

Commonwealth of Kentucky
Division for Air Quality
STATEMENT OF BASIS / SUMMARY

Title V/Title I - PSD, Operating/Construction
Permit: V-21-041 R2

BlueOval SK, LLC
2022 Battery Park Drive
Glendale, KY 42740

March 11, 2025
William Parsons, Reviewer

SOURCE ID:	21-093-00176
AGENCY INTEREST:	170550
ACTIVITY:	APE20240004

Table of Contents

SECTION 1 – SOURCE DESCRIPTION	2
SECTION 2 – CURRENT APPLICATION AND EMISSION SUMMARY FORM.....	3
SECTION 3 – EMISSIONS, LIMITATIONS AND BASIS	30
SECTION 4 – SOURCE INFORMATION AND REQUIREMENTS	96
SECTION 5 – PERMITTING HISTORY	102
SECTION 6 – PERMIT APPLICATION HISTORY.....	103
APPENDIX A – ABBREVIATIONS AND ACRONYMS	129

SECTION 1 – SOURCE DESCRIPTION

SIC Code and description: 3692, Primary Batteries, Dry and Wet

Single Source Det. Yes No If Yes, Affiliated Source AI:

Source-wide Limit Yes No If Yes, See Section 4, Table A

28 Source Category Yes No If Yes, Category:

County: Hardin

Nonattainment Area N/A PM₁₀ PM_{2.5} CO NO_x SO₂ Ozone Lead

If yes, list Classification:

PTE* greater than 100 tpy for any criteria air pollutant Yes No

If yes, for what pollutant(s)?

PM₁₀ PM_{2.5} CO NO_x SO₂ VOC

PTE* greater than 250 tpy for any criteria air pollutant Yes No

If yes, for what pollutant(s)?

PM₁₀ PM_{2.5} CO NO_x SO₂ VOC

PTE* greater than 10 tpy for any single hazardous air pollutant (HAP) Yes No

If yes, list which pollutant(s):

PTE* greater than 25 tpy for combined HAP Yes No

*PTE does not include self-imposed emission limitations.

Description of Facility:

BlueOval SK, LLC's Glendale Kentucky facility is a lithium-ion electric vehicle battery manufacturing plant.

SECTION 2 – CURRENT APPLICATION AND EMISSION SUMMARY FORM

Permit Number: V-21-041 R2 Activities: APE20240004

Received: December 11, 2024 Application Complete Date(s): January 29, 2025

Permit Action: Initial Renewal Significant Rev Minor Rev Administrative

Construction/Modification Requested? Yes No NSR Applicable? Yes No

Previous 502(b)(10) or Off-Permit Changes incorporated with this permit action Yes No

Description of Action:

BlueOval SK submitted an application to update equipment listed under each emission unit and applied for updated BACT limits for the Battery Assembly plant. This activity is revisiting their initial application to rename previously applied for equipment to better delineate between building 1 and building 2 units, update the process units themselves as their number and their controls have changed, and address previous BACT limits as some have been found to be unfeasible for the facility's design. Buildings 1 and 2, while under the common business control, will be making locally different battery products. Also, some EU02 Battery Assembly added a few new processes in the Anode and Cathode press and tab welding activities. Overall, very few changes were made to the BACT methodology in the initial application other than stating EU13 cannot use low NOx burners because it isn't compatible their needed clean room environmental controls. Because all criteria pollutant emissions except for VOC have decreased since the initial application, revised PSD modeling was also not supplied.

1. Emission Unit 01 Electrode Manufacturing:

- a. Update the number of equipment, emission factors, and control equipment configurations.
- b. Dust collectors no longer vent internally so internal venting PM removal efficiency was removed for applicable activities.
- c. Anode and Cathode processing units were combined into one activity.
- d. Anode Powder now has HAP emissions and will be subject to MACT.
- e. MACT applicability changed from 40 CFR 63 Subpart HHHHH National Emission Standards for Hazardous Air Pollutants: Miscellaneous Coating Manufacturing to 40 CFR 63 Subpart CCCCCC National Emission Standards for Hazardous Air Pollutants for Area Sources: Paints and Allied Products Manufacturing due to the facility's change to area source status for HAP emissions.
- f. Cathode/Anode Processing and Electrode Cleaning applied for BACT limits are changed from 3.0 ppmv VOC (as NMP) to 4.5 ppmv VOC (as NMP).

2. Emission Unit 02 Battery Assembly:

- a. Update the number of equipment, emission factors, and control equipment configurations.
- b. Added 1,3-propane sultone HAP emission
- c. Added Cathode Press and Anode Press, Cathode Slitting and Anode Slitting, and Tab Welding processes.
- d. Applied for BACT limits for VOC discharging activities are changed from 3.0 ppmv VOC (as NMP) to 6.0 ppmv VOC (as Electrolyte). The electrolyte is not pure NMP.

3. Emission unit 03 Battery Formation, Emission Unit 4 Cell Discharge, and Emission Unit 5 Laboratories:

- a. Update the number of equipment, emission factors, and control equipment configurations.

- b. Applied for BACT limits for VOC discharging activities are changed from 3.0 ppmv VOC (as NMP) to 6.0 ppmv VOC (as Electrolyte). The electrolyte is not pure NMP.
4. *Emission Unit 06 Natural Gas-Fired Boilers:*
 - a. Number and unit capacity changed
 - b. BACT NOx limit changed (20 ppm to 9 ppm)
 - c. Hexane emission factor changed
 - d. 40 CFR 63 Subpart DDDDD National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters, applicability removed due to area source HAP status
 5. *Emission Unit 07 Natural Gas-Fired Hot Oil Heaters:*
 - a. Number and unit capacity changed
 - b. Hexane emission factor changed
 - c. 40 CFR 63 Subpart DDDDD National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters, applicability removed due to area source HAP status
 6. *Emission Unit 08A Diesel Fire Pump Engines:*
 - a. Number and unit capacity changed
 - b. 40 CFR 60 Subpart IIII emission standards are different for the revised engines.
 7. *Emission Unit 08B Diesel-Fired Emergency Fire Pump Engines*
 - a. Number and unit capacity changed
 8. *Emission Unit 09 Cooling Towers:*
 - a. Number and unit capacity changed
 9. *Emission Unit 10 Storage Tanks*
 - a. Number of NMP tanks have been changed.
 - b. Electrolyte tanks have been added
 - c. Added separator tanks have activated carbon adsorbers, but they were not added as BACT
 10. *Emission Unit 11 Date Code Printers and 12 Paved Haul Roads*
 - a. Functionally no changes other than to designate a building to attribute their emissions for recordkeeping purposes
 11. *EU13 Natural Gas Fired Dehumidification Units:*
 - a. Number of units changed
 - b. BACT NOx and CO limit changed (35 ppm to 89 ppm NOx and 50 ppm to 25 ppm CO)
 - c. Hexane emission factor changed
 - d. Indirect Units removed
 12. *EU14 Indirect-Fired Natural Gas-Fired Building Aire Handling Units:*
 - a. Number of units changed
 - b. BACT NOx limit changed (35 ppm to 55 ppm)
 - c. Hexane emission factor changed
 13. *EU15 Indirect-Fired Natural Gas-Fired Office Air Handling Units*
 - a. Number of units changed
 - b. BACT NOx limit changed (35 ppm to 55 ppm)
 - c. Hexane emission factor changed
 14. *EU16 Natural Gas-Fired Coater Oven Air Handling Units*
 - a. Number and unit capacity changed
 - b. BACT NOx limit changed (35 ppm to 25 ppm)
 - c. Hexane emission factor changed
 - d. Indirect Units removed

V-21-041 R2 Emission Summary				
Pollutant	Actual (tpy)	Previous PTE V-21-041 R1 (tpy)	Change (tpy)	Revised PTE V-21-041 R2 (tpy)
CO	N/A	264.0	-57.1	206.9
NO _x	N/A	279.0	-32.6	246.4
*PT	N/A	11.13	-4.7	6.43
*PM ₁₀	N/A	10.92	-4.6	6.32
*PM _{2.5}	N/A	9.16	-3.94	5.22
SO ₂	N/A	4.93	-1.07	3.86
VOC	N/A	292.6	226.1	518.7
Lead	N/A	0.0044	-0.0003	0.0041
Greenhouse Gases (GHGs)				
Carbon Dioxide	N/A	828,525	-185,292	643,233
Methane	N/A	15.67	-3.46	12.21
Nitrous Oxide	N/A	1.58	-0.34	1.24
CO ₂ Equivalent (CO ₂ e)	N/A	829,387	-185,480	643,907
Hazardous Air Pollutants (HAPs)				
1,3-Propane Sultone	N/A	N/A	1.39	1.39
Acetonitrile	N/A	5.28	0	5.28
Formaldehyde	N/A	0.52	-0.11	0.41
N-Hexane	N/A	12.48	-12.45	0.03
Hydrochloric Acid	N/A	9.31	-3.98	5.33
Combined HAPs:	N/A	27.71	-15.17	12.54

*Excludes fugitive emissions from Haul Roads

I. Revised Emissions (V-21-041 R2)

A. Project PSD Significance

In the application to construct and operate a greenfield facility, BlueOval calculated the potential air pollutants emitted by the new source. The new equipment is expected to be a source of these regulated NSR pollutants: PM, PM₁₀, PM_{2.5}, lead (Pb), NO_x, CO, VOC, SO₂ and GHGs.

The BlueOval project will be located in Hardin County, Kentucky, designated by the U.S. EPA as Unclassifiable/Attainment for all criteria pollutants in accordance with 40 CFR 81.318. Therefore, under the federal New Source Review permitting program, Prevention of Significant Deterioration (PSD) requirements apply to the proposed facility and the application has been reviewed accordingly.

Potential to emit pollutants for this facility were calculated based on emission factors obtained from U.S. EPA’s AP-42, *Compilation of Air Pollutant Emission Factors*, engineering estimates, mass balances, and manufacturer’s specifications. Based on these emission factors, and the assumption of a 24 hour, 7 days a week, 52 weeks a year operation (8760 hours per year) for most units, the potential emissions of regulated NSR pollutants, the potential to emit NO_x, CO and VOC exceeding the 250 tons major source threshold, and GHG will exceed the 75,000 ton significant emission rate threshold.

The potential increases in emissions of regulated NSR pollutants from the new facility have been calculated and are presented in the following table. A discussion of each pollutant, sources, calculation assumptions and source of emission factors used follows.

Table A-1, Project PSD Significance

Pollutant	PTE (tpy)	Major Source Threshold/ Significant Emission Rate Increase in tpy	PSD Significant Emissions Increase?
PM (filterable, only)	6.43	25	No
PM ₁₀ (filterable & condensable)	6.32	15	No
PM _{2.5} (filterable & condensable)	5.22	10	No
Pb	0.0041	0.6	No
NO _x	246.4	40	Yes
CO	206.9	100	Yes
VOC	518.7	250*	Yes
SO ₂	3.86	40	No
GHGs (CO ₂ e)	643,907	75,000	Yes

* Because VOC exceed the major source threshold of 250 tpy, all other pollutants are compared to the Significant Emission Rate (SER) instead.

B. Volatile Organic Compounds (VOC) Emissions

VOC emissions originate from the use and storage of 1-Methyl-2-Pyrrolidinone (NMP), 1,3-propane sultone, acetonitrile, and cleaning solutions as a part of the battery manufacturing processes, and the combustion of fossil fuels. VOC emissions also arise from date code printing activities.

EU01 Electrode Manufacturing:

This emission unit is made up of several processes. The processes that deal with VOC are listed below. The majority of the VOC is NMP, which is used as a solvent in the electrode coating suspension.

EU01, Cathode Processing and Anode Processing:

Cathode and anode processing emissions come from the electrode suspension being applied to metal foil sheet. Emissions are controlled using activated carbon adsorbers, which are shared between the cathode and anode processes. Emissions are calculated using a facility provided emissions estimation (post control) of 4.5 ppmv VOC. The potential to emit (PTE) of VOC emissions has been calculated to be 7.92 tpy from buildings 1 and 2.

EU01, Electrode Cleaning:

This process is for cleaning rollers. The main emissions are NMP from the electrode slurry and VOC from the cleaning solution applied. Emissions are controlled using activated carbon adsorbers. Emissions are calculated using a facility provided emissions estimation (post control) of 4.5 ppmv VOC. The PTE of VOC emissions has been calculated to be 15.94 tpy from buildings 1 and 2.

EU01, Cathode Drying:

Cathode Drying cures the electrode solution that has been applied to the metal foil sheet. The main VOC emitted is the NMP from the electrode slurry. Emissions are controlled using packed bed scrubbers. The scrubbers are considered inherent equipment and recover NMP which is conveyed to waste storage tanks that whose contents are shipped offsite for treatment. Emissions are calculated using a facility provided emissions estimation (post control) of 2.0 ppmv VOC. The PTE of VOC emissions has been calculated to be 273.7 tpy from buildings 1 and 2.

EU02 Battery Assembly, Vacuum Dryer, Cathode/Anode Presses, Electrolyte Filling and Sealing:

Battery Assembly has four VOC emitting processes, the cathode vacuum drying, electrolyte filling and sealing, the cathode press and the anode press. The cathode vacuum dryer is used to control humidity and further cure stacks of coated foil sheets. The cathode and anode presses are the process of un-winding a large roll and pressing foil with coating through two large rollers to a uniform thickness and then rewinding into a large roll. Electrode filling and sealing is where the electrodes are filled with electrolyte solution and sealed. The main VOCs emitted at these processes is the electrolyte in the electrode slurry, and the use of acetonitrile at electrode filling and sealing. These processes are controlled by activated carbon adsorbers. Emissions are calculated using a facility provided emissions estimation (post control) of 6.0 ppmv VOC. The PTE of VOC emissions has been calculated to be 16.75 tpy from buildings 1 and 2.

EU03 Battery Formation, Cell Degassing:

During cell degassing, accumulated gasses within the battery cells are released. The main VOC emitted is the NMP in the electrode slurry. Emissions are controlled using activated carbon adsorbers. Emissions are calculated using a facility provided emissions estimation (post control) of 6.0 ppmv VOC. The PTE of VOC emissions has been calculated to be 91.22 tpy from buildings 1 and 2.

EU04 Cell Discharge:

At cell discharge, batteries deemed by quality control as fit for disposal are disposed of. The main VOC emitted is the NMP in the electrode slurry. Emissions are controlled using activated carbon adsorbers. Emissions are calculated using a facility provided emissions estimation (post control) of 6.0 ppmv VOC. The PTE of VOC emissions has been calculated to be 23.57 tpy from buildings 1 and 2.

EU05 Laboratories, Quality Evaluation 1+2:

The main VOC emitted is the NMP in the electrode slurry. Emissions are controlled using activated carbon adsorbers. Emissions are calculated using a facility provided emissions estimation (post control) of 6.0 ppmv VOC. The PTE of VOC emissions has been calculated to be 23.17 tpy from buildings 1 and 2.

EU06 Natural Gas-Fired Boilers:

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using AP-42 factors. The PTE of VOC emissions has been calculated to be 6.24 tpy from buildings 1 and 2.

EU07 Natural Gas-Fired Hot Oil Heaters:

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using AP-42 factors. The PTE of VOC emissions has been calculated to be 12.19 tpy from buildings 1 and 2.

EU08 Diesel Fired Emergency Engines:

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using 40 CFR 60, Subpart IIII table 4 limits for the fire pumps and 40 CFR 1039 Appendix I limits for the other emergency generators. 500 hours of annual operation were assumed for the purposes of calculating potential to emit. The PTE of VOC emissions has been calculated to be 35.14 tpy from buildings 1 and 2.

EU10 Storage Tanks:

VOC is emitted in the tank's working and breathing losses. The VOC emitted is NMP. VOC emissions are calculated using AP-42 Section 7.1. The PTE of VOC emissions has been calculated to be 0.23 tpy from buildings 1 and 2.

EU11 Printing:

VOC is emitted from the use of printing ink and solvent. VOC emissions are calculated using mass balances. The PTE of VOC emissions has been calculated to be 1.90 tpy from buildings 1 and 2.

EU13 Natural Gas-Fired Dehumidification Units:

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using AP-42 factors. The PTE of VOC emissions has been calculated to be 4.35 tpy from buildings 1 and 2.

EU14 Fired Natural Gas-Fired Building Air Handling Units:

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using AP-42 factors. The PTE of VOC emissions has been calculated to be 1.42 tpy from buildings 1 and 2.

EU15 Fired Natural Gas-Fired Office Air Handling Units:

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using AP-42 factors. The PTE of VOC emissions has been calculated to be 1.42 tpy from buildings 1 and 2.

EU16 Fired Natural Gas-Fired Office Air Handling Units:

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using AP-42 factors. The PTE of VOC emissions has been calculated to be 3.89 tpy from buildings 1 and 2.

VOC PSD Significance

The emissions calculations, using the planned throughputs and accepted emission factors for each piece of equipment, show that potential source-wide VOC emissions are estimated to be 519.0 tpy. This emission rate exceeds the PSD major stationary source threshold of 250 tpy. Since the major stationary source threshold for VOC is exceeded, a BACT analysis for VOC is required for each piece of equipment that emits VOC. Establishment of a BACT for the emission of VOC for each emission point that emits VOC is also required. Refer to the **BACT Analysis for VOC**, below, for a discussion of the BACT for VOC.

C. Nitrogen Oxides (NOx) Emissions

NOx emissions originate from the combustion of fossil fuels.

EU06 Natural Gas-Fired Boilers:

NOx emissions are calculated using the manufacturer's burner specification. The PTE of NOx emissions has been calculated to be 12.64 tpy from buildings 1 and 2.

EU07 Natural Gas-Fired Hot Oil Heaters:

NOx emissions are calculated using the manufacturer's burner specification. The PTE of NOx emissions has been calculated to be 54.88 tpy from buildings 1 and 2.

EU08 Diesel Fired Emergency Engines:

NOx emissions are calculated using 40 CFR 60, Subpart IIII table 4 limits for the fire pumps and 40 CFR 1039 Appendix I limits for other emergency generators. 500 hours of annual operation were assumed for the purposes of calculating potential to emit. The PTE of NOx emissions has been calculated to be 35.14 tpy from buildings 1 and 2.

EU13 Natural Gas-Fired Dehumidification Units:

NOx emissions are calculated using the manufacturer's burner specification. The PTE of NOx emissions has been calculated to be 87.10 tpy from buildings 1 and 2.

EU14 Fired Natural Gas-Fired Building Air Handling Units:

NOx emissions are calculated using the manufacturer's burner specification. The PTE of NOx emissions has been calculated to be 17.55 tpy from buildings 1 and 2.

EU15 Fired Natural Gas-Fired Office Air Handling Units:

NOx emissions are calculated using the manufacturer's burner specification. The PTE of NOx emissions has been calculated to be 17.55 tpy from buildings 1 and 2.

EU16 Fired Natural Gas-Fired Office Air Handling Units:

NOx emissions are calculated using the manufacturer's burner specification. The PTE of NOx emissions has been calculated to be 21.92 tpy from buildings 1 and 2.

NOx PSD Significance

The emissions calculations, using the planned throughputs and accepted emission factors for each piece of equipment, show that potential source-wide NOx emissions are estimated to be 246.8 tpy. This emission rate exceeds the PSD significant emission rate threshold of 40 tpy. Since the major stationary source threshold for VOC and subsequently the significant emission rate for NOx is exceeded, a BACT analysis for NOx is required for each piece of equipment that emits NOx. Establishment of a BACT for the emission of NOx for each emission point that emits NOx is also required. Refer to the **BACT Analysis for NOx**, below, for a discussion of the BACT for NOx.

D. Carbon Monoxide (CO) Emissions

CO emissions originate from the combustion of fossil fuels.

EU06 Natural Gas-Fired Boilers:

CO emissions are calculated using the manufacturer's burner specification. The PTE of CO emissions has been calculated to be 42.74 tpy from buildings 1 and 2.

EU07 Natural Gas-Fired Hot Oil Heaters:

CO emissions are calculated using the manufacturer's burner specification. The PTE of CO emissions has been calculated to be 83.53 tpy from buildings 1 and 2.

EU08 Diesel Fired Emergency Engines:

CO emissions are calculated using 40 CFR 60, Subpart IIII table 4 limits for the fire pumps and 40 CFR 1039 Appendix I limits for other emergency generators. 500 hours of annual operation were assumed for the purposes of calculating potential to emit. The PTE of CO emissions has been calculated to be 19.85 tpy from buildings 1 and 2.

EU13 Natural Gas-Fired Dehumidification Units:

CO emissions are calculated using the manufacturer's burner specification. The PTE of CO emissions has been calculated to be 14.89 tpy from buildings 1 and 2.

EU14 Fired Natural Gas-Fired Building Air Handling Units:

CO emissions are calculated using the manufacturer's burner specification. The PTE of CO emissions has been calculated to be 9.71 tpy from buildings 1 and 2.

EU15 Fired Natural Gas-Fired Office Air Handling Units:

CO emissions are calculated using the manufacturer's burner specification. The PTE of CO emissions has been calculated to be 9.71 tpy from buildings 1 and 2.

EU16 Fired Natural Gas-Fired Office Air Handling Units:

CO emissions are calculated using the manufacturer's burner specification. The PTE of CO emissions has been calculated to be 26.68 tpy from buildings 1 and 2.

CO PSD Significance

The emissions calculations, using the planned throughputs and accepted emission factors for each piece of equipment, show that potential source-wide CO emissions are estimated to be 207.1 tpy. This emission rate exceeds the PSD significant emission rate threshold of 100 tpy. Since the major stationary source threshold VOC and subsequently the significant emission rate for CO is exceeded, a BACT analysis for CO is required for each piece of equipment that emits CO. Establishment of a BACT for the emission of CO for each emission point that emits CO is also required. Refer to the **BACT Analysis for CO**, below, for a discussion of the BACT for CO.

E. Greenhouse Gas (GHG) Emissions

Greenhouse gas emissions (represented as CO_{2e}) originate from the combustion of fossil fuels.

EU06 Natural Gas-Fired Boilers:

CO_{2e} emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. The PTE of CO_{2e} emissions has been calculated to be 135,403 tpy from buildings 1 and 2.

EU07 Natural Gas-Fired Hot Oil Heaters:

CO_{2e} emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. The PTE of CO_{2e} emissions has been calculated to be 264,651 tpy from buildings 1 and 2.

EU08 Diesel Fired Emergency Engines:

CO_{2e} emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. 500 hours of annual operation were assumed for the purposes of calculating potential to emit. The PTE of CO_{2e} emissions has been calculated to be 3,952 tpy from buildings 1 and 2.

EU13 Natural Gas-Fired Dehumidification Units:

CO_{2e} emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. The PTE of CO_{2e} emissions has been calculated to be 94,174 tpy from buildings 1 and 2.

EU14 Fired Natural Gas-Fired Building Air Handling Units:

CO_{2e} emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. The PTE of CO_{2e} emissions has been calculated to be 30,709 tpy from buildings 1 and 2.

EU15 Fired Natural Gas-Fired Office Air Handling Units:

CO_{2e} emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. The PTE of CO_{2e} emissions has been calculated to be 30,709 tpy from buildings 1 and 2.

EU16 Fired Natural Gas-Fired Office Air Handling Units:

CO_{2e} emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. The PTE of CO_{2e} emissions has been calculated to be 84,347 tpy from buildings 1 and 2.

Greenhouse Gas (GHG) PSD Significance

Based on the submitted emission factors and calculations, the potential CO_{2e} emissions for the new facility are estimated to be 643,945 tpy of CO_{2e}. This emission rate exceeds the PSD significant emission rate threshold of 75,000 tpy for CO_{2e}. Since the SER for GHGs and at least one other PSD pollutant are exceeded, a BACT analysis for GHG is required for each piece of equipment that emits GHG. Establishment of a BACT for the emission of GHG for each emission point that emits GHG is also required. Refer to the **BACT Analysis for GHG**, below, for a discussion of the BACT for GHG.

II. Revised BACT Analysis (V-21-041 R2)

The following is a summary of the various BACT analyses and the limits and requirements attributed to each emission unit. This discussion is separated into parts, on a per pollutant basis, with first VOC being discussed, then NO_x, then CO, then GHG. At the beginning of each pollutant section, there is an overview of the control technologies and methods reviewed for that pollutant. The technology summary will be followed by a summary of the BACT for each unit on a per unit basis. Some units will be grouped together for convenience. For example, all units whose VOC was controlled by activated carbon adsorbers have the same analysis and standards applied.

A. BACT Analysis for VOC

Technologies Reviewed:

Adsorption

Adsorption controls VOC by adsorbing gaseous compounds on the surface of a solid material. The adsorbent typically used is activated carbon due to its highly porous nature. The VOC-laden gases pass through the carbon bed, and the VOC is adsorbed on the activated carbon. The cleaned gas is discharged to the atmosphere. The spent carbon is regenerated either at an on-site regeneration facility or by an off-site activated carbon supplier by using steam to replace adsorbed organic compounds at high temperatures.

Thermal Incinerators

Incineration destroys VOC by oxidizing them to carbon dioxide and water. If nitrogen-containing compounds are contained within the exhaust stream, using oxidation technology for VOC control can produce NO_x as a “collateral emissions” impact of reducing VOC emissions. Any VOC heated to a sufficiently high temperature in the presence of oxygen will burn or oxidize. Common thermal incinerators include thermal oxidizers, recuperative thermal oxidizers, and regenerative thermal oxidizers. These three technologies generally achieve VOC destruction in the same manner. However, straight thermal oxidizers do not include any heat recovery while heat is recovered in recuperative thermal oxidizers via heat exchangers and in regenerative thermal oxidizers via a ceramic-packed bed. Thermal incinerators require an operating temperature above the materials ignition temperature, which is typically greater than 1,000°F.

Catalytic Incinerators

Catalytic incinerators are similar to thermal incinerators except oxidation occurs in the presence of a catalyst. Common examples include catalytic oxidizers and regenerative catalytic oxidizers. With the catalyst, the same VOC destruction rate can be achieved at a lower temperature. Typical operating temperatures range from 600°F to 800°F.

Absorption

With absorption, VOC is removed from a gaseous stream via liquid solvent. There are a variety of design options, but the most common system is known as a packed tower wet scrubber. With this device, the solute in the gas stream is absorbed by the liquid solvent running counter current through the tower. The cleaned gas is discharged to the atmosphere. The recovered solvent can then be further processed by stripping or desorbing to remove the solute.

Condensation

Condensers utilize a cooling media to condense and recover volatile organics. The choice of the cooling media is based on the condensation point of the VOC to be controlled and is typically water or refrigerant.

Alternative Raw Materials

Alternative solvent materials with lower VOC contents could be considered as a potential control option for BACT.

Oxidation Catalyst

Oxidation catalysts are exhaust treatment devices which enhance oxidation of VOC, without the addition of any chemical reagents, because there is sufficient oxygen in the exhaust gas stream for the oxidation reactions to proceed in the presence of the catalyst alone. Typically, precious metals are used as the catalyst to promote oxidation. The activity of oxidation catalysts is dependent on the amount of particulate in the flue gas stream and the flue gas temperature.

Good Combustion Practices

The use of good combustion practices optimizes combustion in the boilers and hot oil heaters. Ensuring that the temperature and oxygen availability are adequate for complete combustion minimizes VOC emissions. This technique includes continued operation of the boilers at the appropriate oxygen range and temperature.

Work Practice Standards

For storage tanks, this means having submerged fill lines and spill and overfill protection. For date coding printers, this means keeping VOC materials in closed containers.

i. Battery Manufacturing:

EU01, Cathode Processing and Anode Processing (KY1-CP01 - KY1-CP16, KY1-AP01 - KY1-AP16 KY2-CP01 – KY2-CP16, KY2-AP01 – KY2-AP16)

EU01, Electrode Cleaning (KY1- CR01 - KY1-CR08, KY2- CR01 - KY2-CR08)

EU02 Battery Assembly,

Vacuum Dryer (KY1-VD01 - KY1-VD16, KY2-VD01 - KY2-VD16)

Electrolyte Filling and Sealing (KY1-EL01 - KY1-EL16, KY2-EL01 - KY2-EL16),

Cathode Press (KY1-CS01 - KY1-CS04, KY2-CS01 - KY2-CS12)

Anode Press (KY1-AS01 - KY1-AS04, KY2-AS01 - KY2-AS12)

EU03 Battery Formation, Cell Degassing (KY1-DG01 - KY1-DG56, KY2-DG01 - KY2-DG56)

EU04 Cell Discharge (KY1-CD01 - KY1-CD08, KY2-CD01 - KY2-CD08)

EU05 Laboratories, Quality Evaluation 1+2 (KY1-QE01 - KY1-QE15, KY2-QE01 - KY2-QE17)
EU01, Cathode Drying (KY1-DR01 - KY1-DR08, KY2-DR01 - KY2-DR08)

Decision Summary:

The following BACT standards apply to the affected facilities:

EMISSION LIMITATIONS
4.5 ppmv VOC (as NMP) post-control for adsorbers based on 3-hr block average basis (EU01 Cathode and Anode Processing and EU01 Electrode Cleaning)
6.0 ppmv VOC (as electrolyte) post-control for adsorbers based on 3-hr block average basis (EU02 through EU05)
2.0 ppmv VOC post-control for scrubbers based on 3-hr block average basis (EU01 Cathode Drying)
9,969 lbs VOC total, for all listed battery manufacturing sources in Building #1, per GWh batteries produced on a rolling 12 month basis. This will apply after production ramp-up period of achieving 90% production capacity or 24 months after startup on a per building basis is reached.
<i>Initial Temporary</i> 214.4 tons VOC total for all listed sources (In Building #1) per rolling 12-month basis, used for a facility production ramp-up period after startup.
11,068 lbs VOC total, for all listed battery manufacturing sources in Building #2, per GWh batteries produced on a rolling 12 month basis. This will apply after production ramp-up period of achieving 90% production capacity or 24 months after startup on a per building basis is reached.
<i>Initial Temporary</i> 238.0 tons VOC total for all listed sources (In Building #2) per rolling 12-month basis, used for a facility production ramp-up period after startup.

Technologies:

The following technologies were reviewed for the above battery manufacturing sources: Adsorption, Thermal Incinerators, Catalytic Incinerators, Absorption, Condensation, Alternative Raw Materials

Rank	Control Option	Control Efficiency (%)
1	Adsorption Regenerative Thermal Incinerator Catalytic Incinerator	~98%
2	Absorption	90%
3	Condensation	73%

Analysis:

To preface, top down BACT was applied to all non-cathode drying sources as if there were no controls to begin with. BACT for the cathode drying scrubbers was different, as the scrubbers are treated as inherent equipment. So BACT for the cathode drying sources was applied post scrubber control.

Using alternative raw materials was determined to be infeasible since the use of NMP was necessary for the process operations.

For the Non-cathode dryer sources, adsorption was considered the top ranked control method and was chosen to control VOC emissions. Since the most effective method is being used, no further BACT analysis is required.

For the cathode dryer sources, it was necessary to determine if add-on controls after absorption were necessary. Using Adsorption, BlueOval’s cost calculations determined the estimated annual costs in 2020 dollars to be \$20,000/ton of VOC removed. Using Incineration, BlueOval’s cost calculations determined the estimated annual costs in 2002 dollars to be \$164,780/ton of VOC removed with catalytic incineration costs assumed to be equal or higher. These costs were found to be prohibitive, so no additional add-on controls after the scrubbers are required for BACT.

ii. Boilers and Hot Oil Heaters:

EU06 Natural Gas-Fired Boilers (KY1-B01 - KY1-B11, KY2-B01 - KY2-B11)

EU07 Natural Gas-Fired Hot Oil Heaters (KY1-H01 - KY1-H10, KY2-H01 – KY2-H10)

Decision Summary:

The following BACT standards apply to the affected facilities:

For EU06:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
VOC	0.0054 lb/MMBtu	0.28 tpy for each unit (3.12 tpy for all 11 units per building)

For EU07:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
VOC	0.0054 lb/MMBtu	0.66 tpy for each unit (3.28 tpy for all five 27.8 MMBtu/hr units per building)
		0.56 tpy for each unit (2.81 tpy for all five 23.8 MMBtu/hr units per building)

For both EU06 and EU07

The facility is required to combust pipeline quality natural gas only, operate and maintain each unit and associated analyzers per manufacturer recommendations.

Technologies:

The following technologies were reviewed for the above sources: Oxidation Catalyst, Good Combustion Practices

Rank	Control Option	Control Efficiency (%)
1	Oxidation Catalyst	98%
2	Good Combustion Practices	undefined

Analysis:

Using an oxidation catalyst, BlueOval’s cost calculations determined the estimated annual costs to be \$175,500/ton VOC removed for the boilers and \$126,900/ton VOC removed for the oil heaters. This is prohibitively expensive, so good combustion practices have been established as BACT.

iii. Emergency Engines:

EU08 Diesel Fired Emergency Engines (KY1-FPE01 - KY1-FPE03, KY1-GE01 - KY1-GE05, KY2-GE01 - KY2-GE04)

Decision Summary:

The following BACT standards apply to the affected facilities:
 For the Fire Pumps:

Pollutant	Emission Standard (g/KW-hr)	Emission Standard (g/HP-hr)
NO _x + NMHC (NO _x BACT) (VOC BACT)	4.0	3.0

For the other generators:

Pollutant	Emission Standard (g/KW-hr)
NO _x + NMHC (NO _x BACT) (VOC BACT)	6.4

Analysis:

The BACT standards for the fire pumps and emergency generators are to comply with the applicable limits of 40 CFR 60, Subpart IIII that apply.

iv. Storage Tanks:

EU10 Storage Tanks

- (KY1-RT01 - KY1-RT04, KY2-RT01 - KY2-RT04)
- (KY1-WT01 - KY1-WT08, KY2-WT01 - KY2-WT08)
- (KY1-ET01 - KY1-ET08, KY2-ET01 - KY2-ET08)
- (KY1-EST101, KY2-EST101)

- (KY1-EST201, KY2-EST201)
- (KY1-EWT01, KY2-EWT01)

Decision Summary:

The following BACT standards apply to the affected facilities:

- All storage tanks shall be equipped with permanent submerged fill pipes and
- All storage tanks shall be equipped with spill and overfill protection.

Technologies:

Work Practice Standards are used.

Analysis:

The storage tanks are white, above ground, fixed roof storage tanks. Submerged fill lines and spill and overfill protection were added as BACT for storage tank facilities.

v. **Date Code Printing:**

EU11 Printing (KY1-PI01, KY2-PI01)

Decision Summary:

The following BACT standards apply to the affected facilities:

All inks, solvents, and makeup fluid used shall be stored in closed, vapor tight, containers.

Technologies:

Work Practice Standards are used.

Analysis:

The affected facility is a date coding printer. Including add-on controls would not be feasible. The BACT applied is to store volatile materials in closed, vapor tight, containers.

vi. **Dehumidification and Air Handling Units:**

EU13 Natural Gas-Fired Dehumidification Units (KY1-DH01 – KY1-DH46, KY2-DH01 – KY2-DH46)

EU14 Fired Natural Gas-Fired Building Air Handling Units (KY1-BA01 – KY1-BA10, KY2-BA01 – KY2-BA10)

EU15 Fired Natural Gas-Fired Office Air Handling Units (KY1-OA01 – KY1-OA10, KY2-OA01 – KY2-OA10)

EU16 Fired Natural Gas-Fired Office Air Handling Units (KY1-COD01 – KY1-COD16, KY2-COD01 – KY2-COD16)

Decision Summary:

The following BACT standards apply to the affected facilities:

Pollutant	Emission Limitation (based on 3-hr block average)
VOC	0.0054 lb/MMBtu

The facility shall only combust pipeline quality natural gas and shall maintain and operate the units (including start up and shut down) in accordance with manufacturer's recommendations.

Technologies:

Good Combustion Practices are used.

Analysis:

Oxidation catalysts were considered not an available control option for the humidification and air handling units because of interferences with highly controlled process supply air, the integrated environmental controls that link the heaters to fans and other temperature controlling and humidification equipment, and the lack of discharge ducts for some units. As such, good combustion practices have been established as BACT.

B. BACT Analysis for NO_x

Technologies Reviewed:

Selective Catalytic Reduction (SCR)

SCR is a post-combustion control technology that reduces NO_x emissions by injecting a nitrogen-based reagent (e.g., ammonia, urea) into the exhaust stream downstream of the combustion unit and upstream of a catalyst bed. On the catalyst surface, the reagent reacts selectively with NO_x to produce molecular nitrogen and water vapor.

Selective Non-catalytic Reduction (SNCR)

SNCR is similar to SCR in that it is based on the reaction of urea or ammonia with NO_x. However, unlike SCR, SNCR does not involve a catalyst.

Low-NO_x and Ultra-Low-NO_x burners

Low-NO_x and ultra-low-NO_x burners reduce NO_x formation through staged combustion and burner design. The first stage is the primary fuel combustion step. The next stage involves reburning to further reduce NO_x. The third stage is the final combustion stage in low excess air to limit the temperature.

Flue Gas Recirculation (FGR)

With FGR, a portion of the flue gas is recycled back to the combustion zone. NO_x emissions are reduced through two mechanisms: diluting oxygen content and reducing combustion zone temperature.

Good Combustion Practices

Boiler and oil heater maintenance and efficient operation in accordance with the manufacturer's recommendations will ensure NO_x emissions are minimized.

i. Boilers and Hot Oil Heaters:

EU06 Natural Gas-Fired Boilers (KY1-B01 - KY1-B11, KY2-B01 - KY2-B11)

EU07 Natural Gas-Fired Hot Oil Heaters (KY1-H01 - KY1-H10, KY2-H01 - KY2-H10)

Decision Summary:

The following BACT standards apply to the affected facilities:

For EU06:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
NO _x	9 ppm at 3% O ₂ equivalent to 0.0243 lb/MMBtu	0.57 tpy for each unit (6.32 tpy for all 11 units per building)

For EU07:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
NO _x	20 ppm at 3% O ₂ equivalent to 0.0243 lb/MMBtu	2.95 tpy for each unit (14.77 tpy for all five 27.8 MMBtu/hr units per building)
		2.53 tpy for each unit (12.66 tpy for all five 23.8 MMBtu/hr units per building)

For both EU06 and EU07

The facility is required to combust pipeline quality natural gas only, operate and maintain each unit and associated analyzers per manufacturer recommendations.

Technologies:

The following technologies were reviewed for the above sources: Selective Catalytic Reduction (SCR), Selective Non-catalytic Reduction (SNCR), Low-NO_x and Ultra-Low-NO_x burners, Flue Gas Recirculation (FGR), and Good Combustion Practices.

Rank	Control Option	Control Efficiency (%)
1	SCR	90%
2	Ultra-Low-NO _x Burners	75%-80%
3	Low-NO _x Burners	38%-63%
4	FGR	63%
5	Good Combustion Practices	undefined

Analysis:

There are no known cases of using SNCR on natural gas fired boilers or oil heaters less than 100 MMBtu/hr so SNCR is considered to be technically infeasible. Using SCR, BlueOval's cost calculations determined the estimated annual costs to be \$61,000/ton NO_x removed for the boilers and \$39,300/ton NO_x removed for the oil heaters in 2020 dollars. SCR costs are prohibitively expensive, so the facility has chosen not to use them. The BACT emission limitations of 9 ppm and 20 ppm at 3% O₂ will be achieved by using good combustion practices and staged combustion with or without flue gas recirculation.

ii. Emergency Generators:

EU08 Diesel Fired Emergency Engines (KY1-FPE01 - KY1-FPE03, KY1-GE01 - KY1-GE05, KY2-GE01 - KY2-GE04)

Decision Summary:

The following BACT standards apply to the affected facilities:
 For the Fire Pumps:

Pollutant	Emission Standard (g/KW-hr)	Emission Standard (g/HP-hr)
NO _x + NMHC (NO _x BACT) (VOC BACT)	4.0	3.0

For the other generators:

Pollutant	Emission Standard (g/KW-hr)
NO _x + NMHC (NO _x BACT) (VOC BACT)	6.4

Analysis:

The BACT standards for the fire pumps and emergency generators are to comply with the applicable limits of 40 CFR 60, Subpart IIII that apply.

iii. Dehumidification and Air Handling Units:

EU13 Natural Gas-Fired Dehumidification Units (KY1-DH01 – KY1-DH46, KY2-DH01 – KY2-DH46)

EU14 Fired Natural Gas-Fired Building Air Handling Units (KY1-BA01 – KY1-BA10, KY2-BA01 – KY2-BA10)

EU15 Fired Natural Gas-Fired Office Air Handling Units (KY1-OA01 – KY1-OA10, KY2-OA01 – KY2-OA10)

EU16 Fired Natural Gas-Fired Office Air Handling Units (KY1-COD01 – KY1-COD16, KY2-COD01 – KY2-COD16)

Decision Summary:

The following BACT standards apply to the affected facilities:

Pollutant	Emission Limitation (based on 3-hr block average)
NO _x	89 ppm at 3% O ₂ equivalent to 0.037 lb/MMBtu (EU13)
	55 ppm at 3% O ₂ equivalent to 0.043 lb/MMBtu (EU14, EU15)
	50 ppm at 3% O ₂ equivalent to 0.037 lb/MMBtu (EU16)

The facility shall only combust pipeline quality natural gas and shall maintain and operate the units (including start up and shut down) in accordance with manufacturer's recommendations.

Technologies:

The following technologies were reviewed for the above sources: Low-NOx and Ultra-Low-NOx burners and Good Combustion Practices

Rank	Control Option	Control Efficiency (%)
1	Ultra-Low-NOx Burners	57%
2	Low-NOx Burners	14%-38%
3	Good Combustion Practices	undefined

Analysis:

The BACT emission limitations will be achieved by using good combustion practices and staged combustion.

C. BACT Analysis for CO

Technologies Reviewed:

Oxidation Catalyst

Oxidation catalysts are exhaust treatment devices which enhance oxidation of CO to CO₂, without the addition of any chemical reagents, because there is sufficient oxygen in the exhaust gas stream for the oxidation reactions to proceed in the presence of the catalyst alone. Typically, precious metals are used as the catalyst to promote oxidation. The activity of oxidation catalysts is dependent on the amount of particulate in the flue gas stream and the flue gas temperature.

Good Combustion Practices

The use of good combustion practices optimizes combustion in the boilers and hot oil heaters. Ensuring that the temperature and oxygen availability are adequate for complete combustion minimizes CO emissions. This technique includes continued operation of the boilers at the appropriate oxygen range and temperature.

i. Boilers and Hot Oil Heaters:

EU06 Natural Gas-Fired Boilers (KY1-B01 - KY1-B11, KY2-B01 - KY2-B11)

EU07 Natural Gas-Fired Hot Oil Heaters (KY1-H01 - KY1-H10, KY2-H01 – KY2-H10)

Decision Summary:

The following BACT standards apply to the affected facilities:

For EU06:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
CO	50 ppm at 3% O ₂ equivalent to 0.037 lb/MMBtu	1.94 tpy for each unit (21.37 tpy for all 11 units per building)

For EU07:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
CO	50 ppm at 3% O ₂ equivalent to 0.037 lb/MMBtu	4.50 tpy for each unit (22.48 tpy for all five 27.8 MMBtu/hr units per building)
		3.85 tpy for each unit (19.27 tpy for all five 23.8 MMBtu/hr units per building)

For both EU06 and EU07

The facility is required to combust pipeline quality natural gas only, operate and maintain each unit and associated analyzers per manufacturer recommendations.

Technologies:

The following technologies were reviewed for the above sources: Oxidation Catalyst, Good Combustion Practices

Rank	Control Option	Control Efficiency (%)
1	Oxidation Catalyst	50%-90%
2	Good Combustion Practices	undefined

Analysis:

Using an oxidation catalyst, BlueOval's cost calculations determined the estimated annual costs to be \$26,510/ton CO removed for the boilers and \$19,688/ton CO removed for the oil heaters. This is prohibitively expensive, so BACT has been established as good combustion practices.

ii. Emergency Generators:

EU08 Diesel Fired Emergency Engines (KY1-FPE01 - KY1-FPE03, KY1-GE01 - KY1-GE05, KY2-GE01 - KY2-GE04)

Decision Summary:

The following BACT standards apply to the affected facilities:

For the Fire Pumps:

Pollutant	Emission Standard (g/KW-hr)	Emission Standard (g/HP-hr)
CO (CO BACT)	3.5	2.6

For the other generators:

Pollutant	Emission Standard (g/KW-hr)
CO (CO BACT)	3.5

Analysis:

The BACT standards for the fire pumps and emergency generators are to comply with the applicable limits of 40 CFR 60, Subpart IIII that apply.

iii. Dehumidification and Air Handling Units:

EU13 Natural Gas-Fired Dehumidification Units (KY1-DH01 – KY1-DH46, KY2-DH01 – KY2-DH46)

EU14 Fired Natural Gas-Fired Building Air Handling Units (KY1-BA01 – KY1-BA10, KY2-BA01 – KY2-BA10)

EU15 Fired Natural Gas-Fired Office Air Handling Units (KY1-OA01 – KY1-OA10, KY2-OA01 – KY2-OA10)

EU16 Fired Natural Gas-Fired Office Air Handling Units (KY1-COD01 – KY1-COD16, KY2-COD01 – KY2-COD16)

Decision Summary:

The following BACT standards apply to the affected facilities:

Pollutant	Emission Limitation (based on 3-hr block average)
CO	25 ppm at 3% O ₂ equivalent to 0.037 lb/MMBtu (EU13)
	50 ppm at 3% O ₂ equivalent to 0.037 lb/MMBtu (Non-EU13)

The facility shall only combust pipeline quality natural gas and shall maintain and operate the units (including start up and shut down) in accordance with manufacturer’s recommendations.

Technologies:

Good Combustion Practices are used.

Analysis:

Oxidation catalysts were considered not an available control option for the humidification and air handling units because of interferences with highly controlled process supply air, the integrated environmental controls that link the heaters to fans and other temperature controlling and humidification equipment, and the lack of discharge ducts for some units. Good combustion practices have been established as BACT.

D. BACT Analysis for GHG
Technologies Reviewed:

Use of Natural Gas

Using natural gas in lieu of a fuel with higher emissions.

Good Combustion Practices

The use of good combustion practices optimizes combustion in the boilers and hot oil heaters. This technique includes continued operation of the boilers at the appropriate oxygen range and temperature.

Carbon Capture

In general, post-combustion capture involves the removal of CO₂ generated by fuel combustion from the flue gas.

i. Boilers and Hot Oil Heaters:

EU06 Natural Gas-Fired Boilers (KY1-B01 - KY1-B11, KY2-B01 - KY2-B11)

EU07 Natural Gas-Fired Hot Oil Heaters (KY1-H01 - KY1-H10, KY2-H01 - KY2-H10)

Decision Summary:

The following BACT standards apply to the affected facilities:

For EU06:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
CO ₂	117 lb/MMBtu	N/A
CO _{2e}		6,154.68 tpy for each unit (67,701.43 tpy for all 11 units per building)

For EU07:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
CO ₂	117 lb/MMBtu	N/A
CO _{2e}		14,242.95 tpy for each unit (71,214.73 tpy for all five 27.8 MMBtu/hr units per building)
		12,206.77 tpy for each unit (61,033.87 tpy for all five 23.8 MMBtu/hr units per building)

For both EU06 and EU07

The facility is required to combust pipeline quality natural gas only, operate and maintain each unit and associated analyzers per manufacturer recommendations.

Technologies:

The following technologies were reviewed for the above sources: The Use of Natural Gas, Good Combustion Practices, and Carbon Capture.

Analysis:

There are no known cases of using an amine absorption system for GHG BACT on natural gas fired boilers less than 100 MMBtu/hr so Carbon Capture using amine absorption is considered to be technically infeasible. Use of pipeline quality natural gas and good combustion practices has been established as BACT.

ii. Emergency Generators:

EU08 Diesel Fired Emergency Engines (KY1-FPE01 - KY1-FPE03, KY1-GE01 - KY1-GE05, KY2-GE01 - KY2-GE04)

Decision Summary:

The following BACT standards apply to the affected facilities:
For the Fire Pumps:

EMISSION LIMITATIONS
Carbon dioxide equivalent (CO ₂ e) emissions shall not exceed 1.18 lb/hp-hr on a 3-hour block average basis.

For the other generators:

EMISSION LIMITATIONS
Carbon dioxide equivalent (CO ₂ e) emissions shall not exceed 0.99 lb/hp-hr on a 3-hour block average basis.

Analysis:

The applied BACT limits are from emission factors for diesel fuel from 40 CFR 98, Subpart C.

iii. Dehumidification and Air Handling Units:

EU13 Natural Gas-Fired Dehumidification Units (KY1-DH01 – KY1-DH46, KY2-DH01 – KY2-DH46)

EU14 Fired Natural Gas-Fired Building Air Handling Units (KY1-BA01 – KY1-BA10, KY2-BA01 – KY2-BA10)

EU15 Fired Natural Gas-Fired Office Air Handling Units (KY1-OA01 – KY1-OA10, KY2-OA01 – KY2-OA10)

EU16 Fired Natural Gas-Fired Office Air Handling Units (KY1-COD01 – KY1-COD16, KY2-COD01 – KY2-COD16)

Decision Summary:

The following BACT standards apply to the affected facilities:

Pollutant	Emission Limitation (based on 3-hr block average)
CO ₂	117 lb/MMBtu

The facility shall only combust pipeline quality natural gas and shall maintain and operate the units (including start up and shut down) in accordance with manufacturer's recommendations.

Technologies:

The following technologies were reviewed for the above sources: The Use of Natural Gas, Good Combustion Practices, and Carbon Capture.

Analysis:

There are no known cases of using an amine absorption system for GHG BACT on natural gas fired boilers less than 100 MMBtu/hr so Carbon Capture using amine absorption is considered to be technically infeasible. Use of pipeline quality natural gas and good combustion practices has been established as BACT.

E. AIR QUALITY IMPACT ANALYSIS

i. Screening Methodology

The incremental increases in ambient pollutant concentrations associated with the BlueOval SK, LLC (BOSK) project have been estimated through the use of a dispersion model (AERMOD) applied in conformance to applicable guidelines in the United States Environmental Protection Agency (USEPA) Guideline on Air Quality Models (GAQM, 40CFR Appendix W, May 2017) and other applicable guidance.

This revised application presents dispersion modeling analyses for pollutants with increased emissions relative to the original permitting basis. As only site-wide VOC emissions have increased relative to the original permitting basis, this application is limited to a revised quantitative assessment of potential ozone impacts from the proposed project using the approach outlined in EPA’s Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool. Minor increases to NO₂ emissions from natural gas-fired air handling units (AHUs) will not adversely affect the conclusions reached by the full March 2022 modeling evaluation currently on file with KDAQ.

ii. Background Concentrations

Representative background concentrations were added to the maximum predicted concentrations so that small sources that were not explicitly modeled are included in the NAAQS and KYAAQS assessment. Background concentrations are based on ambient monitoring data collected for the most recent three-year period available (2021 through 2023) determined to be the most representative for use in the modeling analysis.

Representative Background Concentrations

Monitoring Location	Site ID	Data Collection Period	Pollutant	Averaging Period	Basis of Design Value	Design Value
Elizabethtown, Ky	21-093-0006	2021-2023	Ozone	8-hour	3-year 4 th high maximum 8-hour average	65 µg/m ³

iii. NO₂ Ambient Impact Analyses

Although site-wide emissions of NO₂ decreased relative to the basis for the March 2022 modeling evaluation this revised application proposes increased NO₂ exhaust concentrations for select categories of combustion equipment. To determine the ambient impacts of these concentration increases, this section presents a revised NO₂ modeling assessment. This analysis uses the results of culpability modeling to adjust the ambient impacts of the combustion equipment by an appropriate scaling factor.

NO2 Emission Rate Scaling Factors

Permit Source ID	Proposed Source ID	Previously Permitted NO _x Emission Rate	Revised NO _x Emission Rate	Model Scaling Factor
EU13A/B	KY1-13 & KY2-13	40.21	87.10	2.17
EU14	KY1-13 & KY2-13	37.98	17.55	0.46
EU15	KY1-13 & KY2-13	7.82	17.55	2.24
EU 16A/B	KY1-13 & KY2-13	80.27	21.91	0.27

In comparison to the results presented in the March 2022 modeling report, NO₂ impacts from the natural gas-fired boilers are expected to decrease. Therefore, the results of the March 2022 modeling report remain valid for the updated design basis presented in this application and no further demonstration of NO₂ impacts is required.

iv. Ozone Formation

The Division has provided recent (November 13, 2024) guidance on addressing secondary pollutant impacts with a state-specific guidance on the application of EPA’s Modeled Emission Rates for Precursors (MERPs) Tier-1 demonstration tool. This guidance was used to assess secondary formation of ozone for this project. A MERP represents a level of precursor emissions that is not expected to contribute significantly to concentrations of ozone.

MERPs are used to determine if proposed emission increases from a facility will result in primary and secondary impacts. NO_x, and VOC emissions from the project must be included in the analysis. If the project emissions from all relevant pollutants are below the SER, no further analysis is required. If the project emissions from any of the relevant emissions are above the SER, a Tier 1 demonstration is required. The Tier 1 demonstration consists of a SILs analysis and, if needed, a cumulative analysis. The analysis must be below the NAAQS for each precursor in order to pass.

BOSK Emission for MERPs Analysis

Precursor	Emissions (tpy)	SER (tpy)
NO _x	246.7	40
VOC	519.0	40

The background concentration for ozone is as follows:

Background Concentrations for MERPs Analysis

Pollutant	Background Concentrations	Monitor ID
Ozone	65 ppb	21-093-0006

If the result of the SIL Analysis is greater than 1, a cumulative analysis is required for that precursor. If the result is less than 1, a cumulative analysis is not required. The SIL analysis results for ozone and PM_{2.5} are as follows:

MERPs SIL Analyses

Pollutant	Analysis Results	Less than 1?
Ozone	1.50	NO

The table below shows the cumulative analysis results for ozone and PM_{2.5}.

MERP Cumulative NAAQS Analysis

Precursor	Analysis	NAAQS	Below NAAQS?
Ozone	66.50 ppb	70 ppb	Yes

SECTION 3 – EMISSIONS, LIMITATIONS AND BASIS

Emission Unit 01: Electrode Manufacturing Processes						
Pollutant	Emission Limit or Standard	Regulatory Basis for Emission Limit or Standard	Emission Factor Used and Basis			Compliance Method
PM	2.34 lbs/hr	401 KAR 59:010, Section 3(2)	EF gr/dscf	KY1- DC	KY2- DC	Maintain Design Documentation proving facility meets ISO 7 cleanroom standards and dust collectors' designs meet outlet grain loading factors
			0.01	N/A	N/A	
			8.54E-5	01-07, 10-19	01- 08,11- 21	
	5.98E-4	08-09, 20-27	09-10, 22-29			
20% opacity	401 KAR 59:010, Section 3(1)	N/A			Weekly Visual Observation of Building	
10% Opacity	40 CFR 63.11601(a)(5)	N/A			EPA Method 22 every three months	
VOC	4.5 ppmv VOC after adsorber	401 KAR 51:017	4.5 ppmv VOC after adsorber			Weekly monitoring of VOC outlet concentration using manual device, initial Method 25A test
VOC	2.0 ppmv VOC after scrubber	401 KAR 51:017	2.0 ppmv VOC after scrubber, confirmed by testing			Initial Method 25A test, continuous NMP concentration monitoring
KY1-VOC (See Section 4 Table A)	9,969 lbs VOC / GWh batteries produced (yearly basis) 214.4 tons VOC total per Building (temporary)	401 KAR 51:017	Emissions Confirmed Via Test Data			Monitor hours of operation (or VOC material throughput and recovery) and GWh of batteries produced
KY2-VOC (See Section 4 Table A)	11,068 lbs VOC / GWh batteries produced (yearly basis) 238.0 tons VOC total per Building (temporary)	401 KAR 51:017	Emissions Confirmed Via Test Data			Monitor hours of operation (or VOC material throughput and recovery) and GWh of batteries produced

Emission Unit 01: Electrode Manufacturing Processes

Initial Construction Date: 5/2022

Process Description:

Source #	Unit Name	Control Device	Applicable Regulations
KY1-PR01 - KY1-PR08	Powder Room: Anode Measure (Building 1)	Dust Collector KY1-DC01 -KY1-DC27	401 KAR 59:010
KY1-PR17 - KY1-PR24	Powder Room: Anode Feed (Building 1)	Dust Collector KY1-DC01 -KY1-DC27	401 KAR 59:010
KY1-PR76 - KY1-PR83	Anode Mixer Vacuum Pump (Building 1)	No Dust Collector, Building Enclosure	401 KAR 59:010
KY1-PR84 - KY1-PR91	Anode Powder Vacuum Pump (Building 1)	No Dust Collector, Building Enclosure	401 KAR 59:010
KY1-PR92 - KY1-PR173	Anode Powder (Building 1)	Dust Collector KY1-DC10 -KY1-DC27	401 KAR 59:010 40 CFR 63, Subpart CCCCCCC
KY1-PR09 - KY1-PR16	Powder Room: Cathode Measure (Building 1)	Dust Collector KY1-DC01 -KY1-DC27	401 KAR 59:010 40 CFR 63, Subpart CCCCCCC
KY1-PR25 - KY1-PR32	Powder Room: Cathode Feed (Building 1)	Dust Collector KY1-DC01 -KY1-DC27	401 KAR 59:010 40 CFR 63, Subpart CCCCCCC
KY1-PR33 - KY1-PR40	Cathode Powder Vacuum Pump (Building 1)	No Dust Collector, Building Enclosure	401 KAR 59:010 40 CFR 63, Subpart CCCCCCC
KY1-PR41 - KY1-PR75	Cathode Powder (Building 1)	Dust Collector KY1-DC01 -KY1-DC09	40 CFR 63, Subpart CCCCCCC
KY1-CP01 - KY1-CP16	Cathode/Anode Processing (Building 1)	Activated Carbon KY1-AC01	401 KAR 51:017 40 CFR 63, Subpart CCCCCCC

Emission Unit 01: Electrode Manufacturing Processes				
KY1-AP01 - KY1-AP16				
KY1-CR01 - KY1-CR08	Electrode Cleaning (Building 1)	Activated Carbon KY1-AC02 -KY1-AC03	401 KAR 51:017 40 CFR 63, Subpart CCCCCC	
KY1-DR01 - KY1-DR08	Cathode Drying (Building 1)	Scrubber KY1-SC01 - KY1-SC08	401 KAR 51:017 40 CFR 63, Subpart CCCCCC	
KY2-PR01 - KY2-PR08	Powder Room: Anode Measure (Building 2)	Dust Collector KY2-DC01 - KY2-DC29	401 KAR 59:010	
KY2-PR17 - KY2-PR24	Powder Room: Anode Feed (Building 2)	Dust Collector KY2-DC01 - KY2-DC29	401 KAR 59:010	
KY2-PR82 - KY2-PR89	Anode Mixer Vacuum Pump (Building 2)	No Dust Collector, Building Enclosure	401 KAR 59:010	
KY2-PR90 - KY2-PR97	Anode Powder Vacuum Pump (Building 2)	No Dust Collector, Building Enclosure	401 KAR 59:010	
KY2-PR98 - KY2-PR187	Anode Powder (Building 2)	Dust Collector KY2-DC11 - KY2-DC29	401 KAR 59:010 40 CFR 63, Subpart CCCCCC	
KY2-PR09 - KY2-PR16	Powder Room: Cathode Measure (Building 2)	Dust Collector KY2-DC01 - KY2-DC29	401 KAR 59:010 40 CFR 63, Subpart CCCCCC	
KY2-PR25 - KY2-PR32	Powder Room: Cathode Feed (Building 2)	Dust Collector KY2-DC01 - KY2-DC29	401 KAR 59:010 40 CFR 63, Subpart CCCCCC	
KY2-PR33 - KY2-PR40	Cathode Powder Vacuum Pump (Building 2)	No Dust Collector, Building Enclosure	401 KAR 59:010 40 CFR 63, Subpart CCCCCC	
KY2-	Cathode Powder (Building 2)	Dust Collector KY2-	401 KAR 59:010	

Emission Unit 01: Electrode Manufacturing Processes				
PR41 - KY2- PR81		DC01 - KY2-DC10	40 CFR 63, Subpart CCCCCCC	
KY2- CP01 – KY2- CP16 KY2- AP01 – KY2- AP16	Cathode/Anode Processing (Building 2)	Activated Carbon KY2- AC01	401 KAR 51:017 40 CFR 63, Subpart CCCCCCC	
KY2- CR01 - KY2- CR08	Electrode Cleaning (Building 2)	Activated Carbon KY2- AC02-KY2-AC03	401 KAR 51:017 40 CFR 63, Subpart CCCCCCC	
KY2- DR01 - KY2- DR08	Cathode Drying (Building 2)	Scrubber KY2-SC01 - KY2-SC08	401 KAR 51:017 40 CFR 63, Subpart CCCCCCC	

Building 1 processes: KYEIS ID: KY1-01

Building 2 processes: KYEIS ID: KY2-01

Applicable Regulation:

401 KAR 51:017, *Prevention of significant deterioration of air quality*, applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).

401 KAR 59:010, *New process operations* applies to each affected facility or source, associated with a process operation, which is not subject to another emission standard with respect to particulates in 401 KAR Chapter 59, commenced on or after July 2, 1975.

401 KAR 63:002, Section 2(4)(aaaaa) 40 C.F.R. 63.11599 through 63.11607, Table 1 (Subpart CCCCCC), *National Emission Standards for Hazardous Air Pollutants for Area Sources: Paints and Allied Products Manufacturing* is applicable to paints and allied products manufacturing that is an area source of hazardous air pollutant (HAP) emissions and processes, uses, or generates materials containing HAP, as defined in 40 CFR 63.11607.

Non-applicable Regulations:

401 KAR 60:005, Section 2(2)(zz) 40 C.F.R. 60.460 through 60.466 (Subpart TT), *Standards of Performance for Metal Coil Surface Coating* 40 CFR 60, Subpart TT is non-applicable because the anode/cathode material will be applied to a metallic foil with a thickness of less than 0.15 mm.

401 KAR 63:002, Section 2(4)(xxx) 40 C.F.R. 63.5080 through 63.5200, Tables 1 through 3 (Subpart SSSS), *National Emission Standards for Hazardous Air Pollutants: Surface Coating of Metal Coil* 40 CFR

Emission Unit 01: Electrode Manufacturing Processes

63, Subpart SSSS is non-applicable because the anode/cathode material will be applied to a metallic foil with a thickness of less than 0.15 mm.

401 KAR 60:005, Section 2(2)(xxx), 40 C.F.R. 60.740 through 60.748 (Subpart VVV), *Standards of Performance for Polymeric Coating of Supporting Substrates Facilities* 40 CFR 60, Subpart VVV does not apply to facilities that coat metallic foil.

401 KAR 63:002, Section 2(4)(rrr) 40 C.F.R. 63.3880 through 63.3981, Tables 1 through 5, and Appendix A (Subpart MMMM), *National Emission Standards for Hazardous Air Pollutants for Surface Coating of Miscellaneous Metal Parts and Products* 40 CFR 63, Subpart MMMM does not apply because the facility applies non-HAP coatings. The quantity of Metal HAP in the cathode is below the 1.0% by mass threshold required by the definition of Non-HAP coating in the regulation.

401 KAR 59:225, *New miscellaneous metal parts and products surface coating operations* 401 KAR 59:225 does not apply because the facility is neither a job shop, nor an original equipment manufacturing industry.

Comments:

40 CFR 63 Subpart CCCCCC

The facility does not use lead, cadmium, chromium, benzene, or methylene chloride.

Dust Collector Controlled Processes Comments

Particulate matter emissions are calculated using an outlet grain loading assumption based upon manufacturer specifications (post dust collector (DC)) with 0.01 gr/scf being assumed for the uncontrolled vacuum pumps, for each emission source. An additional 90% particulate matter control is assumed for ventilation within the building enclosure. This 90% is in consideration of the building's special ventilation conditions that are a result of maintaining clean room environments within the facility that result in a high amount of recirculated air that will recirculate through the associated dust collectors. Also, there are HEPA filters in the ventilation system as well. The dust collectors are considered inherent process equipment because they are for maintaining the cleanroom manufacturing environment and are not explicitly for the purpose of reducing PM emissions. The facility will be meeting ISO 7 cleanroom design standards, which is less than 352,000 particles of less than 0.5 microns per cubic meter and 60 HEPA-filtered air changes per hour.

Because the anode/cathode measure and feed processes share dust collectors with the Anode and Cathode powder, they do not have their own emissions calculations. Those emissions are accounted for in the Anode and Cathode Powder calculations.

The facility intends to meet the conditions of 401 KAR 59:010 by meeting the most stringent emission limitation of 2.34 lbs PM per hour regardless of raw material throughput.

Adsorber Controlled Processes Comments

VOC emissions are calculated using an outlet VOC loading assumption of 4.5 ppmv, (post adsorber) for each emission source. VOC concentration is monitored weekly after the carbon adsorbers using manual organic vapor analyzers.

The facility is designed to produce 86 Gigawatt-hours of batteries each year or 43 Gigawatt-hours per building. The primary VOC BACT emission limitation is 4.5 ppmv based on a 3-hr block average. A

Emission Unit 01: Electrode Manufacturing Processes

secondary VOC BACT emission limitation of 9,969 lb VOC/GWh batteries produced for KY1 (11,068 VOC/GWh for KY2), has been established to link the 4.5 ppmv, 2.0 ppmv and 6.0 ppmv BACT standards related to battery production to the facility's battery production capacity. Due to technical concerns about achieving the lb VOC/GWh batteries produced limits during facility startup and production ramp-up, a temporary initial secondary VOC BACT emission limitation was added that will transfer over to the lb VOC/GWh batteries produced standard after a production rate or time after startup would be met. Until the facility reaches either 90% of its rated production capacity or 24 months after startup, whichever occurs first, on a per building basis, the facility will abide by a limit of 214.4 tons VOC total for all affected sources on a 12-month rolling basis for KY1 instead of the 9,969 lb VOC/GWh batteries produced. Similarly the standard is 238.0 tons VOC total for all affected sources for KY2. This is done on a per building basis as Building 1's and Building 2's construction will be staggered, and each building contains half of the facility's production capacity and have it's own dedicated management teams. 24 months is the estimated amount of time BlueOval expects to have to test their equipment prior to starting full production on a per building basis.

The non-ppmv BACT VOC limits are calculated using the total VOC PTE from EU01 through EU05 on a per building basis for the initial limitation. The ongoing limitation is the initial limitation divided by 43 Gigawatt hours produced per building.

Cathode Drying Comments

VOC emissions are calculated using an outlet VOC loading assumption of 2.0 ppmv, (post scrubber) for each emission source. Emission assumptions are to be confirmed via testing.

The facility is designed to produce 86 Gigawatt-hours of batteries each year. BACT has been established as 2.0 ppmv based on 3-hr block average for the Cathode Dryers.

Cathode drying scrubbers have a continuous NMP concentration monitor.

Regulation Comments

The facility is subject to 40 CFR 63, Subpart CCCCCC because the facility is an area source for HAP emissions, and the cathode coating that is manufactured on site contains HAP components.

BACT discussion for EU01-05 (Permit V-21-041, Revised Permit V-21-041 R2)

BlueOval submitted an initial permit application to construct a new electric vehicle lithium-ion battery manufacturing facility. The potential to emit VOC emissions is over 250 tons per year and above PSD thresholds. BlueOval did not propose to limit VOC emissions to preclude PSD. As a result, the project will trigger the applicability of PSD regulations.

The below text regarding the BACT steps is taken from the revised narrative sent to the Division 1/28/2022 and is provided by the facility. It has been edited by the Division to remove numbered references and references to appendices not attached to this Statement of Basis/Summary document. Step Five was edited permit V-21-041 R2.

Step One: Identify All Potentially Available Control Technologies

BlueOval researched VOC control technologies and developed the following list of potential options.

- Adsorption
- Thermal incinerators

Emission Unit 01: Electrode Manufacturing Processes

- Catalytic incinerators
- Adsorption
- Absorption
- Condensation
- Alternative raw materials

Adsorption

Adsorption controls VOC by adsorbing gaseous compounds on the surface of a solid material. The adsorbent typically used is activated carbon due to its highly porous nature. The VOC-laden gases pass through the carbon bed, and the VOC is adsorbed on the activated carbon. The cleaned gas is discharged to the atmosphere. The spent carbon is regenerated either at an on-site regeneration facility or by an off-site activated carbon supplier by using steam to replace adsorbed organic compounds at high temperatures.

Activated carbon towers are included in the baseline design for all volatile emission sources except the NMP recovery system. Carbon adsorption has been identified as the optimal VOC control option for removal of organic compound emissions generated by the EV battery manufacturing process. The relatively low temperature, low humidity/moisture content, and low concentration exhaust streams from the other volatile sources besides the NMP recovery process are all best suited for the application of carbon adsorption. Other available VOC control options are more compatible with conventional high VOC loading exhaust streams found in other industrial sectors that use organic solvents at much higher rates and apply solvents with higher volatility than those used in the EV battery manufacturing process. EPA specifically highlights the aforementioned features of carbon adsorption within the relevant Air Pollution Control Cost Manual chapter for this control option by stating “they are particularly useful for situations where there are relatively dilute VOC concentrations (less than 100 ppmv) and moderate flow rates, which can be difficult or uneconomical to remove using other types of pollution controls.”

Thermal Incinerators

Incineration destroys VOC by oxidizing them to carbon dioxide and water. If nitrogen-containing compounds are contained within the exhaust stream, using oxidation technology for VOC control can produce NO_x as a “collateral emissions” impact of reducing VOC emissions. Any VOC heated to a sufficiently high temperature in the presence of oxygen will burn or oxidize. Common thermal incinerators include thermal oxidizers, recuperative thermal oxidizers, and regenerative thermal oxidizers. These three technologies generally achieve VOC destruction in the same manner. However, straight thermal oxidizers do not include any heat recovery while heat is recovered in recuperative thermal oxidizers via heat exchangers and in regenerative thermal oxidizers via a ceramic-packed bed. Thermal incinerators require an operating temperature above the materials ignition temperature, which is typically greater than 1,000°F.

Catalytic Incinerators

Catalytic incinerators are similar to thermal incinerators except oxidation occurs in the presence of a catalyst. Common examples include catalytic oxidizers and regenerative catalytic oxidizers. With the catalyst, the same VOC destruction rate can be achieved at a lower temperature. Typical operating temperatures range from 600°F to 800°F.

Absorption

With absorption, VOC is removed from a gaseous stream via liquid solvent. There are a variety of design options, but the most common system is known as a packed tower wet scrubber. With this device, the solute in the gas stream is absorbed by the liquid solvent running counter current through the tower. The cleaned

Emission Unit 01: Electrode Manufacturing Processes

gas is discharged to the atmosphere. The recovered solvent can then be further processed by stripping or desorbing to remove the solute.

Packed tower wet scrubbers are used as inherent process equipment for the NMP recovery system. The use of a scrubber as process equipment allows BlueOval to recover NMP for subsequent regeneration, which occurs offsite. This application would not be considered an application of absorption for air emissions control, and thus, BlueOval has not proposed the use of an absorption system/scrubber in the context of this EV battery manufacturing process VOC BACT analysis.

Condensation

Condensers utilize a cooling media to condense and recover volatile organics. The choice of the cooling media is based on the condensation point of the VOC to be controlled and is typically water or refrigerant.

Alternative Raw Materials

Alternative solvent materials with lower VOC contents could be considered as a potential control option for BACT.

Step Two: Eliminate Technically Infeasible Control Options

The next step in the process is to evaluate all possible options and determine if any of them are technically infeasible for the proposed project. Adsorption included in BlueOval's baseline design and is therefore considered technically feasible. Absorption and condensation are also considered to be technically feasible.

Incinerators

As previously stated, the required temperature for incinerators ranges from 600 °F and above for catalytic systems to over 1,000 °F for thermal systems. However, the exhaust gas temperature for the cathode dryers routed to the NMP recovery system is approximately 190 °F while other volatile sources operate at approximately 104 °F. Therefore, significant heating requirements would be needed to raise the gas streams to the required operating temperatures for effective incineration. In addition, the pollutant loading to a non-catalytic incinerator typically needs to be at least 100 ppmv for effective VOC emissions control to occur. Since the temperature is not within the required operating range and pollutant inlet loading may not be within the required operating range for certain applications at the EV battery manufacturing process, thermal incinerators are considered to be technically infeasible. Although catalytic incinerators have been used effectively at pollutant inlet loadings as low as 1 ppmv, the same temperature range limitations applicable to thermal incinerators also applies to catalytic incinerators, and thus, BlueOval also considers catalytic incinerators to be technically infeasible. However, for the sake of conservatism, thermal and catalytic incinerators are considered in the remaining steps of the BACT evaluation.

Alternative Raw Materials

The specific properties of NMP and acetonitrile are necessary to achieve the desired product specifications. It is technically infeasible to utilize other materials in the process. As such, this control strategy has been removed from the BACT analysis.

Step Three: Rank Remaining Control Technologies by Control Effectiveness

Because carbon adsorption, regenerative thermal incinerators, and catalytic incinerators have all been assigned the same nominal VOC control efficiency and listed as the top "Rank 1" within the Step 3 control effectiveness ranking, additional supporting documentation is provided to explain the sources of the assigned VOC control efficiencies.

Emission Unit 01: Electrode Manufacturing Processes

Carbon adsorption can generally achieve VOC removal efficiencies in the range of 95 to 99 percent at input VOC concentrations of between 500 and 2,000 ppm in air depending on the physical and chemical properties of the exhaust stream affecting pollutant removal (e.g. VOC constituents present, exhaust flow rate, exhaust temperature, exhaust relative humidity, etc.). For BlueOval’s specific EV battery manufacturing process applications, a nominal VOC removal efficiency of 98% has been assigned based on EPA’s general statement that “removal efficiencies greater than 98 percent can be achieved for dilute waste streams.”

For thermal incinerators, typical VOC removal (or destruction) efficiencies fall in the range of 95% to 99% for regenerative thermal oxidizers (RTO), where an RTO would be the most appropriate application to the VOC emissions profile of an EV battery manufacturing process exhaust stream. While the lower bound or midpoint of this RTO VOC control efficiency range could generally be applied due to the EPA’s observation that “lower control efficiencies are generally associated with lower concentration flows”, BlueOval has conservatively set the nominal control efficiency for an RTO in this EV battery manufacturing process application to 98%. A 98% VOC removal efficiency for a thermal incinerator is also equivalent to the organic HAP removal efficiency that is used within several recently revised MACT standards under the Residual Risk and Technology Review (RTR) process, where thermal incineration is a commonly applied VOC control option called out specifically with the MACT rule provisions [i.e., MACT Subpart SSSS for Surface Coating of Metal Coil, MACT Subpart FFFF for Miscellaneous Organic Chemical Manufacturing (MON), etc.].

Finally, similar to an RTO, a catalytic incinerator is capable of achieving VOC removal (or destruction) efficiencies in the range of 95% to 99% depending on VOC composition and concentration, operating temperature, oxygen concentration, catalyst characteristics, and space velocity. Achieving VOC control efficiencies at the upper end of this nominal range (98%-99%) requires larger catalyst volumes and/or higher temperatures and are usually only applicable on a site-specific basis. When applied to this novel EV battery manufacturing process, BlueOval only considers a 98% removal efficiency to be achievable due to the relatively low inlet loadings expected and the collateral VOC emissions contribution that would occur from supplemental natural gas combustion to raise the temperature of the exhaust stream (e.g., thermal and catalytic incinerators generate VOC from supplemental fuel combustion that can offset the achievable VOC removal efficiency on an inlet to outlet emission rate comparison basis).

Rank	Control Option	Control Efficiency (%)
1	Adsorption Regenerative Thermal Incinerator Catalytic Incinerator	~98%
2	Absorption	90%
3	Condensation	73%

Step Four: Evaluate Top Control Alternatives

As part of BlueOval’s baseline design, all VOC emission sources, except the cathode dryers routed to the

Emission Unit 01: Electrode Manufacturing Processes

NMP recovery system, are controlled by adsorption through activated carbon towers representing application of a top control option for these sources. An assessment of energy and environmental impacts for carbon adsorption, regenerative thermal incineration, and catalytic incineration are presented in the following subsections to identify the “most effective” control option for this EV battery manufacturing process application.

For the NMP recovery process, no add-on controls for VOC are being implemented, so a full evaluation of economical, energy, and environmental impacts of the full list of VOC control options is presented. Specifically, control cost analyses were performed to compare total costs (capital and annual) per ton of pollutant removed for carbon adsorption and regenerative thermal and catalytic incinerators applied to the NMP recovery process exhaust streams.

Adsorption

For all VOC emissions sources other than the cathode dryers, BlueOval has chosen to implement the control technology with the top ranked VOC control efficiency (carbon adsorption). Therefore, an economic analysis is not necessary to select the BACT control technology for these sources. Moreover, application of carbon adsorption to these sources does not pose any adverse energy or environmental impacts. Energy usage for carbon adsorption systems is limited to a small amount of electricity consumption to drive the induced draft fan drawing exhaust from the process equipment and routing it through the carbon adsorption beds. The spent carbon collected from the carbon adsorption vessels would be routed for off-site regeneration and subsequent beneficial reuse, and thus, spent carbon handling and disposal does not represent an adverse environmental impact.

The NMP recovery system/cathode dryer, carbon adsorption represents a technically feasible control option. As previously discussed, the cathode dryers will be routed to a packed tower wet scrubber system to recover NMP. This system is considered inherent process equipment and not an add-on control device since the primary purpose is to recover raw material. Due to the low VOC concentration of the stream exiting this system (2.0 ppmv), any additional add-on control schemes would result in a very large cost per ton of controlled pollutant. To demonstrate these high annualized control costs associated with installing a carbon standard cubic feet per minute (scfm) referenced in the cathode drying potential emission calculations (46,658 scfm) was converted to an actual flow rate basis (>57,000 acfm) for the adsorber control cost calculation using the nominal NMP recovery process scrubber exhaust temperature (190°F). The NMP recovery process VOC exit concentration is 2.0 ppmv (expressed as NMP).

At this very low inlet concentration associated with the NMP recovery process exhaust stream (2.0 ppm as NMP or 1/50th of the 100 ppm concentration typically characterized as a “dilute” inlet VOC concentration exhaust stream), carbon adsorption would be expected to achieve an appreciably lower VOC removal efficiency than the nominal 98% control efficiency. The lowest measurable VOC concentration using EPA’s primary VOC reference test method that would be applicable for any stack testing of the battery manufacturing process VOC emissions sources (Method 25A) is nominally 1 ppmv “as the calibration gas” used in the Method 25A sampling procedure. Section 1.1 of Method 25A lists the sensitivity as <2% of the span value. A commonly applied span value in most source testing applications of Method 25A would be on the order of 50 ppmv as calibration gas. This span value follows the general guidelines in Section 3.6 of Method 25A with respect to being equal to “1.5 to 2.5 times the applicable emission limit” where commonly applied emission limits from NSPS and MACT standards in the surface coating and chemical manufacturing sectors are on the order of 20-30 ppm. In addition, a 50 ppm span value ensures that minute-to-minute spikes in VOC concentration that may occur in some applications can be adequately captured without

Emission Unit 01: Electrode Manufacturing Processes

logging any “over range” VOC concentrations within the duration of a stack testing program. Therefore, using 2% of a 50 ppm as calibration gas span value (or 1 ppm as calibration gas) defines a reasonable sensitivity level for Method 25A VOC emissions measurements. This 1 ppm as calibration gas sensitivity level also defines the minimum reportable concentration for Method 25A that could be relied upon for compliance demonstrations as well as the lowest concentration upon which a reasonably quantifiable VOC BACT limit could be based.

The most common Method 25A calibration gases are methane and propane. With a lower molecular weight and only a single carbon atom, reporting Method 25A results as methane generally produces lower detection limits/sensitivities for the actual VOC constituent being measured (NMP in this case) than calibration with propane. At the 46,658 scfm flow rate associated with the NMP recovery system exhaust stream, a 1 ppm as methane VOC exit concentration would equate to a mass emission rate of approximately 0.12 lb/hr. Based on the inlet mass VOC emission rate from the NMP recovery process of 1.44 lb VOC/hr, this estimated lowest measurable controlled VOC emission rate with carbon adsorption (0.12 lb VOC/hr) would equate to a theoretical VOC removal efficiency of approximately 92%.

The remaining input data needed to complete the carbon adsorber control cost calculations are “Name of VOC/HAP”, partial pressure of pollutant in waste gas stream, parameter “k”, and parameter “m.” The name of VOC/HAP is an input data field for EPA’s carbon adsorber control cost analysis template to allow the “Typical Parameters for Selected Adsorption Isotherms” to be selected from Table A. NMP is not a listed compound in this table for defining the adsorption isotherm parameters and associated “Equilibrium Capacity at the Inlet ($W_e(\max)$)” in units of lb VOC/lb carbon. Therefore, BlueOval conducted a general literature search to identify any potentially representative published values for the adsorption capacity of activated carbon for NMP as an adsorbate. A peer-reviewed technical journal article entitled An Investigation of the Removal of 1-Methyl-2-Pyrrolidinone (NMP) was identified that contained a published value for “NMP Capacity (wt.%)” of 0.573 lb NMP/lb carbon in “Table 1: Initial efficiency and capacity for a series of adsorbent materials for 25 ppmv NMP”. The specific adsorbent material selected from Table 1 of the referenced article is labelled as “NIC” and is described as high surface area coconut shell-based activated carbon that has been chosen for its optimized surface chemistry and pore structure without any further modifications by the paper’s authors. The laboratory apparatus used to evaluate the NMP adsorption capacity of the various adsorbent materials involved a laboratory carbon bed exposed to an air stream with an NMP concentration of 24 ppmv, 50% relative humidity, and at a flow rate of 30 LPM.

As revealed by the adsorption isotherm relationships in Table A, equilibrium adsorption capacity of an adsorbent typically decreases with lower partial pressures of the VOC/HAP compound (i.e., lower inlet concentrations). Therefore, use of an NMP adsorption capacity based on an experimental inlet NMP concentration of 25 ppm versus the actual NMP concentration of 2.0 ppm in the NMP recovery system exhaust should provide a conservatively high basis for the assigned carbon adsorption capacity. This conservative assumption for carbon adsorption capacity for NMP subsequently minimizes the overall carbon requirement and associated control system costs to achieve the specified control efficiency. The expected design basis for an industrial-scale application of carbon adsorption to the NMP recovery process would include higher carbon requirements and higher annual capital and operating costs than those presented in the initial Title V application.

The next user-specified input to the control cost calculations is partial pressure of the pollutant in the exhaust gas. Partial pressure is directly proportional to the VOC concentration of the exhaust gas if the total system pressure is known. BlueOval expects the total system pressure of a carbon adsorber to be at or near

Emission Unit 01: Electrode Manufacturing Processes

atmospheric pressure (14.696 psia) such that the NMP partial pressure equivalent to the 2.0 ppm VOC exhaust concentration can be calculated as follows: $2.0E-6 \text{ lbmol NMP/lbmol exhaust gas} \times 14.696 \text{ psia total system pressure} = 2.93E-5 \text{ psia NMP partial pressure}$.

The final input parameters for completing the data inputs tab of EPA's control cost template would typically be the parameter "k" and parameter "m" terms to be entered in the equilibrium carbon adsorption capacity equation of $w = kP^m$ [where w is the equilibrium adsorptivity (lb adsorbate/lb adsorbant), P is the partial pressure of VOC in the gas stream (psia), and k and m are empirical parameters based on Calgon BPL carbon]. However, by defining an "Equilibrium Capacity at the Inlet ($W_e(\text{max})$)" in the design parameters section of EPA's control cost template based on the aforementioned literature reference, the parameter "k" and "m" terms do not need to be included in the data inputs section of EPA's control cost template.

Annualized control costs are approximately \$20,000/ton removed in 2020 dollars. Actual costs in 2021 dollars are expected to be higher based on recent monthly trends in the Chemical Engineering Plant Cost Index. Given the high annualized control costs and additional VOC emissions from electricity generation to supply the additional exhaust fan power required for overcoming the carbon adsorption bed pressure drop, installing and operating a carbon adsorption system for VOC removal of the NMP recovery system exhaust will be eliminated from further consideration in this BACT analysis. Carbon adsorbers can be eliminated on the basis of both not being cost effective and posing adverse energy impacts in relation to the relatively small VOC emissions reductions that may be achievable (<5.8 tpy).

Incinerator

For the other volatile sources, regenerative thermal incinerators and catalytic incinerators have the potential to achieve equivalent/comparable VOC control efficiencies and exit VOC concentrations to that assigned for the selected carbon adsorbers. However, incinerators pose significantly higher energy and environmental impacts than carbon adsorbers with no known benefit in terms of substantively reducing VOC emissions at a level beyond what is expected to be achievable for carbon adsorbers. Specifically, natural gas will need to be used as a supplemental fuel to raise the temperature of the exhaust gas from 104 °F to at least 700 °F (midpoint of lower operating range for catalytic incinerators from 600-800 °F). This supplemental fuel usage introduces an energy impact that does not exist when installing and operating carbon adsorbers. In addition, incinerators generate collateral emissions of NO_x, CO, VOC, PM/PM₁₀/PM_{2.5}, and GHG from both natural gas combustion byproducts and any combustion reaction byproducts for the VOC constituents being targeted for removal/destruction. In this specific application, the nitrogen atom contained within the NMP molecule is expected to form additional NO_x emissions (commonly referred to as "fuel-bound" NO_x) beyond the thermal NO_x formed as a natural gas combustion byproduct in the incinerator.

Using the basic energy balance calculation methodologies published in Section 3 – VOC Controls; Section 3.2 – VOC Destruction Controls; Chapter 2 – Incinerators and Oxidizers for of EPA's Air Pollution Control Cost Manual, a collection of regenerative thermal oxidizers operating at a maximum heat recovery rate of 95% in place of the carbon adsorbers for the other volatile sources would require at least 46 MMBtu/hr of supplemental natural gas on a combined basis to achieve the minimum exhaust temperature for the incinerator. This level of supplemental fuel consumption for a regenerative incinerator would produce collateral emission of approximately 25.1 tpy of NO_x (19.8 tpy thermal NO_x and 5.3 tpy of fuel-bound NO_x), 16.6 tpy of CO, 1.5 tpy of PM/PM₁₀/PM_{2.5}, 1.1 tpy of VOC, and 23,879 tpy of GHG. These collateral emissions represent a significant fraction of the source-wide emissions totals for the EV battery manufacturing process, and thus, would substantially increase the overall "air quality footprint" of the

Emission Unit 01: Electrode Manufacturing Processes

proposed project. For a catalytic incinerator where heat recovery rates of only 70% can be achieved, the amount of supplemental natural gas and associated collateral emissions would be approximately 2.7 times higher than for a regenerative thermal incinerator. Based on this quantitative energy and environmental impact assessment, BlueOval has disqualified both regenerative thermal incinerators and catalytic incinerators on the basis of adverse energy and environmental impacts relative to the selected carbon adsorption systems for other volatile sources.

For the NMP recovery system/cathode dryer, regenerative incinerators and catalytic incinerators represent technically feasible control options that warrant a separate economic, energy, and environmental impact assessment. Based on EPA's Air Pollution Control Technology Fact Sheet for Regenerative Incinerators, annualized costs for installing and operating a regenerative thermal incinerator (RTO) range from \$8 to \$33 per scfm per year (expressed in 2002 dollars). Although the upper-level costs in the range would be expected to apply in practice for the battery manufacturing VOC emissions sources due to the very low-VOC concentration in the NMP recovery process exhaust stream (2.0 ppm as NMP), BlueOval has conservatively applied the average costs of \$20.5 per scfm per year (expressed in 2002 dollars) within the streamlined/simplified annualized control calculation. Based on the inlet loadings from the NMP recovery process to an RTO (2.0 ppmv) and the minimum measurable emissions level that could be established as a BACT limit with an RTO (1 ppm as methane or 0.16 ppm as NMP), a theoretical control efficiency of 92% was applied for the cathode dryer control cost analysis. In practice, BACT limits for RTO installations controlling VOC emissions from a range of similar industrial operations to BlueOval's proposed battery manufacturing process would not be established at an emissions performance level below 10-20 ppm as methane. An alternate thermal/catalytic incinerator emissions standard within numerous MACT standards is set to an exit concentration of 20 ppmv as methane in place of a specific control efficiency target because this is considered the minimum achievable emissions level in many cases. Therefore, BlueOval's assumption of an incinerator achieving a 1 ppm as methane exit concentration is extremely conservative and not representative of the true emissions level that would be achieved if such a control option were deployed for the battery manufacturing process.

Based on these input data and conservative assumptions, cost effectiveness calculations for the battery manufacturing VOC emissions sources are calculated as follows:

Sample Calculation for Cost Effectiveness

$$\text{Cost} \left(\frac{\$}{\text{ton}} \right) = \text{Annualized Cost} \left(\frac{\$}{\text{scfm} - \text{year}} \right) * \text{Flow Rate} (\text{scfm})$$

$$/ \left(\text{Flow Rate} (\text{scfm}) * \frac{\text{Outlet Pollutant Loading Rate} (\text{ppmv})}{10^6} * \frac{60 \text{ mins}}{\text{hour}} / \text{Standard Molar Volume} \left(\frac{385.3 \text{ scf}}{\text{lb} - \text{mol}} \right) \right)$$

$$* \text{NMP Molecular Weight} \left(\frac{\text{lb}}{\text{lb} - \text{mol}} \right) * \text{Operating Hours} \left(\frac{\text{hr}}{\text{yr}} \right) 2,000 \left(\frac{\text{lb}}{\text{ton}} \right) * \text{Destruction Efficiency} \left(\right)$$

Cost Effectiveness Calculation for NMP Recovery System

$$\text{Cost } \$/\text{ton} = 20.5 \frac{\$}{\text{scfm} - \text{year}} / \left(\frac{2 \text{ ppmv}}{10^6} \right)$$

$$* 60 \frac{\text{mins}}{\text{hr}} / 385.3 \frac{\text{scf}}{\text{lb-mol}} * 99.13 \frac{\text{lb}}{\text{lb-mol}} * 8760 \frac{\text{hrs}}{\text{year}} / 2,000 \frac{\text{lb}}{\text{ton}} * 92\% = \$164,780 / \text{ton}$$

The overall costs of installing and operating an RTO for VOC emissions control at the NMP recovery

Emission Unit 01: Electrode Manufacturing Processes

exhausts are clearly prohibitive in terms of a \$/ton pollutant removed basis, even if the previously noted technical challenges regarding low pollutant inlet loadings and inadequate temperature of the exhaust could be addressed. In addition, supplemental natural gas and electricity will be needed for the operation of an RTO system which will result in collateral emissions from natural gas combustion and power generation. Given the negative economic, environmental and energy considerations, as well as the technical challenges associated with operating an RTO with low inlet concentration, installing an RTO for the NMP recovery process VOC emissions control is deemed economically infeasible and has been eliminated from the remaining steps of the BACT analysis.

Although a catalytic incinerator may not be subject to the same VOC inlet loading limitations as an RTO, the annualized costs for installing and operating a catalytic incinerator are significantly higher than for an RTO (range of \$8 to \$50 per scfm with an average cost of \$29 per scfm). The excessively high annualized control costs estimated for installing an RTO on the NMP recovery process VOC emissions sources would be even higher if the same analysis was performed for a catalytic incinerator application. Therefore, BlueOval can readily eliminate both thermal and catalytic incinerators as an NMP recovery process VOC control option on the basis that this option is economically infeasible in addition to noting the adverse energy and environmental impacts associated with additional natural gas usage, electricity consumption, and catalytic disposal for catalytic incinerators.

Absorption

Selection of carbon adsorbers as a higher ranked VOC control option in terms of VOC removal effectiveness eliminates the need to evaluate absorbers for the other volatile sources. For the NMP recovery process, absorption is technically feasible. However, installing and operating an add-on absorber/scrubber exclusively for VOC emissions control purposes on the NMP recovery exhaust stream would provide no additional VOC emission control. A specially designed scrubber acting as inherent process equipment is already in place for the NMP recovery process, and this inherent scrubber system achieves a very low exhaust concentration (2.0 ppm) that would represent the inlet concentration for a subsequent absorber installed for VOC emissions control.

Absorption is applied predominantly in instances where a substantial amount of VOC can be recovered, and the recovered VOC can be reused in the process or routed off-site as a marketable byproduct. The typical inlet loading expressed as a pollutant concentration for gaseous pollutants (like VOC) controlled by an absorber is 250 ppm to 10,000 ppm. Absorption is usually not considered for VOC emissions control applications when the VOC concentration is below 200-300 ppm. The NMP recovery process VOC exhaust concentration is 1/100th of the lower end of this commonly applied lower bound for the acceptable inlet concentration of an air pollution control-focused absorber. Therefore, BlueOval does not believe that adding an absorber for VOC emission control to the NMP recovery process would provide any additional pollutant removal and can be readily eliminated on the basis of not being applicable or effective in this unique application of an EV battery manufacturing cathode drying exhaust stream equipped with an inherent NMP recovery process.

Condensation

Following the same rationale presented previously for absorption, applying condensation for VOC emissions control at the other volatile sources does not need to be evaluated because these sources use the higher ranked carbon adsorption VOC control option. Also, for the NMP recovery process, installing and operating a condensation system is not expected to provide any VOC emissions removal due to the very low VOC concentration achieved by the NMP recovery process scrubber (acting as inherent process

Emission Unit 01: Electrode Manufacturing Processes

equipment). EPA's guidance document entitled Survey of Control Technologies for Low Concentration Organic Vapor Gas Streams indicates condensation is not considered to be applicable to low concentration organic vapor streams "because condensation is a simple vapor liquid equilibrium process and the temperatures needed to condense OV [organic vapor] at levels below several thousand ppm have been impractical." Furthermore, when evaluating the technical feasibility and cost effectiveness of condensation systems applied to representative vent streams in the organic chemical industry at the time of developing the initial federal air regulations for this industrial sector, the minimum inlet VOC concentration considered was 5,000 ppmv. Finally, condensers are not well suited for vent streams containing large quantities of inerts such as carbon dioxide, air, and nitrogen or low VOC concentration vent streams. The high air concentration and low VOC concentration of the NMP recovery process exhaust stream do not meet the applicable design constraints of a condensation system, and thus, condensation is not considered to be an applicable or effective VOC control option in this unique application of an EV battery manufacturing cathode drying exhaust stream equipped with an inherent NMP recovery process.

Step Five: Select BACT

The Glendale plant will reduce VOC emissions from the NMP recovery process through absorption and from other volatile sources through adsorption, according to the requirements of BACT. For the NMP recovery process, BlueOval is proposing a VOC BACT limit of 2.0 ppmv on a 3-hour block average basis. For the other volatile sources controlled by activated carbon towers, BlueOval is proposing a VOC BACT limit of 4.5 ppmv as NMP on a 3-hour block average basis for EU01 and 6.0 ppmv as Electrolyte on a 3-hours block average basis for EU02 through EU05.

In addition to the proposed BACT from the facility in their application discussed in the paragraph above, additional BACT standards were introduced for the adsorbers and scrubbers to link these ppmv (as NMP) standards to their design production rate of 43 GWh/year per building. Additional discussion of these standards can be found under "**Adsorber Controlled Processes Comments**" in Section 3 of this Statement of Basis/Summary.

Emission Unit 02: Battery Assembly						
Pollutant	Emission Limit or Standard	Regulatory Basis for Emission Limit or Standard	Emission Factor Used and Basis			Compliance Method
PM	2.34 lbs/hr	401 KAR 59:010, Section 3(2)	EF gr/dscf	KY1- DC	KY2- DC	Maintain Design Documentation proving facility meets ISO 7 cleanroom standards and dust collectors' designs meet outlet grain loading factors
			5.25E-7	28-41	30-39	
			1.20E-6	42,43		
			6.46E-7	44,45		
			1.07E-6	46-49		
			6.83E-7	50-53	45-48	
			1.46E-6	54-69	49-64	
			1.18E-6		40	
			9.82E-7		41	
			6.61E-7		42	
			9.00E-7		43,44	
	20% opacity	401 KAR 59:010, Section 3(1)	N/A			Weekly Visual Observation of Building
VOC	6.0 ppmv VOC after adsorber	401 KAR 51:017	6.0 ppmv VOC after adsorber			Weekly monitoring of VOC outlet concentration using manual device, initial Method 25A test
KY1-VOC (See Section 4 Table A)	9,969 lbs VOC / GWh batteries produced (yearly basis) 214.4 tons VOC total per Building (temporary)	401 KAR 51:017	Emissions Confirmed Via Test Data			Monitor hours of operation (or VOC material throughput and recovery) and GWh of batteries produced
KY2-VOC (See Section 4 Table A)	11,068 lbs VOC / GWh batteries produced (yearly basis) 238.0 tons VOC total per Building (temporary)	401 KAR 51:017	Emissions Confirmed Via Test Data			Monitor hours of operation (or VOC material throughput and recovery) and GWh of batteries produced
Initial Construction Date: 5/2022						
Process Description:						

Emission Unit 02: Battery Assembly			
Source #	Unit Name	Control Device	Applicable Regulations
KY1-CN01 - KY1-CN56	Cathode Notching (Building 1)	Dust Collector KY1-DC28-KY1-DC34	401 KAR 59:010
KY1-AN01 - KY1-AN56	Anode Notching (Building 1)	Dust Collector KY1-DC35-KY1-DC41	401 KAR 59:010
KY1-CL01 - KY1-CL10	Cathode Slitting (Building 1)	Dust Collector KY1-DC42 - KY1-DC43	401 KAR 59:010
KY1-AL01 - KY1-AL10	Anode Slitting (Building 1)	Dust Collector KY1-DC44 - KY1-DC45	401 KAR 59:010
KY1-VD01 - KY1-VD16	Vacuum Dryer (Cathode) (Building 1)	Activated Carbon KY1-AC04	401 KAR 51:017
KY1-EL01 - KY1-EL16	Electrolyte Filling, Sealing (Building 1)	Activated Carbon KY1-AC05	401 KAR 51:017 401 KAR 63:020
KY1-CS01 - KY1-CS04	Cathode Press (Building 1)	Dust Collector KY1-DC46 - KY1-DC47 Activated Carbon KY1-AC06	401 KAR 51:017 401 KAR 59:010
KY1-AS01 - KY1-AS04	Anode Press (Building 1)	Dust Collector KY1-DC48 - KY1-DC49 Activated Carbon KY1-AC07	401 KAR 51:017 401 KAR 59:010
KY1-WB01 - KY1-WB16	Tab Welding (BME) (Building 1)	Dust Collector KY1-DC50-KY1-DC53 Building Enclosure	401 KAR 59:010
KY1-WB17 - KY1-WB32	Tab Welding (SK) (Building 1)	Dust Collector KY1-DC54 - KY1-DC69	401 KAR 59:010
KY1-MA01 - KY1-	Tab Welding (SK) Module Assembly (Building 1)	Dust Collector KY1-DC70 - KY1-DC101	401 KAR 59:010

Emission Unit 02: Battery Assembly			
MA32			
KY2-CN01 - KY2-CN35	Cathode Notching (Building 2)	Dust Collector KY2-DC30-KY2-DC34 Building Enclosure	401 KAR 59:010
KY2-AN01 - KY2-AN35	Anode Notching (Building 2)	Dust Collector KY2-DC35-KY2-DC39	401 KAR 59:010
KY2-VD01 - KY2-VD16	Vacuum Dryer (Cathode) (Building 2)	Activated Carbon KY2-AC04	401 KAR 51:017
KY2-EL01 - KY2-EL16	Electrolyte Filling, Sealing (Building 2)	Activated Carbon KY2-AC05	401 KAR 51:017 401 KAR 63:020
KY2-CS01 - KY2-CS12	Cathode Press (Building 2)	Dust Collector KY2-DC40 - KY2-DC41 Activated Carbon KY2-AC06	401 KAR 51:017 401 KAR 59:010
KY2-AS01 - KY2-AS12	Anode Press (Building 2)	Dust Collector KY2-DC42 - KY2-DC44 Activated Carbon KY2-AC07	401 KAR 51:017 401 KAR 59:010
KY2-WB01 - KY2-WB16	Tab Welding (BME) (Building 2)	Dust Collector KY2-DC45-KY2-DC48 Building Enclosure	401 KAR 59:010
KY2-WB17 - KY2-WB32	Tab Welding (SK) (Building 2)	Dust Collector KY2-DC49-KY2-DC64	401 KAR 59:010

Building 1 processes: KYEIS ID: KY1-02

Building 2 processes: KYEIS ID: KY2-02

Applicable Regulation:

401 KAR 51:017, *Prevention of significant deterioration of air quality* applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).

401 KAR 59:010, *New process operations* applies to each affected facility or source, associated with a process operation, which is not subject to another emission standard with respect to particulates in 401 KAR

Emission Unit 02: Battery Assembly

Chapter 59, commenced on or after July 2, 1975.

State Origin Requirement

401 KAR 63:020, *Potentially hazardous matter and toxic substance emissions* (applies to Electrolyte Filling and Sealing) applies to each affected facility which emits or may emit potentially hazardous matter or toxic substances as defined in 401 KAR 63:020 Section 2, provided such emissions are not elsewhere subject to the provisions of the administrative regulations of the Division for Air Quality.

Comments:

Welding Comments,

The Tab welding BME and Tab Welding SK are processes identical in nature. They were just installed by different companies. Only Tab Welding (SK) Module Assembly is a different process.

Dust Collector Controlled Processes Comments

Particulate matter emissions are calculated using an outlet grain loading assumption based upon manufacturer specifications (post dust collector (DC)) for each emission source. An additional 90% particulate matter control is assumed for ventilation within the building enclosure. This 90% is in consideration of the building's special ventilation conditions that are a result of maintaining clean room environments within the facility that result in a high amount of recirculated air that will recirculate through the associated dust collectors. Also, there are HEPA filters in the ventilation system as well. The dust collectors are considered inherent process equipment because they are for maintaining the cleanroom manufacturing environment and are not explicitly for the purpose of reducing PM emissions. The facility will be meeting ISO 7 cleanroom design standards, which is less than 352,000 particles of less than 0.5 microns per cubic meter and 60 HEPA-filtered air changes per hour.

The facility intends to meet the conditions of 401 KAR 59:010 by meeting the most stringent emission limitation of 2.34 lbs pm per hour regardless of raw material throughput.

Adsorber Controlled Processes Comments

VOC emissions are calculated using an outlet VOC loading assumption of 6.0 ppmv, (post adsorber) for each emission source. VOC concentration is monitored weekly after the carbon adsorbers using manual organic vapor analyzers.

The facility is designed to produce 86 Gigawatt-hours of batteries each year or 43 Gigawatt-hours per building. The primary VOC BACT emission limitation is 6.0 ppmv based on a 3-hr block average. A secondary VOC BACT emission limitation of 9,969 lb VOC/GWh batteries produced for KY1 (11,068 VOC/GWh for KY2), has been established to link the 4.5 ppmv, 2.0 ppmv and 6.0 ppmv BACT standards related to battery production to the facility's battery production capacity. Due to technical concerns about achieving the lb VOC/GWh batteries produced limits during facility startup and production ramp-up, a temporary initial secondary VOC BACT emission limitation was added that will transfer over to the lb VOC/GWh batteries produced standard after a production rate or time after startup would be met. Until the facility reaches either 90% of its rated production capacity or 24 months after startup, whichever occurs first, on a per building basis, the facility will abide by a limit of 214.4 tons VOC total for all affected sources on a 12-month rolling basis for KY1 instead of the 9,969 lb VOC/GWh batteries produced. Similarly the standard is 238.0 tons VOC total for all affected sources for KY2. This is done on a per building basis as Building 1's and Building 2's construction will be staggered, and each building contains half of the facility's production capacity and have it's own dedicated management teams. 24 months is the estimated amount of

Emission Unit 02: Battery Assembly

time BlueOval expects to have to test their equipment prior to starting full production on a per building basis.

The non-ppmv BACT VOC limits are calculated using the total VOC PTE from EU01 through EU05 on a per building basis for the initial limitation. The ongoing limitation is the initial limitation divided by 43 Gigawatt hours produced per building.

BACT discussion

See Emission Unit 01: Electrode Manufacturing Process, BACT discussion for EU01-05 (Permit V-21-041)

Emission Unit 03: Battery Formation				
Pollutant	Emission Limit or Standard	Regulatory Basis for Emission Limit or Standard	Emission Factor Used and Basis	Compliance Method
VOC	6.0 ppmv VOC after adsorber	401 KAR 51:017	6.0 ppmv VOC after adsorber	Weekly monitoring of VOC outlet concentration using manual device, initial Method 25A test
KY1-VOC (See Section 4 Table A)	9,969 lbs VOC / GWh batteries produced (yearly basis) 214.4 tons VOC total per Building (temporary)	401 KAR 51:017	Emissions Confirmed Via Test Data	Monitor hours of operation (or VOC material throughput and recovery) and GWh of batteries produced
KY2-VOC (See Section 4 Table A)	11,068 lbs VOC / GWh batteries produced (yearly basis) 238.0 tons VOC total per Building (temporary)	401 KAR 51:017	Emissions Confirmed Via Test Data	Monitor hours of operation (or VOC material throughput and recovery) and GWh of batteries produced

Initial Construction Date: 5/2022

Process Description:

Source #	Unit Name	Control Device
KY1-DG01 - KY1-DG56	Cell Degassing (Building 1)	Activated Carbon KY1-AC08 - KY1-AC15
KY2-DG01 - KY2-DG56	Cell Degassing (Building 2)	Activated Carbon KY2-AC08 - KY2-AC15

Building 1 processes: KYEIS ID: KY1-03

Building 2 processes: KYEIS ID: KY2-03

Applicable Regulation:

401 KAR 51:017, *Prevention of significant deterioration of air quality* applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).

Emission Unit 03: Battery Formation

Comments:

Adsorber Controlled Processes Comments

VOC emissions are calculated using an outlet VOC loading assumption of 6.0 ppmv, (post adsorber) for each emission source. VOC concentration is monitored weekly after the carbon adsorbers using manual organic vapor analyzers.

The facility is designed to produce 86 Gigawatt-hours of batteries each year or 43 Gigawatt-hours per building. The primary VOC BACT emission limitation is 6.0 ppmv based on a 3-hr block average. A secondary VOC BACT emission limitation of 9,969 lb VOC/GWh batteries produced for KY1 (11,068 VOC/GWh for KY2), has been established to link the 4.5 ppmv, 2.0 ppmv and 6.0 ppmv BACT standards related to battery production to the facility's battery production capacity. Due to technical concerns about achieving the lb VOC/GWh batteries produced limits during facility startup and production ramp-up, a temporary initial secondary VOC BACT emission limitation was added that will transfer over to the lb VOC/GWh batteries produced standard after a production rate or time after startup would be met. Until the facility reaches either 90% of its rated production capacity or 24 months after startup, whichever occurs first, on a per building basis, the facility will abide by a limit of 214.4 tons VOC total for all affected sources on a 12-month rolling basis for KY1 instead of the 9,969 lb VOC/GWh batteries produced. Similarly the standard is 238.0 tons VOC total for all affected sources for KY2. This is done on a per building basis as Building 1's and Building 2's construction will be staggered, and each building contains half of the facility's production capacity and have it's own dedicated management teams. 24 months is the estimated amount of time BlueOval expects to have to test their equipment prior to starting full production on a per building basis.

The non-ppmv BACT VOC limits are calculated using the total VOC PTE from EU01 through EU05 on a per building basis for the initial limitation. The ongoing limitation is the initial limitation divided by 43 Gigawatt hours produced per building.

BACT discussion

See Emission Unit 01: Electrode Manufacturing Process, BACT discussion for EU01-05 (Permit V-21-041)

Emission Unit 04: Cell Discharge				
Pollutant	Emission Limit or Standard	Regulatory Basis for Emission Limit or Standard	Emission Factor Used and Basis	Compliance Method
VOC	6.0 ppmv VOC after adsorber	401 KAR 51:017	6.0 ppmv VOC after adsorber	Weekly monitoring of VOC outlet concentration using manual device, initial Method 25A test
KY1-VOC (See Section 4 Table A)	9,969 lbs VOC / GWh batteries produced (yearly basis) 214.4 tons VOC total per Building (temporary)	401 KAR 51:017	Emissions Confirmed Via Test Data	Monitor hours of operation (or VOC material throughput and recovery) and GWh of batteries produced
KY2-VOC (See Section 4 Table A)	11,068 lbs VOC / GWh batteries produced (yearly basis) 238.0 tons VOC total per Building (temporary)	401 KAR 51:017	Emissions Confirmed Via Test Data	Monitor hours of operation (or VOC material throughput and recovery) and GWh of batteries produced

Initial Construction Date: 5/2022

Process Description:

Source #	Unit Name	Control Device
KY1-CD01 - KY1-CD08	Cell Discharge (Building 1)	Activated Carbon KY1-AC16 - KY1-AC17
		Scrubber KY1-SC09
KY2-CD01 - KY2-CD08	Cell Discharge (Building 2)	Activated Carbon KY2-AC16 - KY2-AC17
		Scrubber KY2-SC09

Building 1 processes: KYEIS ID: KY1-04

Building 2 processes: KYEIS ID: KY2-04

Applicable Regulation:

401 KAR 51:017, *Prevention of significant deterioration of air quality* applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).

Emission Unit 04: Cell Discharge

State Origin Requirement

401 KAR 63:020, *Potentially hazardous matter and toxic substance emissions* applies to each affected facility which emits or may emit potentially hazardous matter or toxic substances as defined in 401 KAR 63:020 Section 2, provided such emissions are not elsewhere subject to the provisions of the administrative regulations of the Division for Air Quality.

Comments:

Adsorber Controlled Processes Comments

VOC emissions are calculated using an outlet VOC loading assumption of 6.0 ppmv, (post adsorber) for each emission source. VOC concentration is monitored weekly after the carbon adsorbers using manual organic vapor analyzers.

The facility is designed to produce 86 Gigawatt-hours of batteries each year or 43 Gigawatt-hours per building. The primary VOC BACT emission limitation is 6.0 ppmv based on a 3-hr block average. A secondary VOC BACT emission limitation of 9,969 lb VOC/GWh batteries produced for KY1 (11,068 VOC/GWh for KY2), has been established to link the 4.5 ppmv, 2.0 ppmv and 6.0 ppmv BACT standards related to battery production to the facility's battery production capacity. Due to technical concerns about achieving the lb VOC/GWh batteries produced limits during facility startup and production ramp-up, a temporary initial secondary VOC BACT emission limitation was added that will transfer over to the lb VOC/GWh batteries produced standard after a production rate or time after startup would be met. Until the facility reaches either 90% of its rated production capacity or 24 months after startup, whichever occurs first, on a per building basis, the facility will abide by a limit of 214.4 tons VOC total for all affected sources on a 12-month rolling basis for KY1 instead of the 9,969 lb VOC/GWh batteries produced. Similarly the standard is 238.0 tons VOC total for all affected sources for KY2. This is done on a per building basis as Building 1's and Building 2's construction will be staggered, and each building contains half of the facility's production capacity and have it's own dedicated management teams. 24 months is the estimated amount of time BlueOval expects to have to test their equipment prior to starting full production on a per building basis.

The non-ppmv BACT VOC limits are calculated using the total VOC PTE from EU01 through EU05 on a per building basis for the initial limitation. The ongoing limitation is the initial limitation divided by 43 Gigawatt hours produced per building.

Cell Discharge Scrubber Comments

For HCl emissions, Cell Discharge has an assumption of 1.25 ppmv after the scrubber. HCl controls for cell discharge will need to go through a representative initial test using EPA method 26.

The scrubbers use daily liquid flow rate, pressure drop, and pH monitoring.

BACT discussion

See Emission Unit 01: Electrode Manufacturing Process, BACT discussion for EU01-05 (Permit V-21-041)

Emission Unit 05: Laboratories				
Pollutant	Emission Limit or Standard	Regulatory Basis for Emission Limit or Standard	Emission Factor Used and Basis	Compliance Method
VOC	6.0 ppmv VOC after adsorber	401 KAR 51:017	6.0 ppmv VOC after adsorber	Weekly monitoring of VOC outlet concentration using manual device
KY1-VOC (See Section 4 Table A)	9,969 lbs VOC / GWh batteries produced (yearly basis) 214.4 tons VOC total per Building (temporary)	401 KAR 51:017	Emissions Confirmed Via Test Data	Monitor hours of operation (or VOC material throughput and recovery) and GWh of batteries produced
KY2-VOC (See Section 4 Table A)	11,068 lbs VOC / GWh batteries produced (yearly basis) 238.0 tons VOC total per Building (temporary)	401 KAR 51:017	Emissions Confirmed Via Test Data	Monitor hours of operation (or VOC material throughput and recovery) and GWh of batteries produced

Initial Construction Date: 5/2022

Process Description:

Source #	Unit Name	Control Device	Applicable Regulation
KY1-QE01 - KY1-QE12	Quality Evaluation 1 (Building 1)	Activated Carbon KY1-AC18 - KY1-AC19	401 KAR 51:017
KY1-QE13 - KY1-QE15	Quality Evaluation 2 (Building 1)	Activated Carbon KY1-AC20 - KY1-AC21	401 KAR 51:017
KY1-LB01 - KY1-LB03	ICP Lab (Building 1)	Scrubber KY1-SC10 - KY1-SC12	401 KAR 63:020
KY1-LB04 - KY1-LB05	Raw Materials Inspection Lab (Building 1)	Scrubber KY1-SC13 - KY1-SC14	401 KAR 63:020
KY2-QE01 - KY2-QE13	Quality Evaluation 1 (Building 2)	Activated Carbon KY2-AC18 - KY2-AC19	401 KAR 51:017

Emission Unit 05: Laboratories

KY2-QE14 - KY2-QE17	Quality Evaluation 2 (Building 2)	Activated Carbon KY2-AC20 - KY2-AC21	401 KAR 51:017
KY2-LB01 - KY2-LB03	ICP Lab (Building 2)	Scrubber KY2-SC10 - KY2-SC12	401 KAR 63:020
KY2-LB04 - KY2-LB05	Raw Materials Inspection Lab (Building 2)	Scrubber KY2-SC13 - KY2-SC14	401 KAR 63:020

Building 1 processes: KYEIS ID: KY1-05

Building 2 processes: KYEIS ID: KY2-05

Applicable Regulation:

401 KAR 51:017, *Prevention of significant deterioration of air quality* applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).

State Origin Requirement

401 KAR 63:020, *Potentially hazardous matter and toxic substance emissions* (ICP lab and Raw Materials Inspection Lab) applies to each affected facility which emits or may emit potentially hazardous matter or toxic substances as defined in 401 KAR 63:020 Section 2, provided such emissions are not elsewhere subject to the provisions of the administrative regulations of the Division for Air Quality.

Comments:

No testing is being required for the laboratory emission control units.

Adsorber Controlled Processes Comments

VOC emissions are calculated using an outlet VOC loading assumption of 6.0 ppmv, (post adsorber) for each emission source. VOC concentration is monitored weekly after the carbon adsorbers using manual organic vapor analyzers.

The facility is designed to produce 86 Gigawatt-hours of batteries each year or 43 Gigawatt-hours per building. The primary VOC BACT emission limitation is 6.0 ppmv based on a 3-hr block average. A secondary VOC BACT emission limitation of 9,969 lb VOC/GWh batteries produced for KY1 (11,068 VOC/GWh for KY2), has been established to link the 4.5 ppmv, 2.0 ppmv and 6.0 ppmv BACT standards related to battery production to the facility's battery production capacity. Due to technical concerns about achieving the lb VOC/GWh batteries produced limits during facility startup and production ramp-up, a temporary initial secondary VOC BACT emission limitation was added that will transfer over to the lb VOC/GWh batteries produced standard after a production rate or time after startup would be met. Until the facility reaches either 90% of its rated production capacity or 24 months after startup, whichever occurs first, on a per building basis, the facility will abide by a limit of 214.4 tons VOC total for all affected sources on a 12-month rolling basis for KY1 instead of the 9,969 lb VOC/GWh batteries produced. Similarly the standard is 238.0 tons VOC total for all affected sources for KY2. This is done on a per building basis as Building 1's and Building 2's construction will be staggered, and each building contains half of the facility's production capacity and have it's own dedicated management teams. 24 months is the estimated amount of

Emission Unit 05: Laboratories

time BlueOval expects to have to test their equipment prior to starting full production on a per building basis.

The non-ppmv BACT VOC limits are calculated using the total VOC PTE from EU01 through EU05 on a per building basis for the initial limitation. The ongoing limitation is the initial limitation divided by 43 Gigawatt hours produced per building.

Lab Scrubber Comments

For HCl emissions, Cell Discharge has an assumption of 2.5 ppmv after the scrubber.

The scrubbers use daily liquid flow rate, pressure drop, and pH monitoring.

BACT discussion

See Emission Unit 01: Electrode Manufacturing Process, BACT discussion for EU01-05 (Permit V-21-041)

Emission Unit 06: Natural Gas-Fired Boilers				
Pollutant	Emission Limit or Standard	Regulatory Basis for Emission Limit or Standard	Emission Factor Used and Basis	Compliance Method
SO ₂	0.8 lbs/MMBtu	401 KAR 59:015, Section 5(1)(b)1.	0.6 lb/MMscf, AP-42 Table 1.4-2	Assumed based upon natural gas combustion
PM	0.10 lbs/MMBtu	401 KAR 59:015, Section 4(1)(b)	0.52 lb/MMscf, 2014 NEI Data	
	20% opacity	401 KAR 59:015, Section 4(2)	--	
CO	50 ppm @ 3% O ₂ on a 3-hr block avg	401 KAR 51:017	37.7 lb/MMscf Burner Specification (APE20210001)	Initial Performance Test for NO _x and CO limitations; Operating Limitations; Monitoring and Recordkeeping Requirements
	1.94 tons/yr each unit			
NO _x	9 ppm @ 3% O ₂ on a 3-hr block avg		11.15 lb/MMscf Burner Specification (APE20240004)	
	0.57 tons/yr each unit			
VOC	0.0054 lb/MMBtu on a 3-hr block avg		5.5 lb/MMscf AP-42 Table 1.4-2	
	0.28 tons/yr each unit			
GHG	117 lb CO ₂ /MMBtu on a 3-hr block avg	CO ₂ : 119,317 lb/MMscf CH ₄ : 2.25 lb/MMscf N ₂ O: 0.22 lb/MMscf CO ₂ e: 119,440 lb/MMscf		
	6154.68 tons CO ₂ e/yr each unit		40 CFR 98 Tables C-1 & C-2	

Initial Construction Date: 5/2022

Process Description:

These indirect heat exchangers are utilized to generate steam for various purposes across the facility

(KY1-B01 - KY1-B11):

Eleven (11) Natural Gas-Fired Boilers

Description:

Maximum Rated Capacity: 12.0 MMBtu/hr, each

Fuel: Natural Gas

Emission Unit 06: Natural Gas-Fired Boilers

KYEIS ID: KY1-06

(KY2-B01 - KY2-B11): Eleven (11) Natural Gas-Fired Boilers

Description:

Maximum Rated Capacity: 12.0 MMBtu/hr, each

Fuel: Natural Gas

KYEIS ID: KY2-06

Applicable Regulation:

401 KAR 51:017, *Prevention of significant deterioration of air quality*, (for CO, NO_x, VOC, and GHG), applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).

401 KAR 59:015, *New indirect heat exchangers*, applicable to indirect heat exchangers having a heat input capacity greater than one (1) million BTU per hour (MMBtu/hr) commenced on or after April 9, 1972 (401 KAR 59:015, Section 2(1)).

401 KAR, Section 2(2)(d), 40 C.F.R. 60.40c through 60.48c (Subpart Dc), *Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units*, applicable to steam generating units for which construction, modification, or reconstruction is commenced after June 9, 1989 and that has a maximum design heat input capacity of 29 megawatts (MW) (100 million British thermal units per hour (MMBtu/h)) or less, but greater than or equal to 2.9 MW (10 MMBtu/h).

State Origin Requirement

401 KAR 63:020, *Potentially hazardous matter and toxic substance emissions* applies to each affected facility which emits or may emit potentially hazardous matter or toxic substances as defined in 401 KAR 63:020 Section 2, provided such emissions are not elsewhere subject to the provisions of the administrative regulations of the Division for Air Quality.

Comments:

The permittee shall monitor and maintain records of fuel usage (MMscf) on a monthly basis [401 KAR 52:020, Section 10 and 40 CFR 60.48c(g)(2)].

BACT for VOC has been established as good combustion practices. BACT for NO_x has been established as staged combustion and good combustion. BACT for CO has been established as good combustion practices. BACT for GHG has been established as use of pipeline quality natural and good combustion practices.

The below text regarding the BACT steps is taken from the revised narrative sent to the Division 1/28/2022 and is provided by the facility. It has been edited by the Division to remove numbered references and

references to appendices not attached to this Statement of Basis/Summary document. Proposed BACT limits were revised V-21-041 R2 and the applicability of 40 CFR 63 Subpart DDDDD was removed.

CO BACT discussion for EU06 & 07 (Permit V-21-041, Revised Permit V-21-041 R2)

The source-wide potential to emit CO is over PSD thresholds. A CO emission limit was not proposed to preclude PSD. As a result, the project will trigger applicability of PSD regulations.

Step One: Identify All Potentially Available Control Technologies

The following potential CO control technology options were researched.

- Oxidation catalyst
- Good combustion practices

Oxidation Catalyst

Oxidation catalysts are exhaust treatment devices which enhance oxidation of CO to CO₂, without the addition of any chemical reagents, because there is sufficient oxygen in the exhaust gas stream for the oxidation reactions to proceed in the presence of the catalyst alone. Typically, precious metals are used as the catalyst to promote oxidation. The activity of oxidation catalysts is dependent on the amount of particulate in the flue gas stream and the flue gas temperature.

Good Combustion Practices

The use of good combustion practices optimizes combustion in the boilers and hot oil heaters. Ensuring that the temperature and oxygen availability are adequate for complete combustion minimizes CO emissions. This technique includes continued operation of the boilers at the appropriate oxygen range and temperature.

Step Two: Eliminate Technically Infeasible Control Options

The next step in the process is to evaluate all possible options and determine if any of them are technically infeasible for the proposed project.

Oxidation Catalyst

The 1990 NSR workshop manual states that one criterion for a control technology to be considered technically feasible is if the control technology is “applicable” to the source category. Specifically, a control option is considered applicable “if it has been or is soon to be deployed (e.g., is specified in a permit) on the same or similar source type.” The results from the RBLC database search show one (1) natural gas-fired boiler rated below 100 MMBtu/hr out of 144 entries that utilizes oxidation catalyst for CO BACT compliance. No other natural gas-fired boilers or oil heaters researched have demonstrated the use of such a system in a full-scale industrial setting.

Publicly available permits for the source utilizing oxidation catalyst were reviewed. The boiler in question is a natural gas-fired auxiliary boiler for a power plant located in Marshalltown, IA, and the original PSD permit was issued in April 2014. The nature of the operation of an auxiliary boiler at an electricity generating plant greatly differs from the proposed sources. The selection of this level of control for a boiler of this size is beyond what should be considered BACT. This position is supported by the fact that no other entries in the RBLC database search results utilize oxidation catalyst, including sources permitted after April 2014. For these reasons, oxidation catalyst is considered technically infeasible. However, for the sake of conservatism, oxidation catalyst is considered in the remaining steps of the BACT evaluation.

Good Combustion Practices

Emission Unit 06: Natural Gas-Fired Boilers

Good combustion practices, such as controlling the air/oxygen supply and maintaining an appropriate temperature in the combustion chambers, is included in the baseline design of the proposed project. Therefore, this control method is considered to be technically feasible.

Step Three: Rank Remaining Control Technologies by Control Effectiveness

The following table ranks CO control technologies in descending order of maximum control efficiency.

Rank	Control Option	Control Efficiency (%)
1	Oxidation Catalyst	50% - 90%
2	Good Combustion Practices	Undefined

Step Four: Evaluate Top Control Alternatives

Cost analyses were performed to compare total costs (capital and annual) per ton of pollutant removed for oxidation catalyst for two types of combustion sources:

- Natural gas-fired boiler rated at 10.0 MMBtu/hr; and
- Natural gas-fired oil heater rated at 31.9 MMBtu/hr

The simplified annualized cost accounts for the units' annual CO emissions, the exhaust temperature, and the exhaust flow rate. The capital cost is calculated using the average capital cost \$/scfm value from EPA's Air Pollution Control Technology Fact Sheet, an equipment lifespan of 10 years, and an interest rate of 7%. The cost analysis assumes that both the CO emitted from the units included in each category and the CO from the natural gas-fired preheating system will be fully captured, and that the dedicated CatOx can achieve a CO control efficiency of 90%.

The total annualized costs, including both the cost for installing and operating an oxidation catalyst and the preheater natural gas usage cost to raise the exhaust gas temperature to 600°F (i.e., the temperature required for optimal CatOx operation), are included in the following table:

Unit Category	Rated Capacity (MMBtu/hr)	CO Removed (tpy)	Total Annual CatOx Cost (\$)	Total Annual Preheating Cost (\$)	Total Combined Control Costs (\$)	Total Cost per ton of CO Removed (\$/ton)
Boiler	10.0	1.58	\$29,746	\$12,020	\$41,766	\$26,510
Oil Heater	31.9	4.82	\$77,562	\$17,260	\$94,822	\$19,688

While the cost of the additional natural gas required to preheat the exhaust streams to the necessary temperature for catalytic oxidation was accounted for, the cost of the preheater itself is not included in these estimates. Furthermore, this estimate does not include additional costs for installation, design, operation and maintenance, associated labor, and indirect operating costs such as overhead, taxes, and insurance. Thus, actual annualized costs for the CatOx control system per ton of CO removed would be significantly

Emission Unit 06: Natural Gas-Fired Boilers

higher than the results presented in the table above.

Given the very high annualized control costs expected for installing CatOx on the boilers and oil heaters and the technical challenges regarding designing and installing a large exhaust gas preheating system, it was concluded that installing and operating a CatOx system for reducing CO emissions from the proposed gas-fired combustion equipment is not cost effective. As such, CatOx technology is eliminated from further consideration in this CO BACT analysis and no further evaluation of energy and environmental impacts is warranted. Good combustion practices were chosen for a BACT emission limit. Therefore, the evaluation under Step 4 is not required.

Step Five: Select BACT

The Glendale plant will reduce CO emissions through the use of good combustion controls, according to the requirements of BACT. For each proposed boiler and oil heater, a BACT limit of 50 ppm CO at 3% oxygen (equivalent to 0.037 lb/MMBtu) on a three-hour block average basis is proposed. Compliance will be demonstrated through the combustion of pipeline quality natural gas, maintaining and operating combustion sources in accordance with manufacturer's recommendations.

NO_x BACT discussion for EU 06 & 07 (Permit V-21-041 Revised Permit V-21-041 R2)

In industrial boiler and furnace combustion processes, NO_x is formed by three fundamentally different mechanisms: thermal NO_x, prompt NO_x, and fuel NO_x. "Thermal NO_x," the principal mechanism in natural gas combustion, is formed from the breakdown of nitrogen molecules in the combustion air at high temperatures. "Prompt NO_x" reactions of nitrogen molecules in the combustion air and hydrocarbon radicals from the fuel occur within the flame. These emissions are usually negligible compared to "thermal NO_x" but may become significant with ultra-low-NO_x burners. The third mechanism, "fuel NO_x," is formed from nitrogen in the fuel. This mechanism is insignificant due to the inherently low nitrogen levels in natural gas.

Thermal NO_x is the primary mechanism for NO_x formation in natural gas combustion processes. Temperature is the most important factor, and at flame temperatures above 2,000°F, thermal NO_x formation increases exponentially. Therefore, the primary mechanisms for reducing thermal NO_x involve methods to reduce the combustion zone peak temperature such as flue gas recirculation, use of low-NO_x burners, and good combustion practices such as limiting excess air and combustion optimization.

Step One: Identify All Potentially Available Control Technologies

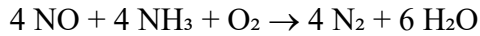
NO_x reduction can be accomplished by two general methodologies: combustion control techniques and post-combustion control methods. Combustion control techniques incorporate fuel or air staging that affect the kinetics of NO_x formation (reducing peak flame temperature) or introduce inert compounds (combustion products, for example) that limit initial NO_x formation, or both. Post-combustion NO_x control technologies employ various strategies to chemically reduce NO_x to elemental nitrogen (N₂) with or without the use of a catalyst. The following control options have been identified as possible techniques to reduce NO_x emissions:

- Selective catalytic reduction (SCR)
- Selective non-catalytic reduction (SNCR)
- Low-NO_x and ultra-low-NO_x burners
- Flue gas recirculation (FGR)
- Good combustion practices

SCR

Emission Unit 06: Natural Gas-Fired Boilers

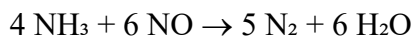
SCR is a post-combustion control technology that reduces NO_x emissions by injecting a nitrogen-based reagent (e.g., ammonia, urea) into the exhaust stream downstream of the combustion unit and upstream of a catalyst bed. On the catalyst surface, the reagent reacts selectively with NO_x to produce molecular nitrogen and water vapor. The overall chemical reaction can be expressed as:



The effectiveness of SCR is dependent mainly on two factors: temperature and catalyst activity. The ideal temperature ranges from 480°F to 800°F and can tolerate temperature fluctuations of up to 200°F. The optimal temperature is typically around 700°F to 750°F. When operated within the optimum temperature range, the reaction can result in removal efficiencies of 90 percent or more.

SNCR

SNCR is similar to SCR in that it is based on the reaction of urea or ammonia with NO_x. However, unlike SCR, SNCR does not involve a catalyst. The overall reaction scheme for ammonia systems can be expressed as follows:



Typical removal efficiencies for SNCR range from 25 to 65 percent, depending on the reducing reagent used. An important consideration for implementing SNCR is the operating temperature range. The optimum temperature range is approximately 1,600°F to 2,100°F. Operation at temperatures below this range results in ammonia slip, and operation above this range results in oxidation of ammonia, forming additional NO_x.

Low-NO_x and Ultra-Low-NO_x Burners

Low-NO_x and ultra-low-NO_x burners reduce NO_x formation through staged combustion and burner design. The first stage is the primary fuel combustion step. The next stage involves reburning to further reduce NO_x. The third stage is the final combustion stage in low excess air to limit the temperature. For conventional natural gas-fired boilers sold as “packaged units”, manufacturers often specify low-NO_x burners with NO_x emissions performance in the range of 30 ppm to 50 ppm at 3% oxygen while the NO_x emissions performance for ultra-low-NO_x burners is often specified within a range of 9 ppm to 20 ppm at 3% oxygen. Based on the representative uncontrolled NO_x emissions factor presented in EPA’s AP-42 Section 1.4 “Natural Gas Combustion” (100 lb NO_x/MMscf or approximately 81 ppm at 3% oxygen), these NO_x emissions performance levels equate to a NO_x emissions reductions in the range of 38% to 63% for low-NO_x burners and 75% to 88% for ultra-low NO_x burners.

FGR

With FGR, a portion of the flue gas is recycled back to the combustion zone. NO_x emissions are reduced through two mechanisms: diluting oxygen content and reducing combustion zone temperature. For the purposes of this top-down assessment, it is assumed that FGR achieves the same NO_x reductions as low NO_x burners. When FGR is used in conjunction with low NO_x burners and ultra-low NO_x burners, the previously specified NO_x reduction levels would still be representative (i.e., FGR and low NO_x burner NO_x reduction efficiencies are not additive when these two control options are used together).

Good Combustion Practices

Boiler and oil heater maintenance and efficient operation in accordance with the manufacturer’s recommendations will ensure NO_x emissions are minimized.

Emission Unit 06: Natural Gas-Fired Boilers

Step Two: Eliminate Technically Infeasible Control Options

The next step in the process is to evaluate all possible options and determine if any of them are technically infeasible for the proposed project.

SCR

As previously stated, the ideal flue gas temperature range for optimal SCR operation is 700°F to 750°F. However, the flue gas temperatures for each boiler is approximately 165°F and each oil heater is approximately 400°F. Therefore, additional exhaust gas preheaters would be required to raise the temperature by approximately 535°F for the boilers and 300°F for the oil heaters. Since the temperature is not within the required operating range, SCR is considered to be technically infeasible. However, for the sake of conservatism, SCR is considered in the remaining steps of the BACT evaluation.

SNCR

The results from the RBLC database search show no natural gas-fired boiler rated below 100 MMBtu/hr that utilize SNCR for NO_x BACT compliance, no other natural gas-fired boilers or oil heaters that have demonstrated the use of such a system in a full-scale industrial setting have been found. Performing a “control method description” keyword search in EPA’s RBLC database revealed a range of cement kilns, solid waste combustors, solid fuel boilers, and industrial process furnaces. This list of source types using SNCR aligns with EPA’s characterization of the most common source types where SNCR is installed within Air Pollution Control Technology Fact Sheet. None of these applications involve using SNCR for NO_x emissions control for relatively small natural gas-fired boilers and process heaters (10-32 MMBtu/hr for BlueOval’s boilers and oil heaters). Therefore, SNCR does not meet the “applicable” requirement and is considered technically infeasible.

Low-NO_x and Ultra-Low-NO_x Burners

At the NO_x performance level assigned to the boilers and hot oil heaters (20 ppm at 3% O₂), candidate burner manufacturers would characterize this burner design basis as achieving “ultra-low NO_x” performance levels. In addition, multiple RBLC entries for natural gas-fired boilers and heaters provided in Appendix E contain a “control method description” with references to “ultra-low” NO_x emissions performance at a similar emissions basis to BlueOval’s boilers and oil heaters (RBLC IDs = MI-0426 and WY-0075). Therefore, the proposed NO_x emissions level for the boilers and oil heaters are considered to be consistent with an ultra-low NO_x burner design basis. Ultra-low-NO_x burners are considered technically feasible.

FGR

FGR is considered technically feasible and will be used in conjunction with the proposed ultra-low NO_x burners for the hot oil heaters. FGR is not planned to be installed on the boilers as it is not needed to obtain the target NO_x emissions performance. The burner design configuration of the hot oil heaters necessitates use of FGR to achieve the target NO_x emissions performance. In contrast, the boiler burner design configuration can achieve the target NO_x emissions performance without this flue gas management design feature added. An oil heater has multiple unique burner design and operating considerations (i.e., higher burner zone heat release, differing flame temperatures, differing combustion air supply temperatures, etc.) based on hot oil as the heat transfer medium for subsequent process use as compared to the more conventional burner arrangement for heating water/steam in a typical boiler arrangement. These unique burner design features of a hot oil heater create a higher “baseline” level of NO_x emissions generation where use of FGR in conjunction with ultra-low NO_x burners to obtain the same NO_x emissions performance as a similarly-sized boiler. Therefore, while FGR is considered to be applicable and technically feasible for the

Emission Unit 06: Natural Gas-Fired Boilers

oil heaters, it is not considered to be an applicable or necessary NO_x emissions reduction technique for the relatively small boilers proposed for supporting the electrical vehicle battery manufacturing operation.

Good Combustion Practices

Good combustion practices are included in the baseline design for the facility and therefore are considered technically feasible.

Step Three: Rank Remaining Control Technologies by Control Effectiveness

The table below ranks the NO_x control technologies in descending order of maximum control efficiency.

Rank	Control Option	Control Efficiency (%)
1	SCR	90%
2	Ultra-low-NO _x burners (baseline)	75%-88%
3	Low-NO _x burners	38%-63%
4	FGR	63%
5	Good combustion practices	0%

Step Four: Evaluate Top Control Alternatives

SCR

Cost analyses for SCR are based on EPA Air Pollution Control Cost Manual (dated June 2019) sections applicable to SCR and associated calculation spreadsheets provided by EPA (dated June 2019) for the two types of combustion sources:

- Natural gas-fired boiler rated at 10.0 MMBtu/hr; and
- Natural gas-fired oil heater rated at 31.9 MMBtu/hr

Default values from EPA’s calculation spreadsheet were used for all SCR design and operating parameters. Annualized control costs for boilers and heaters are approximately \$61,000/ton NO_x removed and \$39,300/ton NO_x removed, respectively in 2020 dollars. Actual costs in 2021 dollars are expected to be higher based on recent monthly trends in the Chemical Engineering Plant Cost Index. Given the high annualized control costs and the previously cited technical challenges regarding designing and installing a large exhaust gas preheating system applicable to both CatOx and SCR, it is concluded that installing and operating a SCR system for reducing NO_x emissions from the boilers or heaters is not cost effective. As such, the SCR will be eliminated from further consideration in this BACT analysis, and thus, no further evaluation of energy and environmental impacts are warranted.

Ultra-Low-NO_x Burners

The next highest control scheme is the use of ultra-low NO_x burners, which is included in the facility’s baseline design. Therefore, ultra low-NO_x burners were considered in setting the NO_x BACT limit.

Low-NO_x Burners

Low-NO_x burners cannot achieve the same level of NO_x emissions performance as ultra-low NO_x burners, so this option ranks below the selected NO_x emissions reduction technique and does not require further

Emission Unit 06: Natural Gas-Fired Boilers

consideration in the NO_x BACT analysis.

FGR

FGR will be implemented with ultra-low NO_x burners for the oil heaters. FGR was not selected for the boilers because it is not necessary to achieve the target level of NO_x emissions performance specified for the boilers. In addition, implementing FGR on the boilers would have the adverse energy impact of increasing electricity usage from a higher flow capacity fan and higher fan motor horsepower required to supply the main combustion air supply fan for an induced FGR system or the dedicated fan for a forced FGR system. This adverse energy impact is not warranted in consideration of any NO_x reduction which may be attributable to the use of FGR for the site-specific application to the facility's proposed boilers.

Good Combustion Practices

Good combustion practices are included in the facility's baseline design and do not pose any adverse energy, environmental, or economic impacts.

Step Five: Select BACT

The facility will reduce NO_x emissions through the use of ultra-low NO_x burners, according to the requirements of BACT. For each proposed boiler and oil heater, BlueOval is proposing a BACT limit of *20 ppm NO_x at 3% oxygen (equivalent to 0.024 lb/MMBtu) on a three-hour block average basis. Compliance will be demonstrated through the combustion of pipeline quality natural gas, maintaining and operating combustion sources in accordance with manufacturer's recommendations.

**EU06 is now 9 ppm as of v-21-041 R2*

VOC BACT discussion for EU 06 & 07 (Permit V-21-041, Revised Permit V-21-041 R2)

VOC emissions from external combustion sources, often in the form of aldehydes, aromatic carbon compounds, and various other organic compounds, are a result of incomplete combustion. Conditions leading to incomplete combustion include the following: insufficient oxygen availability, poor fuel/air mixing, reduced combustion temperature, and reduced combustion gas residence time.

Step One: Identify All Potentially Available Control Technologies

The same candidate control options for CO were considered for VOC and include the following:

- Oxidation catalyst
- Good combustion practices

Oxidation Catalyst

Oxidation catalysts are exhaust treatment devices which enhance oxidation of CO to CO₂, without the addition of any chemical reagents, because there is sufficient oxygen in the exhaust gas stream for the oxidation reactions to proceed in the presence of the catalyst alone. Typically, precious metals are used as

the catalyst to promote oxidation. The activity of oxidation catalysts is dependent on the amount of particulate in the flue gas stream and the flue gas temperature.

Good Combustion Practices

The use of good combustion practices optimizes combustion in the boilers and hot oil heaters. Ensuring that the temperature and oxygen availability are adequate for complete combustion minimizes CO emissions. This technique includes continued operation of the boilers at the appropriate oxygen range and temperature.

Step Two: Eliminate Technically Infeasible Control Options

The next step in the process is to evaluate all possible options and determine if any of them are technically infeasible for the proposed project.

Oxidation Catalyst

The results from the RBLC database search show no natural gas-fired boiler rated below 100 MMBtu/hr that utilize oxidation catalyst for VOC BACT compliance, and no other natural gas-fired boilers or oil heaters that have demonstrated the use of such a system in a full-scale industrial setting have been found. Therefore, oxidation catalyst does not meet the “applicable” requirement and is considered technically infeasible. However, for the sake of conservatism, oxidation catalyst is considered in the remaining steps of the BACT evaluation.

Good Combustion Practices

Good combustion practices, such as controlling the air/oxygen supply and maintaining an appropriate temperature in the combustion chambers, is included in the baseline design of the proposed project. Therefore, this control method is considered to be technically feasible.

Step Three: Rank Remaining Control Technologies by Control Effectiveness

Table 5-5 ranks the VOC control technologies in descending order of maximum control efficiency.

Rank	Control Option	Control Efficiency (%)
1	Oxidation Catalyst	98%
2	Good Combustion Practices	Undefined

Step Four: Evaluate Top Control Alternatives

Following the same simplified annualized control cost analysis approach for applying CatOx to boilers and heaters for CO emission control, the VOC control cost analysis for CatOx shows annualized control costs in excess of \$175,500/ton of VOC removed for boilers and in excess of \$126,900/ton of VOC removed for oil heaters. Given the excessively high annualized control costs expected for installing CatOx on the boilers and oil heaters and the technical challenges regarding designing and installing a large exhaust gas preheating system, It is concluded that installing and operating a CatOx system for reducing VOC emissions from the proposed gas-fired combustion equipment is not cost effective. As such, CatOx technology is eliminated from further consideration in this VOC BACT analysis and no further evaluation of energy and environmental impacts is warranted.

Good combustion practices for selecting a BACT emission limit has been chosen. Therefore, the evaluation under Step 4 is not required.

Emission Unit 06: Natural Gas-Fired Boilers

Step Five: Select BACT

The facility will reduce VOC emissions through good combustion practices, according to the requirements of BACT. For each source, BlueOval is proposing a VOC BACT limit of 0.0054 lb/MMBtu on a 3-hour block average basis. Compliance will be demonstrated through the combustion of pipeline quality natural gas and maintaining and operating combustion sources in accordance with manufacturer's recommendations.

GHG/CO₂ BACT discussion for EU 06 – 07 and 13 – 16 (Permit V-21-041 Revised Permit V-21-041 R2)

Beginning in 2011, major sources of GHG emissions that trigger PSD permitting must implement BACT from new and modified sources. The EPA has issued a variety of guidance in an attempt to clarify the BACT determination process for CO₂e emissions from common stationary sources. The following documents were referenced for this BACT analysis:

- Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Industrial, Commercial, and Institutional Boilers (“boiler white paper”)
- PSD and Title V Permitting Guidance for Greenhouse Gases

In the following sections, a top-down BACT analysis for GHG is presented for boilers, oil heaters, and building/process heating units. Note, since CO₂ is the primary component of CO₂e emissions, it is assumed that a majority of CO₂e reductions through add-on controls will be achieved through CO₂ reduction techniques.

Step One: Identify All Potentially Available Control Technologies

CO₂ control technologies were researched and developed the following list of potential options which are commonly reviewed in making BACT determinations that are included in the RBLC database:

- Use of natural gas
- Good combustion practices
- Carbon capture

Use of Natural Gas

The use of pipeline quality natural gas as fuel is inherent to the proposed project. Note that it is not appropriate to consider other fuels for this BACT analysis because it would change the proposed project and redefine the source. Per the general PSD guidance, control technologies that would fundamentally redefine the nature of the source do not need to be evaluated.

Good Combustion Practices

Boiler, oil heater, and building/process heating units maintenance and operation will be performed according to the manufacturer's recommendations.

Carbon Capture

As proposed by the National Energy Technology Laboratory, removal of carbon from the combustion system can be achieved through three main approaches: post-combustion capture, pre-combustion capture,

Emission Unit 06: Natural Gas-Fired Boilers

and oxy-combustion.

In general, post-combustion capture involves the removal of CO₂ generated by fuel combustion from the flue gas. The prevalent technology uses an amine solution, commonly monoethanolamine (MEA), to absorb CO₂ from the flue gas stream. Once the CO₂ is stripped from the flue gas stream, the CO₂/amine solution is sent to a stripping column to separate the CO₂ and regenerate the solvent.

There are a number of other emerging post-combustion technologies that are also being studied. However, since these have not been demonstrated on a large scale, they are not considered here.

Pre-combustion capture of CO₂ involves utilizing the integrated gasification combine cycle (IGCC) with a shift reaction. First the fuel is gasified through a reaction with oxygen from air to produce synthesis gas (syngas), which is mostly comprised of CO and hydrogen. The CO in syngas is then further reacted with steam through the shift mechanism to produce CO₂ and hydrogen. The CO₂ is separated from the stream while hydrogen is used for fuel.

The final technique, oxy-combustion, involves combusting the fuel in an oxygen-rich environment. The oxygen promotes complete combustion and results in flue gas stream of mostly CO₂ and water. CO₂ is then removed from the stream by condensing the water.

As previously stated, and per the general PSD guidance, control technologies that would fundamentally redefine the nature of the source do not need to be evaluated with the BACT analysis. The pre-combustion capture process fundamentally modifies the nature of the fuel source while the oxy-combustion process requires the use of nearly pure oxygen. The proposed boilers, oil heaters, and building/process heating units at the facility are designed to burn commercial natural gas and use air for combustion. Since the proposed project does not involve alternative fuels or combustion with pure oxygen, the pre-combustion and oxy-combustion processes will redefine the source and are not considered under this analysis.

Step Two: Eliminate Technically Infeasible Control Options

The next step in the process is to evaluate all possible options and determine if any of them are technically infeasible for the proposed project.

Use of Natural Gas

The use of pipeline quality natural gas fuel is included in the baseline design. Therefore, it is technically feasible.

Good Combustion Practices

The use of good combustion practices is included in the baseline design. Therefore, it is technically feasible.

Carbon Capture

The results from the RBLC database search show no natural gas-fired boiler rated below 100 MMBtu/hr that utilize an amine absorption system for GHG BACT compliance. Furthermore, no other natural gas-fired combustion systems of the scope and scale of those proposed for the facility that have demonstrated the use of such a system in a full-scale industrial setting have been found. Therefore, a post-combustion amine absorption system does not meet the “applicable” requirement and is considered technically infeasible.

Emission Unit 06: Natural Gas-Fired Boilers

Step Three: Rank Remaining Control Technologies by Control Effectiveness

The remaining technologies, namely the use of pipeline quality natural gas fuel and good combustion practices, are both included in the facility's proposed project. This baseline operating scenario will be used for determining BACT.

Step Four: Evaluate Top Control Alternatives

The use of pipeline quality natural gas fuel and good combustion practices for selecting a BACT emission limit has been chosen. Therefore, the evaluation under Step 4 is not required.

Step Five: Select BACT

The facility will reduce CO₂e emissions through the use of pipeline quality natural gas for fuel and good combustion practices, according to the requirements of BACT. For each source, it is proposed that a CO₂ BACT limit of 117 lb/MMBtu on a 3-hour block average basis be used. Compliance will be demonstrated through the combustion of pipeline quality natural gas.

Emission Unit 07: Natural Gas-Fired Oil Heaters				
Pollutant	Emission Limit or Standard	Regulatory Basis for Emission Limit or Standard	Emission Factor Used and Basis	Compliance Method
SO ₂	0.8 lbs/MMBtu	401 KAR 59:015, Section 5(1)(b)1.	0.6 lb/MMscf, AP-42 Table 1.4-2	Assumed based upon natural gas combustion
PM	0.10 lbs/MMBtu	401 KAR 59:015, Section 4(1)(b)	0.52 lb/MMscf, 2014 NEI Data	
	20% opacity	401 KAR 59:015, Section 4(2)	--	
CO	50 ppm @ 3% O ₂ on a 3-hr block avg	401 KAR 51:017	37.7 lb/MMscf Burner Specification (APE20210001)	Initial Performance Test for NO _x and CO limitations; Operating Limitations; Monitoring and Recordkeeping Requirements
	4.50 tons/yr each 27.8 MMBtu/hr unit			
	3.85 tons/yr each 23.8 MMBtu/hr unit			
NO _x	20 ppm @ 3% O ₂ on a 3-hr block avg		24.77 lb/MMscf Burner Specification (APE20210001)	
	2.95 tons/yr each 27.8 MMBtu/hr unit			
	2.53 tons/yr each 23.8 MMBtu/hr unit			
VOC	0.0054 lb/MMBtu on a 3-hr block avg		5.5 lb/MMscf AP-42 Table 1.4-2	
	0.66 tons/yr each 27.8 MMBtu/hr unit			
	0.56 tons/yr each 23.8 MMBtu/hr unit			
GHG	117 lb CO ₂ /MMBtu on a 3-hr block avg		CO ₂ : 119,317 lb/MMscf CH ₄ : 2.25 lb/MMscf N ₂ O: 0.22 lb/MMscf CO ₂ e: 119,440 lb/MMscf	
	14,242.95 tons CO ₂ e/yr each 27.8 MMBtu/hr unit			

Emission Unit 07: Natural Gas-Fired Oil Heaters				
	12,206.77 tons/yr each 23.8 MMBtu/hr unit		40 CFR 98 Tables C- 1 & C-2	
Initial Construction Date: 5/2022				
Process Description: These indirect heat exchangers are utilized to provide hot oil to process units at the facility				
(KY1-H01 - KY1-H10):		Ten (10) Natural Gas-Fired Oil Heaters		
Description:				
Maximum Rated Capacity:		27.8 MMBtu/hr, each (KY1-H01 - KY1-H05) 23.8 MMBtu/hr, each (KY1-H06 - KY1-H10)		
Fuel:		Natural Gas		
KYEIS ID: KY1-07				
(KY2-H01 – KY2-H10):		Ten (10) Natural Gas-Fired Oil Heaters		
Description:				
Maximum Rated Capacity:		27.8 MMBtu/hr, each (KY2-H01 – KY2-H05) 23.8 MMBtu/hr, each (KY2-H06 – KY2-H10)		
Fuel:		Natural Gas		
KYEIS ID: KY2-07				
Applicable Regulation:				
401 KAR 51:017 , <i>Prevention of significant deterioration of air quality</i> , (for CO, NO _x , VOC, and GHG), applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).				
401 KAR 59:015 , <i>New indirect heat exchangers</i> , applicable to indirect heat exchangers having a heat input capacity greater than one (1) million BTU per hour (MMBtu/hr) commenced on or after April 9, 1972 (401 KAR 59:015, Section 2(1)).				
401 KAR 60:005, Section 2(2)(d), 40 C.F.R. 60.40c through 60.48c (Subpart Dc) , <i>Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units</i> , applicable to steam generating units for which construction, modification, or reconstruction is commenced after June 9, 1989 and that has a maximum design heat input capacity of 29 megawatts (MW) (100 million British thermal units per hour (MMBtu/h)) or less, but greater than or equal to 2.9 MW (10 MMBtu/h).				
State Origin Requirement				
401 KAR 63:020 , <i>Potentially hazardous matter and toxic substance emissions</i> applies to each affected facility which emits or may emit potentially hazardous matter or toxic substances as defined in 401 KAR 63:020 Section 2, provided such emissions are not elsewhere subject to the provisions of the administrative regulations of the Division for Air Quality.				

Emission Unit 07: Natural Gas-Fired Oil Heaters

Comments:

The permittee shall monitor and maintain records of fuel usage (MMscf) on a monthly basis [401 KAR 52:020, Section 10 and 40 CFR 60.48c(g)(2)].

BACT for VOC has been established as good combustion practices. BACT for NO_x has been established as staged combustion with flue gas recirculation and good combustion. BACT for CO has been established as good combustion practices. BACT for GHG has been established as use of pipeline quality natural and good combustion practices.

The BACT assessment for these units is located in the entry for Emission Unit 06 (B01 – B08).

Emission Unit 08A: Diesel-Fired Emergency Fire Pump Engines				
Pollutant	Emission Limit or Standard	Regulatory Basis for Emission Limit or Standard	Emission Factor Used and Basis	Compliance Method
NMHC + NO _x	3.0 g/HP-hr	40 CFR 60.4205(c) and 401 KAR 51:017	129.4 lb/Mgal, 40 CFR 60, Subpart III, Table 4	Compliance is demonstrated by purchasing a certified engine and operating according to the requirements of 40 CFR 60, Subpart III
CO	2.6 g/HP-hr		159.6 lb/Mgal, 40 CFR 60, Subpart III, Table 4	
PM	0.15 g/HP-hr		9.5 lb/Mgal, 40 CFR 60, Subpart III, Table 4	
CO _{2e}	1.18 lb/HP-hr	401 KAR 51:017	CO ₂ : 22,338 lb/Mgal CH ₄ : 0.91 lb/Mgal N ₂ O: 0.18 lb/Mgal 40 CFR 98 Tables C-1 & C-2	Emission factors for diesel fuel from 40 CFR 98, Subpart C

Initial Construction Date: 5/2022

Process Description:

Emergency engines to pump sprinkler water in the case of a fire.

(KY1-FPE01 - KY1-FPE03) Three (3) Diesel-Fired Emergency Fire Pump Engines

Description:

Maximum Engine Rating: 399 hp each

Primary Fuel: Diesel

KYEIS ID: KY1-08

Applicable Regulation:

401 KAR 51:017, *Prevention of significant deterioration of air quality*, (for CO, NO_x, VOC, and GHG), applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).

401 KAR 60:005 Section 2(2)(dddd), **40 C.F.R. 60.4200 to 60.4219, Tables 1 to 8 (Subpart III)**, *Standards of Performance for Stationary Compression Ignition Internal Combustion Engines*.

401 KAR 63:002 Section 2(4)(eeee), **40 C.F.R. 63.6580 to 63.6675, Tables 1a to 8, and Appendix A (Subpart ZZZZ)**, *National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines*.

Comments:

The permittee shall comply with the emission standards for new nonroad CI engines in 40 CFR Part 60, Subpart III, for all pollutants, for the same model year and maximum engine power.

Emission Unit 08A: Diesel-Fired Emergency Fire Pump Engines

BACT for VOC, NO_x, and CO has been established as compliance with 40 CFR 60, Subpart IIII. BACT for GHG has been established as use of pipeline quality natural and good combustion practices.

BACT discussion for EU 08A and 08B (Permit V-21-041)

The proposed fire pump and emergency generator engines will be diesel-fired. Potential emissions of each criteria pollutant from each engine are well below 5 tpy. In addition, the operation of this equipment will be limited to emergency events and required routine testing. Therefore, the potential to emit is calculated based upon 500 hours per year. Due to the small quantity of emissions associated with the emergency units, and the emergency nature of operation of the units, a “top-down” BACT analysis has not been conducted. These units will meet BACT requirements by complying with the applicable requirements of NSPS Subpart IIII and NESHAP Subpart ZZZZ. For the fire pump engines, a BACT emission limit equivalent to the emissions limitations under NSPS Subpart IIII for CO, NO_x, and VOC; and CO_{2e} emission factors for diesel fuel presented in 40 CFR 98 Subpart C are proposed. For the emergency generator engines, a BACT emission limit equivalent to the engine certification standard for CO, NO_x, and VOC (as total unburned hydrocarbons);and CO_{2e} emission factors for diesel fuel presented in 40 CFR 98 Subpart C are proposed.

Emission Unit 08B: Diesel-Fired Emergency Engines				
Pollutant	Emission Limit or Standard	Regulatory Basis for Emission Limit or Standard	Emission Factor Used and Basis	Compliance Method
NMHC + NO _x	6.4 g/KW-hr	40 CFR 60.4205(b), 60.4202(a)(2), 40 CFR Part 1039, and 401 KAR 51:017	325.5 lb/Mgal, 40 CFR 60, Subpart III	Compliance is demonstrated by purchasing a certified engine and operating according to the requirements of 40 CFR 60, Subpart III
CO	3.5 g/KW-hr		16.5 lb/Mgal, 40 CFR 60, Subpart III	
PM	0.20 g/KW-hr		2.5 lb/Mgal, 40 CFR 60, Subpart III	
CO _{2e}	0.99 lb/HP-hr on a 3-hr block avg	401 KAR 51:017	CO ₂ : 22,338 lb/Mgal CH ₄ : 0.91 lb/Mgal N ₂ O: 0.18 lb/Mgal 40 CFR 98 Tables C-1 & C-2	Emission factors for diesel fuel from 40 CFR 98, Subpart C

Initial Construction Date: 5/2022

Process Description:

(KY1-GE01 - KY1-GE05)

Five (5) Diesel-Fired Emergency Engines

Description:

Maximum Engine Rating: 1,609 hp Emergency Engines (KY1-GE01 - KY1-GE02)
 1,341 hp Emergency Engine (KY1-GE03)
 805 hp Emergency Engine (KY1-GE04)
 1,140 hp Emergency Engine (KY1-GE05)

Primary Fuel: Diesel

KYEIS ID: KY1-08

(KY2-GE01 - KY2-GE04)

Four (4) Diesel-Fired Emergency Engines

Description:

Maximum Engine Rating: 1,073 hp Emergency Engines (KY2-GE01 - KY2-GE02)
 1,676 hp Emergency Engine (KY2-GE03)
 2146 hp Emergency Engine (KY2-GE04)

Primary Fuel: Diesel

KYEIS ID: KY2-08

Applicable Regulation:

401 KAR 51:017, *Prevention of significant deterioration of air quality*, (for CO, NO_x, VOC, and GHG), applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).

Emission Unit 08B: Diesel-Fired Emergency Engines

401 KAR 60:005 Section 2(2)(dddd), 40 C.F.R. 60.4200 to 60.4219, Tables 1 to 8 (Subpart III), *Standards of Performance for Stationary Compression Ignition Internal Combustion Engines.*

401 KAR 63:002 Section 2(4)(eeee), 40 C.F.R. 63.6580 to 63.6675, Tables 1a to 8, and Appendix A (Subpart ZZZZ), *National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines.*

Comments:

The permittee shall comply with the emission standards for new nonroad CI engines in 40 CFR Part 60, Subpart III, for all pollutants, for the same model year and maximum engine power.

The BACT assessment for these units is located in the entry for Emission Unit 08A.

Emission Unit 09: Cooling Towers				
Pollutant	Emission Limit or Standard	Regulatory Basis for Emission Limit or Standard	Emission Factor Used and Basis	Compliance Method
PM	For process rates >0.5 tons/hour ≤ 30 tons/hour E=3.59P ^{0.62}	401 KAR 59:010, Section 3(2)	0.033 lb/MMgal, Application APE20210001	Manufacturer Certification
Opacity	20% opacity	401 KAR 59:010, Section 3(1)	N/A	Weekly Stack Visual Observation

Initial Construction Date: 5/2022

Process Description:

Induced Draft Cooling Towers

(KY1-CT01 - KY1-CT07): Cooling Towers

Description:

Operating Rate: 7,507 gpm (KY1-CT01 - KY1-CT04)

3,804 gpm (KY1-CT05 - KY1-CT07)

Construction Commenced: May 2022

KYEIS ID: KY1-09

(KY2-CT01 - KY2-CT07): Cooling Towers

Description:

Operating Rate: 7,507 gpm (KY2-CT01 - KY2-CT04)

3,804 gpm (KY2-CT05 - KY2-CT07)

Construction Commenced: May 2022

KYEIS ID: KY2-09

Applicable Regulation:

401 KAR 59:010, *New process operations* applies to each affected facility or source, associated with a process operation, which is not subject to another emission standard with respect to particulates in 401 KAR Chapter 59, commenced on or after July 2, 1975.

Precluded Regulation:

401 KAR 63:002, Section 2(4)(j), 40 C.F.R. 63.400 through 63.407, Table 1 (Subpart Q), *National Emission Standards for Hazardous Air Pollutants for Industrial Process Cooling Towers* 40 CFR 63, Subpart Q is not applicable because the facility will not use chromium based water treatment chemicals.

Comments:

An assumed 0.0005% drift rate was assumed for the purpose of calculating particulate matter emissions. PM₁₀ and PM_{2.5} emissions were estimated using *Calculating Realistic PM₁₀ from Cooling Towers* by Joel

Emission Unit 09: Cooling Towers

Reisman and Gordan Frisbie (2002).

The 401 KAR 59:010 process weight rate is the weight rate of particulates in the cooling water. Assuming 800 ppmw, P=0.76 ton/hr for the 3,804 gpm cooling towers and P=1.50 ton/hr for the 7,507 gpm cooling towers.

Emission Unit 10: Storage Tanks

Initial Construction Date: 5/2022

Process Description:

Source #	Source Name	Tank Size
EU10: Storage Tanks		
KY1-RT01 - KY1-RT04	Raw Material Tanks (Raw NMP)	13,800 gallons
KY1-WT01 - KY1-WT08	Waste Tanks (Recovered Waste NMP)	13,800 gallons
KY1-ET01 - KY1-ET08	Electrolyte Storage Tanks	13,800 gallons
KY1-EST101	Electrolyte Separator Tanks 1 (with Activated Carbon Adsorber Control KY1-AC22)	790 gallons
KY1-EST201	Electrolyte Separator Tanks 2 (with Activated Carbon Adsorber Control KY1-AC22)	790 gallons
KY1-EWT01	Electrolyte Waste Tanks	1,320 gallons
KY2-RT01 - KY2-RT04	Raw Material Tanks (Raw NMP)	13,800 gallons
KY2-WT01 - KY2-WT08	Waste Tanks (Recovered Waste NMP)	13,800 gallons
KY2-ET01 - KY2-ET08	Electrolyte Storage Tanks (Electrolyte is not pure NMP)	13,800 gallons
KY2-EST101	Electrolyte Separator Tanks 1 (with Activated Carbon Adsorber Control KY2-AC22)	790 gallons
KY2-EST201	Electrolyte Separator Tanks 2 (with Activated Carbon Adsorber Control KY2-AC22)	790 gallons
KY2-EWT01	Electrolyte Waste Tanks	1,320 gallons

Building 1 processes: KYEIS ID: KY1-10

Building 2 processes: KYEIS ID: KY2-10

Applicable Regulation:

401 KAR 51:017, *Prevention of significant deterioration of air quality* applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).

Emission Unit 10: Storage Tanks

State Origin Requirement

401 KAR 63:020, *Potentially hazardous matter and toxic substance emissions* applies to each affected facility which emits or may emit potentially hazardous matter or toxic substances as defined in 401 KAR 63:020 Section 2, provided such emissions are not elsewhere subject to the provisions of the administrative regulations of the Division for Air Quality.

Non-applicable Regulation:

401 KAR 60:005, Section 2(2)(r), 40 C.F.R. 60.110b through 60.117b (Subpart Kb), *Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984* 40 CFR 60, Subpart Kb is not applicable to the storage tanks because no tank has a storage capacity of 75 m³.

401 KAR 59:050, *New storage vessels for petroleum liquids* 401 KAR 59:050 does not apply because the tanks do not meet the definition of petroleum liquids.

Comments:

All tanks are Vertical Above-Ground White Fixed Roof tanks.

Emissions were calculated using AP-42 Section 7.1.

The tanks were identified as units without a large amount of potential emissions. The facility proposed for VOC BACT compliance purposes the following work practice standards:

- All storage tanks shall be equipped with submerged fill lines and
- All storage tanks shall be equipped with spill and overfill protection.

NMP solution stored in waste tanks is shipped offsite for recovery.

Activated Carbon Adsorbers

There is one activated carbon adsorber per pair of electrolyte separator tanks per building. The separator tanks are used to separate nitrogen gas used for pushing fluids from the electrolyte. The adsorbers are used to control electrolyte emissions that may occur during the operation of the separator tank. The activated carbon adsorbers were not added as a part of BACT considerations and there are not any control efficiencies assumed for their operation. The permittee has accepted voluntarily operating, monitoring, and recordkeeping requirements for the activated carbon adsorbers. The permittee also states that the additional costs to install and operate emission control equipment to capture the small amount of estimated VOC emissions from these tanks would not be considered cost-effective under BACT. As such, these requirements are enforced under the state of Kentucky's permitting authority [401 KAR 52:020, Section 10].

Emission Unit 11: Date Code Printers

Initial Construction Date: 5/2022

(KY1-PI01): **Date Code Printers (Building 1)**
KYEIS ID: KY1-11

(KY2-PI01): **Date Code Printers (Building 2)**
KYEIS ID: KY2-11

Applicable Regulation:

401 KAR 51:017, *Prevention of significant deterioration of air quality* applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).

Comments:

Emissions were calculated using mass balances.

The printers were identified as units without a large amount of potential emissions. The facility proposed for VOC BACT compliance purposes the following work practice standards:

- All inks, solvents and makeup fluid used shall be stored in closed, vapor tight containers.

Emission Unit 12: Paved Haul Roads

Initial Construction Date: 5/2022

Process Description:

Paved Haul Roads, KY1-HR01
KYEIS ID: KY1-12

State Origin Requirement

401 KAR 63:010, *Fugitive Emissions* applies to each apparatus, operation, or road that emits or could emit fugitive emissions not elsewhere subject to an opacity standard within 401 KAR Chapters 50 through 68.

Comments:

Emission factors provided by the facility were calculated using AP-42.13.2.1 equation (1). The PM-30, PM-10, and PM-2.5 factors from table 13.2.1-1 were used in the calculation with a vehicle weight of 40 tons and silt loading factor of 0.6.

Emission Unit 13: Direct-Fired Natural Gas-Fired Dehumidification Units Emission Unit 16: Direct-Fired Natural Gas-Fired Coater Oven Air Handling Units				
Pollutant	Emission Limit or Standard	Regulatory Basis for Emission Limit or Standard	Emission Factor Used and Basis	Compliance Method
PM	2.34 lb/hr	401 KAR 59:010, Section 3(2)	0.52 lb/MMscf 2014 NEI Data	Assumed based upon natural gas combustion
	20% opacity	401 KAR 59:010, Section 3(1)(a)	--	
CO	25 ppm @ 3% O ₂ on a 3-hr block avg EU13	401 KAR 51:017	18.85 lb/MMscf Burner Specification (APE20240004)	Operating Limitations; Monitoring and Recordkeeping Requirements
	50 ppm @ 3% O ₂ on a 3-hr block avg EU16		37.7 lb/MMscf Burner Specification (APE20210001)	
NO _x	89 ppm @ 3% O ₂ on a 3-hr block avg EU13		110.24 lb/MMscf Burner Specification (APE20240004)	
	25 ppm @ 3% O ₂ on a 3-hr block avg EU16		30.97 lb/MMscf Burner Specification (APE20240004)	
VOC	0.0054 lb/MMBtu on a 3-hr block avg		5.5 lb/MMscf AP-42 Table 1.4-2	
CO ₂	117 lb/MMBtu on a 3-hr block avg		119,067 lb/MMscf 40 CFR 98 Table C-1	

Process Description:

These units are utilized for dehumidification and control of the physical and chemical properties of the air space within the cleanroom process environment.

Source #	Source Name	Maximum Rated Capacity (MMBtu/hr)	Construction Commenced
Emission Unit 13 (Direct-Fired)			
KY1-DH01 – KY1-DH46	Natural Gas-Fired Dehumidification Units (Building 1)	2	May 2022
KY2-DH01 –	Natural Gas-Fired Dehumidification Units (Building 2)	2	May 2022

Emission Unit 13: Direct-Fired Natural Gas-Fired Dehumidification Units			
Emission Unit 16: Direct-Fired Natural Gas-Fired Coater Oven Air Handling Units			
KY2-DH46			
Emission Unit 16 (Direct-Fired)			
KY1-COD01 – KY1-COD12	Natural Gas-Fired Coater Oven Air Handling Units (Building 1)	5	May 2022
KY1-COD13 – KY1-COD16	Natural Gas-Fired Coater Oven Air Handling Units (Building 1)	5.6	May 2022
KY2-COD01 – KY2-COD12	Natural Gas-Fired Coater Oven Air Handling Units (Building 2)	5	May 2022
KY2-COD13 – KY2-COD16	Natural Gas-Fired Coater Oven Air Handling Units (Building 2)	5.6	May 2022

Building 1 processes: KYEIS ID: KY1-13 and KY1-16

Building 2 processes: KYEIS ID: KY2-13 and KY2-16

Applicable Regulation:

401 KAR 51:017, *Prevention of significant deterioration of air quality* (for CO, NO_x, VOC, and GHG) applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).

401 KAR 59:010, *New process operations* applies to each affected facility or source, associated with a process operation, which is not subject to another emission standard with respect to particulates in 401 KAR Chapter 59, commenced on or after July 2, 1975.

State Origin Requirement

401 KAR 63:020, *Potentially hazardous matter and toxic substance emissions* applies to each affected facility which emits or may emit potentially hazardous matter or toxic substances as defined in 401 KAR 63:020 Section 2, provided such emissions are not elsewhere subject to the provisions of the administrative regulations of the Division for Air Quality.

Comments:

The permittee shall monitor fuel usage (MMscf) on a monthly basis [401 KAR 52:020, Section 10].

BACT for VOC has been established as good combustion practices. BACT for NO_x has been established as staged combustion and good combustion. BACT for CO has been established as good combustion practices. BACT for GHG has been established as use of pipeline quality natural and good combustion

Emission Unit 13: Direct-Fired Natural Gas-Fired Dehumidification Units
Emission Unit 16: Direct-Fired Natural Gas-Fired Coater Oven Air Handling Units

practices.

CO BACT discussion for EU 13-16 (Permit V-21-041, Revised Permit V-21-041 R2)

A limit to CO emissions to preclude PSD were not proposed. As a result, the project will trigger applicability of PSD regulations.

The below text regarding the BACT steps is taken from the revised narrative sent to the Division 1/28/2022 and is provided by the facility. It has been edited by the Division to remove numbered references and references to appendices not attached to this Statement of Basis/Summary document. Proposed BACT limits were revised V-21-041 R2 and the applicability of 40 CFR 63 Subpart DDDDD was removed.

Step One: Identify All Potentially Available Control Technologies

In theory, for larger industrial scale boilers and process heaters performing in a simple indirect-fired heat exchange system context, CO emissions can be controlled with add-on air pollution control equipment through further oxidation. However, this general concept of further oxidation to control CO emissions is not transferrable to the facility's building/process heating units for dehumidification and cleanroom air handling. First, some of the heating occurring in the dehumidification units and Coater Oven AHU is performed via direct-fired combustion. The natural gas combustion byproducts containing CO emissions are mixed directly with the supply air to the process. This process supply air has a very specific set of properties (i.e., temperature, humidity, oxygen content, etc.) that must be maintained to subsequently achieve the intended process purpose of the affected unit (i.e., cleanroom air supply dehumidification or Coater Oven air handling/heating). Installing additional equipment for CO emissions control on the process supply air stream before it is routed to its final destination is not an available control option, because this application would fundamentally alter the process supply air management function of the direct-fired dehumidification and Coater Oven AHU. Furthermore, no small direct-fired natural gas combustion systems (2.0 MMBtu/hr each for dehumidification units and 3.5 MMBtu/hr each for Coater Over AHU) were identified within the RBLC that used add-on controls for CO emissions.

For the indirect-fired dehumidification units and Building, Office, and Coater Oven AHUs, the natural gas combustion byproducts are separated from the process/building supply air such that treatment of the CO emissions in the indirect-fired heating system exhaust would not directly affect the properties of the process supply air. However, the most common CO emissions control option for indirect-fired boilers and process heater applications (oxidation catalysts) is not applicable or available for the facility's highly specialized building and process heating systems. The small natural gas burners used in indirect-fired portions of the dehumidification and AHU (3.0 MMBtu/hr each for the dehumidification units and 3.0 MMBtu/hr each for the Building, Office, and Coater Oven AHUs) are integrated with a range of other equipment (fans, filters, humidifiers/dehumidifiers, air cooling, etc.) to form a modular building/process heating system equipped with advanced process controls. Introducing an oxidation catalyst within the boundary limits of the modular dehumidification and AHU is not an available design option. Furthermore, the exhaust stream characteristics at the discharge of the indirect-fired portions of the dehumidification and AHU units are not compatible with oxidation catalyst because the exhaust is not contained within a duct, the discharge temperature is relatively low (<200 deg. C or 392 deg. F), and the exhaust flow is negligible (<1,100 acfm). Finally, no small indirect-fired natural gas combustion systems were identified within the RBLC that used add-on controls for CO emissions.

With oxidation catalysts considered to be not available, the only remaining control option to achieve a more

Emission Unit 13: Direct-Fired Natural Gas-Fired Dehumidification Units
Emission Unit 16: Direct-Fired Natural Gas-Fired Coater Oven Air Handling Units

complete combustion of the flue gas is good combustion practices.

Step Two: Eliminate Technically Infeasible Control Options

Good combustion practices, such as controlling the air/oxygen supply and maintaining an appropriate temperature in the combustion chambers, is included in the baseline design of the proposed project. Therefore, this control method is technically feasible.

Step Three: Rank Remaining Control Technologies by Control Effectiveness

Good combustion practices are the only available control option for the dehumidification and AHU, so no ranking by CO control efficiency is necessary.

Step Four: Evaluate Top Control Alternatives

Good combustion practices do not pose any adverse economic, energy, or environmental impacts. While catalytic oxidation is not considered to be an available control option for the unique design and operating characteristics of the facility's dehumidification and AHU, this option would also not be cost effective even if it were available. The annualized control cost analysis for catalytical oxidation to control CO emissions from the much larger boilers and hot oil heaters indicates this CO control option would be even less cost effective for the smaller building/process heating systems. Under the concept of "economies of scale," using an equivalent control option on a smaller emission unit would generally produce higher annualized control costs on a dollar per ton of pollutant removed basis than deploying this same control option on a larger emission unit.

Step Five: Select BACT

The facility will reduce CO emissions through the use of good combustion controls, according to the requirements of BACT. For each proposed building/process heating unit, a BACT limit of 50 ppm CO at 3% oxygen (equivalent to 0.037 lb/MMBtu) on a three-hour block average basis is proposed for all units except EU13 which is 25 ppm CO. Compliance will be demonstrated through the combustion of pipeline quality natural gas and maintaining and operating combustion sources in accordance with manufacturer's recommendations.

No stack testing for CO emissions should be required for the building/process heating units because the burner systems will be designed to achieve the specified CO emissions performance and direct pollutant sampling following EPA's reference test methods is not expected to be technically feasible in all cases (i.e., direct-fired systems cannot be "stack tested" and indirect-fired units are not expected to be equipped with ducts/stacks for exhaust stream pollutant sampling).

NO_x BACT discussion for EU 13-16 (Permit V-21-041, Revised Permit V-21-041 R2)

The same general principles of NO_x emissions formation discussed for the natural gas-fired boilers and oil heaters based on indirect heat exchange also apply to the direct and indirect-fired sections of the building/process heating units. However, the small heat input capacities (2.0 to 3.5 MMBtu/hr), modular design, and direct interface/integration with other features of the cleanroom supply air management system for these building/process heating units introduce a range of unique considerations for evaluating the availability and technical feasibility of the commonly applied NO_x control options (i.e., those NO_x control options considered in the boilers and oil heaters NO_x BACT analysis).

Step One: Identify All Potentially Available Control Technologies

The following control options have been identified as possible techniques to reduce NO_x emissions from

Emission Unit 13: Direct-Fired Natural Gas-Fired Dehumidification Units
Emission Unit 16: Direct-Fired Natural Gas-Fired Coater Oven Air Handling Units

the building/process heating units:

- Low-NO_x and ultra-low-NO_x burners
- Good combustion practices

Add-on controls for NO_x are not available for the dehumidification units and AHU. Using add-on equipment for NO_x emissions removal cannot be effectively incorporated into the heating unit design without also fundamentally altering the basic building/process air supply function of these heating units. For example, the reagent injection process associated with both SCR and SNCR would introduce the potential for ammonia slip within the process environment which is not acceptable for maintaining the process environment's cleanroom status. Even for the indirect-fired sections of the dehumidification unit and Coater Oven AHUs where the combustion gases are segregated from the process air, SCR and SNCR are not available because they would compromise the highly controlled combustion gas-to-process air heat transfer process occurring in these highly specialized and complex heating units.

FGR is not an available NO_x emissions reduction option for direct-fired system as there is no "flue gas" available for recirculation; only heated process air. For the indirect-fired portions of the dehumidification and Coater Oven AHU, FGR is not available because it would fundamentally alter the design and operating principles of the burner systems used to create the combustion gas-to-process air heat transfer process. FGR is generally limited for applications in larger, indirect-fired boilers and process heaters/furnaces where the burner flame zone is accessible for the re-introduction of flue gas. The highly specialized burner arrangement and controlled combustion conditions associated with the indirect-fired portions of the dehumidification units and AHU cannot support this flue gas recirculation process without adversely impacting the heat transfer performance of the heating units.

Low-NO_x and Ultra-Low-NO_x Burners

For conventional AHU sold as "packaged units", manufacturers often specify low-NO_x burners with NO_x emissions performance in the range of 50 ppm to 70 ppm at 3% oxygen. The NO_x emissions performance for ultra-low-NO_x burners selected as the NO_x emissions performance target for the facility's building/process heating units is *35 ppm at 3% oxygen. The low NO_x and ultra-low NO_x performance designations for small heating units are different from the previous designations for larger boilers and heaters due to the differences in burner design specifications, operational practices, and combustion controls at these distinct maximum hourly firing rate ranges and the distinct process applications for these different natural gas combustion systems (i.e., transferring heat to building/process air in the case of the heating units as opposed to heating steam/water or oil in the case of the boilers and oil heaters). Based on the representative uncontrolled NO_x emissions factor presented in EPA's AP-42 Section 1.4 "Natural Gas Combustion" (100 lb NO_x/MMscf or approximately 81 ppm at 3% oxygen), these NO_x emissions performance levels for building/process heating units equate to a NO_x emissions reductions in the range of 14% to 38% for low-NO_x burners and 57% for ultra-low NO_x burners. Although the specified *35 ppm at 3% oxygen NO_x performance level is considered technically feasible, for the dehumidification units, additional engineering analysis will be necessary to ensure the unit can be controlled to the precision necessary to maintain the tolerances for the cleanroom environment in terms of humidity and temperature as ambient conditions change. Achieving the target ultra-low NO_x emissions performance level for the dehumidification units may require the addition of electric heat supplements to ensure that the required cleanroom air supply parameters are maintained at all times. Because no commercially available dehumidification units have been engineered to utilize ultra-low NO_x burners, the engineering design team for the facility's proposed EV battery manufacturing plant will need to conduct extensive site/unit-specific

Emission Unit 13: Direct-Fired Natural Gas-Fired Dehumidification Units
Emission Unit 16: Direct-Fired Natural Gas-Fired Coater Oven Air Handling Units

engineering and equipment testing to ensure that the system can operate as needed.

**Discussion addendum: The previously assumed target of 35 ppm for the affected units is no longer feasible. Burners for the EU14 and 15 with those NOx specifications were not available, and for EU13 low NOx burners were determined to be unable to meet the fine environmental control requirements for the clean rooms. EU13 is 89 ppm NOx, EU14 and 15 are 55 ppm NOx, and EU16 is 25 ppm NOx. (V-21-041 R2)*

Good Combustion Practices

Building/process heating unit maintenance and efficient operation in accordance with the manufacturer's recommendations will ensure NOx emissions are minimized.

Step Two: Eliminate Technically Infeasible Control Options

The next step in the process is to evaluate all possible options and determine if any of them are technically infeasible for the proposed project.

Low-NO_x and Ultra-Low-NO_x Burners

Ultra-low-NOx burners selected for the building/process heating units are considered technically feasible.

Good Combustion Practices

Good combustion practices are included in the facility's baseline design and therefore technically feasible.

Step Three: Rank Remaining Control Technologies by Control Effectiveness

The table below ranks the NOx control technologies in descending order of maximum control efficiency.

Rank	Control Option	Control Efficiency (%)
1	Ultra-low-NO _x burners (baseline)	57%
2	Low-NO _x burners	14%-38%
3	Good combustion practices	0%

Step Four: Evaluate Top Control Alternatives

Low-NO_x and Ultra-Low-NO_x Burners

Besides the additional expense for the dehumidification unit engineering efforts noted in Step 2, ultra-low-NOx burners do not pose any adverse energy, environmental, or economic impacts.

Good Combustion Practices

Good combustion practices are included in the facility's baseline design and do not pose any adverse energy, environmental, or economic impacts.

Step Five: Select BACT

The facility will reduce NOx emissions through the use of ultra-low NOx burners, according to the requirements of BACT. For each proposed building/process heating unit, a BACT limit of *35 ppm NOx at 3% oxygen on a three-hour block average basis is proposed. Compliance will be demonstrated through the combustion of pipeline quality natural gas, maintaining and operating combustion sources in accordance with manufacturer's recommendations. No stack testing for NOx emissions should be required for the

Emission Unit 13: Direct-Fired Natural Gas-Fired Dehumidification Units
Emission Unit 16: Direct-Fired Natural Gas-Fired Coater Oven Air Handling Units

building/process heating units because the burner systems will be designed to achieve the specified NO_x emissions performance and direct pollutant sampling following EPA's reference test methods is not expected to be technically feasible in all cases (i.e., direct-fired systems cannot be "stack tested" and indirect-fired units are not expected to be equipped with ducts/stacks for exhaust stream pollutant sampling).

**Discussion addendum: The previously assumed target of 35 ppm for the affected units is not feasible. Burners for the EU14 and 15 with those NO_x specifications were not available, and for EU13 low NO_x burners were determined to be unable to meet the fine environmental control requirements for the clean rooms. EU13 is 89 ppm NO_x, EU14 and 15 are 55 ppm NO_x, and EU16 is 25 ppm NO_x. (V-21-041 R2)*

VOC BACT discussion for EU 13-16 (Permit V-21-041, Revised Permit V-21-041 R2)

VOC emissions from external combustion sources, often in the form of aldehydes, aromatic carbon compounds, and various other organic compounds, are a result of incomplete combustion. Conditions leading to incomplete combustion include the following: insufficient oxygen availability, poor fuel/air mixing, reduced combustion temperature, and reduced combustion gas residence time.

Step One: Identify All Potentially Available Control Technologies

The same candidate control options for CO were considered for VOC and include the following:

- Oxidation catalyst
- Good combustion practices

Oxidation Catalyst

Oxidation catalysts are exhaust treatment devices which enhance oxidation of CO to CO₂, without the addition of any chemical reagents, because there is sufficient oxygen in the exhaust gas stream for the oxidation reactions to proceed in the presence of the catalyst alone. Typically, precious metals are used as the catalyst to promote oxidation. The activity of oxidation catalysts is dependent on the amount of particulate in the flue gas stream and the flue gas temperature.

Good Combustion Practices

The use of good combustion practices optimizes combustion in the boilers and hot oil heaters. Ensuring that the temperature and oxygen availability are adequate for complete combustion minimizes CO emissions. This technique includes continued operation of the boilers at the appropriate oxygen range and temperature.

Step Two: Eliminate Technically Infeasible Control Options

The next step in the process is to evaluate all possible options and determine if any of them are technically infeasible for the proposed project.

Oxidation Catalyst

The results from the RBLC database search show no natural gas-fired boiler rated below 100 MMBtu/hr that utilize oxidation catalyst for VOC BACT compliance, and no other natural gas-fired boilers or oil heaters that have demonstrated the use of such a system in a full-scale industrial setting have been identified. Therefore, oxidation catalyst does not meet the "applicable" requirement and is considered technically infeasible. However, for the sake of conservatism, oxidation catalyst is considered in the remaining steps of the BACT evaluation.

Emission Unit 13: Direct-Fired Natural Gas-Fired Dehumidification Units
Emission Unit 16: Direct-Fired Natural Gas-Fired Coater Oven Air Handling Units

Good Combustion Practices

Good combustion practices, such as controlling the air/oxygen supply and maintaining an appropriate temperature in the combustion chambers, is included in the baseline design of the proposed project.

Step Three: Rank Remaining Control Technologies by Control Effectiveness

The table below ranks the VOC control technologies in descending order of maximum control efficiency.

Rank	Control Option	Control Efficiency (%)
1	Oxidation Catalyst	98%
2	Good Combustion Practices	Undefined

Step Four: Evaluate Top Control Alternatives

Good combustion practices do not pose any adverse economic, energy, or environmental impacts. While catalytic oxidation is not considered to be an available control option for the unique design and operating characteristics of the facility's dehumidification and AHU, this option would also not be cost effective even if it were available. The annualized control cost analysis for catalytical oxidation to control VOC emissions from the much larger boilers and hot oil heaters indicates this VOC control option would be even less cost effective for the smaller building/process heating systems.

Step Five: Select BACT

The facility will reduce VOC emissions through the use of good combustion controls, according to the requirements of BACT. For each proposed building/process heating unit, a VOC BACT limit of 0.0054 lb/MMBtu on a 3-hour block average basis is proposed. Compliance will be demonstrated through the combustion of pipeline quality natural gas and maintaining and operating combustion sources in accordance with manufacturer's recommendations.

No stack testing for VOC emissions should be required for the building/process heating units because the burner systems will be designed to achieve the specified VOC emissions performance and direct pollutant sampling following EPA's reference test methods is not expected to be technically feasible in all cases (i.e., direct-fired systems cannot be "stack tested" and indirect-fired units are not expected to be equipped with ducts/stacks for exhaust stream pollutant sampling).

Emission Unit 14: Indirect-Fired Natural Gas-Fired Building Air Handling Units				
Emission Unit 15: Indirect-Fired Natural Gas-Fired Office Air Handling Units				
Pollutant	Emission Limit or Standard	Regulatory Basis for Emission Limit or Standard	Emission Factor Used and Basis	Compliance Method
PM	0.10 lb/MMBtu	401 KAR 59:015, Section 4(1)(b)	0.52 lb/mmscf 2014 NEI Data	Assumed based upon natural gas combustion
	20% opacity	401 KAR 59:015, Section 4(2)	--	
SO ₂	0.8 lb/MMBtu	401 KAR 59:015, Section 5(1)(b)1.	0.6 lb/MMscf	
CO	50 ppm @ 3% O ₂ on a 3-hr block avg	401 KAR 51:017	37.7 lb/MMscf Burner Specification (APE20210001)	
NO _x	55 ppm @ 3% O ₂ on a 3-hr block avg		68.13 lb/MMscf Burner Specification (APE20210001)	
VOC	0.0054 lb/MMBtu on a 3-hr block avg		5.5 lb/MMscf AP-42 Table 1.4-2	
CO ₂	117 lb/MMBtu on a 3-hr block avg		119,067 lb/MMscf 40 CFR 98 Table C-1	

Process Description:

These units are utilized for dehumidification and control of the physical and chemical properties of the air space within the cleanroom process environment.

Source #	Source Name	Maximum Rated Capacity (MMBtu/hr)	Construction Commenced
Emission Unit 14 (Indirect-Fired)			
KY1-BA01 – KY1-BA10	Natural Gas-Fired Building Air Handling Units (Building 1)	3	May 2022
KY2-BA01 – KY2-BA10	Natural Gas-Fired Building Air Handling Units (Building 2)	3	May 2022
Emission Unit 15 (Indirect-Fired)			
KY1-OA01 – KY1-OA10	Natural Gas-Fired Office Air Handling Units (Building 1)	3	May 2022

Emission Unit 14: Indirect-Fired Natural Gas-Fired Building Air Handling Units			
Emission Unit 15: Indirect-Fired Natural Gas-Fired Office Air Handling Units			
KY2- OA01 – KY2- OA10	Natural Gas-Fired Office Air Handling Units (Building 2)	3	May 2022

Building 1 processes: KYEIS ID: KY1-14 and KY1-15

Building 2 processes: KYEIS ID: KY2-14 and KY2-15

Applicable Regulation:

401 KAR 51:017, *Prevention of significant deterioration of air quality*, (for CO, NO_x, VOC, and GHG), applies to the construction of a new major stationary source or a project at an existing major stationary source that commences construction after September 22, 1982, and locates in an area designated attainment or unclassifiable under 42 U.S.C. 7407(d)(1)(A)(ii) and (iii).

401 KAR 59:015, *New indirect heat exchangers*, applicable to indirect heat exchangers having a heat input capacity greater than one (1) million BTU per hour (MMBtu/hr) commenced on or after April 9, 1972 (401 KAR 59:015, Section 2(1)).

State Origin Requirement

401 KAR 63:020, *Potentially hazardous matter and toxic substance emissions* applies to each affected facility which emits or may emit potentially hazardous matter or toxic substances as defined in 401 KAR 63:020 Section 2, provided such emissions are not elsewhere subject to the provisions of the administrative regulations of the Division for Air Quality.

Comments:

The permittee shall monitor fuel usage (MMscf) on a monthly basis [401 KAR 52:020, Section 10].

BACT for VOC has been established as good combustion practices. BACT for NO_x has been established as staged combustion and good combustion. BACT for CO has been established as good combustion practices. BACT for GHG has been established as use of pipeline quality natural and good combustion practices.

The BACT assessment for these units is located in the entry for Emission Units 13 & 16.

SECTION 3 – EMISSIONS, LIMITATIONS AND BASIS (CONTINUED)

Testing Requirements/Results

Emission Unit(s)	Control Device	Parameter	Regulatory Basis	Frequency	Test Method	Permit Limit	Test Result	Thruput and Operating Parameter(s) Established During Test	Activity Graybar	Date of last Compliance Testing
KY1-CP01/A P01	Adsorber AC01	VOC	401 KAR 51:017	Initial	Method 25A	4.5 ppmv as NMP	TBD	TBD (Airflow) Inlet+Outlet VOC	TBD	TBD
KY1-CR01	Adsorber AC09	VOC	401 KAR 51:017	Initial	Method 25A	4.5 ppmv as NMP	TBD	TBD (Airflow) Inlet+Outlet VOC	TBD	TBD
KY1-VD01/E L01	Adsorber AC16	VOC	401 KAR 51:017	Initial	Method 25A	6.0 ppmv as Electrolyte	TBD	TBD (Airflow) Inlet+Outlet VOC Electrolyte Molecular Weight	TBD	TBD
KY1-DG01	Adsorber AC24	VOC	401 KAR 51:017	Initial	Method 25A	6.0 ppmv as Electrolyte	TBD	TBD (Airflow) Inlet+Outlet VOC Electrolyte Molecular Weight	TBD	TBD
KY1-CD01	Adsorber AC48	VOC	401 KAR 51:017	Initial	Method 25A	6.0 ppmv as Electrolyte	TBD	TBD (Airflow)	TBD	TBD

								Inlet+Outlet VOC Electrolyte Molecular Weight		
KY1-DR01	Scrubber SC01	VOC	401 KAR 51:017	Initial	Method 25A	2.0 ppmv	TBD	TBD (Airflow, gpm, pressure drop) Outlet VOC	TBD	TBD
KY1-CD01	Scrubber SC21	HCl	401 KAR 50:045	Initial	Method 26	1.25 ppmv	TBD	TBD (Airflow, gpm, pressure drop) Outlet HCL	TBD	TBD
KY1-B01	----	CO NO _x	401 KAR 51:017	Initial	Method 10 Method 7	50ppm @ 3% O ₂ 9 ppm @ 3% O ₂	TBD	TBD	TBD	TBD
KY1-H01	----	CO NO _x	401 KAR 51:017	Initial	Method 10 Method 7	50ppm @ 3% O ₂ 20ppm @ 3% O ₂	TBD	TBD	TBD	TBD
KY1-H06	----	CO NO _x	401 KAR 51:017	Initial	Method 10 Method 7	50ppm @ 3% O ₂ 20ppm	TBD	TBD	TBD	TBD

						@ 3% O ₂				
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Footnotes:

SECTION 4 – SOURCE INFORMATION AND REQUIREMENTS

Table A - Group Requirements:

Emission and Operating Limit	Regulation	Emission Unit
4.5 ppmv (as NMP) VOC after adsorber	BACT limit (Pursuant to 401 KAR 51:017)	KY1-CP01 - KY1-CP16 KY1-AP01 - KY1-AP16 KY1- CR01 - KY1-CR08 KY2-CP01 – KY2-CP16 KY2-AP01 – KY2-AP16 KY2- CR01 - KY2-CR08
6.0 ppmv (as electrolyte) VOC after adsorber	BACT limit (Pursuant to 401 KAR 51:017)	KY1-VD01 - KY1-VD16 KY1-EL01 - KY1-EL16 KY1-CS01 - KY1-CS04 KY1-AS01 - KY1-AS04 KY1-DG01 - KY1-DG56 KY1-CD01 - KY1-CD08 KY1-QE01 - KY1-QE15 KY2-VD01 - KY2-VD16 KY2-EL01 - KY2-EL16 KY2-CS01 - KY2-CS12 KY2-AS01 - KY2-AS12 KY2-DG01 - KY2-DG56 KY2-CD01 - KY2-CD08 KY2-QE01 – KY2-QE17
2.0 ppmv VOC after scrubber	BACT limit (Pursuant to 401 KAR 51:017)	KY1-DR01 - KY1-DR08, KY2-DR01 - KY2-DR08
9,969 lbs VOC total for all listed sources per GWh batteries produced on a rolling 12 month basis (applicable after the 214.4 tpy temporary BACT for facility production ramp-up expires)	BACT limit (Pursuant to 401 KAR 51:017)	Building 1 KY1-CP01 - KY1-CP16 KY1-AP01 - KY1-AP16 KY1- CR01 - KY1-CR08 KY1-DR01 - KY1-DR08 KY1-VD01 - KY1-VD16 KY1-EL01 - KY1-EL16 KY1-CS01 - KY1-CS04 KY1-AS01 - KY1-AS04 KY1-DG01 - KY1-DG56 KY1-CD01 - KY1-CD08 KY1-QE01 - KY1-QE15
11,068 lbs VOC total for all listed sources per GWh batteries produced on a rolling 12 month basis (applicable after the 238.0 tpy temporary BACT for facility production ramp-up expires)	BACT limit (Pursuant to 401 KAR 51:017)	Building 2 KY2-CP01 – KY2-CP16 KY2-AP01 – KY2-AP16 KY2- CR01 - KY2-CR08 KY2-DR01 - KY2-DR08 KY2-VD01 - KY2-VD16 KY2-EL01 - KY2-EL16 KY2-CS01 - KY2-CS12

		KY2-AS01 - KY2-AS12 KY2-DG01 - KY2-DG56 KY2-CD01 - KY2-CD08 KY2-QE01 - KY2-QE17
214.4 tons VOC total for all listed Building 1 sources per rolling 12-month basis (Temporary until 90% production capacity has been reached or 24 months after startup of a listed emission unit)	BACT limit (Pursuant to 401 KAR 51:017)	Building 1 KY1-CP01 - KY1-CP16 KY1-AP01 - KY1-AP16 KY1- CR01 - KY1-CR08 KY1-DR01 - KY1-DR08 KY1-VD01 - KY1-VD16 KY1-EL01 - KY1-EL16 KY1-CS01 - KY1-CS04 KY1-AS01 - KY1-AS04 KY1-DG01 - KY1-DG56 KY1-CD01 - KY1-CD08 KY1-QE01 - KY1-QE15
238.0 tons VOC total for all listed Building 2 sources per rolling 12-month basis (Temporary until 90% production capacity has been reached or 24 months after startup of a listed emission unit)	BACT limit (Pursuant to 401 KAR 51:017)	Building 2 KY2-CP01 - KY2-CP16 KY2-AP01 - KY2-AP16 KY2- CR01 - KY2-CR08 KY2-DR01 - KY2-DR08 KY2-VD01 - KY2-VD16 KY2-EL01 - KY2-EL16 KY2-CS01 - KY2-CS12 KY2-AS01 - KY2-AS12 KY2-DG01 - KY2-DG56 KY2-CD01 - KY2-CD08 KY2-QE01 - KY2-QE17

Table B - Summary of Applicable Regulations:

Applicable Regulations	Emission Unit
401 KAR 51:017, <i>Prevention of significant deterioration of air quality</i>	KY1-(CP01 - CP16, AP01 - AP16, CR01 - CR08, DR01-DR08, VD01-VD16, EL01-EL16, CS01-CS04, AS01 - AS04, DG01-DG56, CD01-CD08, QE01-QE15, B01 - B11, H01-H10, FPE01 - FPE03, GE01 - GE05, RT01-RT04, WT01-WT08, ET01-ET08, EST101, EST201, EWT01, PI01, DH01 -DH46, COD01-COD16, BA01-BA10, OA01-OA10) KY2-(CP01 - CP16, AP01 - AP16, CR01-CR08,

	DR01-DR08, VD01-VD16, EL01 – EL16, CS01-CS12, AS01-AS12, DG01-DG56, CD01-CD08, QE01-QE17, B01 - B11, H01-H10, GE01-GE04, RT01-RT04, WT01-WT08, ET01-ET08, EST101, EST201, EWT01, PI01, DH01 - DH46, COD01-COD16, BA01–BA10, OA01-OA10)
401 KAR 59:010, <i>New process operations</i>	KY1-PR01 - KY1-PR173 KY2-PR01 - KY2-PR187 KY1-CN01 - KY1-CN56 KY2-CN01 - KY2-CN35 KY1-AN01 - KY1-AN56 KY2-AN01 - KY2-AN35 KY1-CL01 - KY1-CL10 KY1-AL01 - KY1-AL10 KY1-CS01 - KY1-CS04 KY2- CS01 - KY2-CS12 KY1-AS01 - KY1-AS04 KY2-AS01 - KY2-AS12 KY1-WB01 - KY1-WB32 KY2-WB01 - KY2-WB32 KY1-MA01 - KY1-MA32 KY1-CT01 - KY1-CT07 KY2-CT01 - KY2-CT07 KY1-DH01 – KY1-DH46 KY2-DH01 – KY2-DH46 KY1-COD01 – KY1-COD16 KY2-COD01 – KY2-COD16
401 KAR 59:015, <i>New indirect heat exchangers</i>	KY1-B01 - KY1-B11 KY2-B01 - KY2-B11 KY1-H01 - KY1-H10 KY2-H01 – KY2-H10 KY1-BA01 – KY1-BA10 KY2-BA01 – KY2-BA10 KY1-OA01 – KY1-OA10 KY2-OA01 – KY2-OA10
401 KAR 60:005, Section 2(2)(d), 40 C.F.R. 60.40c through 60.48c (Subpart Dc), <i>Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units</i>	KY1-B01 - KY1-B11 KY2-B01 - KY2-B11 KY1-H01 - KY1-H10 KY2-H01 – KY2-H10
401 KAR 60:005, Section 2(2)(dddd), 40 C.F.R. 60.4200 through 60.4219, Tables 1 through 8 (Subpart III), <i>Standards of Performance for Stationary Compression Ignition Internal Combustion Engines</i>	KY1-FPE01 - KY1-FPE03 KY1-GE01 - KY1-GE05 KY2-GE01 - KY2-GE04

<p>401 KAR 63:002, Section 2(4)(eeee), 40 C.F.R. 63.6580 through 63.6675, Tables 1a through 8, and Appendix A (Subpart ZZZZ), <i>National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines.</i></p>	<p>KY1-FPE01 - KY1-FPE03 KY1-GE01 - KY1-GE05 KY2-GE01 - KY2-GE04</p>
<p>401 KAR 63:002, Section 2(4)(aaaaa) 40 C.F.R. 63.11599 through 63.11607, Table 1 (Subpart CCCCCC), <i>National Emission Standards for Hazardous Air Pollutants for Area Sources: Paints and Allied Products Manufacturing</i></p>	<p>KY1-PR09 - KY1-PR16 KY1-PR25 - KY1-PR75 KY1-PR92 - KY1-PR173 KY2-PR09 - KY2-PR16 KY2-PR25 - KY2-PR81 KY2-PR98 - KY2-PR187 KY1-CP01 - KY1-CP16 KY1-AP01 - KY1-AP16 KY2-CP01 - KY2-CP16 KY2-AP01 - KY2-AP16 KY1-CR01 - KY1-C08 KY2-CR01 - KY2-CR08 KY1-DR01 - KY1-DR08 KY2-DR01 - KY2-DR08</p>
<p>401 KAR 63:010, <i>Fugitive Emissions</i></p>	<p>KY1-HR01</p>
<p>401 KAR 63:020, <i>Potentially hazardous matter or toxic substances.</i></p>	<p>KY1-EL01 - KY1-EL16 KY2-EL01 - KY2-EL16 KY1-CD01 - KY1-CD08 KY2-CD01 - KY2-CD08 KY1-LB01 - KY1-LB05 KY2-LB01 - KY2-LB05 KY1-B01 - KY1-B11 KY2-B01 - KY2-B11 KY1-H01 - KY1-H10 KY2-H01 - KY2-H10 KY1-ET01 - KY1-ET08 KY2-ET01 - KY2-ET08 KY1-EST101 KY2-EST101 KY1-EST201 KY2-EST201 KY1-EWT01 KY2-EWT01 KY1-DH01 - KY1-DH46 KY2-DH01 - KY2-DH46 KY1-COD01 - KY1-COD16 KY2-COD01 - KY2-COD16 KY1-BA01 - KY1-BA10 KY2-BA01 - KY2-BA10 KY1-OA01 - KY1-OA10 KY2-OA01 - KY2-OA10</p>

Table C - Summary of Precluded Regulations:

Precluded Regulations	Emission Unit
401 KAR 63:002, Section 2(4)(j), 40 C.F.R. 63.400 through 63.407, Table 1 (Subpart Q), <i>National Emission Standards for Hazardous Air Pollutants for Industrial Process Cooling Towers</i>	KY1-CT01 - KY1-CT07 KY2-CT01 - KY2-CT07

Table D - Summary of Non Applicable Regulations:

Non Applicable Regulations	Emission Unit
401 KAR 59:050, <i>New storage vessels for petroleum liquids</i>	KY1-RT01 - KY1-RT04 KY2-RT01 - KY2-RT04 KY1-WT01 - KY1-WT08 KY2-WT01 - KY2-WT08 KY1-ET01 - KY1-ET08 KY2-ET01 - KY2-ET08 KY1-EST101 KY2-EST101 KY1-EST201 KY2-EST201 KY1-EWT01 KY2-EWT01
401 KAR 59:225, <i>New miscellaneous metal parts and products surface coating operations</i>	KY1-DR01 - KY1-DR08 KY2-DR01 - KY2-DR08
401 KAR 60:005, Section 2(2)(r), 40 C.F.R. 60.110b through 60.117b (Subpart Kb), <i>Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984</i>	KY1-RT01 - KY1-RT04 KY2-RT01 - KY2-RT04 KY1-WT01 - KY1-WT08 KY2-WT01 - KY2-WT08 KY1-ET01 - KY1-ET08 KY2-ET01 - KY2-ET08 KY1-EST101 KY2-EST101 KY1-EST201 KY2-EST201 KY1-EWT01 KY2-EWT01
401 KAR 60:005, Section 2(2)(zz) 40 C.F.R. 60.460 through 60.466 (Subpart TT), <i>Standards of Performance for Metal Coil Surface Coating</i>	KY1-CP01 - KY1-CP16 KY1-AP01 - KY1-AP16 KY2-CP01 - KY2-CP16 KY2-AP01 - KY2-AP16
401 KAR 60:005, Section 2(2)(xxx), 40 C.F.R. 60.740 through 60.748 (Subpart VVV), <i>Standards of Performance for Polymeric Coating of Supporting Substrates Facilities</i>	KY1-DR01 - KY1-DR08 KY2-DR01 - KY2-DR08
401 KAR 63:002, Section 2(4)(rrr) 40 C.F.R. 63.3880 through 63.3981, Tables 1 through 5, and Appendix A (Subpart MMM), <i>National Emission Standards for Hazardous Air Pollutants for Surface Coating of Miscellaneous Metal Parts and Products</i>	KY1-DR01 - KY1-DR08 KY2-DR01 - KY2-DR08

401 KAR 63:002, Section 2(4)(xxx) 40 C.F.R. 63.5080 through 63.5200, Tables 1 through 3 (Subpart SSSS), <i>National Emission Standards for Hazardous Air Pollutants: Surface Coating of Metal Coil</i>	KY1-CP01 - KY1-CP16 KY1-AP01 - KY1-AP16 KY2-CP01 – KY2-CP16 KY2-AP01 – KY2-AP16
40 CFR 64 <i>Compliance assurance monitoring (CAM)</i>	

Air Toxic Analysis

401 KAR 63:020, *Potentially Hazardous Matter or Toxic Substances*

BlueOval has supplied and the Division for Air Quality (Division) has reviewed AERMOD analysis on March 18, 2022 of potentially hazardous matter or toxic substances (Acetonitrile and Hydrochloric Acid) that may be emitted by the facility based upon the process rates, material formulations, stack heights and other pertinent information provided by the applicant. Based upon this information, the Division has determined that the conditions outlined in this permit will assure compliance with the requirements of 401 KAR 63:020.

Single Source Determination

N/A

SECTION 5 – PERMITTING HISTORY

Permit	Permit Type	Activity#	Complete Date	Issuance Date	Summary of Action	PSD/Syn Minor
V-21-041	Title V/ PSD Initial	APE20210001	2/4/2022	6/20/2022	Initial Construction Permit	PSD
V-21-041 R1	Admin. Change	APE20240001	7/24/2024	8/12/2024	Name Change	N/A

SECTION 6 – PERMIT APPLICATION HISTORY

Permit Number: V-21-041 R1 Activities: APE20240001

Received: June 5, 2024 Application Complete Date(s): July 24, 2024

Permit Action: Initial Renewal Significant Rev Minor Rev Administrative

Construction/Modification Requested? Yes No NSR Applicable? Yes No

Previous 502(b)(10) or Off-Permit Changes incorporated with this permit action Yes No

Description of Action:

The permittee submitted an application to change the permittee name and source name from Ford Motor Company to BlueOval SK, LLC. No further changes were requested.

V-21-041 R1 Emission Summary				
Pollutant	Actual (tpy)	Previous PTE V-21-041 (tpy)	Change (tpy)	Revised PTE V-21-041 R1 (tpy)
CO	N/A	264.0	0	264.0
NO _x	N/A	279.0	0	279.0
PT	N/A	11.13	0	11.13
PM ₁₀	N/A	10.92	0	10.92
PM _{2.5}	N/A	9.16	0	9.16
SO ₂	N/A	4.93	0	4.93
VOC	N/A	292.6	0	292.6
Lead	N/A	0.0044	0	0.0044
Greenhouse Gases (GHGs)				
Carbon Dioxide	N/A	828,525	0	828,525
Methane	N/A	15.67	0	15.67
Nitrous Oxide	N/A	1.58	0	1.58
CO ₂ Equivalent (CO ₂ e)	N/A	829,387	0	829,387
Hazardous Air Pollutants (HAPs)				
Acetonitrile	N/A	5.28	0	5.28
Formaldehyde	N/A	0.52	0	0.52
N-Hexane	N/A	12.48	0	12.48
Hydrochloric Acid	N/A	9.31	0	9.31
Combined HAPs:	N/A	27.71	0	27.71

Permit Number: V-21-041

Activities: APE20210001

Received: October 28, 2021

Application Complete Date(s): February 4, 2022

Permit Action: Initial Renewal Significant Rev Minor Rev Administrative

Construction/Modification Requested? Yes No NSR Applicable? Yes No

Previous 502(b)(10) or Off-Permit Changes incorporated with this permit action Yes No

Description of Action:

With this application, Ford Motor Company (Ford) seeks a permit to construct a new lithium-ion electric vehicle battery manufacturing plant in Hardin County.

V-21-041 Emission Summary		
Pollutant	Actual (tpy)	PTE V-21-041 (tpy)
CO	N/A	264.0
NOx	N/A	279.0
PT	N/A	11.13
PM ₁₀	N/A	10.92
PM _{2.5}	N/A	9.16
SO ₂	N/A	4.93
VOC	N/A	292.6
Lead	N/A	0.0044
Greenhouse Gases (GHGs)		
Carbon Dioxide	N/A	828,525
Methane	N/A	15.67
Nitrous Oxide	N/A	1.58
CO ₂ Equivalent (CO ₂ e)	N/A	829,387
Hazardous Air Pollutants (HAPs)		
Acetonitrile	N/A	5.28
Formaldehyde	N/A	0.52
N-Hexane	N/A	12.48
Hydrochloric Acid	N/A	9.31
Combined HAPs	N/A	27.71

I. Emissions

A. Project PSD Significance

In the application to construct and operate a greenfield facility, Ford calculated the potential air pollutants emitted by the new source. The new equipment is expected to be a source of these regulated NSR pollutants: PM, PM₁₀, PM_{2.5}, lead (Pb), NOx, CO, VOC, SO₂ and GHGs.

The Ford project will be located in Hardin County, Kentucky, designated by the U.S. EPA as Unclassifiable/Attainment for all criteria pollutants in accordance with 40 CFR 81.318. Therefore, under the federal New Source Review permitting program, Prevention of Significant Deterioration (PSD) requirements apply to the proposed facility and the application has been reviewed accordingly.

Potential to emit pollutants for this facility were calculated based on emission factors obtained from U.S. EPA's AP-42, *Compilation of Air Pollutant Emission Factors*, engineering estimates, mass balances, and manufacturer's specifications. Based on these emission factors, and the assumption of a 24 hour, 7 days a week, 52 weeks a year operation (8760 hours per year) for most units, the potential emissions of regulated NSR pollutants, the potential to emit NO_x, CO and VOC exceeding the 250 tons major source threshold, and GHG will exceed the 75,000 ton significant emission rate threshold.

The potential increases in emissions of regulated NSR pollutants from the new facility have been calculated and are presented in the following table. A discussion of each pollutant, sources, calculation assumptions and source of emission factors used follows.

Table A-1, Project PSD Significance

Pollutant	PTE (tpy)	Major Source Threshold/ Significant Emission Rate Increase in tpy	PSD Significant Emissions Increase?
PM (filterable, only)	11.13	25	No
PM ₁₀ (filterable & condensable)	10.92	15	No
PM _{2.5} (filterable & condensable)	9.16	10	No
Pb	0.0044	0.6	No
NO _x	279.0	250*	Yes
CO	264.0	250*	Yes
VOC	292.6	250*	Yes
SO ₂	4.93	40	No
GHGs (CO ₂ e)	829,387	75,000	Yes

* Because VOC, NO_x and CO exceed the major source threshold of 250 tpy, all other pollutants are compared to the Significant Emission Rate (SER) instead.

B. Volatile Organic Compounds (VOC) Emissions

VOC emissions originate from the use and storage of 1-Methyl-2-Pyrrolidinone (NMP), acetonitrile, and cleaning solutions as a part of the battery manufacturing processes, and the combustion of fossil fuels. VOC emissions also come from date code printing activities.

EU01 Electrode Manufacturing:

This emission unit is made up of several processes. The processes that deal with VOC are listed below. The majority of the VOC is NMP, which is used as a solvent in the electrode coating suspension.

EU01, Cathode Processing (CP01-CP32) and Anode Processing (AP01-AP32):

Cathode and anode processing emissions come from the electrode suspension being applied to metal foil sheet. Emissions are controlled using activated carbon adsorbers, which are shared between the cathode and anode processes. Emissions are calculated using a facility provided emissions estimation (post control) of 3.0 ppmv VOC. The VOC has a calculated potential to emit of 8.02 tpy.

EU01, Electrode Cleaning (CR01-CR08):

This process is for cleaning rollers. The main emissions are NMP from the electrode slurry and VOC from the cleaning solution applied. Emissions are controlled using activated carbon adsorbers. Emissions are calculated using a facility provided emissions estimation (post control) of 3.0 ppmv VOC. The VOC has a calculated potential to emit of 14.33 tpy.

EU01, Cathode Drying (DR01-DR20):

Cathode Drying cures the electrode solution that has been applied to the metal foil sheet. The main VOC emitted is the NMP from the electrode slurry. Emissions are controlled using packed bed scrubbers. The scrubbers are considered inherent equipment and recover NMP which is conveyed to waste storage tanks that whose contents are shipped offsite for treatment. Emissions are calculated using a facility provided emissions estimation (post control) of 2.0 ppmv VOC. The VOC has a calculated potential to emit of 126.2 tpy.

EU02 Battery Assembly, Cathode Oven (CO01-CO48) and Electrolyte Filling and Sealing (EL01-EL48):

Battery Assembly has two VOC emitting processes, the cathode oven and electrolyte filling and sealing. The cathode oven is used to control humidity and further cure stacks of coated foil sheets. Electrode filling and sealing is where the electrodes are filled with electrolyte solution and sealed. The main VOCs emitted at these processes is the NMP in the electrode slurry, and the use of acetonitrile at electrode filling and sealing. These processes share activated carbon adsorbers between them. Emissions are calculated using a facility provided emissions estimation (post control) of 3.0 ppmv VOC. The VOC has a calculated potential to emit of 8.60 tpy.

EU03 Battery Formation, Cell Degassing (DG01-DG48):

During cell degassing, accumulated gasses within the battery cells are released. The main VOC emitted is the NMP in the electrode slurry. Emissions are controlled using activated carbon adsorbers. Emissions are calculated using a facility provided emissions estimation (post control) of 3.0 ppmv VOC. The VOC has a calculated potential to emit of 42.99 tpy.

EU04 Cell Discharge (CD01-CD08):

At cell discharge, batteries deemed by quality control as fit for disposal are disposed of. The main VOC emitted is the NMP in the electrode slurry. Emissions are controlled using activated carbon adsorbers. Emissions are calculated using a facility provided emissions estimation (post control) of 3.0 ppmv VOC. The VOC has a calculated potential to emit of 14.33 tpy.

EU05 Laboratories, Quality Evaluation 1+2 (QE01-QE16):

The main VOC emitted is the NMP in the electrode slurry. Emissions are controlled using activated carbon adsorbers. Emissions are calculated using a facility provided emissions estimation (post control) of 3.0 ppmv VOC. The VOC has a calculated potential to emit of 37.25 tpy.

EU06 Natural Gas-Fired Boilers (B01-B08):

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using AP-42 factors. The VOC has a calculated potential to emit of 1.89 tpy.

EU07 Natural Gas-Fired Hot Oil Heaters (H01-H20):

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using AP-42 factors. The VOC has a calculated potential to emit of 15.07 tpy.

EU08 Diesel Fired Emergency Engines (FPE01-FPE04 and GE01-GE08):

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using 40 CFR 60, Subpart III table 4 limits for the fire pumps and manufacturer specifications for other emergency generators. 500 hours of annual operation were assumed for the purposes of calculating potential to emit. The VOC has a calculated potential to emit of 0.83 tpy.

EU10 Storage Tanks (RT01-RT12 and WT01-WT24):

VOC is emitted in the tank's working and breathing losses. The VOC emitted is NMP. VOC emissions are calculated using the EPA's TANKS 4.09 software. The VOC has a calculated potential to emit of 0.086 tpy.

EU11 Printing:

VOC is emitted from the use of printing ink and solvent. VOC emissions are calculated using mass balances. The VOC has a calculated potential to emit of 1.90 tpy.

EU13 Natural Gas-Fired Dehumidification Units (DH01-DH60):

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using AP-42 factors. The VOC has a calculated potential to emit of 5.10 tpy.

EU14 Fired Natural Gas-Fired Building Air Handling Units (BA01-BA68):

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using AP-42 factors. The VOC has a calculated potential to emit of 4.82 tpy.

EU15 Fired Natural Gas-Fired Office Air Handling Units (OA01-OA14):

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using AP-42 factors. The VOC has a calculated potential to emit of 0.99 tpy.

EU16 Fired Natural Gas-Fired Office Air Handling Units (COD01-COD32 and COI01-COI-70):

VOC is emitted as a byproduct of fossil fuel combustion. VOC emissions are calculated using AP-42 factors. The VOC has a calculated potential to emit of 10.25 tpy.

VOC PSD Significance

The emissions calculations, using the planned throughputs and accepted emission factors for each piece of equipment, show that potential source-wide VOC emissions are estimated to be 292.6 tpy. This emission rate exceeds the PSD major stationary source threshold of 250 tpy. Since the major stationary source threshold for VOC is exceeded, a BACT analysis for VOC is required for each piece of equipment that emits VOC. Establishment of a BACT for the emission of VOC for each emission point that emits VOC is also required. Refer to the **BACT Analysis for VOC**, below, for a discussion of the BACT for VOC.

C. Nitrogen Oxides (NOx) Emissions

NOx emissions originate from the combustion of fossil fuels.

EU06 Natural Gas-Fired Boilers (B01-B08):

NOx emissions are calculated using the manufacturer's burner specification. The NOx has a calculated potential to emit of 8.51 tpy.

EU07 Natural Gas-Fired Hot Oil Heaters (H01-H20):

NOx emissions are calculated using the manufacturer's burner specification. The NOx has a calculated potential to emit of 67.86 tpy.

EU08 Diesel Fired Emergency Engines (FPE01-FPE04 and GE01-GE08):

NOx emissions are calculated using 40 CFR 60, Subpart IIII table 4 limits for the fire pumps and manufacturer specifications for other emergency generators. 500 hours of annual operation were assumed for the purposes of calculating potential to emit. The NOx has a calculated potential to emit of 35.80 tpy.

EU13 Natural Gas-Fired Dehumidification Units (DH01-DH60):

NOx emissions are calculated using the manufacturer's burner specification. The NOx has a calculated potential to emit of 40.21 tpy.

EU14 Fired Natural Gas-Fired Building Air Handling Units (BA01-BA68):

NOx emissions are calculated using the manufacturer's burner specification. The NOx has a calculated potential to emit of 37.97 tpy.

EU15 Fired Natural Gas-Fired Office Air Handling Units (OA01-OA14):

NOx emissions are calculated using the manufacturer's burner specification. The NOx has a calculated potential to emit of 7.82 tpy.

EU16 Fired Natural Gas-Fired Office Air Handling Units (COD01-COD32 and COI01-COI-70):

NOx emissions are calculated using the manufacturer's burner specification. The NOx has a calculated potential to emit of 80.79 tpy.

NO_x PSD Significance

The emissions calculations, using the planned throughputs and accepted emission factors for each piece of equipment, show that potential source-wide NO_x emissions are estimated to be 279.0 tpy. This emission rate exceeds the PSD major stationary source threshold of 250 tpy. Since the major stationary source threshold for NO_x is exceeded, a BACT analysis for NO_x is required for each piece of equipment that emits NO_x. Establishment of a BACT for the emission of NO_x for each emission point that emits NO_x is also required. Refer to the **BACT Analysis for NO_x**, below, for a discussion of the BACT for NO_x.

D. Carbon Monoxide (CO) Emissions

CO emissions originate from the combustion of fossil fuels.

EU06 Natural Gas-Fired Boilers (B01-B08):

CO emissions are calculated using the manufacturer's burner specification. The CO has a calculated potential to emit of 12.95 tpy.

EU07 Natural Gas-Fired Hot Oil Heaters (H01-H20):

CO emissions are calculated using the manufacturer's burner specification. The CO has a calculated potential to emit of 103.3 tpy.

EU08 Diesel Fired Emergency Engines (FPE01-FPE04 and GE01-GE08):

CO emissions are calculated using 40 CFR 60, Subpart III table 4 limits for the fire pumps and manufacturer specifications for other emergency generators. 500 hours of annual operation were assumed for the purposes of calculating potential to emit. The CO has a calculated potential to emit of 2.73 tpy.

EU13 Natural Gas-Fired Dehumidification Units (DH01-DH60):

CO emissions are calculated using the manufacturer's burner specification. The CO has a calculated potential to emit of 34.97 tpy.

EU14 Fired Natural Gas-Fired Building Air Handling Units (BA01-BA68):

CO emissions are calculated using the manufacturer's burner specification. The CO has a calculated potential to emit of 33.03 tpy.

EU15 Fired Natural Gas-Fired Office Air Handling Units (OA01-OA14):

CO emissions are calculated using the manufacturer's burner specification. The CO has a calculated potential to emit of 6.80 tpy.

EU16 Fired Natural Gas-Fired Office Air Handling Units (COD01-COD32 and COI01-COI-70):

CO emissions are calculated using the manufacturer's burner specification. The CO has a calculated potential to emit of 70.26 tpy.

CO PSD Significance

The emissions calculations, using the planned throughputs and accepted emission factors for each piece of equipment, show that potential source-wide CO emissions are estimated to be 264.0 tpy. This emission rate exceeds the PSD major stationary source threshold of 250 tpy. Since the major stationary source threshold CO is exceeded, a BACT analysis for CO is required for each piece of equipment that emits CO. Establishment of a BACT for the emission of CO for each emission point that emits CO is also required. Refer to the **BACT Analysis for CO**, below, for a discussion of the BACT for CO.

E. Greenhouse Gas (GHG) Emissions

Greenhouse gas emissions (represented as CO₂e) originate from the combustion of fossil fuels.

EU06 Natural Gas-Fired Boilers (B01-B08):

CO₂e emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. The CO₂e has a calculated potential to emit of 41,031 tpy.

EU07 Natural Gas-Fired Hot Oil Heaters (H01-H20):

CO₂e emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. The CO₂e has a calculated potential to emit of 327,224 tpy.

EU08 Diesel Fired Emergency Engines (FPE01-FPE04 and GE01-GE08):

CO₂e emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. 500 hours of annual operation were assumed for the purposes of calculating potential to emit. The CO₂e has a calculated potential to emit of 2,546 tpy.

EU13 Natural Gas-Fired Dehumidification Units (DH01-DH60):

CO₂e emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. The CO₂e has a calculated potential to emit of 110,552 tpy.

EU14 Fired Natural Gas-Fired Building Air Handling Units (BA01-BA68):

CO₂e emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. The CO₂e has a calculated potential to emit of 104,410 tpy.

EU15 Fired Natural Gas-Fired Office Air Handling Units (OA01-OA14):

CO₂e emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. The CO₂e has a calculated potential to emit of 21,496 tpy.

EU16 Fired Natural Gas-Fired Office Air Handling Units (COD01-COD32 and COI01-COI-70):

CO₂e emissions are calculated using emission factors for CO₂, Methane, and Nitrous Oxide from 40 CFR 98 Subpart C. The CO₂e has a calculated potential to emit of 222,127 tpy.

Greenhouse Gas (GHG) PSD Significance

Based on the submitted emission factors and calculations, the potential CO_{2e} emissions for the new facility are estimated to be 829,387 tpy of CO_{2e}. This emission rate exceeds the PSD significant emission rate threshold of 75,000 tpy for CO_{2e}. Since the SER for GHGs and at least one other PSD pollutant are exceeded, a BACT analysis for GHG is required for each piece of equipment that emits GHG. Establishment of a BACT for the emission of GHG for each emission point that emits GHG is also required. Refer to the **BACT Analysis for GHG**, below, for a discussion of the BACT for GHG.

II. BACT Analysis

The following is a summary of the various BACT analyses and the limits and requirements attributed to each emission unit. This discussion is separated into parts, on a per pollutant basis, with first VOC being discussed, then NO_x, then CO, then GHG. At the beginning of each pollutant section, will be an overview of the control technologies and methods reviewed for that pollutant. The technology summary will be followed by a summary of the BACT for each unit on a per unit basis. Some units will be grouped together for convenience. For example, all units whose VOC was controlled by activated carbon adsorbers have the same analysis and standards applied.

A. BACT Analysis for VOC

Technologies Reviewed:

Adsorption

Adsorption controls VOC by adsorbing gaseous compounds on the surface of a solid material. The adsorbent typically used is activated carbon due to its highly porous nature. The VOC-laden gases pass through the carbon bed, and the VOC is adsorbed on the activated carbon. The cleaned gas is discharged to the atmosphere. The spent carbon is regenerated either at an on-site regeneration facility or by an off-site activated carbon supplier by using steam to replace adsorbed organic compounds at high temperatures.

Thermal Incinerators

Incineration destroys VOC by oxidizing them to carbon dioxide and water. If nitrogen-containing compounds are contained within the exhaust stream, using oxidation technology for VOC control can produce NO_x as a “collateral emissions” impact of reducing VOC emissions. Any VOC heated to a sufficiently high temperature in the presence of oxygen will burn or oxidize. Common thermal incinerators include thermal oxidizers, recuperative thermal oxidizers, and regenerative thermal oxidizers. These three technologies generally achieve VOC destruction in the same manner. However, straight thermal oxidizers do not include any heat recovery while heat is recovered in recuperative thermal oxidizers via heat exchangers and in regenerative thermal oxidizers via a ceramic-packed bed. Thermal incinerators require an operating temperature above the materials ignition temperature, which is typically greater than 1,000°F.

Catalytic Incinerators

Catalytic incinerators are similar to thermal incinerators except oxidation occurs in the presence of a catalyst. Common examples include catalytic oxidizers and regenerative catalytic oxidizers. With the catalyst, the same VOC destruction rate can be achieved at a lower temperature. Typical operating temperatures range from 600°F to 800°F.

Absorption

With absorption, VOC is removed from a gaseous stream via liquid solvent. There are a variety of design options, but the most common system is known as a packed tower wet scrubber. With this device, the solute in the gas stream is absorbed by the liquid solvent running counter current through the tower. The cleaned gas is discharged to the atmosphere. The recovered solvent can then be further processed by stripping or desorbing to remove the solute.

Condensation

Condensers utilize a cooling media to condense and recover volatile organics. The choice of the cooling media is based on the condensation point of the VOC to be controlled and is typically water or refrigerant.

Alternative Raw Materials

Alternative solvent materials with lower VOC contents could be considered as a potential control option for BACT.

Oxidation Catalyst

Oxidation catalysts are exhaust treatment devices which enhance oxidation of VOC, without the addition of any chemical reagents, because there is sufficient oxygen in the exhaust gas stream for the oxidation reactions to proceed in the presence of the catalyst alone. Typically, precious metals are used as the catalyst to promote oxidation. The activity of oxidation catalysts is dependent on the amount of particulate in the flue gas stream and the flue gas temperature.

Good Combustion Practices

The use of good combustion practices optimizes combustion in the boilers and hot oil heaters. Ensuring that the temperature and oxygen availability are adequate for complete combustion minimizes VOC emissions. This technique includes continued operation of the boilers at the appropriate oxygen range and temperature.

Work Practice Standards

For storage tanks, this means having submerged fill lines and spill and overfill protection. For date coding printers, this means keeping VOC materials in closed containers.

*i. **Battery Manufacturing:***

EU01, Cathode Processing (CP01-CP32) and Anode Processing (AP01-AP32)

EU01, Electrode Cleaning (CR01-CR08)

EU02 Battery Assembly, Cathode Oven (CO01-CO48) and Electrolyte Filling and Sealing (EL01-EL48)

EU03 Battery Formation, Cell Degassing (DG01-DG48)

EU04 Cell Discharge (CD01-CD08)

EU05 Laboratories, Quality Evaluation 1+2 (QE01-QE16)

EU01, Cathode Drying (DR01-DR20)

Decision Summary:

The following BACT standards apply to the affected facilities:

EMISSION LIMITATIONS
3.0 ppmv VOC post-control for adsorbers based on 3-hr block average basis
2.0 ppmv VOC post-control for scrubbers based on 3-hr block average basis
5,854 lbs VOC total, for all listed battery manufacturing sources, per GWh batteries produced on a rolling 12 month basis. This will apply after production ramp-up period of achieving 90% production capacity or 24 months after startup on a per building basis is reached.
<i>Initial Temporary</i> 125.8 tons VOC total for all listed sources (on a per building basis) per rolling 12-month basis, used for a facility production ramp-up period after startup.

Technologies:

The following technologies were reviewed for the above the battery manufacturing sources: Adsorption, Thermal Incinerators, Catalytic Incinerators, Absorption, Condensation, Alternative Raw Materials

Rank	Control Option	Control Efficiency (%)
1	Adsorption Regenerative Thermal Incinerator Catalytic Incinerator	~98%
2	Absorption	90%
3	Condensation	73%

Analysis:

To preface, top down BACT was applied to all non-cathode drying sources as if there were no controls to begin with. BACT for the cathode drying scrubbers was different, as the scrubbers are treated as inherent equipment. So BACT for the cathode drying sources was applied post scrubber control.

Using alternative raw materials was determined to be infeasible since the use NMP was necessary for the process operations.

For the Non-cathode dryer sources, adsorption was considered the top ranked control method and was chosen to control VOC emissions. Since the most effective method is being used, no further BACT analysis is required.

For the cathode dryer sources, it was necessary to determine if add-on controls after absorption were necessary. Using Adsorption, Ford's cost calculations determined the estimated annual costs in 2020 dollars to be \$20,000/ton VOC removed. Using

Incineration, Ford’s cost calculations determined the estimated annual costs in 2002 dollars to be \$164,780/ton VOC removed with catalytic incineration costs assumed to be equal or higher. These costs were found to be prohibitive, so no additional add on controls after the scrubbers are required for BACT.

ii. Boilers and Hot Oil Heaters:

EU06 Natural Gas-Fired Boilers (B01-B08)

EU07 Natural Gas-Fired Hot Oil Heaters (H01-H20)

Decision Summary:

The following BACT standards apply to the affected facilities:

For EU06:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
VOC	0.0054 lb/MMBtu	0.237 tpy for each unit (1.9 tpy for all 8 units)

For EU07:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
VOC	0.0054 lb/MMBtu	0.76 tpy for each unit (15.07 tpy for all 20 units)

For both EU06 and EU07

The facility is required to combust pipeline quality natural gas only, operate and maintain of each unit and associated analyzers per manufacturer recommendations, and conduct boiler tune ups pursuant to 40 CFR 63.7540(a)(10).

Technologies:

The following technologies were reviewed for the above sources: Oxidation Catalyst, Good Combustion Practices

Rank	Control Option	Control Efficiency (%)
1	Oxidation Catalyst	98%
2	Good Combustion Practices	undefined

Analysis:

Using an oxidation catalyst, Ford’s cost calculations determined the estimated annual costs to be \$175,500/ton VOC removed for the boilers and \$126,900/ton VOC removed for the oil heaters. This is prohibitively expensive so good combustion practices have been established as BACT.

iii. Emergency Engines:

EU08 Diesel Fired Emergency Engines (FPE01-FPE04 and GE01-GE08)

Decision Summary:

The following BACT standards apply to the affected facilities:

For the Fire Pumps:

Pollutant	Emission Standard (g/KW-hr)	Emission Standard (g/HP-hr)
NO _x + NMHC (NO _x BACT) (VOC BACT)	4.0	3.0

For the other generators:

Pollutant	Emission Standard (g/KW-hr)
NO _x + NMHC (NO _x BACT) (VOC BACT)	6.4

Analysis:

The BACT standards for the fire pumps and emergency generators are to comply with the applicable limits of 40 CFR 60, Subpart IIII that apply.

iv. Storage Tanks:

EU10 Storage Tanks (RT01-RT12 and WT01-WT24)

Decision Summary:

The following BACT standards apply to the affected facilities:

- All storage tanks shall be equipped with permanent submerged fill pipes and
- All storage tanks shall be equipped with spill and overflow protection.

Technologies:

Work Practice Standards are used.

Analysis:

The storage tanks are white, above ground, fixed roof storage tanks. Submerged fill lines and spill and overflow protection were added as BACT for storage tank facilities.

v. Date Code Printing:

EU11 Printing

Decision Summary:

The following BACT standards apply to the affected facilities:

All inks, solvents, and makeup fluid used shall be stored in closed, vapor tight, containers.

Technologies:

Work Practice Standards are used.

Analysis:

The affected facility is a date coding printer. Including add on controls would not be feasible. The BACT applied is to store volatile materials in closed, vapor tight, containers.

vi. Dehumidification and Air Handling Units:

EU13 Natural Gas-Fired Dehumidification Units (DH01-DH60)

EU14 Fired Natural Gas-Fired Building Air Handling Units (BA01-BA68)

EU15 Fired Natural Gas-Fired Office Air Handling Units (OA01-OA14)

EU16 Fired Natural Gas-Fired Office Air Handling Units (COD01-COD32 and COI01-COI-70))

Decision Summary:

The following BACT standards apply to the affected facilities:

Pollutant	Emission Limitation (based on 3-hr block average)
VOC	0.0054 lb/MMBtu

The facility shall only combust pipeline quality natural gas and shall maintain and operate the units (including start up and shut down) in accordance with manufacturer's recommendations.

Technologies:

Good Combustion Practices are used.

Analysis:

Oxidation catalysts were considered not an available control option for the humidification and air handling units because of interferences with highly controlled process supply air, the integrated environmental controls that link the heaters to fans and other temperature controlling and humidification equipment, and the lack of discharge ducts for some units. As such good combustion practices has been established as BACT.

B. BACT Analysis for NOx

Technologies Reviewed:

Selective Catalytic Reduction (SCR)

SCR is a post-combustion control technology that reduces NOx emissions by injecting a nitrogen-based reagent (e.g., ammonia, urea) into the exhaust stream downstream of the combustion unit and upstream of a catalyst bed. On the catalyst surface, the reagent reacts selectively with NOx to produce molecular nitrogen and water vapor.

Selective Non-catalytic Reduction (SNCR)

SNCR is similar to SCR in that it is based on the reaction of urea or ammonia with NOx. However, unlike SCR, SNCR does not involve a catalyst.

Low-NOx and Ultra-Low-NOx burners

Low-NOx and ultra-low-NOx burners reduce NOx formation through staged combustion and burner design. The first stage is the primary fuel combustion step. The next stage involves

returning to further reduce NO_x. The third stage is the final combustion stage in low excess air to limit the temperature.

Flue Gas Recirculation (FGR)

With FGR, a portion of the flue gas is recycled back to the combustion zone. NO_x emissions are reduced through two mechanisms: diluting oxygen content and reducing combustion zone temperature.

Good Combustion Practices

Boiler and oil heater maintenance and efficient operation in accordance with the manufacturer’s recommendations will ensure NO_x emissions are minimized.

i. Boilers and Hot Oil Heaters:

EU06 Natural Gas-Fired Boilers (B01-B08)

EU07 Natural Gas-Fired Hot Oil Heaters (H01-H20)

Decision Summary:

The following BACT standards apply to the affected facilities:

For EU06:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
NO _x	20 ppm at 3% O ₂ equivalent to 0.0243 lb/MMBtu	1.06 tpy for each unit (8.51 tpy for all 8 units)

For EU07:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
NO _x	20 ppm at 3% O ₂ equivalent to 0.0243 lb/MMBtu	3.39 tpy for each unit (67.86 tpy for all 20 units)

For both EU06 and EU07

The facility is required to combust pipeline quality natural gas only, operate and maintain of each unit and associated analyzers per manufacturer recommendations, and conduct boiler tune ups pursuant to 40 CFR 63.7540(a)(10).

Technologies:

The following technologies were reviewed for the above sources: Selective Catalytic Reduction (SCR), Selective Non-catalytic Reduction (SNCR), Low-NO_x and Ultra-Low-NO_x burners, Flue Gas Recirculation (FGR), and Good Combustion Practices.

Rank	Control Option	Control Efficiency (%)
1	SCR	90%
2	Ultra-Low-NOx Burners	75%-80%
3	Low-NOx Burners	38%-63%
4	FGR	63%
5	Good Combustion Practices	undefined

Analysis:

There are no known cases of using SNCR on natural gas fired boilers or oil heaters less than 100 MMBtu/hr so SNCR is considered to be technically infeasible. Using SCR, Ford's cost calculations determined the estimated annual costs to be \$61,000/ton NOx removed for the boilers and \$39,300/ton NOx removed for the oil heaters in 2020 dollars. SCR costs are prohibitively expensive so the facility has chosen not to use them. The BACT emission limitation of 20 ppm at 3% O₂ will be achieved by using good combustion practices and staged combustion with or without flue gas recirculation.

ii. Emergency Generators:

EU08 Diesel Fired Emergency Engines (FPE01-FPE04 and GE01-GE08)

Decision Summary:

The following BACT standards apply to the affected facilities:
 For the Fire Pumps:

Pollutant	Emission Standard (g/KW-hr)	Emission Standard (g/HP-hr)
NO _x + NMHC (NO _x BACT) (VOC BACT)	4.0	3.0

For the other generators:

Pollutant	Emission Standard (g/KW-hr)
NO _x + NMHC (NO _x BACT) (VOC BACT)	6.4

Analysis:

The BACT standards for the fire pumps and emergency generators are to comply with the applicable limits of 40 CFR 60, Subpart IIII that apply.

iii. Dehumidification and Air Handling Units:

EU13 Natural Gas-Fired Dehumidification Units (DH01-DH60)

EU14 Fired Natural Gas-Fired Building Air Handling Units (BA01-BA68)

EU15 Fired Natural Gas-Fired Office Air Handling Units (OA01-OA14)

EU16 Fired Natural Gas-Fired Office Air Handling Units (COD01-COD32 and COI01-COI-70))

Decision Summary:

The following BACT standards apply to the affected facilities:

Pollutant	Emission Limitation (based on 3-hr block average)
NO _x	35 ppm at 3% O ₂ equivalent to 0.043 lb/MMBtu

The facility shall only combust pipeline quality natural gas and shall maintain and operate the units (including start up and shut down) in accordance with manufacturer's recommendations.

Technologies:

The following technologies were reviewed for the above sources: Low-NO_x and Ultra-Low-NO_x burners and Good Combustion Practices

Rank	Control Option	Control Efficiency (%)
1	Ultra-Low-NO _x Burners	57%
2	Low-NO _x Burners	14%-38%
3	Good Combustion Practices	undefined

Analysis:

The BACT emission limitation of 35 ppm at 3% O₂ will be achieved by using good combustion practices and staged combustion.

C. BACT Analysis for CO

Technologies Reviewed:

Oxidation Catalyst

Oxidation catalysts are exhaust treatment devices which enhance oxidation of CO to CO₂, without the addition of any chemical reagents, because there is sufficient oxygen in the exhaust gas stream for the oxidation reactions to proceed in the presence of the catalyst alone. Typically, precious metals are used as the catalyst to promote oxidation. The activity of oxidation catalysts is dependent on the amount of particulate in the flue gas stream and the flue gas temperature.

Good Combustion Practices

The use of good combustion practices optimizes combustion in the boilers and hot oil heaters. Ensuring that the temperature and oxygen availability are adequate for complete combustion minimizes CO emissions. This technique includes continued operation of the boilers at the appropriate oxygen range and temperature.

i. Boilers and Hot Oil Heaters:

EU06 Natural Gas-Fired Boilers (B01-B08)

EU07 Natural Gas-Fired Hot Oil Heaters (H01-H20)

Decision Summary:

The following BACT standards apply to the affected facilities:
 For EU06:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
CO	50 ppm at 3% O ₂ equivalent to 0.037 lb/MMBtu	1.619 tpy for each unit (12.95 tpy for all 8 units)

For EU07:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
CO	50 ppm at 3% O ₂ equivalent to 0.037 lb/MMBtu	5.165 tpy for each unit (103.29 tpy for all 20 units)

For both EU06 and EU07

The facility is required to combust pipeline quality natural gas only, operate and maintain of each unit and associated analyzers per manufacturer recommendations, and conduct boiler tune ups pursuant to 40 CFR 63.7540(a)(10).

Technologies:

The following technologies were reviewed for the above sources: Oxidation Catalyst, Good Combustion Practices

Rank	Control Option	Control Efficiency (%)
1	Oxidation Catalyst	50%-90%
2	Good Combustion Practices	undefined

Analysis:

Using an oxidation catalyst, Ford's cost calculations determined the estimated annual costs to be \$26,510/ton CO removed for the boilers and \$19,688/ton CO removed for the oil heaters. This is prohibitively expensive so BACT has been established as good combustion practices.

ii. Emergency Generators:

EU08 Diesel Fired Emergency Engines (FPE01-FPE04 and GE01-GE08)

Decision Summary:

The following BACT standards apply to the affected facilities:
 For the Fire Pumps:

Pollutant	Emission Standard (g/KW-hr)	Emission Standard (g/HP-hr)
CO (CO BACT)	5.0	3.7

For the other generators:

Pollutant	Emission Standard (g/KW-hr)
CO (CO BACT)	3.5

Analysis:

The BACT standards for the fire pumps and emergency generators are to comply with the applicable limits of 40 CFR 60, Subpart IIII that apply.

iii. Dehumidification and Air Handling Units:

EU13 Natural Gas-Fired Dehumidification Units (DH01-DH60)

EU14 Fired Natural Gas-Fired Building Air Handling Units (BA01-BA68)

EU15 Fired Natural Gas-Fired Office Air Handling Units (OA01-OA14)

EU16 Fired Natural Gas-Fired Office Air Handling Units (COD01-COD32 and COI01-COI-70))

Decision Summary:

The following BACT standards apply to the affected facilities:

Pollutant	Emission Limitation (based on 3-hr block average)
CO	50 ppm at 3% O ₂ equivalent to 0.037 lb/MMBtu

The facility shall only combust pipeline quality natural gas and shall maintain and operate the units (including start up and shut down) in accordance with manufacturer's recommendations.

Technologies:

Good Combustion Practices are used.

Analysis:

Oxidation catalysts were considered not an available control option for the humidification and air handling units because of interferences with highly controlled process supply air, the integrated environmental controls that link the heaters to fans and other temperature controlling and humidification equipment, and the lack of discharge ducts for some units. Good combustion practices have been established as BACT.

D. BACT Analysis for GHG
Technologies Reviewed:

Use of Natural Gas

Using natural gas in lieu of a fuel with higher emissions.

Good Combustion Practices

The use of good combustion practices optimizes combustion in the boilers and hot oil heaters. This technique includes continued operation of the boilers at the appropriate oxygen range and temperature.

Carbon Capture

In general, post-combustion capture involves the removal of CO₂ generated by fuel combustion from the flue gas.

i. Boilers and Hot Oil Heaters:

EU06 Natural Gas-Fired Boilers (B01-B08)

EU07 Natural Gas-Fired Hot Oil Heaters (H01-H20)

Decision Summary:

The following BACT standards apply to the affected facilities:

For EU06:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
CO ₂	117 lb/MMBtu	N/A
CO _{2e}		5,128.9 tpy for each unit (41,031.2 tpy for all 8 units)

For EU07:

Pollutant	Emission Limitation	
	(based on 3-hr block average)	(12-month rolling total)
CO ₂	117 lb/MMBtu	N/A
CO _{2e}		16,361.2 tpy for each unit (327,224 tpy for all 20 units)

For both EU06 and EU07

The facility is required to combust pipeline quality natural gas only, operate and maintain each unit and associated analyzers per manufacturer recommendations, and conduct boiler tune ups pursuant to 40 CFR 63.7540(a)(10).

Technologies:

The following technologies were reviewed for the above sources: The Use of Natural Gas, Good Combustion Practices, and Carbon Capture.

Analysis:

There are no known cases of using an amine absorption system for GHG BACT on natural gas fired boilers less than 100 MMBtu/hr so Carbon Capture using amine

absorption is considered to be technically infeasible. Use of pipeline quality natural gas and good combustion practices has been established as BACT.

ii. Emergency Generators:

EU08 Diesel Fired Emergency Engines (FPE01-FPE04 and GE01-GE08)

Decision Summary:

The following BACT standards apply to the affected facilities:

For the Fire Pumps:

EMISSION LIMITATIONS
Carbon dioxide equivalent (CO ₂ e) emissions shall not exceed 1.18 lb/hp-hr on a 3-hour block average basis.

For the other generators:

EMISSION LIMITATIONS
Carbon dioxide equivalent (CO ₂ e) emissions shall not exceed 0.99 lb/hp-hr on a 3-hour block average basis.

Analysis:

The applied BACT limits are from emission factors for diesel fuel from 40 CFR 98, Subpart C.

iii. Dehumidification and Air Handling Units:

EU13 Natural Gas-Fired Dehumidification Units (DH01-DH60)

EU14 Fired Natural Gas-Fired Building Air Handling Units (BA01-BA68)

EU15 Fired Natural Gas-Fired Office Air Handling Units (OA01-OA14)

EU16 Fired Natural Gas-Fired Office Air Handling Units (COD01-COD32 and COI01-COI-70))

Decision Summary:

The following BACT standards apply to the affected facilities:

Pollutant	Emission Limitation (based on 3-hr block average)
CO ₂	117 lb/MMBtu

The facility shall only combust pipeline quality natural gas and shall maintain and operate the units (including start up and shut down) in accordance with manufacturer's recommendations.

Technologies:

The following technologies were reviewed for the above sources: The Use of Natural Gas, Good Combustion Practices, and Carbon Capture.

Analysis:

There are no known cases of using an amine absorption system for GHG BACT on natural gas fired boilers less than 100 MMBtu/hr so Carbon Capture using amine

absorption is considered to be technically infeasible. Use of pipeline quality natural gas and good combustion practices has been established as BACT.

E. AIR QUALITY IMPACT ANALYSIS

i. Screening Methodology

The incremental increases in ambient pollutant concentrations associated with the Ford Motor Company project have been estimated through the use of a dispersion model (AERMOD) applied in conformance to applicable guidelines in the United States Environmental Protection Agency (USEPA) Guideline on Air Quality Models (GAQM, 40 CFR 51, Appendix W, May 2017) and other applicable guidance, and followed the methodology presented in the Air Dispersion Modeling Protocol approved by KDAQ on December 8th, 2021.

Model simulations for short-term and annual-averaged CO and NO₂ emissions are performed with the AERMOD model using the 5-year meteorological database. The highest predicted impacts (H1H) were used as the design concentrations in the SIL analyses while the design concentrations for the NAAQS and PSD increment analyses followed the form of the NAAQS and PSD increment for each applicable pollutant and averaging time. Each pollutant is being assessed against the SIL for the NAAQS, the maximum value over 5 years for each applicable time averaging period is compared to the appropriate SIL.

Significant Impact Levels (SILs)

Pollutant	Averaging Period	Modeled Concentration (µg/m ³)	Significant Impact Level (µg/m ³)	Significant Monitoring Concentrations (µg/m ³)	SIL Exceeded & Additional Modeling Required?	Significant Monitoring Concentration Exceeded?
CO	1-hour	296.7	2000	-	No	-
	8-hour	88.9	500	575	No	No
NO ₂	1-hour	132.3	7.5	-	Yes	-
	Annual	6.82	1	14	Yes	No

ii. Background Concentrations

Representative background concentrations were added to the maximum predicted concentrations so that small sources that were not explicitly modeled are included in the NAAQS assessment. Background concentrations are based on ambient monitoring data collected for the most recent three-year period available (2018 through 2020) determined to be the most representative for use in the modeling analysis. Since not all of the demonstration pollutants are monitored at one location, data from several different monitoring locations are used.

Representative Background Concentrations

Monitoring Location	Site ID	Data Collection Period	Pollutant	Averaging Period	Basis of Design Value	Design Value
Owensboro, Daviess Co., KY	21-059-0005	2018-2020	NO ₂	1-hour	Average of the three year 98 th percentile	50.8 µg/m ³
				Annual	Annual Mean	7.5 µg/m ³
Elizabethtown, Hardin Co., KY	21-093-0006	2018-2020	Ozone	8-hour	3 year 4 th high maximum 8-hour average	.061ppm

iii. Cumulative NAAQS Analyses

NAAQS analyses, using five years of meteorological data, were performed for the 1-hour and annual NO₂ standard. The NAAQS analyses were carried out by modeling facility-wide Ford Motor Company source parameters and emission rates; modeling off-property source inventory for the surrounding area; and adding the representative background concentrations to modeled concentrations for comparison with the NAAQS.

NAAQS Modeling Results

Pollutant	Averaging Period	Modeled Concentration (µg/m ³)	Background (µg/m ³)	Total (µg/m ³)	NAAQS (µg/m ³)	Max Ford Contribution (µg/m ³)
NO ₂	1-hour	2009.6	50.8	2060.4	188	0.02478
NO ₂	Annual	8.57	7.5	16.07	100	N/A

iv. Class II Increment Analysis

In addition, a PSD Class II increment modeling analysis, using five years of meteorological data, was also performed for annual NO₂ by modeling increment consuming and expanding Ford Motor Company source parameters and emission rates as well increment consuming and expanding off-property sources.

The Ford Motor Company Facility is the first PSD application for NO₂ in Hardin County. This project will set the Minor Source Baseline Date for NO₂ in Hardin County. The regional inventories for the annual NO₂ NAAQS were conservatively assumed to be increment consuming and were used in the cumulative PSD increment modeling to assess compliance.

Class II Increments

Pollutant	Averaging Period	Modeled Concentration (µg/m ³)	PSD Class II Increment Standard (µg/m ³)
NO ₂	Annual	8.57	25

v. Ozone Ambient Impact Analysis

The Division has provided recent (August 2, 2018) guidance on addressing secondary pollutant impacts with a state-specific guidance on the application of EPA’s Modeled Emission Rates for Precursors (MERPs) Tier-1 demonstration tool. This guidance was used to assess secondary formation of Ozone and PM_{2.5} for this project. A MERP

represents a level of precursor emissions that is not expected to contribute significantly to concentrations of ozone or secondarily formed PM_{2.5}.

MERPs are used to determine if proposed emission increases from a facility will result in primary and secondary impacts. NO_x, SO₂, PM_{2.5}, and VOC emissions from the project must be included in the analysis. If the project emissions from all relevant pollutants are below the SER, no further analysis is required. If the project emissions from any of the relevant emissions are above the SER, a Tier 1 demonstration is required. The Tier 1 demonstration consists of a SILs analysis and, if needed, a cumulative analysis. The analysis must be below the NAAQS for each precursor in order to pass.

Ford Motor Company Emission for MERPs Analysis

Precursor	Emissions (tpy)	SER (tpy)
NO _x	278.96	40
SO ₂	4.93	40
PM _{2.5}	9.16	10
VOC	292.64	40

The background concentration for ozone is as follows:

Background Concentrations for MERPs Analysis

Pollutant	Background Concentrations	Monitor ID
Ozone	61 ppb	21-093-0006, Hardin Co. KY

If the result of the SIL Analysis is greater than 1, a cumulative analysis is required for that precursor. If the result is less than 1, a cumulative analysis is not required. The SIL analysis results for Ozone is as follows:

Ozone SIL Analysis

Averaging Period	Precursor	Critical Air Quality Threshold (ppb)	Modeled Emission Rate from Hypo. Source (tpy)	Modeled Impact from Hypo. Source (ppb)	Ozone MERP (tpy)	Projected Emissions (tpy)	% of Critical Air Quality Threshold	Ozone Project Impact (ppb)	SIL (ppb)
8-hour	NO _x	1.0	500	2.908	172	278.46	169.9%	1.62	
	VOC	1.0	500	0.060	8,306	293.05	3.5%	0.04	
Total								1.66	1.0

The calculated MERPs concentration is added to the background ozone concentration taken from the Elizabethtown, KY monitor (21-093-0006). The analysis demonstrates compliance with the Ozone 8 hour NAAQS.

Ozone NAAQS Analysis

Averaging Period	Pollutant	Ozone Project Impact (ppb)	Ozone Background Conc. (ppb)	Cumulative Ozone Impact (ppb)	NAAQS
8-hour	Ozone	1.65	61	62.65	70

vi. Secondary PM_{2.5} Impact Assessment

In order to assess the secondary PM_{2.5} impacts, the USEPA approved distance-dependent technique was used. In this case, the MERPs values were calculated based on the concentrations from a representative hypothetical stack at a specific distance representative of the distance between the Project and the Class I area. Based on the MERP Guidance offered by the USEPA, Ford has prepared a site-specific secondary PM_{2.5} impact assessment to demonstrate that the precursor emissions from the project will not cause or contribute to a violation of the PM_{2.5} NAAQS or PSD increment standards. The selected MERPs values for the Barren County hypothetical source, calculated PM_{2.5} MERPs, project emissions increase of NO_x, and the estimated PM_{2.5} impact associated with the expansion project are well below the respective Class II SILs.

PM_{2.5} MERPs Analysis

Averaging Period	Precursor	Critical Air Quality Threshold (µg/m ³)	Modeled Emission Rate from Hypo. Source (tpy)	Modeled Impact from Hypo. Source (µg/m ³)	PM _{2.5} MERP (tpy)	Project Emissions (tpy)	% of Critical Air Quality Threshold	Secondary PM _{2.5} Impact (µg/m ³)
24-hr	NO _x	1.2	500	0.107	5,615	278.46	4.96%	0.05952
Annual	NO _x	0.2	500	0.007	13,902	278.46	2.0%	0.004

The specific Class I area secondary PM_{2.5} impacts associated with NO_x emissions at a selected distance (20 km conservatively, and using 10 m stack height) are utilized to estimate the secondary PM_{2.5} modeled impacts. Predicted modeled impacts are well below the Class I SILs for PM_{2.5} and no further analysis is necessary.

PM_{2.5} Class I PSD SIL Analysis Considering Secondary Formation

Averaging Period	Precursor	Modeled Emission Rate from Hypo. Source (tpy)	Modeled Impact from Hypo. Source (µg/m ³)	Project Emissions (tpy)	Scaled Modeled Impact (µg/m ³)	Class I SIL (µg/m ³)
24-hour	NO _x	500	0.073	278.46	0.04066	0.27
Annual	NO _x	500	0.006	278.46	0.003342	0.05

vii. Class I Area Analysis

Class I area impacts are addressed if the proposed project has an impact that exceeds the screening threshold as described by Federal Land Managers’ (FLM) Air Quality Related Values Work Group (FLAG) guidance. In this guidance the sum of the proposed project emissions (in tpy) of SO₂, NO_x, PM₁₀ and H₂SO₄ is divided by the distance to the Class I area and compared to the value of 10. This ratio is known as Q/D. If Q/D is 10 or less, the project is considered to have a negligible impact on the Class I area. If the Q/D value is greater than 10, then further analysis to evaluate impacts in the Class I area is warranted.

There are two Federal Class I areas within 300 km of the Ford Motor Company: Great Smoky Mountains (NPs), at 278 km and Joyce Kilmer Slickrock Wilderness (USFS). The sum of emissions (SO₂, NO_x, PM₁₀ and H₂SO₄) for the proposed project is 295.02 tpy. The calculated Q/D for the proposed project relative to Great Smoky Mountains is 1.06 and Joyce Kilmer Slickrock Wilderness is 1.02; which are below the FLM screening level of 10.

Class I Area Q/D Screening Analysis

Pollutant	Project Emissions (tpy)	Q/D Analysis
NO ₂	278.96	
SO ₂	4.93	
Particulate Matter	11.13	
H ₂ SO ₄	0.0	
Total	295.02	
Great Smoky Mountains	278 km	1.06
Joyce Kilmer Slick Rock Wilderness	288 km	1.02

The project related increase of NO₂ was evaluated against the Class I SILs by applying the AERMOD dispersion model receptors at the maximum spatial extent (48, 49, and 50 km from the Project site to receptor). The maximum-modeled concentrations at the 50 km receptors are less than the Class I SILs for averaging period.

Class I SIL Analysis with AERMOD

Pollutant	Averaging Period	Modeled Concentration at 50 km (µg/m ³)	Class I SIL	% of SIL
NO ₂	Annual	0.054	0.1	54.0%

APPENDIX A – ABBREVIATIONS AND ACRONYMS

AAQS	– Ambient Air Quality Standards
acfm	– Actual cubic feet per minute
AHU	– Air Handling Unit
BACT	– Best Available Control Technology
bhp	– Brake horsepower
Btu	– British thermal unit
CAM	– Compliance Assurance Monitoring
CO	– Carbon Monoxide
Division	– Kentucky Division for Air Quality
dscf	– Dry Standard Cubic Feet
ESP	– Electrostatic Precipitator
EV	– Electric vehicle
GHG	– Greenhouse Gas
GWh	– Gigawatt hour
HAP	– Hazardous Air Pollutant
HF	– Hydrogen Fluoride (Gaseous)
KY1	– Refers to Building #1
KY2	– Refers to Building #2
MSDS	– Material Safety Data Sheets
mmHg	– Millimeter of mercury column height
NAAQS	– National Ambient Air Quality Standards
NESHAP	– National Emissions Standards for Hazardous Air Pollutants
NMP	– 1-Methyl-2-Pyrrolidinone
NO _x	– Nitrogen Oxides
NSR	– New Source Review
PM	– Particulate Matter
PM ₁₀	– Particulate Matter equal to or smaller than 10 micrometers
PM _{2.5}	– Particulate Matter equal to or smaller than 2.5 micrometers
PSD	– Prevention of Significant Deterioration
PTE	– Potential to Emit
SER	– Significant Emissions Rate
SO ₂	– Sulfur Dioxide
TF	– Total Fluoride (Particulate & Gaseous)
VOC	– Volatile Organic Compounds
NEI	– National Emission Inventory
M	– Thousand
MM	– Million