Stepan

Stepan Company

951 Bankhead Hwy.
Winder, Georgia 30680
770-867-7471

Ms. Heather Brown
Chemical Unit Manager
Air Protection Branch
4244 International Parkway
Suite 120
Atlanta, GA 30354

Re: Air Permit Application for Ethylene Oxide Emissions – Response to Modeling Request
Stepan Company (Winder Facility, GA)
Permit Nos. 2843-013-0001-S-02-0, S-02-1, and S-02-2

Dear Ms. Brown:

Please find attached the December 2020 synthetic minor air permit application update for the Winder facility. The application was originally submitted in April 2020 with the preliminary stack test numbers as the final stack test report was not available at that time. The application was updated in June 2020 with the final stack test report numbers, where calendar year 2019 actual ethylene oxide emissions were used for the modeling assessment. The application has been updated to include a modeling assessment conducted using potential ethylene oxide emissions. In addition, emissions from line purges and tank cleaning have been estimated and included in the modeling assessment.

If you have any questions, please feel free to contact me at (847) 501-2339 or via email at chardaway@stepan.com. The contact persons for additional information about this permit application submittal are Ms. Tracey Crawford of Stepan Company (770-867-8669, tcrawford@stepan.com), Mr. Marc Taylor of Stepan Company (224-330-4214, mtaylor@stepan.com), and Ms. Pilar Johansson of EPS (678-336-8562, pjohansson@montrose-env.com).

Sincerely,

Robert L. Poage, Director, NA Plant Operations
Stepan Company

Attachment – Synthetic Minor Air Permit Application Updated December 2020

Prepared for:

STEPAN COMPANY
951 Bankhead Highway,
Winder, GA

SYNTHETIC MINOR AIR PERMIT APPLICATION
STEPAN COMPANY
Winder, Georgia

Prepared by:

EPS
a Montrose Environmental Group company
400 Northridge Road, Suite 400
Sandy Springs, GA 30350
Tel: 404-315-9113

Submitted April 2020
December 2020 Update

SYNTHETIC MINOR AIR PERMIT APPLICATION

STEPAN COMPANY

Winder, GA 30680

Prepared for:

STEPAN COMPANY
951 Bankhead Hwy
Winder, GA 30680
(Barrow County)

Prepared by:

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Pilar Johansson
Associate

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Principal

December 2020 Update

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APPENDICES

1 INTRODUCTION

Stepan Company (Stepan) owns and operates a specialty chemical manufacturing facility located at 951 Bankhead Hwy, Winder, GA 30680 (Barrow County). The facility operates under Synthetic Minor Permit Nos. 2843-013-0001-S-02-0, S-02-1 and S-02-2.

The Georgia Environmental Protection Division (EPD) issued a letter to Stepan dated December 9, 2019 requesting submittal of an air permit application, which should incorporate the changes to be implemented at the facility to reduce ethylene oxide (EO) emissions, by March 31, 2020. The letter also included a request for submission of a written Leak Detection and Repair (LDAR) Plan and detailed emissions calculations with a description of the methodology used, emission factors, any assumptions used, and operational parameters. An extension of the deadline was granted by the GA EPD. The new deadline was extended to April 10th, 2020. The application was submitted electronically, as approved by the GA EPD.

The air emissions calculations in this application show the benefit from the proposed additional control measures: LDAR implementation and the installation of rupture disks on all pressure relief valves. These details were previously provided to the EPD by January 31, 2020, and this amendment is seeking to make those changes enforceable. Finally, the letter also included a request for EO emissions testing to be performed. The air emissions calculations have been updated as part of this application to reflect the stack test results. The application was originally submitted in April 2020 with the preliminary stack test numbers as the final report was not available at that time. The application was updated in June 2020 with the final stack test report numbers, where calendar year 2019 actual emissions were used for the modeling assessment. The application has been updated to include a modeling assessment conducted using potential emissions. In addition, emissions from line purges and tank cleaning have been estimated and included in the modeling assessment.

1.1 Application Contacts

The contact persons for additional information about this permit application submittal are Ms. Tracey Crawford of Stepan Company (770-867-8669, tcrawford@stepan.com), Mr. Marc Taylor of Stepan Company (224-330-4214, mtaylor@stepan.com), and Ms. Pilar Johansson of EPS (678-336-8562, pjohansson@montrose-env.com).

1.2 Submittal Organization

This submittal is organized into five (5) sections with additional appendices. The five main sections and appendices are as follows:

Section 1.0 (Introduction) provides background information on the facility, the permit application, and identifies the contact personnel. A summary of the permit application organization is provided.

Section 2.0 (Facility Description) provides detailed information on current facility operations related to EO.

Section 3.0 (Emissions Estimates) contains summary information on EO emissions from the facility.

Section 4.0 (Regulatory Analysis) presents the results and conclusions of a detailed regulatory review for the facility.

Section 5.0 (Testing and Monitoring) presents the proposed testing and monitoring for the facility.

Appendix A (SIP Application Forms) contains the required Georgia EPD SIP application forms.

Appendix B (Figures) contains the figures supporting the permit application.

Appendix C (Emissions Calculations) contains the emission calculations supporting the permit application.

Appendix D (Toxics Impact Assessment) contains the toxics impact assessment of relevant air toxics supporting the permit application.

2 FACILITY DESCRIPTION

2.1 Facility Operations

The Stepan Winder facility produces intermediates for laundry detergent manufacturing and other similar products. These intermediates are produced through batch and continuous reaction processes. The facility consists of four reactor vessels, three blenders, four batch neutralizers, two continuous sulfonation process lines, one re-blend tank, and numerous storage tanks.

EO emissions from the Stepan Winder facility result from the following processes:

- The depressurization of the alkoxylation process reactor (R01);
- The depressurization of the EO Storage Tank (T-3400) after railcar unloading;
- The cleaning of the EO Storage Tank (T-3400);
- Fugitive equipment leaks from EO unloading, EO storage, and the alkoxylation process reactor area; and
- The purging of EO lines throughout the facility.

2.1.1 Alkoxylation Reactor (R01)

Reactor R01 operates as a batch reactor and produces certain products that use EO as a raw material. There are no emissions from the reactor during the reaction process, as R01 is a jet stream reactor that constantly pulls the headspace gas back into the reaction. However, when the reaction process ends the vessel is depressurized after the product has been pumped out of the reactor. The depressurized gas, which contains EO, is vented to the EO column scrubber (SCR-R01). Depressurization occurs for approximately 20 minutes per cycle.

Approximately once or twice a month, batches with an additional cook time are conducted in Reactor R01. For these batches, operation charges the reactor with EO, allows the reaction to take place, and then depressurizes the reactor. This process is repeated several times before the batch is completed. All venting is routed to the EO column scrubber (SCR-R01). In addition, maintenance activities performed on the reactor, such as a reactor cleanout, include emptying the reactor and purging with nitrogen to ensure safety.

2.1.2 EO Storage (T-3400)

EO is treated and stored under pressure at specific temperature as liquid or gas dependent on pressure and temperature of the system. During railcar unloading, liquid EO is transferred from the railcar to the storage tank (T-3400). This transfer is performed under a closed system between the railcar and the storage tank which allows the balancing of vapors displaced during loading from the storage tank to the railcar (vapor balance system). EO emissions result from depressurization of the tank (approximately 10-15 psig) after the railcar unloading has been completed. Depressurization occurs for approximately 20 minutes per cycle.

Emissions from tank depressurization are routed to the EO scrubber (SCR-R01) as required by current Permit No. 2843-013-0001-S-02-1, Conditions No. 4.10 and 4.11. The EO tank (T-3400) is subject to 40 CFR Part 60, Subpart Kb, which requires a control efficiency of ≥ 95% by weight for Volatile Organic Compounds (VOCs) (as stated in Condition 2.11). The stack test conducted on March 19th, 2020 indicates that the scrubber has an average control efficiency for EO of 99.94%, which is greater than the above-referenced control requirements. This application is requesting a permit limit of 99.5% DRE for SCR-R01.

Maintenance activities performed on the tank, such as a tank cleanout, include emptying the tank and purging with nitrogen to ensure safety. Tank cleaning is generally only performed approximately once every ten years to satisfy regulatory requirements for internal inspections. The tank cleaning process occurs in two stages, controlled and uncontrolled. In the controlled stage, stage one, EO is unloaded from the tank to Reactor R01 where it is neutralized with potassium hydroxide (KOH). Reactor R01 is filled under a closed system and thus, there are no emissions associated with this part of the process. It is assumed that all EO left in Reactor R01 is fully reacted with potassium hydroxide (KOH) and no EO remains from the neutralization process. After EO is unloaded to Reactor R01, the tank is depressurized several times to the EO scrubber (SCR-R01) following the pressurizing with nitrogen.

After the tank is purged with nitrogen, it is washed with water several times, with the vent open to the scrubber when filling with water. The water is moved and neutralized with potassium hydroxide (KOH) in Reactor R01. Reactor R01 is also filled under a closed loop system and has no emissions. It is also assumed that all EO left in Reactor R01 is fully reacted with potassium hydroxide (KOH) and no EO remains from the neutralization process. During the last wash, water is pumped to the storage tank (T-3400) to overflowing. This represents the uncontrolled stage of tank cleaning, stage two.

2.1.3 EO Fugitive Equipment Leaks

Piping components, such as valves, connectors, and pump seals, have the potential for fugitive leaks of EO. Stepan has allocated resources and created an enhanced LDAR program, the details of which was submitted to the Division on January 31, 2020.

2.1.4 Line Purging

As a preventive measure prior to maintenance activity, certain EO lines throughout the facility are purged. The vapor lines are purged to the scrubber (SCR-R01). For the liquid lines, all of the liquid is blown down to Reactor R01 under a closed system where it is neutralized with potassium hydroxide (KOH) prior to purging of the line to the scrubber (SCR-R01). During line breaks, any EO remaining after the purge to the scrubber is vented to the atmosphere. When calculating emissions, the controlled portion of the calculations conservatively assume that all vapor inside the pipes is EO prior to purging to the scrubber (SCR-R01). For the liquid lines, it is assumed that no EO remains from the neutralization process. Some of the lines associated with the unloading area are also purged to the scrubber after railcar unloading. There are no line breaks associated with these emissions. Controlled emissions were calculated using the proposed scrubber DRE of 99.5 %. The uncontrolled emissions portion of the calculation assumes there is some EO left in the lines after purging to the scrubber (SCR-R01).

Table 2-1. EO Emission Units

Vessel ID	Description	Capacity (gal)	Associated Control Device		Applicable Requirements/Standards
R01	Alkoxylation process reactor including catch tanks and heat exchangers	8,000	SCR-R01	Scrubber (1998)	391-3-1-.02(2)(e) 391-3-1-.02(2)(b) Avoidance of 40 CFR Part 70
UNLOAD	Railcar Unloading of EO/PO	N/A	SCR-R01	Scrubber (1998)	391-3-1-.02(2)(e) 391-3-1-.02(2)(b) Avoidance of 40 CFR Part 70
T-3400	Pressurized EO tank (Regular Operations) Maximum true vapor pressure of contents: 20.2 psia	31,780	SCR-R01	Scrubber (1998)	391-3-1-.02(2)(e) 391-3-1-.02(2)(b) 40 CFR 60 Subpart A 40 CFR 60 Subpart Kb Avoidance of 40 CFR Part 70
T-3400 (CLEANING)	Vapor space purge emissions from tank cleaning - Controlled (Maintenance Activities)	31,780	SCR-R01	Scrubber (1998)	391-3-1-.02(2)(e) 391-3-1-.02(2)(b) 40 CFR 60 Subpart A 40 CFR 60 Subpart Kb Avoidance of 40 CFR Part 70
T-3400 (CLEANING FUGITIVE)	Vapor space purge emissions from tank cleaning – Uncontrolled (Maintenance Activities)	31,780	N/A	N/A	391-3-1-.02(2)(e) 391-3-1-.02(2)(b) 40 CFR 60 Subpart A 40 CFR 60 Subpart Kb Avoidance of 40 CFR Part 70
EQUIPMENT FUGITIVE EO	EO fugitive emissions from piping components	N/A	LDAR	LDAR program	391-3-1-.02(2)(e) 391-3-1-.02(2)(b) Avoidance of 40 CFR Part 70
LINE PURGES	EO emissions from purging of lines – Controlled	N/A	SCR-R01	Scrubber (1998)	391-3-1-.02(2)(e) 391-3-1-.02(2)(b) Avoidance of 40 CFR Part 70
LINE PURGES (FUGITIVE)	EO emissions from purging of lines – Uncontrolled (Maintenance Activities)	N/A	N/A	N/A	391-3-1-.02(2)(e) 391-3-1-.02(2)(b) Avoidance of 40 CFR Part 70

EMISSIONS ESTIMATES

For the purposes of this application the pollutant of concern was restricted to EO. Facility-wide potential emissions of EO are presented in Table 3-1 below.

Table 3-1. Facility-Wide EO Emissions Summary

Emission Unit	Emission Unit Description	Potential EO Emissions (lbs/yr)
R01	Alkoxylation Process Reactor	2.05
T-3400	EO Pressurized Storage Tank	4.26
UNLOAD	Railcar Unloading of EO	
FUGITIVE EO	Fugitive Equipment Leaks EO	73.15
T-3400 CLEANING	EO Pressurized Storage Tank	3.61
T-3400 CLEANING FUGITIVE	EO Pressurized Storage Tank	0.48
LINE PURGES	Fugitive Equipment Leaks EO	3.18
LINE PURGES FUGITIVE	Fugitive Equipment Leaks EO	0.12
	Total:	86.85

2.2 Emissions Calculations Methodology

The facility manufactures many products; however only the emissions of EO are discussed in this permit application.

2.2.1 Alkoxylation Reactor (R01) Potential Emissions

As described in Section 2.1.1, when the alkoxylation reaction process ends the vessel is depressurized after the product has been pumped out of the reactor. The transfer is performed under a closed system between the reactor and scrubber (SCR-R01). The depressurized gas, which contains EO, is vented to the EO column scrubber (SCR-R01). Depressurization occurs for approximately 20 minutes per cycle, but may vary based on the batch and specific product being produced.

Stack testing was performed at the facility on March 19th, 2020 on the EO scrubber for one depressurization event of the reactor. The average hourly emission rate from the stack test was adjusted to represent a 99.5 % DRE for the short-term emission rate (actual DRE stack test average was 99.98% for reactor degassing and 99.94% for tank degassing). The annual emission rate was calculated based on this hourly emission rate and a maximum of 1,003 batches per year.

2.2.2 EO Tank (T-3400) Potential Emissions

Regular Operations

As described in Section 2.1.2, during railcar unloading liquid EO is transferred from the railcar to the storage tank. This transfer is performed under a closed system between the railcar and the storage tank which allows the balancing of vapors displaced during loading from the storage tank to the railcar. EO emissions result from depressurization of the tank (approximately 10-15 psig) after the railcar unloading has been completed.

Stack testing was performed at the facility on March 19th, 2020 on the EO scrubber for three depressurization events of the tank. As there are limited unloading events, the testing was conducted by depressurization of the storage tank alone (without the railcar) based on approximately 10-15 psi, which is operationally identical to a railcar offloading event. The average hourly emission rate from the stack test was adjusted to represent a 99.5 % DRE for the short-term emission rate (actual DRE stack test average was 99.94% for tank degassing). The annual emission rate was calculated based on this hourly emission rate and unloaded maximum of 100 railcars per year.

Tank Cleaning (Maintenance Activity)

EO emissions also result from cleaning of the tank. As described in Section 2.1.2, the tank cleaning process is generally only performed approximately once every ten years to satisfy regulatory requirements for internal inspections. The tank cleaning process occurs in two stages, controlled and uncontrolled. In the controlled stage, stage one, EO is unloaded from the tank to Reactor R01 where it is neutralized with potassium hydroxide (KOH). Reactor R01 is filled under a closed system and thus, there are no emissions associated with this part of the process. It is assumed that all EO left in Reactor R01 is fully reacted with potassium hydroxide (KOH) and no EO remains from the neutralization process. After EO is unloaded to Reactor R01, the tank is depressurized several times following the pressurizing with nitrogen. The emission calculation for stage one conservatively assumes that all vapor inside the tank after the first unloading/depressurization event to Reactor R01 is EO and the number of moles remaining inside the tank after liquid EO unloading is the maximum amount of EO that could be emitted. Therefore, although the pressurization and depressurization of the tank to the scrubber occurs in several steps, all emissions from the control stage are conservatively assumed to happen within one hour.

After the tank is purged with nitrogen, it is washed with water several times, with the vent open to the scrubber when filling with water. The water is moved and neutralized with potassium hydroxide (KOH) in R01. Reactor R01 is also filled under a closed loop system and has no emissions. It is also assumed that all EO left in Reactor R01 is fully reacted with potassium hydroxide (KOH) and no EO remains from the neutralization process. During the last wash, water is pumped to T-3400 to overflowing. This represents the uncontrolled stage of tank cleaning, stage two. The calculations conservatively assume there is some EO left in the tank which results in the uncontrolled EO emissions of tank cleaning, which is also assumed to occur within one hour.

Emission estimates for both stages are based on the ideal gas law. The second stage incorporates a post control degas concentration as the tank is not fully saturated with EO. It is conservatively assumed that emissions from Stage 1 and Stage 2 occur within the same hour. The annual emission rate was calculated based on one tank cleaning event per year. Stage 1 was calculated using the proposed scrubber DRE of 99.5 %.

2.2.3 EO Fugitive Equipment Leak Potential Emissions

Piping components, such as valves, connectors, and pump seals, have the potential for fugitive leaks of EO. Fugitive emissions are calculated by counting the number of fugitive components, utilizing an emission factor based on component type and service, and applying a control efficiency where applicable. Rupture discs are being installed on all pressure relief valves in EO service as part of the emissions reduction plan. A control efficiency of 100% was applied for these components.

The total number of each component was determined for the development of the LDAR program and used for these calculations. The mass emission rate as a function of screening value for each type of equipment was determined in accordance with EPA guidance document EPA-453/R-95-017, November 1995, "Table 2-9. SOCMI Leak Rate/Screening Value Correlations." Site-specific screening data was used.

Monitoring was performed in accordance with the sampling requirements of the TCEQ monitoring program 28VHP. However, given the data size available and recent implementation of the program, averaged emission factors for each type of component described above for each process and location were obtained. The average screening values plus the standard deviation of these values were used in the EPA correlation equations in order to represent possible future variation in the data. Monitoring data included readings for September 2019 through March 2020 for most components. Screening values for bolded items in Table C-3 were not obtained during the above listed inspection. Once these screening values are obtained they are expected to be equivalent to other similar components.

Several of the valve, connectors, and equipment are used in both the EO and propylene oxide (PO) processes. It was assumed that the fraction of time that the equipment was on either EO or

PO service was proportional to their ratio of annual throughputs; specifically, 79% of time in EO service (6,920 hours per year). Hours for the loading rack and railcar offloading area are based on an unloading rate of 5 hours per railcar and a maximum of 100 railcars per year. These lines are purged when not in use.

Product line components were identified in the process. The EO emission rate from the product line components was calculated by multiplying the calculated VOC emissions from each component by the maximum concentration of EO in the product lines (0.1% EO by weight).

2.2.4 EO Line Purging Potential Emissions

Purging of lines throughout the facility have the potential to emit EO. Prior to maintenance activities, lines are purged to the scrubber (SCR-R01) prior to breaking of the lines. For the liquid lines, all of the liquid is blown down to Reactor R01 under a closed system where it is neutralized with potassium hydroxide (KOH) prior to purging of the line to the scrubber (SCR-R01). During line breaks, any EO remaining after the purge to the scrubber is vented to the atmosphere. When calculating emissions, the controlled portion of the calculations conservatively assume that all vapor inside the pipes is EO prior to purging to the scrubber (SCR-R01). For the liquid lines, it is assumed that no EO remains from the neutralization process. Some of the lines associated with the unloading area are also purged to the scrubber after railcar unloading. There are no line breaks associated with these emissions. Controlled emissions were calculated using the proposed scrubber DRE of 99.5 %.

The uncontrolled emissions portion of the calculation assumes there is some EO left in the lines after purging to the scrubber (SCR-R01). Both controlled and uncontrolled emissions are based on the ideal gas law. The second stage incorporates a post control degas concentration as the line is not fully saturated with EO.

The overall emissions calculation assumes a maximum of one event per hour and that the controlled and uncontrolled stages can occur within the hour. The annual emission rate was calculated based on the maximum number events per year (140 for line purges and 40 for line breaks).

REGULATORY ANALYSIS

Requirements for control of air pollution in Georgia are contained in Georgia's Rules for Air Quality Control, Chapter 391-3-1. Subparts of the Code that are potentially applicable to the project are discussed below.

2.3 Construction and Operating Permits [391-3-1-.03(1) and (2)]

The facility operates as a synthetic minor source under operating permit number 2843-013-001-S-02-0 and amendment S-02-1. The Georgia EPD issued a letter to Stepan dated December 9, 2019 requesting submittal of an air permit application by March 31, 2020. The letter stated that the air permit application should incorporate the changes to be implemented at the facility to reduce EO emissions. This application is being submitted to satisfy this requirement. An extension of the deadline was granted by the GA EPD. The new deadline was extended to April 10th, 2020.

2.4 Title V Operating Permits [391-3-1-.03(10) and 40 CFR Part 70]

This rule is applicable to sources with potential emissions above the Title V operating permitting program thresholds: greater than 100 tpy for any criteria pollutant, 10 tpy for any single Hazardous Air Pollutant (HAP), or 25 tpy for combined HAPs. The facility operates as a synthetic minor source under operating permit number 2843-013-001-S-02-0 and amendments S-02-1 and S-02-2. The facility's current permit limits SO_2 and VOC emissions below 100 tpy and potential emissions of all other pollutants are below the Title V major source thresholds; thus, the facility is not subject to this rule.

2.5 Prevention of Significant Deterioration (PSD) of Air Quality [391-3-1-.02(7)]

The facility is located in Barrow County, which is classified "attainment" or "unclassifiable" for all criteria pollutants. Therefore, PSD permitting requirements apply in Barrow County for these pollutants. PSD requirements define a "major source" as any source that has the potential to emit criteria air pollutants at levels equal to or greater than 250 tons per year or 100 tons per year (if the source falls under one of 28 source categories). The facility is categorized as one of the 28 listed source categories: Chemical process plants (SIC Code 2841). Therefore, the 100 ton per year threshold applies.

The facility's current permit limits SO_2 and VOC emissions below 100 tpy and potential emissions of all other pollutants are below the PSD major source thresholds. Therefore, the facility is not subject to this rule.

2.6 Nonattainment Area New Source Review [391-3-1-.03(8)]

The facility is located in Barrow County, which is classified "attainment" or "unclassifiable" for all criteria pollutants. Therefore, Nonattainment New Source Review permitting requirements do not apply.

2.7 New Source Performance Standards (NSPS) [40 CFR Part 60; 391-3-1-.02(8)]

2.7.1 Applicable NSPS

The following NSPS regulations were assessed and deemed to be applicable to the project:

2.7.1.1 40 CFR Part 60, 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

Subpart Kb regulates VOC emissions from storage vessels with a capacity greater than or equal to 75 m^3 (~19,813 gallons) that are used to store volatile organic liquids (VOLs) for which construction, reconstruction, or modification is commenced after July 23, 1984. The EO storage tank (T-3400) is subject to this regulation.

The EO storage tank complies with this regulation by operating a closed vent system and control device (SCR-R01) as required by §60.112b(a)(3) and Permit No. 2843-013-0001-S-02-1, Conditions No. 4.10 and 4.11. In addition, the facility operates and monitors the closed vent system and control device in accordance with the operating plan submitted to the Georgia EPD as required by §60.113b(c)(1).

§60.112b(a)(3) and Permit No. 2843-013-0001-S-02-1, Condition No. 2.11 require a control efficiency of ≥ 95% by weight for VOCs. The stack test conducted on March 19th, 2020 indicates that the scrubber has an average control efficiency for EO of 99.94%, which is greater than the above-referenced control requirements. This application is requesting a permit limit of 99.5% DRE for SCR-R01.

2.7.2 Non-Applicable NSPS

The following NSPS regulations were assessed and deemed not applicable to the project:

2.7.2.1 40 CFR Part 60, Subpart VV – Standards of Performance for Equipment Leaks of VOC in the Synthetic Organic Chemicals Manufacturing Industry for which Construction, Reconstruction, or Modification Commenced After January 5, 1981, and on or Before November 7, 2006

The Alkoxylation process reactor (R01) was installed in 1990; however, this standard does not apply to the EO Alkoxylation process. EO is a listed chemical under §60.489, but EO is used as a raw material and is not produced as an intermediate or final product.

2.7.2.2 40 CFR Part 60, Subpart VVa – Standards of Performance for Equipment Leaks of VOC in the Synthetic Organic Chemicals Manufacturing Industry for which Construction, Reconstruction, or Modification Commenced After November 7, 2006

The Alkoxylation process reactor (R01) was installed prior to November 7, 2006; therefore, this rule is not applicable to the EO Alkoxylation process unit. In addition, as stated for NSPS Subpart VV above, EO is a listed chemical under §60.489, but EO is used as a raw material and is not produced as an intermediate or final product.

2.7.2.3 40 CFR Part 60, Subpart III – Standards of Performance for VOC Emissions from the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Air Oxidation Unit Processes

This subpart applies to each air oxidation reactor that produces any of the chemicals listed in §60.489 as a product, co-product, by-product, or intermediate and which was constructed, modified, or reconstructed after October 21, 1983. An air oxidation reactor is defined in § 60.611 as follows:

> "**Air Oxidation Reactor** means any device or process vessel in which one or more organic reactants are combined with air, or a combination of air and oxygen, to produce one or more organic compounds. Ammoxidation and oxychlorination reactions are included in this definition."

The EO Alkoxylation process reactor (R01) is not an air oxidation reactor; therefore, this rule is not applicable.

2.7.2.4 40 CFR Part 60, Subpart NNN – Standards of Performance for Volatile Organic Compound (VOC) Emissions from SOCMI Distillation Operations

In accordance with §60.660(b), this standard applies to each distillation unit that is part of a process unit that produces any of the chemicals listed in § 60.667 as a product, co-product, by-product, or intermediate and which was constructed, modified, or reconstructed after December 30, 1983.

Distillation unit and distillation operation are defined in § 60.661 as follows:

> "**Distillation unit** means a device or vessel in which distillation operations occur, including all associated internals (such as trays or packing) and accessories (such as reboiler, condenser, vacuum pump, steam jet, etc.), plus any associated recovery system."
>
> "**Distillation operation** means an operation separating one or more feed stream(s) into two or more exit stream(s), each exit stream having component concentrations different from those in the feed stream(s). The separation is achieved by the redistribution of the components between the liquid and vapor-phase as they approach equilibrium within the distillation unit."

The EO Alkoxylation process does not have a distillation unit; thus, this rule is not applicable.

2.7.2.5 40 CFR Part 60, Subpart RRR – Standards of Performance for Volatile Organic Compound (VOC) Emissions from SOCMI Reactor Processes

In accordance with §60.700(b), this standard applies to reactor processes constructed, modified, or reconstructed after June 29, 1990. Pursuant to §60.700(c)(1) this standard does not apply to reactors that are designed and operated as batch reactors. A batch operation is defined in § 60.701 as follows:

> "**Batch operation** means any noncontinuous reactor process that is not characterized by steady-state conditions and in which reactants are not added and products are not removed simultaneously."

The EO Alkoxylation process reactor (R01) is operated as batch reactor; therefore, this rule is not applicable.

2.8 National Emission Standards for Hazardous Air Pollutants (NESHAPs) [40 CFR Parts 61 and 63; 391-3-1-.02(9)]

The Stepan facility is a true minor source of HAP (area source) as facility-wide potential total HAP and largest individual HAP emissions are less than 25 tpy and 10 tpy, respectively. Therefore, major source NESHAPs and Clean Air Act Section 112(g) ["Case-by-Case MACT"] permitting do not apply. The NESHAPs reviewed for applicability to the project are described in the following sections.

2.8.1 Non-Applicable NESHAPs

The following NESHAPs have been reviewed for applicability to the project:

2.8.1.1 40 CFR Part 63, Subpart VVVVVV – NESHAP for Chemical Manufacturing Area Sources

The EO Alkoxylation process does not utilize any Table 1 HAP as a feedstock, nor does it produce any Table 1 HAP as a by-product or product. Therefore, Subpart VVVVVV does not apply.

2.8.1.2 40 CFR 63, Subpart H, TT, and UU – National Emissions Standards for Equipment Leaks

These regulations apply only if another Subpart references the use of these rules as part of its requirements. However, none of the applicable Subparts refer to use these rules. Therefore, these rules are not applicable to the facility.

2.8.1.3 40 CFR 63, Subpart EEEE – NESHAP: Organic Liquids Distribution (Non-Gasoline)

In accordance with §63.2330, this regulation does not apply because the facility is not located at, or part of, a major source of HAP emissions as defined in Section 112(a) of the Clean Air Act.

2.8.1.4 40 CFR 63, Subpart FFFF – NESHAP: Miscellaneous Organic Chemical Manufacturing

In accordance with §63.2435, this regulation does not apply because the facility is not located at, or part of, a major source of HAP emissions as defined in Section 112(a) of the Clean Air Act.

2.8.1.5 40 CFR 63, Subpart NNNNNN – NESHAP for Chemical Manufacturing Area Sources: Chromium Compounds

In accordance with §63.11409, this regulation does not apply to the EO Alkoxylation process because the process is not a chromium compounds manufacturing facility.

2.8.1.6 40 CFR Part 63, Subpart BBBBBBB - NESHAP for Area Sources: Chemical Preparations Industry

This regulation applies to owners or operators of chemical preparations facilities as defined in §63.11588 that are a stationary area source of HAPs and handle a target HAP (chromium, lead, or nickel). A chemical preparation operation is defined in § 63.11588 as follows:

> **“Chemical preparation** means a target HAP-containing product, or intermediate used in the manufacture of other products, manufactured in a process operation described by the NAICS code 325998 if the operation manufactures target HAP-containing products or intermediates other than indelible ink, India ink, writing ink, and stamp pad ink. Indelible ink, India ink, writing ink, and stamp pad ink manufacturing operations are subject to regulation by the paints and allied products area source rule (40 CFR part 63, subpart CCCCCCC).”

The EO Alkoxylation process operation is described by NAICS 325611 (Soap and Other Detergents Manufacturing) which is not included in the definition of “Chemical Preparation” under the rule. In addition, the EO Alkoxylation process does not handle a target HAP. Therefore, Subpart BBBBBBB does not apply.

2.9 Visible Emissions [391-3-1-.02(2)(b)]

The following limit applies to the equipment at the facility:

- Opacity may not be equal to or exceed 40 percent.

The facility complies by operating and maintaining the equipment appropriately.

2.10 Particulate Emissions from Manufacturing Processes [391-3-1-.02(2)(e)]

The following limit applies to equipment at the facility:

- Particulate emissions must not exceed 4.1 x $P^{0.67}$ for process input weight rate up to and including 30 tons per hour;
- Particulate emissions must not exceed 55 x $P^{0.11}$ - 40 for process input weight above 30 tons per hour.

Where P = process input weight rate in tons per hour. The facility complies by operating and maintaining the equipment appropriately.

2.11 Fugitive Dust [391-3-1-.02(2)(n)]

Stepan takes all reasonable precautions to prevent fugitive dust from becoming airborne and to maintain visible emissions from fugitive dust below 20% opacity.

2.12 Volatile Organic Liquid Handling and Storage [391-3-1-.02(2)(vv)]

This rule is applicable to storage tanks located in Barrow County with capacities greater than 4,000 gallons and storing volatile organic liquids (other than gasoline). This rule requires that these tanks be equipped with submerged fill pipes. The EO Storage Tank (T-3400) is subject to and complies with this regulation.

2.13 VOC Emissions from Major Sources [391-3-1-.02(2)(tt)]

The requirements of this regulation apply to sources located in Barrow county which have potential VOC emissions exceeding 100 tons per year. This regulation requires the utilization of Reasonably Available Control Technology (RACT) in controlling those VOC emissions. The facility’s current permit limits facility-wide VOC emissions below 100 tpy; thus, this regulation is not applicable.

2.14 VOC Emissions from Bulk Mixing Tanks [391-3-1-.02(2)(ccc)]

This regulation establishes VOC emissions control requirements for mixing tanks. The requirements of this regulation apply to sources located in Barrow county which have potential VOC emissions exceeding 100 tons per year. The facility’s current permit limits facility-wide VOC emissions below 100 tpy; thus, this regulation is not applicable.

2.15 Toxic Impact Assessment

A Toxic Impact Assessment was conducted for the Stepan Facility based on potential EO emissions. The TIA and a discussion of the results are included in Appendix D.

3 TESTING AND MONITORING

To demonstrate compliance with the applicable regulations, the following testing and monitoring are proposed.

3.1 Testing

The Georgia EPD issued a letter to Stepan dated December 9, 2019 for EO emissions testing to be completed no later than April 15, 2020. Testing was conducted on the EO scrubber stack (SCR-R01) using operations and emissions from the Alkoxylation Process Reactor (R01) and the EO Storage Tank (T-3400). The facility conducted this testing on March 19, 2020 and the final report was submitted to Georgia EPD by April 15, 2020.

The stack test indicates that the scrubber has a control efficiency for EO of 99.94% when controlling emissions from the storage tank, which is greater than the current permit requirements for T-3400 (> 95%). This application is requesting a permit limit of 99.5% DRE for SCR-R01 while controlling emissions from T-3400 and R01.

3.2 Monitoring

Table 5-1 provides a summary of the proposed monitoring.

Table 5-1. Proposed Monitoring

Source	Pollutant	Parameter	Frequency	Averaging Period
Equipment in EO Service	EO	LDAR Inspections	As Detailed in LDAR Plan	N/A

APPENDIX A

SIP Application Forms

State of Georgia
Department of Natural Resources
Environmental Protection Division
Air Protection Branch

Stationary Source Permitting Program
4244 International Parkway, Suite 120
Atlanta, Georgia 30354
404/363-7000
Fax: 404/363-7100

SIP AIR PERMIT APPLICATION

EPD Use Only

Date Received: ____________ Application No. ____________

FORM 1.00: GENERAL INFORMATION

1. Facility Information

Facility Name: Stepan Company
AIRS No. (if known): 04-13- 013 - 00001
Facility Location: Street: 951 Bankhead Hwy
City: Winder Georgia Zip: 30680 County: Barrow
Is this facility a "small business" as defined in the instructions? Yes: ☐ No: ☒

2. Facility Coordinates

Latitude: 33° 59' 51" **NORTH** Longitude: 83° 47' 19" **WEST**
UTM Coordinates: 242,434 **EAST** 3,765,377m **NORTH** **ZONE** 17

3. Facility Owner

Name of Owner: Stepan Company
Owner Address Street: 22 West Frontage Rd.
City: Northfield State: IL Zip: 60093

4. Permitting Contact and Mailing Address

Contact Person: Tracey Crawford Title: EHS&S Manager
Telephone No.: 770-867-8669 Ext. ____ Fax No.: ____
Email Address: tcrawford@stepan.com
Mailing Address: Same as: Facility Location: ☒ Owner Address: ☐ Other: ☐
If Other: Street Address: ____________
City: ____ State: ____ Zip: ____

5. Authorized Official

Name: Robert L. Poage Title: Director, NA Plant Operations
Address of Official Street: 951 Bankhead Hwy
City: Winder State: Georgia Zip: 30680

This application is submitted in accordance with the provisions of the Georgia Rules for Air Quality Control and, to the best of my knowledge, is complete and correct.

Signature: ____________ Date: 12/17/2020

6. **Reason for Application: (Check all that apply)**

☐ New Facility (to be constructed)

☐ Existing Facility (initial or modification application)

☐ Permit to Construct

☐ Permit to Operate

☐ Change of Location

☐ Permit to Modify Existing Equipment: Affected Permit No.: ______

☒ Revision of Data Submitted in an Earlier Application

Application No.: N/A (Stepan EO Application)

Date of Original Submittal: First Submittal: April 2020
Second Submittal: June 2020

7. **Permitting Exemption Activities (for permitted facilities only):**

Have any exempt modifications based on emission level per Georgia Rule 391-3-1-.03(6)(i)(3) been performed at the facility that have not been previously incorporated in a permit?

☒ **No** ☐ **Yes, please fill out the SIP Exemption Attachment** (See Instructions for the attachment download)

8. **Has assistance been provided to you for any part of this application?**

☐ **No** ☐ **Yes, SBAP** ☒ **Yes, a consultant has been employed or will be employed.**

If yes, please provide the following information:

Name of Consulting Company: Environmental Planning Specialists

Name of Contact: Pilar Johansson

Telephone No.: 678-336-8562 Fax No.: ______

Email Address: pjohansson@montrose-env.com

Mailing Address: Street: 400 Northridge Rd, Suite 400

City: Sandy Springs State: GA Zip: 30350

Describe the Consultant's Involvement:

Preparation of application

9. **Submitted Application Forms:** Select only the necessary forms for the facility application that will be submitted.

No. of Forms	Form
1	2.00 Emission Unit List
	2.01 Boilers and Fuel Burning Equipment
1	2.02 Storage Tank Physical Data
	2.03 Printing Operations
	2.04 Surface Coating Operations
	2.05 Waste Incinerators (solid/liquid waste destruction)
1	2.06 Manufacturing and Operational Data
1	3.00 Air Pollution Control Devices (APCD)
1	3.01 Scrubbers
	3.02 Baghouses & Other Filter Collectors
	3.03 Electrostatic Precipitators
1	4.00 Emissions Data
1	5.00 Monitoring Information
1	6.00 Fugitive Emission Sources
1	7.00 Air Modeling Information

10. **Construction or Modification Date**

Estimated Start Date: N/A

11. If confidential information is being submitted in this application, were the guidelines followed in the "Procedures for Requesting that Submitted Information be treated as Confidential"?

☒ No ☐ Yes

12. New Facility Emissions Summary

Criteria Pollutant	New Facility	
	Potential (tpy)	Actual (tpy)
Carbon monoxide (CO)		
Nitrogen oxides (NOx)		
Particulate Matter (PM) (filterable only)		
PM <10 microns (PM10)		
PM <2.5 microns (PM2.5)		
Sulfur dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Greenhouse Gases (GHGs) (in CO2e)		
Total Hazardous Air Pollutants (HAPs)		
Individual HAPs Listed Below:		

13. Existing Facility Emissions Summary

Criteria Pollutant	Current Facility		After Modification	
	Potential (tpy)	Actual (tpy)	Potential (tpy)	Actual (tpy)
Carbon monoxide (CO)				
Nitrogen oxides (NOx)				
Particulate Matter (PM) (filterable only)				
PM <10 microns (PM10)				
PM <2.5 microns (PM2.5)				
Sulfur dioxide (SO_2)				
Volatile Organic Compounds (VOC)				
Greenhouse Gases (GHGs) (in CO2e)				
Total Hazardous Air Pollutants (HAPs)				
Individual HAPs Listed Below:				
Ethylene Oxide	**Please see Appendix C for Details**		**Please see Appendix C for Details**	

14. 4-Digit Facility Identification Code:

SIC Code: 2841 SIC Description: Soap and Other Detergents Manufacturing

NAICS Code: 325611 NAICS Description: Soap and Other Detergents Manufacturing

15. Description of general production process and operation for which a permit is being requested. If necessary, attach additional sheets to give an adequate description. Include layout drawings, as necessary, to describe each process. References should be made to source codes used in the application.

See narrative for further details.

16. Additional information provided in attachments as listed below:

Attachment A - SIP Application Forms

Attachment B - Figures (Facility Location Map and Flow Diagram)

Attachment C - Emissions Calculations

Attachment D - Toxic Impact Assessment

Attachment E -

Attachment F -

17. Additional Information: Unless previously submitted, include the following two items:

☒ Plot plan/map of facility location or date of previous submittal:

☒ Flow Diagram or date of previous submittal:

18. Other Environmental Permitting Needs:

Will this facility/modification trigger the need for environmental permits/approvals (other than air) such as Hazardous Waste Generation, Solid Waste Handling, Water withdrawal, water discharge, SWPPP, mining, landfill, etc.?

☒ **No** ☐ **Yes, please list below:**

19. List requested permit limits including synthetic minor (SM) limits.

See narrative for further details.

20. Effective March 1, 2019, permit application fees will be assessed. The fee amount varies based on type of permit application. Application acknowledgement emails will be sent to the current registered fee contact in the GECO system. If fee contacts have changed, please list that below:

Fee Contact name:

Fee Contact email address:

Fee Contact phone number:

Fee invoices will be created through the GECO system shortly after the application is received. It is the applicant's responsibility to access the facility GECO account, generate the fee invoice, and submit payment within 10 days after notification.

Facility Name: Stepan Company **Date of Application:** December 2020

FORM 2.00 – EMISSION UNIT LIST

Emission Unit ID	Name	Manufacturer and Model Number	Description
R-01	Reactor, R01	Tate Metal Works, SN:89022, Yr. 1990	Reactor, SS, R01
T-3400	Tank, T-3400 (Regular Operations)	Capital City Iron Works, SN 47979, Yr. 1998	Tank, SS, T-3400, SS
T-3400 CLEANING	Vapor space purge emissions from tank cleaning – Controlled (Maintenance Activity)		
T-3400 CLEANING FUGITIVE	Vapor space purge emissions from tank cleaning – Vapors vented after control (Uncontrolled) (Maintenance Activities)		
LINE PURGES	EO emissions from purging of lines – Controlled (Maintenance Activities)	-	Line Purges
LINE PURGES (FUGITIVE)	EO emissions from purging of lines – Vapors vented after controlled (uncontrolled) (Maintenance Activities)	-	Fugitive Line Purges
EQUIPMENT FUGITIVE EO	Fugitive Equipment Leaks of EO	-	Fugitive Equipment Leaks EO
UNLOAD	Railcar Unloading of EO/PO	-	Railcar Unloading of EO/PO

Facility Name: Stepan Company **Date of Application:** December 2020

FORM 2.02 – ORGANIC COMPOUND STORAGE TANK

Emission Unit ID	Emission Unit Name	Capacity (gal)	Material Stored	Maximum True Vapor Pressure (psi @ ºF)	Storage Temp. (ºF)	Filling Method	Construction/ Modification Date	Roof Type	Seal Type
Tank 3400	Tank T-3400	31,780	Ethylene Oxide	20.2	65	Submerged	1998	Fixed Roof	N/A

Facility Name: Stepan Company **Date of Application:** December 2020

FORM 2.06 – MANUFACTURING AND OPERATIONAL DATA

Normal Operating Schedule: 24 hours/day 7 days/week 52 weeks/yr

Additional Data Attached? ☒ - No ☐ - Yes, please include the attachment in list on Form 1.00, Item 16.

Seasonal and/or Peak Operating Periods: N/A

Dates of Annually Occurring Shutdowns: N/A

PRODUCTION INPUT FACTORS

Emission Unit ID	Emission Unit Name	Const. Date	Input Raw Material(s)	Annual Input	Hourly Process Input Rate		
					Design	Normal	Maximum
R01	Reactor, R01	1990	Please see narrative and calculations for production input factors				

PRODUCTS OF MANUFACTURING

Emission Unit ID	Description of Product	Production Schedule		Hourly Production Rate (Give units: e.g. lb/hr, ton/hr)			
		Tons/yr	Hr/yr	Design	Normal	Maximum	Units
R01	**Reactor, R01**	Please see narrative and calculations for production input factors					

Facility Name: Stepan Company **Date of Application:** December 2020

Form 3.00 – AIR POLLUTION CONTROL DEVICES - PART A: GENERAL EQUIPMENT INFORMATION

APCD Unit ID	Emission Unit ID	APCD Type (Baghouse, ESP, Scrubber etc)	Date Installed	Make & Model Number (Attach Mfg. Specifications & Literature)	Unit Modified from Mfg Specifications?	Gas Temp. °F		Inlet Gas Flow Rate (acfm)
						Inlet	Outlet	
SCR-R01	R01, T3400, Unload, T3400 Cleaning, Line Purges	Scrubber	1998	Croll-Reynolds, 20T-20H (SN:100067)	No. Note, this unit also serves as the control device for the propylene oxide process	Ambient	Ambient	200 acfm (for Ethylene Oxide)

Facility Name: Stepan Company **Date of Application:** December 2020

Form 3.00 – AIR POLLUTION CONTROL DEVICES – PART B: EMISSION INFORMATION

APCD Unit ID	Pollutants Controlled	Percent Control Efficiency		Inlet Stream To APCD		Exit Stream From APCD		Pressure Drop Across Unit (Inches of water)
		Design	Actual	lb/hr	Method of Determination	lb/hr	Method of Determination	
SCR-R01	Ethylene Oxide & Propylene Oxide	**Please see Appendix C for Details**						3-6 (EO)

Facility Name: Stepan Company **Date of Application:** December 2020

FORM 3.01 – SCRUBBERS

APCD Unit ID	Scrubber Type	Materials of Construction (Plastic, 1040 steel, etc.)	Scrubbant	pH Range	Pressure Drop Range (inches of H2O)	Minimum Scrubbant Flow Rate (Gal/min)	Is Scrubbant Recirculated?	Minimum Makeup Rate (Gal/min)	Size of Pond or Holding Tank (Acre-ft or gal)
SCR-R01	Packed Column	Fiberglass, Reinforced Plastic	Sulfuric Acid	4-7%	3-6 (EO)	>35	☒		
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Facility Name: Stepan Company **Date of Application:** December 2020

FORM 4.00 – EMISSION INFORMATION

Emission Unit ID	Air Pollution Control Device ID	Stack ID	Pollutant Emitted	Emission Rates				
				Hourly Actual Emissions (lb/hr)	Hourly Potential Emissions (lb/hr)	Actual Annual Emission (tpy)	Potential Annual Emission (tpy)	Method of Determination
R-01 T-3400 UNLOAD T-3400 CLEANING LINE PURGES	SCR-R01	SCR-R01	EO	**Please See Appendix C for Details**				

Facility Name: Stepan Company **Date of Application:** December 2020

FORM 5.00 MONITORING INFORMATION

Emission Unit ID/ APCD ID	Emission Unit/APCD Name	Monitored Parameter		Monitoring Frequency
		Parameter	Units	
R01/SCR-R01	EO/PO Reactor and Scrubber	Liquid flow rate of the scrubbant	>35 gpm	One data point collected every 15 minutes, reduced to daily block average
R01/SCR-R01	EO/PO Reactor and Scrubber	Gas flow rate entering the scrubber	250 scfm	One data point collected every 15 minutes, reduced to daily block average
R01/SCR-R01	EO/PO Reactor and Scrubber	Scrubbant % acid	4-7%	Once per week

Comments:

Facility Name: Stepan Company **Date of Application:** December 2020

FORM 6.00 – FUGITIVE EMISSION SOURCES

Fugitive Emission Source ID	Description of Source	Emission Reduction Precautions	Pot. Fugitive Emissions	
			Amount (tpy)	Pollutant
Equipment Fugitive EO	EO/PO/DMS Unloading	LDAR Program, sealless pumps, rupture discs	**Please see Appendix C for Details**	
Equipment Fugitive EO	EO/PO/DMS Storage	LDAR Program, sealless pumps, rupture discs		
Equipment Fugitive EO	EO/PO/DMS Alkoxylation	LDAR Program, sealless pumps, rupture discs		
T-3400 CLEANING FUGITIVE	T-3400 Cleaning Fugitive	Purging prior to opening to atmosphere		
LINE PURGES FUGITIVE	Line Purges Fugitive	Purging prior to opening to atmosphere		

Facility Name: Stepan Company **Date of Application:** December 2020

FORM 7.00 – AIR MODELING INFORMATION: Stack Data

Stack ID	Emission Unit ID(s)	Stack Information			Dimensions of largest Structure Near Stack		Exit Gas Conditions at Maximum Emission Rate			
		Height Above Grade (ft)	Inside Diameter (ft)	Exhaust Direction	Height (ft)	Longest Side (ft)	Velocity (ft/sec)	Temperature (°F)	Flow Rate (acfm) Average	Flow Rate (acfm) Maximum
Please see appendix D for details										

NOTE: If emissions are not vented through a stack, describe point of discharge below and, if necessary, include an attachment. List the attachment in Form 1.00 *General Information*, Item 16.

Facility Name: Stepan Company **Date of Application:** December 2020

FORM 7.00 AIR MODELING INFORMATION: Chemicals Data

Chemical	Potential Emission Rate (lb/hr)	Toxicity	Reference	MSDS Attached
Ethylene Oxide	**Please see appendix D for details**			☐
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APPENDIX B

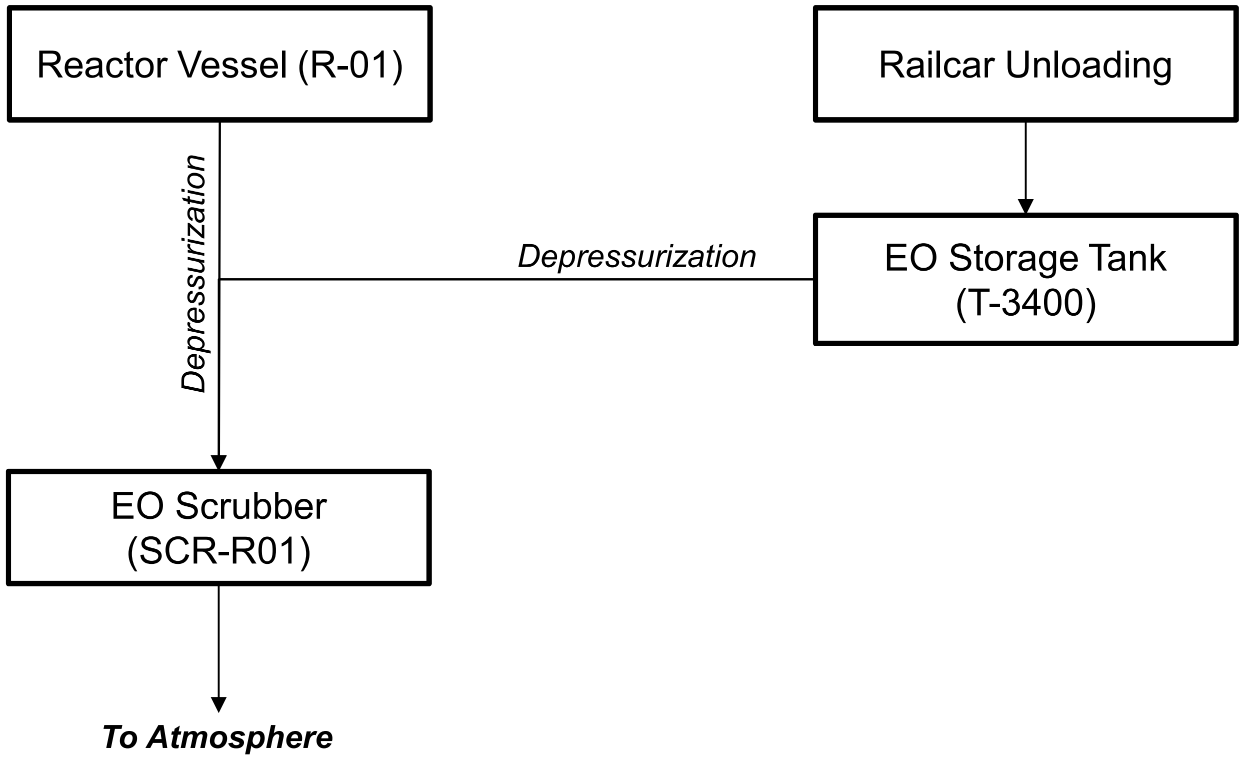
Figures

General Location Map
Stepan Company
951 Bankhead Hwy
Winder, GA 30680

EPS
Revised November 2019; G:\Stepan\GIS\mxd

Figure No. 1

Process Flow Diagram – Ethylene Oxide (EO) Process



a Montrose Environmental Group company	400 Northridge Road Suite 400 Sandy Springs, GA 30350 Phone (404) 315-9113 Fax (404) 315-8509	Stepan Company 951 Bankhead Highway Winder, GA 30680 Stepan Company Synthetic Minor Construction Permit Application	Figure 2

APPENDIX C

Emissions Calculations

Table C-1: Facility-wide EO Emissions Estimations - Potential

Source Name[1]	Source Type	May 2017 Potential Emissions - Post-Control (lb/yr)[2]	Proposed DRE 99.5% Potential Emissions - Post-Control (lb/yr)
EO/PO/DMS Unloading	Fugitive	920	2.41
EO/PO/DMS Storage	Fugitive		36.80
R-01 Alkoxylation	Fugitive		33.94
Pressure Relief Valves[3]	Scrubber Stack		N/A
Railcar Offloading		80	4.26
R-01 Process		0.02	2.05
Line Purges	Scrubber Stack	Not Included	3.18
	Fugitive	Not Included	0.12
Tank Cleaning	Scrubber Stack	Not Included	3.61
	Fugitive	Not Included	0.48
		1,000	86.85

1. EO: Ethylene Oxide, PO: Propylene Oxide. DMS: Dimethyl Sulfide
2. Stepan's comments on Draft Permit 2843-013-0001-S-01-1 letter "Stepan Winder Preliminary Draft Permit : AIRS number 04-13-013-00001" dated May 19, 2017.
3. As detailed in Table C-3, 100% credit reduction is applied to pressure relief valves with rupture discs.

Table C-2: EO/PO Railcar and Reactor Depressurization Potential Emissions Estimations
Based on Stack Test Conducted at the Facility on March 19th, 2020 [1]

		Stack Test Results											Proposed DRE	
Emission Unit ID	**Emission Unit**	**Run Date and Time**	**Flow (acfm)**	**Outlet Concentration (ppm)**	**Inlet Concentration (ppm)**	**Stack Test DRE**	**Stack Test Concentration (lb/dscf)**	**Stack Test Mass Flow (lb/hr)**	**Proposed DRE**	**Mass Flow at 99.5% DRE (lb/hr)[2]**	**Maximum No. Events per Day[3]**	**Maximum No. Events per year[3]**	**Potential Emissions (lb/day)[4]**	**Potential Emissions (lb/yr)[4]**
T-3400/ UNLOAD	EO Storage Tank/ Railcar Unloading	Run 1: 03/19/2020 9:10-10:10	49.6	15.74	23,495.00	99.93%	1.80E-06	0.0054	99.50%	0.0400				
		Run 2: 03/19/2020 10:53-11:53	34.3	22.47	39,937.00	99.94%	2.57E-06	0.0053	99.50%	0.0470				
		Run 3: 03/19/2020 12:31-13:31	32.5	16.79	36,623.00	99.95%	1.92E-06	0.0037	99.50%	0.0408				
					Average:	99.94%	2.10E-06	0.0048		0.0426	1	100	0.04	4.26
R-01	Reactor	Run 1: 03/19/2020 14:15-15:15	22.3	0.54	2,672.00	99.98%	6.17E-08	0.0001	99.50%	0.0020	4	1,003	0.01	2.05
									Total:	**0.0446**			**0.05**	**6.31**

1. Based on stack test Conducted at the Facility on March 19th, 2020. The stack test was conducted as specified in the "Source Test Report, 2020 Compliance Testing, Stepan Company, Scrubber (SCR-R01) Inlet & Outlet" Submitted to EPD April 15th, 2020.
2. Mass flowrate from stack test prorated to 99.5% DRE, lb/hr = Stack Test Mass Flow Rate (lb/hr) * (1-99.5%)/ (1-Stack Test DRE %)
3. Based on maximum number of events. Each event last less than 1 hour.
4. Potential Emissions = Mass Flow at 99.5% DRE (lb/hr) * Maximum Number of Events

Table C-3: Equipment Component Potential Fugitive EO Emissions Estimations with Proposed Reductions
Based on EPA guidance document EPA-453/R-95-017

Process / Area	Use	Contents [1]	Level	Product?	WP_{EO} [2]		Service	Equip. Type	Component Count	Screening Value (SV) [3]	Screening Value + STDEV (SV) [4]	Emissions Reduction Credit[5]	Credit Description	SV Correlation Emission Rate per Component [6]	Total Emissions (lb/hr)[7]		Annual Hours[8]	Total Emissions (tpy)[9]	
EO/PO/DMS Unloading	Loading Rack	Ethylene Oxide	N/A	N/A	100.0%	EO	Gas	Valves	3	0.8	6.9			2.24E-05	6.71E-05	4.82E-03	500	1.68E-05	1.21E-03
			N/A	N/A	100.0%	EO	Gas	Connectors	13	0.8	6.9			3.74E-05	4.86E-04		500	1.21E-04	
			N/A	N/A	100.0%	EO	Gas	Pressure Relief Valves	4	0.8	6.9	100%	Scrubber/Rupture Disc						
			N/A	N/A	100.0%	EO	Light Liquid	Pressure Relief Valves	1	41.7	47.8	100%	Scrubber/Rupture Disc						
			N/A	N/A	100.0%	EO	Light Liquid	Pump Seals	1	0.7	6.8	100%	Sealless						
			N/A	N/A	100.0%	EO	Light Liquid	Valves	11	0.7	6.8			6.54E-05	7.20E-04		500	1.80E-04	
			N/A	N/A	100.0%	EO	Light Liquid	Connectors	47	0.7	6.8			3.69E-05	1.73E-03		500	4.33E-04	
	Railcar	Ethylene Oxide	N/A	N/A	100.0%	EO	Gas	Valves	12	1	7.1			2.29E-05	2.75E-04		500	6.88E-05	
			N/A	N/A	100.0%	EO	Gas	Connectors	23	1	7.1			3.83E-05	8.81E-04		500	2.20E-04	
			N/A	N/A	100.0%	EO	Light Liquid	Valves	3	0.8	6.9			6.62E-05	1.99E-04		500	4.97E-05	
			N/A	N/A	100.0%	EO	Light Liquid	Connectors	9	3.8	9.9			5.13E-05	4.62E-04		500	1.16E-04	
EO/PO/DMS Storage	Storage	Ethylene Oxide	N/A	N/A	100.0%	EO	Gas	Valves	18	1	7.1			2.29E-05	4.13E-04	4.22E-03	8,760	1.81E-03	1.84E-02
			N/A	N/A	100.0%	EO	Gas	Connectors	50	0.9	7.0			3.78E-05	1.89E-03		8,760	8.29E-03	
			N/A	N/A	100.0%	EO/PO	Gas	Connectors	3	0.7	6.8			3.69E-05	1.11E-04		6,920	3.83E-04	
			N/A	N/A	100.0%	EO	Gas	Pressure Relief Valves	3	0.9	7.0	100%	Scrubber/Rupture Disc						
			N/A	N/A	100.0%	EO	Light Liquid	Pressure Relief Valves	1	0.9	7.0	100%	Scrubber/Rupture Disc						
			N/A	N/A	100.0%	EO	Light Liquid	Valves	11	1.2	7.3			6.92E-05	7.61E-04		8,760	3.34E-03	
			N/A	N/A	100.0%	EO	Light Liquid	Connectors	27	1.1	7.2			3.88E-05	1.05E-03		8,760	4.59E-03	
R-01 Alkoxylation	Batch Loading	R-01 Feed and Products	Lower Level	N/A	100.0%	EO	Gas	Valves	1	1	7.1			2.29E-05	2.29E-05	1.39E-03	8,760	1.00E-04	6.07E-03
			Lower Level	N/A	100.0%	EO	Gas	Connectors	1	13.9	20.0			9.55E-05	9.55E-05		8,760	4.18E-04	
			Lower Level	N/A	100.0%	EO	Light Liquid	Pump Seals	1	0.7	6.8	100%	Diaphragm						
			Lower Level	Product	0.1%	EO/PO	Light Liquid	Pump Seals	2	0.9	7.0	90%	Closed-vent to Scrubber	2.09E-07	4.18E-07		6,920	1.45E-06	
			Lower Level	N/A	100.0%	EO	Light Liquid	Valves	3	1.1	7.2			6.85E-05	2.05E-04		8,760	9.00E-04	
			Lower Level	Product	0.1%	EO/PO	Light Liquid	Valves	24	1.1	7.2			6.85E-08	1.64E-06		6,920	5.69E-06	
			Lower Level	**Product**	**0.1%**	**EO/PO**	**Light Liquid**	**Valves**	**1**	**1.1**	**7.2**			6.85E-08	6.85E-08		6,920	2.37E-07	
			Lower Level	N/A	100.0%	EO	Light Liquid	Connectors	26	1.5	7.6			4.07E-05	1.06E-03		8,760	4.63E-03	
			Lower Level	Product	0.1%	EO/PO	Light Liquid	Connectors	46	0.7	6.8			3.69E-08	1.70E-06		6,920	5.87E-06	
			Lower Level	**Product**	**0.1%**	**EO/PO**	**Light Liquid**	**Connectors**	**25**	**0.7**	**6.8**			3.69E-08	**9.22E-07**		6,920	3.19E-06	
			1st Level	N/A	100.0%	EO/PO	Gas	Valves	2	0.9	7.0			2.27E-05	4.53E-05	3.15E-03	6,920	1.57E-04	1.09E-02
			1st Level	Product	0.1%	EO/PO	Gas	Valves	12	0.9	7.0			2.27E-08	2.72E-07		6,920	9.41E-07	
			1st Level	N/A	100.0%	EO/PO	Gas	Connectors	13	0.7	6.8			3.69E-05	4.79E-04		6,920	1.66E-03	
			1st Level	Product	0.1%	EO/PO	Gas	Connectors	49	0.9	7.0			3.78E-08	1.85E-06		6,920	6.41E-06	
			1st Level	N/A	100.0%	EO/PO	Gas	Pressure Relief Valves	2	0.7	6.8	100%	Scrubber/Rupture Disc						
			1st Level	N/A	100.0%	EO/PO	Light Liquid	Valves	12	1.6	7.7			7.22E-05	8.67E-04		6,920	3.00E-03	
			1st Level	Product	0.1%	EO/PO	Light Liquid	Valves	1	1.5	7.6			7.15E-08	7.15E-08		6,920	2.47E-07	
			1st Level	N/A	100.0%	EO/PO	Light Liquid	Connectors	25	1	7.1			3.83E-05	9.58E-04		6,920	3.31E-03	
			1st Level	Product	0.1%	EO/PO	Light Liquid	Connectors	2	1.5	7.6			4.07E-08	8.13E-08		6,920	2.81E-07	
			2nd Level	Product	0.1%	EO/PO	Gas	Valves	19	1.2	7.3			2.35E-08	4.46E-07		6,920	1.54E-06	
			2nd Level	N/A	100.0%	EO/PO	Gas	Connectors	2	1	7.1			3.83E-05	7.66E-05		6,920	2.65E-04	
			2nd Level	Product	0.1%	EO/PO	Gas	Connectors	67	3.7	9.8			5.09E-08	3.41E-06		6,920	1.18E-05	
			2nd Level	**Product**	**0.1%**	**EO/PO**	**Gas**	**Connectors**	**15**	**3.7**	**9.8**			5.09E-08	**7.63E-07**		6,920	2.64E-06	
			2nd Level	N/A	100.0%	EO/PO	Gas	Pressure Relief Valves	1	1	7.1	100%	Scrubber/Rupture Disc						
			2nd Level	Product	0.1%	EO/PO	Light Liquid	Pressure Relief Valves	1	0.6	6.7	100%	Scrubber/Rupture Disc						
			2nd Level	N/A	100.0%	EO/PO	Light Liquid	Valves	4	1	7.1			6.77E-05	2.71E-04		6,920	9.37E-04	
			2nd Level	PO Addition to R1	100.0%	EO/PO	Light Liquid	Valves	1	1.2	7.3			6.92E-05	6.92E-05		6,920	2.40E-04	
			2nd Level	N/A	100.0%	EO/PO	Light Liquid	Connectors	8	0.9	7.0			3.78E-05	3.03E-04		6,920	1.05E-03	
			2nd Level	Product	0.1%	EO/PO	Light Liquid	Connectors	3	0.7	6.8			3.69E-08	1.11E-07		6,920	3.83E-07	
			2nd Level	PO Addition to R1	100.0%	EO/PO	Light Liquid	Connectors	2	0.9	7.0			3.78E-05	7.57E-05		6,920	2.62E-04	
								TOTAL	611							0.0136			0.037
								Standard Deviation		6.14									

1. EO: Ethylene Oxide, PO: Propylene Oxide, DMS: Dimethyl Sulfide

2. Maximum concentration of EO in the equipment in weight percent. Some product's Safety Data Sheets identify EO in the product but a specific concentration is not listed. Per 29 CFR 1910.1200, carginogenic compounds must be listed if found in quantites greater than 0.1%. Thus, 0.1% conservatively assumed. Other product Safety Data Sheets identify EO concentrations lower than 0.1%.

3. Screening values are based on monitoring performed at the facility. Monitoring was performed in accordance with the sampling requirements of the TCEQ monitoring program 28VHP. However, given the data size currently available, averaged emission factors for each type of component described above for each process/section were used. Monitoring was performed for September 2019 through March 2020 for most components. Screening values for bolded items were not obtained during the above listed inspection. Once these screening values are obtained they are expected to be equivalent to other similar components. Largest screening value for that component type for that process and content used for predicting expected emissions reductions with the Leak Detection and Repair (LDAR) Program.

4. Average screening values + Standard Deviation of the Average Screening Values. To be conservative, Stepan has applied a safety factor of one standard deviation, conservatively determined over all monitored values for all components, to each component Screening Value (see footnote 3, above).

5. Factors used are from EPA guidance document EPA-453/R-95-017, "Table 5-1. Summary of Equipment Modifications", diaphragm pump not included in EPA-453/R-95-017 but specified in TCEQ's Fugitive Guidance Document APDG 6422v2, Revised 06/2018. Rupture discs will be installed on all pressure relief vales, as described in the *Response to Letter Dated December 9, 2019, Regarding Ethylene Oxide Emissions, Leak Detection and Repair (LDAR) Program, and Rupture Disk Installation.*

6. The screening value methodology from EPA guidance document EPA-453/R-95-017, "Table 2-9. SOCMI Leak Rate/Screening Value Correlations" was used to determine an "as-monitored" emission factor for each component. The correlation for light liquid pumps can be applied to compressor seals, pressure relief valves, agitator seals, and heavy liquid pumps per this guidance document. As Table 2-9 Equations are in kg/hr/component, each equation was multiplied by 2.20462 lb/kg.

Gas valves Leak rate (lb/hr/component) = 2.20462 lb/kg x 1.87E-06 × $(SV)^{0.873}$ x (WP_{EO}/WP_{TOC})

Light liquid valves Leak rate (lb/hr/component) = 2.20462 lb/kg x 6.41E-06 × $(SV)^{0.797}$ x (WP_{EO}/WP_{TOC})

Light liquid pumps Leak rate (lb/hr/component) = 2.20462 lb/kg x 1.90E-05 × $(SV)^{0.824}$ x (WP_{EO}/WP_{TOC})

Connectors Leak rate (lb/hr/component) = 2.20462 lb/kg x 3.05E-06 × $(SV)^{0.885}$ x (WP_{EO}/WP_{TOC})

Where WP_{TOC} is assumed to be 100%

7. Total Emissions (lb/hr) = SV Correlation Emission Rate per Component lb/hr x Component count

8. In cases where the equipment contains either ethylene oxide or propylene oxide, it was assumed that the fraction of time that the equipment emitted either compound was proportional to their ratio of annual throughputs, specifically 79% of time emitting ethylene oxide and 21% of time emitted propylene oxide. Hours for loading rack and railcar based on an unloading rate of 5 hours per railcar and a maximum of 100 railcars per year. These lines are purged when not in use.

9. Total Emissions (tpy) = Total Emissions (lb/hr) x Annual Hours / 2,000 lb/ton

StepanTable C-4: Line Purges Potential Ethylene Oxide (EO) Emissions Calculations

Site Data: [1]

L: Pipe Length (ft)[2]	100
D: Pipe Diameter (ft)[2]	0.58
Number of Events (Events/yr) - Line Purge and Line Break [2]	40.00
Number of Events (Events/yr) - Line Purge Only[3]	140.00
V_{V1}: Volume of the Vapor Space (ft^3/yr) - Line Purge and Line Break[4]	1,069
V_{V2}: Volume of the Vapor Space (ft^3/yr) - Line Purge Only [4]	3,742
Tv: Average Gas Temperature (°F) [5]	70
Tv: Average Gas Temperature (°R) [6]	529.67

Note:

1) Data provided by Stepan.

2) Maximum Pipe Diameter and Length from line breaks occuring January 2017-Sept 2020. Maximum number of line breaks per year is based on maximum annual events (2020) prorated by multiplying by 12/9, as only 9 months were available. 2020 is a very consevative year as additional components were installed per permitting requirements. Total actual volume for 2020 was 35.65 ft^3 (prorated 12/9). Line breaks includes emissions from purging of the line to the scrubber prior to a line break and emissions to atmosphere from line breaks. A maximum of one event per hour is assumed.

3) Maximum number of purges per line breaks is discussed in footnote 2, plus a maximum number of purge events only for the EO unloading area based on a the maximum number of unloading events (100 per year). A maximum of one event per hour is assumed.

4) V_V is calculated by the volume of a cylinder equation: $V_V = \pi * (D/2)^2 * L *$ Number of Events per year

5) Tv is the average temperature of the material.

6) Temperature Conversion: 68°F + 459.67 = 527.67°R

$$P_{VA} = 10^{(A - \frac{B}{T_B + C})}$$

True Vapor Pressure (P_{VA}) [1]

A: Constant in Vapor Pressure Equation (dimensionless) [2]	8.722
B: Constant in Vapor Pressure Equation (°C) [2]	2,022.80
C: Constant in Vapor Pressure Equation (°C) [2]	335.81
T_B: Liquid Bulk Temperature (°C) [3]	21
P_{VA} (mm Hg) =	**1134.07**
P_{VA} (psia)[4] =	**21.93**

Note:

1) True Vapor Pressure equation is Eq 1-26 in AP-42, Chapter 7. *Organic Liquid Storage Tanks.*

2) Constants A, B, and C are from AP-42, Chapter 7. *Organic Liquid Storage Tanks* , Table 7.1-3, Page 7.1-95.

3) Temperature Conversion: (68°F − 32) × 5/9 = 20°C

4) Pressure Conversion: 760 mm Hg = 14.7 psia

$$L_{P1} = \left(\frac{P_3 * Vv}{R * Tv}\right) * Mv * S$$

Vapor Space Purge Emissions (L_{P1}) - Controlled [1,2]

P_3: Total Pressure of Gas (psia) [3]	21.9
V_V: Volume of the Vapor Space (ft^3/yr) [4]	3,742
R: Ideal Gas Constant (10.731 psia ft^3 / lb-mole °R)	10.73
T_V: Average Gas Temperature (°R)	529.67
M_V: Molecular Weight of Stock Vapor - Ethlyene Oxide (lb/lb-mole) [5]	44.05
S: Saturation Factor (dimentionless) [6]	1
L_{P1} (lb/yr) Uncontrolled =	**635.88**
Scrubber Proposed Control Efficiency (%)	99.50%
L_{P1} (lb/yr) Controlled =	**3.18**
L_{P1} (lb/hr) Controlled [7] =	**0.02**

Note:

1) Vapor Space Purge Emissions equation is Eq 4-2 in AP-42, Chapter 7. *Organic Liquid Storage Tanks.*

2) The calculation assumes that all vapor inside the pipes is EO prior to purging to the scrubber. For the liquid lines, assumes that all liquid is blown down to R01 in a closed system where it is neutralized with potassium hydroxide (KOH) and no EO remains from the neutralization process.

3) P_3 is the vapor pressure of pure EO at that tempererature.

4) V_V is calculated above.

5) M_V is obtained from AP-42, Chapter 7. *Organic Liquid Storage Tanks* , Page 7.1-95.

6) S is assumed not to be applicable as pipe is fully saturated with EO prior to depressurization and there is no standing idle time as the pipe under pressure.

7) Conservatively assumes all emissions from one event occur within an hour. Number is annual emissions divided by number of annual events.

Vapor Space Purge Emissions (L_{P2}) - Vapors Vented After Control (Uncontrolled) [1,2]

$$L_{P2} = \left(\frac{P_1 * Vv}{R * Tv}\right) * Mv * \frac{PPM}{1{,}000{,}000}$$

P_1: Pressure of Gas Inside the Unit Before Venting (psia) [3]	14.7
V_V: Volume of the Vapor Space (ft^3) [4]	1,069
R: Ideal Gas Constant (10.731 psia ft^3 / lb-mole °R)	10.73
T_V: Average Gas Temperature (°R)	529.67
M_V: Molecular Weight of Stock Vapor - Ethlyene Oxide (lb/lb-mole) [5]	44.05
Post Control Degas Concentration (ppm) [6]	1,000
L_{P2} (lb/yr) =	**0.12**
L_{P2} (lb/hr) [7] =	**0.003**

Note:

1) Vapor Space Purge Emissions equation is Eq 4-2 in AP-42, Chapter 7. *Organic Liquid Storage Tanks.*

2) The calculations assume there is some EO left in the lines after the first depressurization event to the scrubber (LP_1).

3) P_1 is equal to atmospheric pressure.

4) V_V is calculated above.

5) M_V is obtained from AP-42, Chapter 7. *Organic Liquid Storage Tanks* , Page 7.1-95.

6) Maximum concentration in the lines prior to opening to atmosphere from Stepan data.

7) Assumes all emissions from one event occur within an hour. Number is annual emissions divided by number of annual events.

Overall Equation for Emissions Released During Liquid Line Purges

$$Total\ Emissions = LP_1 + LP_2$$

L_{P1}: Vapor Space Purge Emissions - Asscociated Controlled (lb/yr)	3.18E+00
L_{P2}: Vapor Space Purge Emissions - Vapors Vented After Control (lb/yr)	1.22E-01
Total Emissions (lb/yr) =	**3.30**
Total Emissions (tpy) =	**1.65E-03**
Max Hourly Emissions (lbs/hr) [1]	**2.58E-02**
Max 24-hour Emissions (lbs/hr) [2]	**6.18E-01**

Note:

1) Assumes LP_1 and LP_2 can occur within the same hour.

2) Conservatively assumes 24 events per day.

Table C-5: Tank Cleaning (T-3400) Ethylene Oxide (EO) Emissions Calculations

Tank Parameters [1]

Tank Roof Type:	Fixed Roof
Tank Oreintation:	Horizontal
Tank Capacity (gal)	31,780
T_B: Liquid Bulk Temperature (°F) [2]	70
T_B: Liquid Bulk Temperature (°R) [3]	529.67

Note:
1) All data on tank is provided by Stepan.
2) The tank is fully insulated. For an insulated tank the liquid bulk temperature, T_B, should preferably be based on measurements or estimated from process knowledge. (AP-42, Chapter 7. *Organic Liquid Storage Tanks* , Page 7.1-26)
3) Temperature Conversion: 68°F + 459.67 = 527.67°R

True Vapor Pressure (P_{VA}) [1]

$$P_{VA} = 10^{(A-\frac{B}{T_B + C})}$$

A: Constant in Vapor Pressure Equation (dimensionless) [2]	8.722
B: Constant in Vapor Pressure Equation (°C) [2]	2,022.80
C: Constant in Vapor Pressure Equation (°C) [2]	335.81
T_B: Liquid Bulk Temperature (°C) [3]	21
P_{VA} (mm Hg) =	**1134.07**
P_{VA} (psia)[4] =	**21.93**

Note:
1) True Vapor Pressure equation is Eq 1-26 in AP-42, Chapter 7. *Organic Liquid Storage Tanks.*
2) Constants A, B, and C are from AP-42, Chapter 7. *Organic Liquid Storage Tanks* , Table 7.1-3, Page 7.1-95.
3) Temperature Conversion: (68°F − 32) × 5/9 = 20°C
4) Pressure Conversion: 760 mm Hg = 14.7 psia

Vapor Space Purge Emissions (L_{P1}) - Controlled [1,2]

$$L_{P1} = \left(\frac{P * Vv}{R * Tv}\right) * Mv * S$$

P: Vapor Pressure of Ethylene Oxide (psia) [3]	21.9
V_V: Volume of the Vapor Space (ft^3) [4]	4,249
R: Ideal Gas Constant (10.731 psia ft^3 / lb-mole °R)	10.73
T_V: Average Temperature of the Vapor Space (°R) [5]	529.67
M_V: Molecular Weight of Stock Vapor - Ethylene Oxide (lb/lb-mole) [6]	44.05
S: Saturation Factor (dimentionless) [7]	1.00
L_{P1} (lb) Uncontrolled =	**722.03**
Scrubber Proposed Control Efficiency (%)	99.50%
L_{P1} (lb) Controlled =	**3.61**

Note:
1) Vapor Space Purge Emissions equation is Eq 4-2 in AP-42, Chapter 7, *Organic Liquid Storage Tanks.*
2) EO is unloaded from the tank to R01 where it is neutralized with potassium hydroxide (KOH). This calculation assumes that R01 is filled under a closed system and has no emissions. Also assumes that all EO left in R01 is fully reacted with KOH and no EO remains from the neutralization process. After EO is unloaded to R01, the tank is depressurized several times after pressurizing with nitrogen. The calculation assumes that all vapor inside the tank after the first unloading/depressurization event to R01 is EO and that the number of moles remaining inside the tank after EO unloading is the maximum amount of EO that could be emitted.
3) P is the vapor pressure of pure EO at that tempererature.
4) Capacity in gal divided by 7.48 gal/ft^3
5) Tank is assumed to be fully insulated. Therefore, $T_B = T_V$. AP-42, Chapter 7, *Organic Liquid Storage Tanks* , Page 7.1-26.
6) M_V is obtained from AP-42, Chapter 7. *Organic Liquid Storage Tanks* , Page 7.1-95.
7) S is assumed not to be applicable as tank is fully saturated with EO prior to depressurization and there is no standing idle time as the tank is under pressure.

$$L_{P2} = \left(\frac{P * Vv}{R * Tv}\right) * Mv * \frac{PPM}{1{,}000{,}000}$$

Vapor Space Purge Emissions (L_{P2}) - Vapors Vented After Control (Uncontrolled)[1,2]

P: Pressure of Gas Inside the Unit Before Venting (psia) [3]	14.7
V_V: Volume of the Vapor Space (ft^3) [4]	4,249
R: Ideal Gas Constant (10.731 psia ft^3 / lb-mole °R)	10.731
T_V: Average Temperature of the Vapor Space (°R) [5]	529.67
M_V: Molecular Weight of Stock Vapor - Ethlyene Oxide (lb/lb-mole) [6]	44.05
Post Control Degas Concentration (ppm) [7]	1,000
L_{P2} (lb) =	**0.48**

Note:

1) Vapor Space Purge Emissions equation is Eq 4-2 in AP-42, Chapter 7. *Organic Liquid Storage Tanks.*
2) The tank is washed with water several times (with the vent to the scrubber when filling with water). The water is moved and neutralized with KOH in R01. This calculation assumes that R01 is filled under a closed loop system and has no emissions. Also assumes that all EO left in R01 is fully reacted with KOH and no EO remains from the neutralization process. During the last wash, water is pumped to T3400 to overflowing. The calculations conservatively assume there is some EO left in the tank. However, since there is a water wash the calculations assume no liquid clingage.
3) P is equal to atmospheric pressure.
4) Capacity in gal divided by 7.48 gal/ft^3
5) Tank is assumed to be fully insulated. Therefore, $T_B = T_V$. AP-42, Chapter 7, *Organic Liquid Storage Tanks* , Page 7.1-26.
6) M_V is obtained from AP-42, Chapter 7. *Organic Liquid Storage Tanks* , Page 7.1-95.
7) Maximum concentration in the tank is from Stepan data.

$$Total\ Emissions = LP_1 + LP_2$$

Overall Equation for Emission Released During Tank Cleaning

L_{P1}: Vapor Space Purge Emissions - Associated Controlled (lb)	3.61
L_{P2}: Vapor Space Purge Emissions - Vapors Vented After Control (lb)	0.48
Maximum Number of Events (Events/yr)[1]	1.00
Total Emissions During Tank Cleaning (lb/yr) =	**4.09**
Total Emissions During Tank Cleaning (tpy) =	**0.002**
Max Hourly Emissions (lbs/hr)[2]	**4.09**
Max 24-hour Emissions (lbs/24-hr)[3]	**4.09**

Note:

1) Maximum number of tank cleanings per year.
2) Assumes LP_1 and LP_2 both occur within an hour (conservative). Maximum emissions is the sum of LP_1 and LP_2.
3) Assumes LP_1 and LP_2 can occur within the same day. Maximum emissions is the sum of LP_1 and LP_2.

APPENDIX D

Toxics Impact Assessment

AIR TOXICS MODELING & IMPACT ASSESSMENT

STEPAN COMPANY

951 Bankhead Highway,
Winder, Georgia (Barrow County)

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY

1.1 Overview

An Air Toxics Modeling & Impact Assessment, herein referred to as the “Assessment,” was conducted for the Stepan Company facility located at 951 Bankhead Hwy, Winder, Georgia (Barrow County). The purpose of the Assessment was to estimate the potential environmental impact from facility-wide sources of ethylene oxide (EO) using potential emission values (with proposed emissions reductions). This application was originally submitted in April 2020 with the preliminary stack test numbers as the final report was not available at that time. The application was updated in June 2020 with the final stack test report numbers, where calendar year 2019 actual emissions were used for the modeling assessment. The application has been updated to include a modeling assessment conducted using potential emissions. In addition, emissions from line purges and tank cleaning have been estimated and included in the modeling assessment.

The Assessment was conducted for the entire facility. The Assessment involved the modeling of the predicted ambient impact, and comparing the modeled results with the toxic air pollutant Acceptable Ambient Concentration (AAC). The assessment was performed on ethylene oxide. Ethylene oxide is emitted from the depressurization of the EO storage tank (T-3400), cleaning of the EO storage tank (T-3400), depressurization of the alkoxylation reactor (R-01), fugitive equipment leaks, and line purges. Please refer to Section 2.1 for a description of these emissions.

The Assessment was performed in accordance with the Georgia Environmental Protection Division (EPD) Air Protection Branch approved protocol for conducting an Air Toxics Modeling & Impact Assessment (i.e., *Georgia EPD Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions*, revised May 2017). The AERMOD (v 19191) refined dispersion model was used to predict the MGLC of the toxic air pollutant.

1.2 Summary of Results

The modeling results were compared to the AAC for the toxic pollutant in order to assess their impact. The results are summarized in Attachment 1.

2 MODELING ASSESSMENT

2.1 Emissions Data

The facility manufactures many products; however only the emissions of EO are discussed in this permit application. Facility-wide potential EO emission rates used in the modeling assessment are calculated in Appendix C and summarized in Attachment 1. EO emissions from the Stepan Winder facility result from the following processes:

- The depressurization of the alkoxylation reactor (R01);
- The depressurization of the EO Storage Tank (T-3400) after railcar unloading;
- The cleaning of the EO Storage Tank (T-3400);
- Fugitive equipment leaks from EO unloading, EO storage, and the alkoxylation reactor area; and
- The purging of EO lines throughout the facility.

For a reference on process descriptions please see Section 2 of the main narrative to this application.

2.1.1 Alkoxylation Reactor (R01) Potential Emissions

As described in Section 2.1.1 of the main narrative, when the alkoxylation reaction process ends the vessel is depressurized after the product has been pumped out of the reactor. The transfer is performed under a closed system between the reactor and scrubber (SCR-R01). The depressurized gas, which contains EO, is vented to the EO column scrubber (SCR-R01). Depressurization occurs for approximately 20 minutes per cycle, but may vary based on the batch and specific product being produced.

Stack testing was performed at the facility on March 19th, 2020 on the EO scrubber for one depressurization event of the reactor. The average hourly emission rate from the stack test was adjusted to represent a 99.5 % DRE for the short-term emission rate (actual DRE stack test average was 99.98% for reactor degassing and 99.94% for tank degassing). The 24-hour emission rate was calculated based on the adjusted hourly emission rate and a maximum of four batches per day for the reactor. The annual emission rate was calculated based on the adjusted hourly emission rate and a maximum of 1,003 batches per year.

2.1.2 EO Tank (T-3400) Potential Emissions

Regular Operations

As described in Section 2.1.2 of the main narrative, during railcar unloading liquid EO is transferred from the railcar to the storage tank. This transfer is performed under a closed system between the railcar and the storage tank which allows the balancing of vapors displaced during loading from the storage tank to the railcar. EO emissions result from depressurization of the tank (approximately 10-15 psig) after the railcar unloading has been completed.

Stack testing was performed at the facility on March 19th, 2020 on the EO scrubber for three depressurization events of the tank. As there are limited unloading events, the testing was conducted by depressurization of the storage tank alone (without the railcar) based on approximately 10-15 psi, which is operationally identical to a railcar offloading event. The 24-hour emission rate was calculated based on the adjusted hourly emission rate and a maximum of one tank depressurization event per day. The average hourly emission rate from the stack test was adjusted to represent a 99.5 % DRE for the short-term emission rate (actual DRE stack test average was 99.94% for tank degassing). The annual emission rate was calculated based on the adjusted hourly emission rate and unloaded maximum of 100 railcars per year.

Tank Cleaning (Maintenance Activity)

EO emissions also result from cleaning of the tank. As described in Section 2.1.2, the tank cleaning process is generally only performed approximately once every ten years to satisfy regulatory requirements for internal inspections. The tank cleaning process occurs in two stages, controlled and uncontrolled. In the controlled stage, stage one, EO is unloaded from the tank to Reactor R01 where it is neutralized with potassium hydroxide (KOH). Reactor R01 is filled under a closed system and thus, there are no emissions associated with this part of the process. It is assumed that all EO left in Reactor R01 is fully reacted with potassium hydroxide (KOH) and no EO remains from the neutralization process. After EO is unloaded to Reactor R01, the tank is depressurized several times following the pressurizing with nitrogen. The emission calculation for stage one conservatively assumes that all vapor inside the tank after the first unloading/depressurization event to Reactor R01 is EO and the number of moles remaining inside the tank after liquid EO unloading is the maximum amount of EO that could be emitted. Therefore, although the pressurization and depressurization of the tank to the scrubber occurs in several steps, all emissions from the control stage are conservatively assumed to happen within one hour.

After the tank is purged with nitrogen, it is washed with water several times, with the vent open to the scrubber when filling with water. The water is moved and neutralized with potassium hydroxide (KOH) in R01. Reactor R01 is also filled under a closed loop system and has no emissions. It is also assumed that all EO left in Reactor R01 is fully reacted with potassium hydroxide (KOH) and no EO remains from the neutralization process. During the last wash, water is pumped to T-3400 to overflowing. This represents the uncontrolled stage of tank cleaning, stage two. The calculations conservatively assume there is some EO left in the tank which results in the uncontrolled EO emissions of tank cleaning, which is also assumed to occur within one hour.

Emission estimates for both stages are based on the ideal gas law. The second stage incorporates a post control degas concentration as the tank is not fully saturated with EO. It is conservatively assumed that emissions from Stage 1 and Stage 2 occur within the same hour. The 24-hour emission rate was calculated based on one tank cleaning event per day. The annual emission rate was calculated based on one tank cleaning event per year. Stage 1 was calculated using the proposed scrubber DRE of 99.5 %.

2.1.3 EO Fugitive Equipment Leak Potential Emissions

Piping components, such as valves, connectors, and pump seals, have the potential for fugitive leaks of EO. Fugitive emissions are calculated by counting the number of fugitive components, utilizing an emission factor based on component type and service, and applying a control efficiency where applicable. Rupture discs are being installed on all pressure relief valves as part of the emissions reduction plan. A control efficiency of 100% was applied for these components.

The total number of each component was determined for the development of the Leak Detection and Repair (LDAR) program and used for these calculations. The mass emission rate as a function of screening value for each type of equipment was determined in accordance with EPA guidance document EPA-453/R-95-017, November 1995, "Table 2-9. SOCMI Leak Rate/Screening Value Correlations." Site-specific screening data was used.

Monitoring was performed in accordance with the sampling requirements of the TCEQ monitoring program 28VHP. However, given the data size available and recent implementation of the program, averaged emission factors for each type of component described above for each process were used. Monitoring data included readings for September 2019 through March 2020 for most components. Screening values for bolded items in Appendix C, Table C-3 were not obtained during the above listed inspection. Once these screening values are obtained they are expected to be equivalent to other similar components.

Several of the valve, connectors, and equipment are used in both the EO and propylene oxide (PO) processes. It was assumed that the fraction of time that the equipment was on either EO or PO service was proportional to their ratio of annual throughputs; specifically, 79% of time in EO service (6,920 hours per year). Hours for the loading rack and railcar offloading area are based on an unloading rate of 5 hours per railcar and a maximum of 100 railcars per year. These lines are purged when not in use.

Product line components were identified in the process. The EO emission rate from the product line components was calculated by multiplying the calculated VOC emissions from each component by the maximum concentration of EO in the product lines (0.1% EO by weight).

2.1.4 Line Purging

Purging of lines throughout the facility have the potential to emit EO. Prior to maintenance activities, lines are purged to the scrubber (SCR-R01) prior to breaking of the lines. For the liquid lines, all of the liquid is blown down to Reactor R01 under a closed system where it is neutralized with potassium hydroxide (KOH) prior to purging of the line to the scrubber (SCR-R01). During line breaks, any EO remaining after the purge to the scrubber is vented to the atmosphere. When calculating emissions, the controlled portion of the calculations conservatively assume that all vapor inside the pipes is EO prior to purging to the scrubber (SCR-R01). For the liquid lines, it is assumed that no EO remains from the neutralization process. Some of the lines associated with the unloading area are also purged to the scrubber after railcar unloading. There are no line breaks associated with these emissions. Controlled emissions were calculated using the proposed scrubber DRE of 99.5 %.

The uncontrolled emissions portion of the calculation assumes there is some EO left in the lines after purging to the scrubber (SCR-R01). Both controlled and uncontrolled emissions are based on the ideal gas law. The second stage incorporates a post control degas concentration as the line is not fully saturated with EO.

The overall emissions calculation assumes a maximum of one event per hour and that the controlled and uncontrolled stages can occur within the hour. The 24-hour calculations assume a maximum of 24 events per day. The annual emission rate was calculated based on the maximum number events per year (140 for line purges and 40 for line breaks).

2.2 Modeling Guidelines

The modeling and impact assessment were performed according to the *Division's Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions* (revised May 2017), herein referred to as the "Guideline". The process of modeling and impact assessment are described in detail in the guidance document. The summary is as follows:

- Compare the facility-wide pollutant emission rate (lb/yr) to the MER (please note that per Appendix A of the Guideline, MERs are applicable to point source emissions only. Volume and Area sources should not use MER for screening purposes. Fugitive emissions account for greater than 80% of EO emissions from the facility);
- Identify the Acceptable Ambient Concentration (AAC) for the pollutant(s) that exceeded the MER;
- Conduct an impact assessment using AERMOD (v 19191) refined dispersion model to predict the Maximum Ground Level Concentration (MGLC); and
- Compare the predicted MGLC's to the AAC's.

AERMOD model set-up is described in Section 3.0.

2.3 Acceptable Ambient Pollutant Concentrations

An AAC must be developed for each toxic air pollutant and applicable averaging time. The AAC is based on current pollutant toxicity data adjusted for operating hours and risk factors, and is expressed as a mg/m^3 or $\mu g/m^3$ limit. For acute sensory irritants, an assessment must be made for both the 24-hour exposures and the short-term, 15-minute exposures.

The AAC's established by EPD and their respective sources are presented in Attachment 1 of the guidance document. The sources for AAC's are:

- Integrated Risk Information System (IRIS);
- OSHA Standards (PEL's) - 29 CFR Part 1910 Subpart Z;
- American Congress of Governmental Industrial Hygienists (ACGIH) Recommendations (TLV's); and
- NIOSH Recommended Standards (REL's).

The toxicity data for ethylene oxide is included in Attachment 1. The annual AAC is based on IRIS, while the 15-minute AAC's are based on the short-term exposure limit presented in the OSHA Standards.

3 AERMOD MODELING

3.1 Model Selection

The latest version of the AERMOD model (v. 19191) was used, with the regulatory default model option. AERMOD (American Meteorological Society (AMS)/EPA Regulatory Model) is the EPA's preferred near-field dispersion modeling system. The North American Datum of 1983 (NAD83) was used to specify receptors, building, and source locations. The latest version of AERMAP (v. 18081) was used to extract terrain elevations from the 1/3-arc second National Elevation Dataset (NED) data obtained from the U.S. Geological Survey (USGS) National Map server.

3.2 Receptor Grid

Discrete receptors with 50-meter intervals were placed along the property line. 100-meter spaced receptors were placed extending 2,500 meters away from the property line. 250-meter spaced receptors were placed extending from 2,500 meters away from the property line to 5,500 meters. Additional 50-meter spaced receptors were placed at the closest residential areas. This refined grid is of sufficient size to ensure the receptor indicating the MGLC has at least one receptor on all sides showing a lower concentration.

3.3 Meteorological Data

Five years of meteorological data (i.e., from 2015 through 2019) with the ADJ_U* option were obtained from the Air Quality Modeling section of Georgia EPD's website with the surface/upper air station pairing for the Lee Gilmer Memorial Airport (WBAN No. 53838)/Peachtree City-Falcon Field Airport (WBAN No. 53819). The meteorological data set was combined into a one 5-year file. A profile base elevation of 388.6 m was specified in the model. ADJ_U* is a regulatory default option that improves model performance during periods of stable, low-wind speed conditions by adjusting the surface friction velocity (u*) in AERMET.

3.3.1 Representativeness Determination

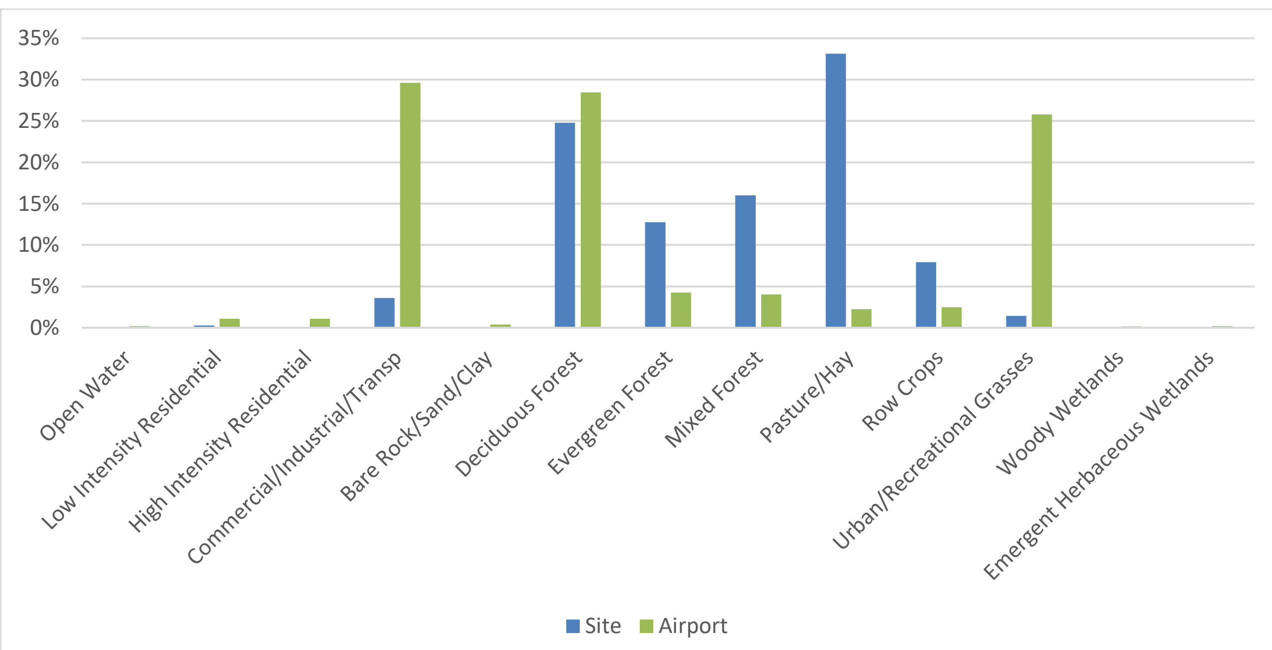
Pursuant to Section 8.4.1 of the *Guideline on Air Quality Models 40 CFR 51, Appendix W* (EPA, Revised, January 17, 2017), the meteorological data used as input to a dispersion model should be selected on the basis of spatial and climatological representativeness as well as the ability of the individual parameters selected to characterize the transport and dispersion conditions in the area of concern. The representativeness of the meteorological data is dependent on multiple factors including the proximity of the meteorological station to the site, complexity of the terrain, exposure of the meteorological monitoring site, and period of time during which data are collected.

The Lee Gilmer Memorial Airport is located less than 30 km north of the site. The five-year meteorological dataset represents the most recent five years of available data (i.e., from 2014 through 2018).

AERSUFACE (v. 13016) [1] was used to process the 1992 National Land Cover Database (NLCD) data and compare the surface characteristics between the area surrounding the facility and the area surrounding the meteorological station. Surface roughness was evaluated for the area within a default 1 km radius. Albedo and Bowen ratio were evaluated within a default domain of a 10 km by 10 km region centered on the site. A total of 12 sectors and 4 seasons were specified for this analysis.

Figure D-1 provides a comparison of the land cover categories for the site and the Lee Gilmer Memorial Airport. Table D-1 provides a comparison of the Albedo, Bowen, and Surface Roughness for the site and the Lee Gilmer Memorial Airport. The Albedo ratio are the same for both the site and the Lee Gilmer Memorial Airport for all seasons. The Bowen ratio are similar for both locations with a maximum difference of 22%. The difference for the Surface Roughness between the site and the Lee Gilmer Memorial Airport ranges from 6.8% to 94.2% for the different seasons and sectors, as it is expected when comparing airport sites to industrial facility sites. Therefore, due to proximity of the meteorological station to the site and similarities of the surface characteristics, the meteorological data used is considered to be adequately representative for this modeling analysis.

Figure D-1: Land Cover Categories



[1] Latest version at the time that the initial modeling was conducted. No significant changes with respect to the conclusions are expected for this site based on latest release of version 20060.

Table D-1: Comparison of Surface Characteristics (Site and Lee Gilmer Memorial Airport)

Season	Albedo (Alb)			Bowen (Bo) Average			Bowen (Bo) Dry			Bowen (Bo) Wet		
	Site	Airport	% Difference	Site	Airport	% Difference	Site	Airport	% Difference	Site	Airport	% Difference
1	0.16	0.16	0.0%	0.83	0.90	8.4%	1.82	1.87	2.7%	0.38	0.42	10.5%
2	0.15	0.15	0.0%	0.53	0.64	20.8%	1.29	1.45	12.4%	0.27	0.33	22.2%
3	0.16	0.16	0.0%	0.37	0.40	8.1%	0.83	0.83	0.0%	0.24	0.26	8.3%
4	0.16	0.16	0.0%	0.83	0.90	8.4%	1.82	1.87	2.7%	0.38	0.42	10.5%
Average	**0.16**	**0.16**	**0.0%**	**0.64**	**0.71**	**11.4%**	**1.44**	**1.51**	**4.5%**	**0.32**	**0.3575**	**12.9%**

Sector	Surface Roughness (Zo) Season 1			Season 2			Season 3			Season 4		
	Site	Airport	% Difference	Site	Airport	% Difference	Site	Airport	% Difference	Site	Airport	% Difference
1	0.111	0.035	68.5%	0.159	0.043	73.0%	0.445	0.051	88.5%	0.445	0.045	89.9%
2	0.311	0.03	90.4%	0.439	0.04	90.9%	0.735	0.049	93.3%	0.73	0.042	94.2%
3	0.327	0.036	89.0%	0.447	0.043	90.4%	0.755	0.05	93.4%	0.755	0.044	94.2%
4	0.212	0.06	71.7%	0.281	0.08	71.5%	0.533	0.101	81.1%	0.533	0.091	82.9%
5	0.338	0.208	38.5%	0.438	0.297	32.2%	0.704	0.409	41.9%	0.697	0.4	42.6%
6	0.388	0.171	55.9%	0.493	0.241	51.1%	0.73	0.334	54.2%	0.727	0.325	55.3%
7	0.689	0.149	78.4%	0.887	0.214	75.9%	1.053	0.326	69.0%	1.051	0.316	69.9%
8	0.149	0.069	53.7%	0.192	0.105	45.3%	0.377	0.137	63.7%	0.371	0.118	68.2%
9	0.151	0.04	73.5%	0.189	0.053	72.0%	0.395	0.065	83.5%	0.393	0.056	85.8%
10	0.104	0.084	19.2%	0.139	0.109	21.6%	0.326	0.13	60.1%	0.321	0.117	63.6%
11	0.087	0.062	28.7%	0.115	0.077	33.0%	0.327	0.088	73.1%	0.327	0.081	75.2%
12	0.059	0.063	6.8%	0.082	0.074	9.8%	0.27	0.085	68.5%	0.27	0.079	70.7%
Average	**0.24**	**0.08**	**56.2%**	**0.32**	**0.11**	**55.5%**	**0.55**	**0.15**	**72.5%**	**0.55**	**0.14**	**74.4%**

AERSURFACE Default Seasons

1 - Winter: Dec, Jan, Feb (no snow cover)
2 - Spring: Mar, Apr, May
3 - Summer: Jun, Jul, Aug
4 - Fall: Sep, Oct, Nov

% Difference calculated as the absolute value from Site-Airport/Site

3.4 Land Use Classification

The selection of rural or urban dispersion coefficients should follow one of the two procedures detailed in Section 7.2.1.1.b. of the *Guideline on Air Quality Models 40 CFR 51, Appendix W* (EPA, Revised, January 17, 2017). These include the land use classification procedure and the population density procedure to determine whether the area is primarily rural or urban.

The land use procedure is considered more definitive than the population density procedure. As specified in Section 7.2.1.1.b.i, the land use within the total area circumscribed by a 3 km radius circle about the facility was classified using the meteorological land use typing scheme proposed by Auer. If land use types I1 (HeavyIndustrial), I2 (Light Industrial), C1 (Commercial), R2 (Residential; Small Lot Single Family & Duplex), and R3 (Residential; Multi-Family) account for 50 percent or more of the circumscribed area, urban dispersion coefficients should be used; otherwise, rural dispersion coefficients are appropriate.

AERSUFACE (v. 13016)[2] was used to process the 1992 NLCD data. The results of the land use analysis are presented in the Table below. Rural dispersion coefficients were selected as 98.2% of the area can be classified as rural. The AERSURFACE input and output files were provided electronically with the initial application.

Table D-2. AERSURFACE Results and Land Use Classification

NLCD Land Class	Land Description	Count	Auer Land Class	Rural/ Urban	Land Area
11	Open Water	0	A5	Rural	0.00%
12	Perennial Ice/Snow	98	A5	Rural	0.31%
21	Low Intensity Residential	0	R1	Rural	0.00%
22	High Intensity Residential	307	R2 & R3	Urban	0.98%
23	Commercial/Industrial/Transp	30	I1, I2, & C1	Urban	0.10%
31	Bare Rock/Sand/Clay	523	A3	Rural	1.66%
32	Quarries/Strip Mines/Gravel	0	A4	Rural	0.00%
33	Transitional	0	A3	Rural	0.00%
41	Deciduous Forest	327	A4	Rural	1.04%
42	Evergreen Forest	10905	A4	Rural	34.71%
43	Mixed Forest	4427	A4	Rural	14.09%

[2] Latest version at the time that the initial modeling was conducted. No significant changes with respect to the conclusions are expected for this site based on latest release of version 20060.

NLCD Land Class	Land Description	Count	Auer Land Class	Rural/ Urban	Land Area
51	Shrubland	4357	A3	Rural	13.87%
61	Orchards/Vineyard/Other	0	A2	Rural	0.00%
71	Grasslands/Herbaceous	0	A3	Rural	0.00%
81	Pasture/Hay	0	A2	Rural	0.00%
82	Row Crops	8454	A2	Rural	26.91%
83	Small Grains	1715	A2	Rural	5.46%
84	Fallow	0	A2	Rural	0.00%
85	Urban/Recreational Grasses	0	A1	Rural	0.00%
91	Woody Wetlands	277	A4	Rural	0.88%
92	Emergent Herbaceous Wetlands	0	A4	Rural	0.00%
	TOTAL:	31,420			
				Rural:	**98.24%**
				Urban	**1.76%**

3.5 GEP Stack Height Analysis and Building Downwash

Good Engineering Practice (GEP) stack height analysis is required to be conducted for all structures within 5 times the lesser dimension (i.e., height or width of nearby structures) from each stack. This analysis is used to identify critical building dimensions to be used in the modeling analysis.

GEP and building downwash calculations were conducted using USEPA’s Building Profile Input Program for PRIME (BPIPPRM, v. 04274). The output of BPIPPRM was included as input in the AERMOD input file. The BPIPPRM input and output files are being provided electronically with this report.

3.6 AERMOD Modeling Parameters

The modeling parameters are presented in Attachment 1. Emissions from R01 and T-3400 both exhaust through the scrubber (SCR-R01) stack. The scrubber stack also includes controlled emissions from tank cleaning and purging of lines.

After implementation of the LDAR program, more detailed information on the location of each one of the components became available; thus, the sources parameters for fugitive sources were updated to reflect this new information.

Fugitive emissions from all components located in the unloading area were modeled as one single volume source, based on the width and height of this area. Similarly, fugitive emissions from all components located in the storage area were modeled as one single volume source, based on the width and height of this area.

Fugitive emissions from the components located in levels 1 and 2 of the Reactor building exhaust through five fans. These fans exhaust horizontally on the side of the building. Fans were modeled as horizontal point sources (POINTHOR).

The lower level of the Reactor building has no walls and is open to the atmosphere, emissions from the components located in this area were modeled as a series of volume sources. The number of volume sources was calculated based on the width and length of the building (as volume sources in AERMOD must have equal width and length).

Fugitive uncontrolled emissions from tank cleaning were included with the fugitive emissions from equipment leaks for the STORAGE model ID. Fugitive uncontrolled emissions from line purging were included as a single volume source. The assumed representative dimensions are included in Attachment 1.

3.7 AERMOD Modeling Scenarios

3.7.1 Annual and 1-hour Models

The annual and 1-hour models include emissions form all EO sources at the facility (which include regular operations and maintenance activities):

- The depressurization of the alkoxylation reactor (R01);
- The depressurization of the EO Storage Tank (T-3400) after railcar unloading;
- The cleaning of the EO Storage Tank (T-3400);
- Fugitive equipment leaks from EO unloading, EO storage, and the alkoxylation reactor area; and
- The purging of EO lines throughout the facility.

This assumption is conservative as tank cleaning only occurs approximately once every ten years. In addition, this assumption is conservative for the 1-hour as not all of these EO emission sources can have simultaneous emissions.

3.7.2 24-hour Models

Two scenarios were included for the 24-hour model as each scenario cannot occur on the same 24-hour period.

Regular Operations Scenario

This scenario includes the following operations:

- The depressurization of the alkoxylation reactor (R01);
- The depressurization of the EO Storage Tank (T-3400) after railcar unloading;
- Fugitive equipment leaks from EO unloading, EO storage, and the alkoxylation reactor area; and
- The purging of EO lines throughout the facility.

This is conservative a not all of these EO emission sources can have simultaneous emissions.

Tank Cleaning Scenario (Maintenance Activity)

This scenario includes the following operation:

- The cleaning of the EO Storage Tank (T-3400).

This scenario assumes that the entire cleaning event takes place within 24-hours.

3.8 MGLC Calculations and Compliance Evaluation

The maximum concentration for each pollutant based on the five-year modeling data was obtained for 1-hr, 24-hr, and annual time periods. The 1-hr averaging-period MGLC for each modeled pollutant was then multiplied by 1.32 in order to obtain the 15-minute averaging concentration per the Guideline.

The calculated MGLC's were then compared to the AAC's for determining acceptability. The results are summarized in Attachment 1. A copy of the AERMOD input/output model results is being provided electronically.

ATTACHMENT 1

Model Parameters, Emissions Data, and Toxic Impact Assessment

Table 1: Stack (Point Source) Parameters

Model ID	Description	Exhaust Type[2] (V/H)	UTM Zone 17 NAD 83 X (m)	Y (m)	Base Elevation (m)	Stack Height (ft)	(m)	Long Term Emissions - With Line Purges & Tank Cleaning[3] (lb/hr)	(g/s)	24-hr Short Term Emission Rate - with no Tank Cleaning[4] (lb/hr)	(g/s)	24-hr Short Term Emission Rate - Tank Cleaning[4] (lb/hr)	(g/s)	1-hr Short Term Emission Rate - Line Purges & Tank Cleaning[5] (lb/hr)	(g/s)	Stack Temperature[6] (F)	(K)	Stack Velocity[7] (ft/s)	(m/s)	Stack Diameter[8] (in)	(m)
2SCR_EO	Scrubber for Reactor R-01 and EO Storage Tank T-3400	V	242,638.68	3,765,591.23	315.14	39.583	12.06	1.50E-03	1.88E-04	2.48E-02	3.13E-03	1.50E-01	1.90E-02	3.68E+00	4.63E-01	74.93	297	1.07	0.33	7.99	0.203
ALKOXY_F51	Alkoxylation Building Fan (Levels 1 &2)[1]	H	242,566.16	3,765,602.28	317.52	25	7.62	4.98E-04	6.27E-05	6.30E-04	7.94E-05	6.30E-04	7.94E-05	6.30E-04	7.94E-05	Ambient	0	31.86	9.71	27.08	0.69
ALKOXY_F50	Alkoxylation Building Fan (Levels 1 &2)[1]	H	242,566.07	3,765,605.73	317.44	15.5	4.72	4.98E-04	6.27E-05	6.30E-04	7.94E-05	6.30E-04	7.94E-05	6.30E-04	7.94E-05	Ambient	0	33.12	10.09	27.08	0.69
ALKOXY_F49	Alkoxylation Building Fan (Levels 1 &2)[1]	H	242,549.41	3,765,609.86	317.87	22	6.71	4.98E-04	6.27E-05	6.30E-04	7.94E-05	6.30E-04	7.94E-05	6.30E-04	7.94E-05	Ambient	0	68.23	20.80	27.08	0.69
ALKOXY_F48	Alkoxylation Building Fan (Levels 1 &2)[1]	H	242,537.63	3,765,609.83	318.23	22	6.71	4.98E-04	6.27E-05	6.30E-04	7.94E-05	6.30E-04	7.94E-05	6.30E-04	7.94E-05	Ambient	0	65.96	20.11	27.08	0.69
ALKOXY_FX	Alkoxylation Building Fan (Levels 1 &2)[1]	H	242,535.31	3,765,604.19	318.4	22	6.71	4.98E-04	6.27E-05	6.30E-04	7.94E-05	6.30E-04	7.94E-05	6.30E-04	7.94E-05	Ambient	0	31.86	9.71	27.08	0.69

Table 2: Volume Source Parameters

Model ID	Description	UTM Zone 17 NAD 83 X (m)	Y (m)	Base Elevation (m)	Release Height[10] (ft)	(m)	Long Term Emissions - With Line Purges and Tank cleaning[11] (lb/hr)	(g/s)	24-hr Short Term Emission Rate - No Tank Cleaning[12] (lb/hr)	(g/s)	24-hr Short Term Emission Rate - Tank Cleaning[12] (lb/hr)	(g/s)	1-hr Short Term Emission Rate - With Line Purges and Tank Cleaning[13] (lb/hr)	(g/s)	Initial Lateral Dimension Syint[14] (ft)	(m)	Initial Vertical Dimension Szinit[15] (ft)	(m)	Volume Height ft	Length of Side ft
UNLOAD	Fugitive emissions unloading area (Equipment Fugitives)	242,644.87	3,765,635.87	314.1	14.0	4.27	2.75E-04	3.47E-05	4.82E-03	6.08E-04	4.82E-03	6.08E-04	4.82E-03	6.08E-04	9.16	2.79	13.02	3.97	28.0	39.37
	Fugitive emissions storage area						4.20E-03	5.29E-04	4.22E-03	5.32E-04	4.22E-03	5.32E-04	4.22E-03	5.32E-04						
STORAGE	Storage Tank T-3400 for Ethlyene Oxide - Tank Cleaning Only (Uncontrolled)	242,646.80	3,765,603.92	314.66	12.5	3.81	5.53E-05	6.96E-06	--	--	2.02E-02	2.54E-03	4.84E-01	6.10E-02	12.97	3.95	11.63	3.54	25.0	55.77
	Total Storage						**4.26E-03**	**5.36E-04**	**4.22E-03**	**5.32E-04**	**2.44E-02**	**3.07E-03**	**4.88E-01**	**6.15E-02**						
ALKOXY_1	Fugitive emissions lower level reactor area[9]	242,539.71	3,765,605.34	318.25	5.5	1.68	3.46E-04	4.36E-05	3.47E-04	4.37E-05	3.47E-04	4.37E-05	3.47E-04	4.37E-05	5.87	1.79	5.12	1.56	11.0	25.26
ALKOXY_2	Fugitive emissions lower level reactor area[9]	242,547.50	3,765,605.39	318.01	5.5	1.68	3.46E-04	4.36E-05	3.47E-04	4.37E-05	3.47E-04	4.37E-05	3.47E-04	4.37E-05	5.87	1.79	5.12	1.56	11.0	25.26
ALKOXY_3	Fugitive emissions lower level reactor area[9]	242,555.35	3,765,605.53	317.77	5.5	1.68	3.46E-04	4.36E-05	3.47E-04	4.37E-05	3.47E-04	4.37E-05	3.47E-04	4.37E-05	5.87	1.79	5.12	1.56	11.0	25.26
ALKOXY_4	Fugitive emissions lower level reactor area[9]	242,563.16	3,765,605.59	317.53	5.5	1.68	3.46E-04	4.36E-05	3.47E-04	4.37E-05	3.47E-04	4.37E-05	3.47E-04	4.37E-05	5.87	1.79	5.12	1.56	11.0	25.26
LINE PURGE	Fugitive emissions line breaks (uncontrolled)	242,610.49	3,765,607.31	315.85	2.0	0.61	1.39E-05	1.75E-06	3.04E-03	3.84E-04			3.04E-03	3.84E-04	0.47	0.14	0.47	0.14	2.0	2.00

1. Emissions from components located in Levels 1 and 2 are enclosed in the reactor building and exhaust through five (5) fans.
2. V: Vertical, H: Horizontal.
3. **2SCR_EO**: Railcar and Reactor depressurization from Appendix C, Table C-2. Based on 99.5% DRE and Maximum Number of events per year for tank and reactor degassing. Total Annual Emissions (lb/yr) divided by 8,760 hours/yr.
Line Purge emissions from Appendix C, Table C-4 (controlled portion only). Tank Cleaning emissions from Appendix C, Table C-5 (controlled portion only). Total Annual Emissions (lb/yr) divided by 8,760 hours/yr.
ALKOXY_F51-FX: From Appendix C, Table C-3. Annual Emissions from Levels 1 and 2 (tpy) * 2,000 (lb/ton) / 8,760 (hr/yr) / 5 fans
4. **2SCR_EO**: Reactor/railcar unloading degassing from Appendix C, Table C-2. Based on 99.5% DRE, 4 reactor degassing events per day, and 1 tank degassing event per day.
Tank Emissions (lb/event) * (1 event/day) + Reactor Emissions (lb/event) * (4 events/day) / 24 hours/day
Tank cleaning from Appendix C, Table C-5 (controlled portion only). Total Emissions (lb) divided by 24 hours. Only one tank cleaning event per 24-hours.Line purges rom Appendix C, Table C-4 (controlled portion only). Assumes 24 events per day (conservative).
All reactor degassing, rail car unloading degassing, line purges, and tank cleaning cannot occur in the same day, the model conservatively assumes one day where all cleaning emissions occur (Tank Cleaning Scenario) and one day where all other emissions occur (Regular Operations Scenario).
ALKOXY_F51-FX: From Appendix C, Table C-3. Hourly Emissions from Levels 1 and 2 (lb/hr) / 5 fans
5. **2SCR_EO**: Reactor/railcar unloading degassing from Appendix C, Table C-2. Based on 99.5% DRE. Line purges from Appendix C, Table C-4 (controlled portion only). Tank cleaning from Appendix C, Table C-5 (controlled portion only).
All reactor degassing, rail car unloading degassing, line purges, and tank cleaning cannot occur within the same hour, the model conservatively assumes they can.
ALKOXY_F51-FX: From Appendix C, Table C-3. Hourly Emissions from Levels 1 and 2 (lb/hr) / 5 fans
6. Ambient exhaust is set to 0 Kelvin which causes AERMOD to use the ambient temperature as the exit temperature.
7. **2SCR_EO**: Based on flowrate obtained from stack testing (Appendix C, Table C-2). Lowest flowrate (reactor) used for conservative estimates.
8. Fans have rectangular stacks. Equivalent diameter calculated. Equivalent Diameter: 2 * SQRT [(LxW) / PI ()], where the L and W are 24 inches.
9. The lower level of the reactor building is open to atmosphere and was modeled as four (4) separate volume sources.
10. Release Height = Volume height / 2 [US EPA's User's Guide for the AMS/EPA Regulatory Model (AERMOD), EPA-454/B-19-027, August, 2019].
11. **UNLOAD/STORAGE (fugitive emissions storage area)/ALKOXY_1-4**: From Appendix C, Table C-3. Annual Emissions (tpy) * 2,000 (lb/ton) / 8,760 (hr/yr). Reactor area lower level emissions divided by four (4) for the ALKOXY volume sources.
STORAGE (Tank Cleaning): From Appendix C, Table C-5 (uncontrolled portion only). **LINE PURGE**: From Appendix C, Table C-4 (uncontrolled portion only). Total Annual Emissions (lb/yr) divided by 8,760 hours/yr.
12. **UNLOAD/STORAGE (fugitive emissions storage area)/ALKOXY_1-4**: From Appendix C, Table C-3. Hourly Emissions (lb/hr). Reactor area lower level emissions divided by four (4) for the ALKOXY volume sources.
STORAGE (Tank Cleaning): From Appendix C, Table C-5 (uncontrolled portion only). Total Emissions (lb) divided by 24 hours. Only one tank cleaning event per 24-hours. **LINE PURGE**: From Appendix C, Table C-4 (uncontrolled portion only).
All reactor degassing, rail car unloading degassing, line purges, and tank cleaning cannot occur in the same day, the model conservatively assumes one day where all cleaning emissions occur (Tank Cleaning Scenario) and one day where all other emissions occur (Regular Operations Scenario).
13. UNLOAD/STORAGE (fugitive emissions storage area)/ALKOXY_1-4: From Appendix C, Table C-3. Hourly Emissions (lb/hr). Reactor area lower level emissions divided by four (4) for the ALKOXY volume sources.
STORAGE (Tank Cleaning): From Appendix C, Table C-5 (uncontrolled portion only). **LINE PURGE**: From Appendix C, Table C-4 (uncontrolled portion only).
All reactor degassing, tank degassing, line purges, and tank cleaning cannot occur in the same day. The model conservatively assumes tank cleaning and line purges can occur within the same hour.
14. Initial lateral dimension of the volume: length of side divided by 4.3 [US EPA's User's Guide for the AMS/EPA Regulatory Model (AERMOD), EPA-454/B-19-027, August, 2019].
15. Initial vertical dimension is vertical dimension of the sources divided by 4.3 for elevated sources not on or adjacent to a building (LINE PURGE) or building height divided by 2.15 for elevated sources on or adjacent to a building (all others).

Appendix D - AIR TOXICS MODELING & IMPACT ASSESSMENT
Attachment 1

Table 3: AERMOD Air Dispersion Modeling Results

Pollutant	5-year Maximum Ground Level Concentrations[1] (µg/m^3)					5-year Maximum Ground Level Concentrations on Nearby Residential Areas[1] (µg/m^3)				AAC[2] (µg/m^3)		
	1-hr	15-Min	24-hour Tank Cleaning	24-hour Regular Operations	Annual	1-hr	15-Min	24-hour	Annual	15-Min	24-hour	Annual
Ethylene Oxide (CAS No. 75-21-8)	426.61	563.12	2.51	0.59	2.11E-02	N/A	N/A	N/A	9.36E-03	900	1.43	3.30E-04

Notes:

1. Maximum 1-hr, 24-hr, and annual concentrations are obtained from the AERMOD model results. 15-minute concentrations are calculated by multiplying the 1-hr concentration with 1.32. Highest residential receptor located on the SE fenceline.
2. AACs as specified in Georgia EPD's "Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions" Updated May 2017.