of visibility impairment.[15] SOAs are formed when VOCs undergo gas-particle transfer in the atmosphere. Each VOC can undergo a number of atmospheric degradation processes to produce a range of oxidized products, which may or may not contribute to

[13] Baker, K.R., R.A. Kotchenruther, and R.C. Hudman. 2016. Estimating ozone and secondary PM2.5 impacts from hypothetical single source emissions in the central and eastern United States. *Atmospheric Pollution Research* 7(1): 122-133. *http://dx.doi.org/10.1016/j.apr.2015.08.003.*

[14] Ramboll Environ U.S. Corp. 2015. Assessment of the Ozone Impacts Associated with New Emissions from Tinker Air Force Base on Oklahoma City. Ramboll Environ U.S. Corp., Novato, California.

[15] U.S. EPA Secondary Organic Aerosols (SOAs) Research. *https://www.epa.gov/air-research/secondary-organic-aerosol-soas-research*.

SOA formation and growth.[16] In general, aromatic species and biogenic species are the main SOA precursors. An analysis of the VOC speciation of the emissions from Spirit finds approximately 33% of the emissions are aromatic compounds. Considering only a small portion of these emissions will go on to further react and form SOAs, it is unlikely these emissions will impair visibility in the area.

In the state of Kansas in 2011, biogenic (natural emissions) of VOCs were 57% of total VOC emissions and industrial sources were 10% of VOC emissions.[17] Total VOC emissions were 1,060,883 tpy, of which the project increase of 108 tons would be 0.01%.

As a result, impacts on local visibility, vegetation, and soils attributable to the project will be negligible.

2. Class I and Class II Areas

In August of 1977, the CAA designated national parks greater than 6,000 acres or national wilderness areas greater than 5,000 acres as Class I Areas with special protections.[18] These areas are granted the most stringent protection from deterioration of air quality. Protection of AQRVs in these areas is the responsibility of the Federal Land Managers (FLMs): U.S. Forest Service, National Park Service, and the U.S. Fish and Wildlife Service.

The State of Kansas Air Quality State Implementation Plan for Regional Haze, dated October 26, 2009, states that "VOC is not anticipated to be a large contributor to visibility impairment in the Class I areas surrounding Kansas." Additionally, as mentioned above, only some specific long chain VOC species are PM/visibility precursors, and there are very few anticipated of these in VOC emissions from Spirit.

The Federal Land Managers' Air Quality Related Values Work Group (FLAG) issued guidance in 2010 that includes initial screening criteria that

[16] Hallquist, M., et al. 2009. The formation, properties and impact of secondary organic aerosol: current and emerging issues, Atmospheric Chemistry and Physics 9(14): 5155–5236.

[17] U.S. EPA. 2011. The 2011 National Emissions Inventory. *https://www.epa.gov/air-emissions-inventories/2011-national-emissions-inventory-nei-data*.

[18] U.S. Fish & Wildlife Service, National Wildlife Refuge System. 2015. Permit Applications: PSD Overview. *https://www.fws.gov/refuges/airquality/permits.html*.

exempts sources from conducting an AQRV impact analysis. The screening criteria is called the Q/D Method and is a threshold ratio of emissions to distance. Q is the project's maximum 24-hour emission rate in tons per day converted to an annual emission rate, and D is the distance of the project to the area of concern, in kilometers. If the Q/D value is less than 10, the EPA stated that it would be reasonable to conclude that the source would not be considered to cause or contribute to visibility impairment for emissions of NO_X or SO_2.[19] The FLMs further expanded the screening criteria to all AQRV, not just visibility, for emissions of SO_2, NO_X, PM_{10} and sulfuric acid mist (H_2SO_4).

Although VOC is not included as a pollutant in the FLM guidance, the Q/D values for the nearest Class I areas and selected Class II areas are included in the Table 9 below.

Table 9. Screening Criteria (Q/D Method) for Class I and Class II Areas Nearest to Spirit AeroSystems' Facility.

Area	Distance from Spirit (km)	Net Emissions Increase divided by Distance Q/D[a] (tpy/km)
Mingo National Wildlife Refuge (Class I)	740.1	0.15
Wichita Mountain Wildlife Refuge (Class I)	402.3	0.27
Salt Plains National Wildlife Refuge (Class II)	149.6	0.72
Quivira National Wildlife Refuge (Class II)	138.4	0.78
Tallgrass Prairie National Reserve (Class II)	128.7	0.84

[a] Annual emissions (Q) are 108 tpy.

As illustrated in Table 9, if VOC emissions were considered in the screening criteria, all Q/D values are less than 10, and the project would have no significant adverse impacts on Class I and Class II areas.

[19] U.S. Forest Service, National Park Service, and U.S. Fish and Wildlife Service. 2010. Federal land managers' air quality related values work group (FLAG): Phase I Report—Revised (2010). Natural Resource Report NPS/NRPC/NRR—2010/232. National Park Service, Denver, Colorado. October 2010.

3. Growth Analysis

The growth analysis is intended to review the potential impact that the project will have on industrial growth and associated secondary emissions in the vicinity of the facility. Secondary emissions are those that can occur as a result of the project or operation of the facility but are not emissions from the facility itself. It is not anticipated that the construction and operation of the project will result in excess secondary emissions during either the construction phase or the general operation of the facility.

Though traffic will increase both during the construction phase of the project and during operation, it is not anticipated that this traffic will cause an excessive amount of emissions from either exhaust or entrainment of particulate matter from the roads.

The facility is expected to provide 300-500 full-time positions staffed with workers already in the area; therefore, no additional housing or transportation growth is anticipated as a result of employment at the facility. Since the estimated population of the Wichita metropolitan area is approximately 650,000, the addition of 500 employees is less than 0.08% of the surrounding area. Furthermore, there is no anticipated impact on public services. The construction period is estimated to be two to four years and will create approximately 50-200 construction jobs; however, these will be short-term, temporary impacts. Attempts will be made to hire primarily local and regional construction workers to the extent feasible. Consequently, no adverse long-term air quality impacts due to growth in the area are expected.

Spirit plans to employ local public works for electricity, municipal water supply, and sewer services at the facility. Since these services exist in the area, the Project is not expected to significantly impact services or infrastructure provided by local governments or municipalities.

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 SPIRIT AEROSYSTEMS, INC.

PROPOSED VOC BACT OPTIONS

Spirit AeroSystems, Inc. evaluated the BACT options to control emissions from the North Plant 2 Booth, the IPB4 Spoven booth and oven, and the two natural gas-fired sludge dryers. The North Plant 2 Booth will operate only for 7,104 hours per year. The IPB4 Spoven booth and oven will operate only for 4,000 hours per year. The two natural gas-fired sludge dryers will operate for 8,760 hours per year.

KDHE reviewed the EPA's RACT/BACT/LAER Clearinghouse (RBLC), California Air Resources Board (CARB), and South Coast Air Quality Management District (SCAQMD), State of Washington Department of Ecology, and other recently issued permits related to aerospace coating, spray booth, and miscellaneous boilers, furnaces, and heaters. The database search was initially set for the previous ten years (2006 - 2016) and when no add-on control technologies were identified, the search was expanded for another ten years (1996 - 2016). Several add-on technologies identified for BACT analysis were discussed below.

For a more thorough evaluation of possible BACT, please refer to the BACT analysis presented in Section 2 of the PSD permit application originally submitted to KDHE on March 24, 2016 and updated on July 29, 2016.

I. <u>VOC BACT for the North Plant 2 Booth</u>

The North Plant 2 Booth, designated EU-2297F-B7, will be used for both exterior (Operation 1) and interior (Operation 2) surface coating of Boeing 737 airplane fuselages. The booth will operate 24 hours per day, 296 days per year, for a total of 7,104 hours per year. Emissions from the Operation 1 will have an exhaust flow rate of 150,000 standard cubic feet per minute (scfm). Emissions from Operation 2 will come from enclosed 737 fuselage through an enclosure and then vented to an add-on control technology sized for a 25,000 scfm exhaust flow through the fuselage and not the entire booth.

VOC control methods considered for the North Plant 2 Booth include:

1. Regenerative thermal oxidizer (RTO),
2. Adsorption system,
3. Thermal oxidizer,
4. Concentrator with an RTO,
5. Emission control enclosures with an RTO, and

6. Compliance with 40 CFR Part 63 Subpart GG, *National Emission Standards for Aerospace Manufacturing and Rework Facilities* (Aerospace NESHAP).

RTOs use high-density media such as a ceramic-packed bed still hot from a previous cycle to preheat an incoming VOC-laden waste gas stream. The preheated, partially oxidized gases then enter a combustion chamber where they are heated by auxiliary fuel combustion to a final oxidization temperature typically between 1,400°F and 1,500°F and maintained at this temperature to achieve maximum VOC destruction. Typical RTO control efficiencies range from 95% to 99% depending on system requirements and characteristics of the waste gas stream.[20] RTO represents state of the art controls for VOC removal from aerospace and other spray coating operations. RTOs are commercially available and have been used on similar operations. Therefore, RTO is technically feasible.

Adsorption systems remove gaseous pollutants from an air stream by transferring the pollutants to the solid surface of an adsorbent. Adsorbents can be activated carbon, silica gel, activated alumina, synthetic zeolites, fuller's earth, polymers, or other clays.[21] Adsorption systems are useful for high-flow, low-concentration exhaust streams. A well-designed adsorber system can achieve 95% to 98% control efficiency at input concentrations between 500 to 2,000 ppm in air.[22] Zeolite adsorber system can achieve up to 99% removal efficiency.[23] Adsorption systems are commercially available and have been used on aerospace coating operations. Therefore, an adsorption system is technically feasible.

Thermal oxidation is the process of oxidizing combustible materials by increasing the temperature of the material above its auto-ignition point in the presence of oxygen and maintaining it at high temperature for sufficient time to complete combustion to CO_2 and water. Typical gas flow rates range from 500 to 50,000 scfm. Typical thermal incinerator or oxidizer design efficiencies range from 98 to 99.99%.[24] Thermal oxidizers are commercially available and have been used in spray booth and aerospace coating operations. Thus, thermal oxidizer is technically feasible.

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[20] U.S. EPA-CICA. 2003. Air Pollution Control Technology Fact Sheet – Regenerative Incinerator. EPA-452/F-03-021. *https://www3.epa.gov/ttncatc1/dir1/fregen.pdf*

[21] U.S. EPA. 1999. EPA Air Pollution Control Cost Manual, Section 3.1, Chapter 1 - Carbon Adsorbers. EPA/452/B-02-001. *https://www3.epa.gov/ttn/catc/dir1/cs3-1ch1.pdf*.

[22] U.S. EPA. 1999. EPA Technical Bulletin - Choosing an Adsorption System for VOC: Carbon, Zeolite, or Polymers? EPA 456/F-99-004. *https://www3.epa.gov/ttnchie1/mkb/documents/fadsorb.pdf*.

[23] U.S. EPA. 1998. EPA Technical Bulletin – Zeolite: A Versatile Air Pollutant Adsorber. EPA 456/F-98-004. *https://www3.epa.gov/ttn/catc/dir1/fzeolite.pdf*.

[24] U.S. EPA-CICA. 2003. Air Pollution Control Technology Fact Sheet – Thermal Incinerator. EPA-452/F-03-022. *https://www3.epa.gov/ttnchie1/mkb/documents/fthermal.pdf*

A concentrator is used when VOC exists in large air flow and must be concentrated before it can be incinerated economically. However, the control efficiency of a combined concentrator (i.e., an adsorber) and incinerator is lower than having each individual control efficiency.[22] A zeolite concentrator with an RTO was commercially available and has been used in aerospace coating and spray booth applications. This option is technically feasible.

The unique operations at Spirit have allowed for the use of emissions control enclosures (ECEs). The cargo doors of a 737 fuselage can each be sealed with an ECE and the passenger doors and windows are sealed so that the airflow and the paint emissions are isolated within the fuselage. Emissions generated during coating operations inside the fuselage are routed through the ECEs to a filter bank and an RTO. The RTO is sized to handle flow from the interior of the fuselage (25,000 scfm flow) and therefore can be much smaller than a control device sized to handle exhaust from the entire paint booth. This technology is essentially a booth within a booth and is only available for interior coating of Spirit's 737 fuselage.

Compliance with Aerospace NESHAP is another BACT evaluated. Aerospace NESHAP sets VOC limits in one of three ways: on a pound per gallon basis in primer and topcoats, requires a destruction efficiency in an air pollution control system, or allows VOC limits through emissions averaging. Other requirements include specific paint application equipment, cleaning operations, and good work practices. Paint applications include high efficiency methods equivalent to a high-volume low-pressure (HVLP) or electrostatic spray. Good work practices include storing coatings and solvents in closed containers, bagging solvent wipe-cleaning rags when not in use, and capturing and containing solvent used to clean equipment.

The PSD regulations require 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.

Table B.1 shows the cost-effectiveness of the top five controls for the North Plant 2 Booth Operation 1 (exterior fuselage coating). The cost-effectiveness of each control increased because of the reduction in the hours of operation from 8,760 hours per year (hr/yr) to 7,104 hr/yr for the North Plant 2 Booth. The top four controls have been rejected based on cost analysis. The last remaining control, which is Compliance with Aerospace NESHAP have been selected as BACT for Operation 1 in the North Plant 2 Booth.

Table B.2 shows the cost-effectiveness of the top six controls for the North Plant 2 Booth Operation 2 (interior fuselage coating). The top five controls have been rejected based on cost analysis. The last remaining control, which are Emission Control Enclosures (ECEs) with an RTO and Compliance with Aerospace NESHAP have been selected as BACT for Operation 2 in the North Plant 2 Booth.

Table B.1. Cost-Effectiveness of the Top Five BACT for the North Plant 2 Booth, Operation 1 (Exterior Fuselage Coating).

Control	Technology Cost Effectiveness ($/ton VOC Removed)	
	8,760 hr/yr	7,104 hr/yr
Regenerative Thermal Oxidizer (RTO)	74,024.19	89,547.05
Adsorption System	48,543.38	58,939.77
Thermal Oxidizer	7,467,579.53	7,468,545.52
Zeolite Concentrator with RTO	78,869.12	95,407.97
Compliance with Aerospace NESHAP	Baseline	Baseline

Table B.2. Cost-Effectiveness of the Top Six BACT for the North Plant 2 Booth, Operation 2 (Interior Fuselage Coating).

Control	Technology Cost Effectiveness ($/ton VOC Removed)	
	8,760 hr/yr	7,104 hr/yr
Regenerative Thermal Oxidizer (RTO)	74,024.19	89,547.05
Adsorption System	48,543.38	58,939.77
Thermal Oxidizer	7,467,579.53	7,468,545.52
Zeolite Concentrator with RTO	78,869.12	95,407.97
Emission Control Enclosures (ECEs) with an RTO	15,763.63	18,851.69
Compliance with Aerospace NESHAP	Baseline	Baseline

The BACT for VOC for Operation 1 is compliance with the Aerospace NESHAP. The BACT limit for VOC Operation 2 is 2.15 pounds per hour (lb/hr) or 6.01 ppm and shall apply at all times, including startup and shutdown. The BACT for VOC for Operation 2 are the use of ECEs with an RTO (which is sized for a 25,000 scfm exhaust flow rate) and compliance with the Aerospace NESHAP. The hours of operation of the North Plant 2 Booth shall be limited to 7,104 hr/yr, which equates to VOC emissions of 24.48 tons per year. The BACT emission rate averaging period is 1 hour.

II. VOC BACT for the IPB4 Spoven Booth

The IPB4 Spoven Booth will be used to coat parts of the Boeing 737 aircraft. The booth will operate 16 hours per day, 250 days per year, for a total of 4,000 hours per year. The booth has an average exhaust flow rate of 40,000 scfm. Parts will be coated in the IPB4 Spoven, the operators will then exit the booth, and switch the booth to cure mode which will turn on the indirect natural-gas-fired burners fed to the booth. Ventilation is used to comply with OSHA's chrome exposure standards.

The same control technologies identified for the North Plant 2 Booth are applicable to the IPB4 Spoven Booth with the exception of the ECEs. The ECE technology is only available for booths that coat the interior of a complete 737 fuselage such as the North Plant 2 Booth and not booths that coat relatively small parts and assemblies like the IPB4 Spoven Booth.

VOC control technologies below have been achievable and determined to be technically feasible for the IPB4 Spoven Booth:

1. Thermal oxidizer,
2. Adsorption system,
3. Regenerative thermal oxidizer (RTO),
4. Concentrator with an RTO, and
5. Compliance with the Aerospace NESHAP.

The control efficiencies achieved in practice for each identified control technologies are determined. Each technically feasible control technology was evaluated for cost effectiveness and energy, environmental and economic impacts.

Table B.3 showed the cost-effectiveness of the top five controls computed based on two hours of operation. The top four controls have been rejected based on cost analysis. The excessive costs of the thermal oxidizer are due to the annual natural gas requirement for the control. The remaining control, i.e., Compliance with Aerospace NESHAP has been selected as BACT. Spirit will continue to implement the use of low-VOC coatings, high-transfer-efficiency coating equipment and good work practices to minimize VOC emissions in compliance with the Aerospace NESHAP.

Table B.3. Cost-Effectiveness of the Top Five BACT for the IPB4 Spoven Booth.

Control	Technology Cost Effectiveness ($/ton VOC Removed)	
	8,760 hr/yr	4,000 hr/yr
Thermal Oxidizer	35,619,626.43	20,088,010.21
Adsorption System	211,574.43	248,084.85
Regenerative Thermal Oxidizer	183,178.20	202,139.70
Zeolite Concentrator with RTO	195,167.34	215,369.87
Compliance with Aerospace NESHAP	Baseline	Baseline

The BACT limit for VOC is 1.34 lb/hr or 2.34 ppm and shall apply at all times, including startup and shutdown. The hours of operation of the IPB4 Spoven Booth shall be limited to 4,000 hr/yr, which equates to VOC emissions of 2.68 tons per year. The BACT emission rate averaging period is 1 hour.

III. VOC BACT for the IPB4 Spoven Oven and Sludge Dryers

VOC emissions from natural gas-fired heaters are the result of incomplete combustion and can be reduced through the use of good combustion practices, including higher operating temperatures, longer residence times and turbulent mixing of fuel and combustion air. This section discussed the result of the top-down VOC BACT analysis conducted for the sludge dryers and the oven portion of the IPB4 Spoven.

In a search of the RBLC database for the previous ten years (2006 - 2016), process 19.600 – Miscellaneous Boilers, Furnaces, Heaters, only three potential BACT control options for VOC emissions were identified:

1. Gaseous fuels such as the use of pipeline quality natural gas,
2. Good combustion practices, and
3. Combination of two previous options.

All three identified potential control technologies are found to be technically feasible and are considered in the remaining top-down BACT analysis. Because pipeline quality natural gas is the intended fuel as part of the initial project design and it is a gaseous fuel, no reductions are quantified for its use. The use of gaseous fuels is considered the base case, leaving good combustion practices as the only remaining and highest-ranking control technology option. The use of good combustion practices is an inherently

efficient process, meaning there are no anticipated negative energy, environmental, or economic impacts associated with implementing this practice.

The VOC emission limit for similar units in RBLC ranges from 0.0033 to 0.008 lb/MMBtu (3.4 to 8.2 lb/MMcf). A third of the units proposed an emission limit of 0.0054 lb/MMBtu (5.5 lb/MMcf) or greater, based on the emission factor found in AP-42 Chapter 1.4.[25]

The IPB4 Spoven *oven* and the natural gas sludge dryers are subject to 40 CFR Part 63 Subpart DDDDD, *National Emissions Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters* (MACT 5D). The requirements of MACT 5D was included as BACT for VOC.

Therefore, the two BACT options and compliance with MACT 5D have been selected as control for the natural gas sludge dryers and IPB4 Spoven *oven*. BACT for VOC shall be the use of pipeline quality natural gas as clean burning fuel, using good combustion practices to reduce VOC emissions, and compliance with the requirements of MACT 5D.

BACT limit is an annual average VOC emission of 0.0054 lb/MMBtu (5.5 lb/MMcf) that shall apply at all times, including startup and shutdown. The BACT emission rate averaging period is a 12-month rolling average for each emission unit.

[25] U.S. EPA. 1998. AP 42 Compilation of Air Pollutant Emission Factors, Volume I - Stationary Point and Area Sources, Chapter 1 – External Combustion Sources. Section 1.4 – Natural Gas Combustion.