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February 12, 2021

VIA ELECTRONIC TRANSMISSION

Karen Hays
Chief, Air Protection Branch
Georgia Environmental Protection Division
4244 International Parkway, Suite 120
Atlanta, GA 30345

Subject: BD Madison Revised Air Quality Permit Application

Dear Karen,

As a follow up to our technical discussions over the past several months, please find attached our revised air quality permit application for the BD Madison plant. As we previously stated regarding the BD Covington application, the approach taken by BD to design and install the new fugitive emissions control systems has resulted in a measurable decrease in EO emissions.

Similar to the Covington permit application, this application includes several unique approaches in the reduction of fugitive emissions. First, the EO outlet concentrations for the new fugitive emissions control systems proposed in the BD Madison permit were evaluated to ensure the potential emissions from the plant will remain at or below the U.S. EPA-derived 100-in-1,000,000 risk threshold level for EO of 0.02 ug/m^3 ("EPA-Derived Risk Value") at the closest residences based on computer dispersion modeling. BD once again employed the services of Trinity Consultants to perform dispersion modeling using the EPA AERMOD model, assuming the facility's full potential to emit (PTE) and using EPD's most recent meteorological data files. As explained in the attached reports, the dispersion modeling results for the Madison facility document that we have met or are below the EPA-Derived Risk Value for EO at the closest residences.

Second, our permit application includes operational procedures—similar to those proposed for the BD Covington facility—that will minimize the facility's EO emissions. The results of the initial performance test indicate the new fugitive emissions control systems are performing as designed with a high level of removal efficiency. Ongoing performance of these systems will be verified through monthly testing to ensure the outlet concentration is well within the parameters defined through modeling which ensures an acceptable level of risk is maintained, and which provides a defined threshold at which media replacement would be necessary.

Third, the new air quality controls proposed in the BD Madison and BD Covington applications are based on extensive EO residuals studies. As explained in previous reports submitted to EPD, BD completed extensive EO residual testing of representative sterilized materials including medical products, packaging, and pallets. The results of the studies were used to estimate fugitive emissions associated with sterilized materials, and, because of this data, BD was able to determine the amount of EO residual on a per-pallet basis for purposes of calculating fugitive emissions from sterilized product. Our mass balance equation reflects both the potential to emit and actual expected emissions using the results of EO residual testing for products and packaging, modeling data, and expected emissions control system efficiency. We believe this approach to be more accurate than previous methods of estimating fugitive emissions.

Overall, we believe the BD Madison and BD Covington plants are now among the most effectively controlled EO sterilization facilities in the United States. Going forward, and in addition to continued compliance to existing requirements for the plant, ongoing performance of the new fugitive emissions control systems will be verified through monthly EO monitoring to ensure the outlet concentrations result in ground level concentrations at nearby residential receptors below the EPA-derived, 100-in-1,000,000 risk threshold level, as mentioned above.

If you have any questions regarding this application please feel free to contact me at your convenience.

Best regards,

Travis Anderton
Vice President, Sterilization
Global Supply Chain
Office: +1.801.565.2810
email: travis.anderton@bd.com

ATTACHMENT
cc: Eric Cornwell with modeling files

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: BD Madison
AIRS No. (if known): 211 - 00021
Facility Location: Street: 1211 Mary Magnan Blvd
City: Madison Georgia Zip: 30650 County: Morgan
Is this facility a "small business" as defined in the instructions? Yes: ☐ No: ☒

2. Facility Coordinates

Latitude:	33° 33’ 52”	**NORTH**	Longitude:	83° 28’ 29”	**WEST**
UTM Coordinates:	270256	**EAST**	3716455	**NORTH**	**ZONE** ____

3. Facility Owner

Name of Owner: Becton, Dickinson and Company
Owner Address Street: 1 Becton Drive
City: Franklin Lakes State: NJ Zip: 07417

4. Permitting Contact and Mailing Address

Contact Person: John LaMontagne Title: Process Technology Engineer
Telephone No.: 770 784 6186 Ext. ____ Fax No.: 770 788 5519
Email Address: john.lamontagne@BD.com
Mailing Address: Same as: Facility Location: ☐ Owner Address: ☐ Other: ☒
If Other: Street Address: 8195 Industrial Blvd.
City: Covington State: GA Zip: 30014

5. Authorized Official

Name: Ron Pasdon Title: Sr.Operations Mgr. Covington
Address of Official Street: 8195 Industrial Blvd.
City: Covington State: GA Zip: 30014

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: ____________

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.: ____

Date of Original Submittal: 11 December 2019

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: (1) Trinity Consultants, (2) Ramboll

Name of Contact: (1) Justin Fickas, P.E., (2) Russell Kemp, P.E.

Telephone No.: (1) 678 441-9977, (2) (678) 388 1654 Fax No.: ____

Email Address: (1) jfickas@trinityconsultants.com, (2) rkemp@ramboll.com

Mailing Address: Street: (1) 3495 Piedmont Rd., Bldg. 10, Suite 9 (2) 1600 Parkwood Cir., Suite 310

City: Atlanta (both) State: GA (both) Zip: (1) 30305, (2) 30339

Describe the Consultant's Involvement:

(1) Air dispersion modeling; (2) Performance testing and air permitting.

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
	2.02 Storage Tank Physical Data
	2.03 Printing Operations
	2.04 Surface Coating Operations
	2.05 Waste Incinerators (solid/liquid waste destruction)
	2.06 Manufacturing and Operational Data
1	3.00 Air Pollution Control Devices (APCD)
	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: Construction estimated to start in February 2020

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)	19.89	2.81	19.89	2.81
Nitrogen oxides (NOx)	36.23	4.60	36.23	4.60
Particulate Matter (PM) (filterable only)	1.94	0.27	1.94	0.27
PM <10 microns (PM10)	1.94	0.3	1.94	0.27
PM <2.5 microns (PM2.5)	1.94	0.27	1.94	0.27
Sulfur dioxide (SO_2)	3.02	0.31	3.02	0.31
Volatile Organic Compounds (VOC)	6.6	1.96	2.81	0.44
Greenhouse Gases (GHGs) (in CO2e)	23748	3542	23748	3542
Total Hazardous Air Pollutants (HAPs)	4.37	1.65	0.58	0.13
Individual HAPs Listed Below:				
Ethylene Oxide	4.0	1.6	0.21	0.08
Remainder of HAPs are products of combustion	0.37	0.05	0.37	0.05

14. 4-Digit Facility Identification Code:

SIC Code: 3841 SIC Description: Surgical & Medical Instruments & Apparatus

NAICS Code: 339112 NAICS Description: Surgical and Medical Instrument 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.

This application is for the addition of emission controls for currently non-captured emissions of Ethylene Oxide (EO) at an existing medical device sterilization facility that are not specifically addressed by the facility's existing regenerative thermal oxidizer (RTO). The existing RTO-regulated process, which includes the sterilization chamber Exhaust Vents, Chamber Vents, and Aeration Exhausts and those features, is not being modified. Information on these air quality control systems has been included in previous permit applications.

The new controls addressed by this revised application will be comprised of two additional control systems:

System One (SYS1) will capture potential emissions from the seven Sterilization Vessel Rooms (VRM1, VRM2, VRM3, VRM4, VRM5, VRM6, VRM7), the Vessel to Aeration Transfer Corridors (UCO1, UC02), and the EO Dispensing Rooms (DRM1, DRM1). Reference Attachment C.

System Two (SYS2) will capture emissions from the Work in Progress Area (WIP1) where product is stored after Sterilization and prior to shipment. Reference Attachment D.

The captured emissions will be treated using Advanced Air Technologies Model DR490 "Dry Bed Scrubbers" designed to achieve at least 99% at initial testing and operating as described in Attachments C and D. As explained below, the application includes additional permit standards and conditions for EO, including operational requirements and procedures for maintenance and operations of SYS1 and SYS2.

Note: This application has been revised to reflect updated EO mass balance calculations, fugitive emissions data, air flows, and air dispersion modeling results and supersedes previous submissions. Form 6.00 was added. Form 7.00 has been revised to reflect minimum flow for STK1. The flows in Attachment H represent minimum flow setpoint for both stacks. Attachment D was updated to include gravity conveyor dedicated exhaust flows.

16. Additional information provided in attachments as listed below:

Attachment A - Floor Plan
Attachment B - Plot Plan with proposed new stack locations
Attachment C - System 1 Flow Diagram
Attachment D - System 2 Flow Diagram
Attachment E - Mass Balance Calculations.
Attachment F - Monitoring Recommendations
Attachment G - Advanced Air Technologies DR-490 Equipment Information
Attachment H - Air Dispersion Modeling

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

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

☒ Flow Diagram or date of previous submittal: Attachment C & D

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.

Proposed Permit Conditions:

Within 60 days of the installation of the equipment and its commencement of operations, the Permittee shall initially test performance of System 1 (SYS 1) and System 2 (SYS2) to confirm ethylene oxide removal efficiency of at least 99% on a concentration basis or less than or equal to 26.4 µg/m3 for SYS 1 and 192.1 µg/m3 for SYS 2 at the system outlets.

Removal efficiency across each system (SYS 1 and SYS2) shall be demonstrated on a concentration reduction basis using simultaneous samples of inlet and outlet gases by Summa Canisters using EPA Method T0-15 with analysis by GC/MS in the Selective Ion Monitoring (SIM) acquisition mode.

During sampling of the inlet and outlet concentrations across each system, the outlet stack airflows will be measured using EPA Methods 1, 2, and 4 for determination of volumetric flow rate and moisture content, and calculation of mass emission rate of EO. The above testing will be repeated annually or, for the impacted system, in the event of a major system modification or following media changeout.

After the initial performance tests, the Permittee will assure effective ongoing performance of SYS1 and SYS2 by conducting a monthly sampling of the stack outlet gases from SYS 1 and SYS 2 to verify measured concentrations of EO are less than or equal to 26.4 µg/m3 for SYS 1 and 192.1 µg/m3 for SYS 2. The concentration sampling duration shall be 24 hours. If the measured exhaust concentration from either unit exceeds the specified maximum, the Permittee will replace the dry bed media in each unit of the respective system within 30 days of receipt of such sampling results.

Note: The stack exhaust concentrations for SYS1 and SYS2 will ensure that the BD Madison facility's emissions result in predicted modeled impacts from the facility below the EPA-derived 100-in-1,000,000 risk threshold level within the closest residential areas, based on the computer dispersion modeling results demonstrated in Attachment H ("EPA-Derived Risk Value"). The EO outlet concentrations were determined based on the stack exhaust flow rates and mass emission rates for SYS 1 and SYS 2 and the RTO.

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: BD Madison **Date of Application:** 12 February 2021

FORM 2.00 – EMISSION UNIT LIST

Emission Unit ID	Name	Manufacturer and Model Number	Description
VRM1	Vessel Room 1	N/A	Dedicated Room for Sterilization Chamber 1
VRM2	Vessel Room 2	N/A	Dedicated Room for Sterilization Chamber 2
VRM3	Vessel Room 3	N/A	Dedicated Room for Sterilization Chamber 3
VRM4	Vessel Room 4	N/A	Dedicated Room for Sterilization Chamber 4
VRM5	Vessel Room 5	N/A	Dedicated Room for Sterilization Chamber 5
VRM6	Vessel Room 6	N/A	Dedicated Room for Sterilization Chamber 6
VRM7	Vessel Room 7	N/A	Dedicated Room for Sterilization Chamber 7
WIP1	Work in Progress	N/A	Common area where sterilized product is stored prior to shipment
UCO1	Vessel to Aeration Transfer 1	N/A	Common corridor between Vessel Rooms 1-5 and Aeration Cells
UCO2	Vessel to Aeration Transfer 2	N/A	Corridor between Vessel Room 7 and Aeration Cell 7
DRM1	EO Dispensing 1	N/A	Dedicated Room for Dispensing EO from supply drums to Vessels #1- #6
DRM2	EO Dispensing 2	N/A	Dedicated Room for Dispensing EO from supply drums to Vessel #7
WIP1	Work in Progress	N/A	Common area where sterilized product is stored prior to shipment

Facility Name: BD Madison **Date of Application:** 12 February 2021

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	
SYS1	VRM1	Dry Beds	June 2020	Advanced Air Technologies, DR490	No	70	70	2,000-10,000
SYS1	VRM2	Dry Beds	June 2020	Advanced Air Technologies, DR490	No	70	70	2,000-10,000
SYS1	VRM3	Dry Beds	June 2020	Advanced Air Technologies, DR490	No	70	70	4,000-10,000
SYS1	VRM4	Dry Beds	June 2020	Advanced Air Technologies, DR490	No	70	70	4,000-10,000
SYS1	VRM5	Dry Beds	June 2020	Advanced Air Technologies, DR490	No	70	70	4,000-10,000
SYS1	VRM6	Dry Beds	June 2020	Advanced Air Technologies, DR490	No	70	70	4,000-10,000
SYS1	VRM7	Dry Beds	June 2020	Advanced Air Technologies, DR490	No	70	70	1,000-2,500
SYS1	UCO1	Dry Beds	June 2020	Advanced Air Technologies, DR490	No	70	70	3,000
SYS1	UCO2	Dry Beds	June 2020	Advanced Air Technologies, DR490	No	70	70	3,000
SYS1	DRM1	Dry Beds	June 2020	Advanced Air Technologies, DR490	No	70	70	2,000-8,000
SYS1	DRM2	Dry Beds	June 2020	Advanced Air Technologies, DR490	No	70	70	200-1,000
SYS2	WIP1	Dry Beds	June 2020	Advanced Air Technologies, DR490	No	70	70	64,000

Facility Name: BD Madison **Date of Application:** 12 February 2021

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	
SYS1	Ethylene Oxide	99%	99%[1]	0.040	Mass Balance	0.0020[2]	Mass Balance	7
SYS2	Ethylene Oxide	99%	99%[1]	0.87	Mass Balance	0.043[2]	Mass Balance	7

[1]Based on initial performance test results.

[2]This value was calculated using the facility's maximum sterilization production rate at 8,760 hours per year (i.e., the PTE). To account for potential reductions in removal efficiency resulting from adsorption of EO by the dry bed media, the existing exit stream emission rate (lb/hr) was calculated using 95% removal rate for SYS1 and SYS2, rather than the 99% achieved at initial testing. The 95% value corresponds with in-stack concentrations at the minimum air flow setpoint determined to result in ground level concentrations at the closest residential receptors to below the EPA-Derived Risk Value (defined above), based on computer dispersion modeling as described in Attachment H.

Facility Name: BD Madison **Date of Application:** 12 February 2021

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
VRM1	SYS1	STK1	Ethylene Oxide	0.00006	0.00006	0.00028	0.00028	Estimate
VRM2	SYS1	STK1	Ethylene Oxide	0.00006	0.00006	0.00028	0.00028	Estimate
VRM3	SYS1	STK1	Ethylene Oxide	0.00006	0.00006	0.00028	0.00028	Estimate
VRM4	SYS1	STK1	Ethylene Oxide	0.00006	0.00006	0.00028	0.00028	Estimate
VRM5	SYS1	STK1	Ethylene Oxide	0.00006	0.00006	0.00028	0.00028	Estimate
VRM6	SYS1	STK1	Ethylene Oxide	0.00006	0.00006	0.00028	0.00028	Estimate
VRM7	SYS1	STK1	Ethylene Oxide	0.00006	0.00006	0.00028	0.00028	Estimate
UCO1	SYS1	STK1	Ethylene Oxide	0.00054	0.00129	0.00238	0.00567	Mass Balance
UCO2	SYS1	STK1	Ethylene Oxide	0.00001	0.00014	0.00002	0.00063	Mass Balance
DMR1	SYS1	STK1	Ethylene Oxide	0.00006	0.00006	0.00028	0.00028	Estimate
DMR2	SYS1	STK1	Ethylene Oxide	0.00006	0.00006	0.00028	0.00028	Estimate
WIP1	SYS2	STK2	Ethylene Oxide	0.01656	0.04332	0.07252	0.18974	Mass Balance

Facility Name: BD Madison **Date of Application:** 12 Feb 2021

FORM 5.00 MONITORING INFORMATION

Emission Unit ID/ APCD ID	Emission Unit/APCD Name	Monitored Parameter		Monitoring Frequency
		Parameter	Units	
VRM1/SYS 1	Vessel Room1/System1	EO Concentration at outlet of SYS1	µg/m^3	Reference Attachment F
VRM2/SYS 1	Vessel Room2/System1	EO Concentration at outlet of SYS1	µg/m^3	Reference Attachment F
VRM3/SYS 1	Vessel Room3/System1	EO Concentration at outlet of SYS1	µg/m^3	Reference Attachment F
VRM4/SYS 1	Vessel Room4/System1	EO Concentration at outlet of SYS1	µg/m^3	Reference Attachment F
VRM5/SYS 1	Vessel Room5/System1	EO Concentration at outlet of SYS1	µg/m^3	Reference Attachment F
VRM6/SYS 1	Vessel Room6/System1	EO Concentration at outlet of SYS1	µg/m^3	Reference Attachment F
VRM7/SYS 1	Vessel Room7/System1	EO Concentration at outlet of SYS1	µg/m^3	Reference Attachment F
UCO1/SYS 1	Vessel to Aeration Transfer/System1	EO Concentration at outlet of SYS1	µg/m^3	Reference Attachment F
UCO2/SYS 1	Vessel to Aeration Transfer/System1	EO Concentration at outlet of SYS1	µg/m^3	Reference Attachment F
DMR1/SYS 1	EO Dispensing/System1	EO Concentration at outlet of SYS1	µg/m^3	Reference Attachment F
DMR2/SYS 1	EO Dispensing/System1	EO Concentration at outlet of SYS1	µg/m^3	Reference Attachment F
WIP1/SYS2	Work in Progress/System2	EO Concentration at outlet of SYS2	µg/m^3	Reference Attachment F

Comments:

Monitoring detail described in attachment F

Facility Name: BD Madison **Date of Application:** 12 February 2021

FORM 6.00 – FUGITIVE EMISSION SOURCES

Fugitive Emission Source ID	Description of Source	Emission Reduction Precautions	Pot. Fugitive Emissions	
			Amount (tpy)	Pollutant
FUG1	Potential fugitive pipe loss	Leak Detection and Repair program (LDAR)	2.35 E-05	HAP

Facility Name: BD Madison **Date of Application:** 12 February 2021

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
STK1	VRM1, VRM2, VRM3, VRM4, VRM5, VRM6, VRM7, UCO1, UCO2, DMR1, DMR2,	100	3.83	To the Sky[1]	23	50	33.5	70	23,200	36,000
STK2	WIP1	100	5.17	To the Sky[1]	23	50	50.9	70	64,000	64,000

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.

n/a

[1] As identified in EPD's options for completing this form.

Facility Name: BD Madison **Date of Application:** 12 February 2021

FORM 7.00 AIR MODELING INFORMATION: Chemicals Data

Chemical	Potential Emission Rate (lb/hr)	Toxicity	Reference	MSDS Attached
Ethylene Oxide CAS#: 71-25-8	0.0486[1]	PEL: 1ppm STEL: 5 ppm See Attachment H for ambient air outside facility	OSHA (29 CFR § 1910.1047) See Attachment H for ambient air outside facility	☐
	[1] From Attachment E page 1			☐
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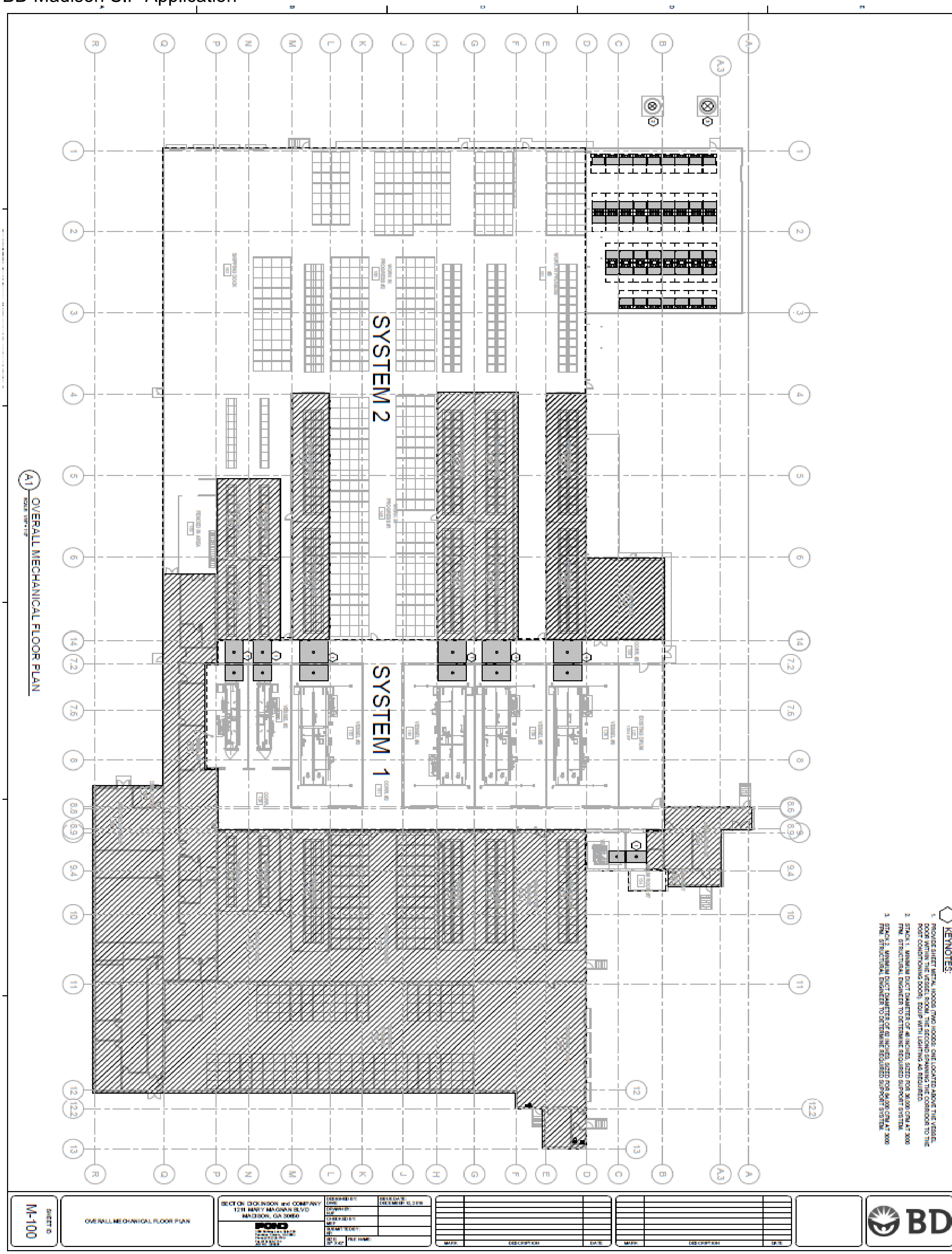

SYSTEM 2
SYSTEM 1
A1 OVERALL MECHANICAL FLOOR PLAN
KEYNOTES:
OVERALL MECHANICAL FLOOR PLAN
M-100
BD

ATTACHMENT B

BD Madison SIP Application

BD Madison SIP Application

BD Madison SIP Application
SYS 1 Description

General Description

The intent of the mechanical systems design upgrade is to capture ethylene oxide (EO) emissions inside the facility not captured by the regenerative thermal oxidizer (RTO) and reduce the potential for releases of these emissions to atmosphere. An effective means of containing emissions is to capture EO at the source. The capture and treatment systems will utilize pressure differential strategies. Using negatively pressurized spaces, extraction will direct air from the lowest EO concentrations to the highest concentrations in the building and then send this exhaust air through an EO removal process. Existing exhaust fans (WIP1) will be replaced with a dedicated EO capture and removal system. Further, the shipping area will be enclosed. The new systems are designed to reduce captured emissions by up to 99% at the outlet as verified in initial testing, and to continually ensure outlet concentrations modeled to be protective of EPA-Derived Risk Value (defined above) of 0.02 µg/m3 at the closest residential receptors as described in Attachment H.

System 1 Description/Flow Diagram

System One (SYS1) will capture potential emissions from the seven Sterilization Vessel Rooms (VRM1, VRM2, VRM3, VRM4, VRM5, VRM6, VRM7), the Vessel to Aeration Transfer Corridors (UCO1, UCO2), and the EO Dispensing Rooms (DRM1, DMR2). All SYS1 exhaust will be manifolded into a Dry Bed System with variable speed exhaust fan with a maximum capacity of 36,000 cfm. The system will maintain negative pressure, with respect to outside, in the Vessel Rooms, Vessel to Aeration Transfer Corridors, Drum Dispensing and use local ventilation exhaust to capture and remove EO.

Normal Mode:

Vessel Rooms (VRM1, VRM2) will exhaust ~2,000, (VRM3-VRM6) will exhaust ~4,000 cfm each, (VRM7) will exhaust ~1,000 cfm, DMR1 will exhaust ~2,000 cfm, DMR2 will exhaust 200 cfm, UC01, UC02 hoods will be off. Total cfm = ~23,200. The other Vessel rooms, DMR1, and NCO1 can increase cfm, to a total of ~36,000 cfm, if monitoring equipment detects elevated EO levels within the vessel rooms.

Chamber Unloading Mode:

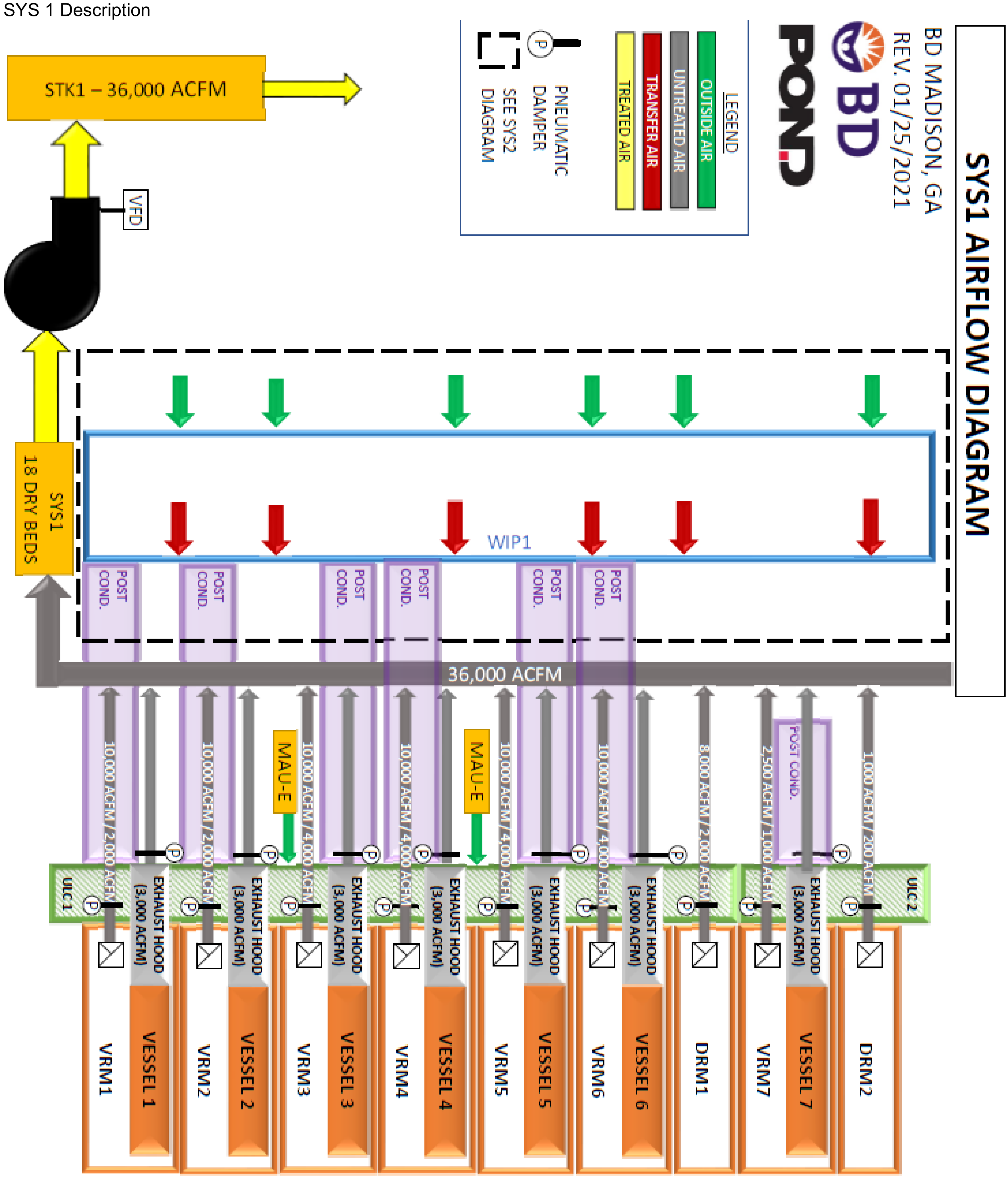
When a chamber is being unloaded the room exhaust will ramp to High Flow ~2,500-10,000 cfm (all other vessel rooms will be at Low Flow (~1,000-4,000 cfm) the corresponding UCO1 or UCO2 hood will go to ~3,000 cfm exhaust (all other hoods will be off). DMR1, DMR2 will remain at ~2000/~200 cfm. Total cfm = ~27,700-34,200 cfm. The other Vessel rooms can increase cfm, to a total of ~36,000 cfm, if monitoring equipment detects elevated EO levels.

Emergency Mode:

SYS1 will also incorporate a safety feature that will serve to shut down the system in the case of a major EO leak (≥25% of LEL or 7,500ppm). The AAT Dry Beds are designed for a maximum limit of 10,000 ppm and can ignite if overfed. An EO sensor will be located in the SYS1 inlet duct and will activate a shutdown sequence based on an internal setpoint. EO emissions will not be captured in this emergency situation. This event will also trigger a sterilization process shutdown. It should be noted that BD has not experienced levels of this magnitude in its twenty-year history and this safety system is being included only to prevent an injury in the event of a catastrophic failure.

ATTACHMENT C

BD Madison SIP Application
SYS 1 Description

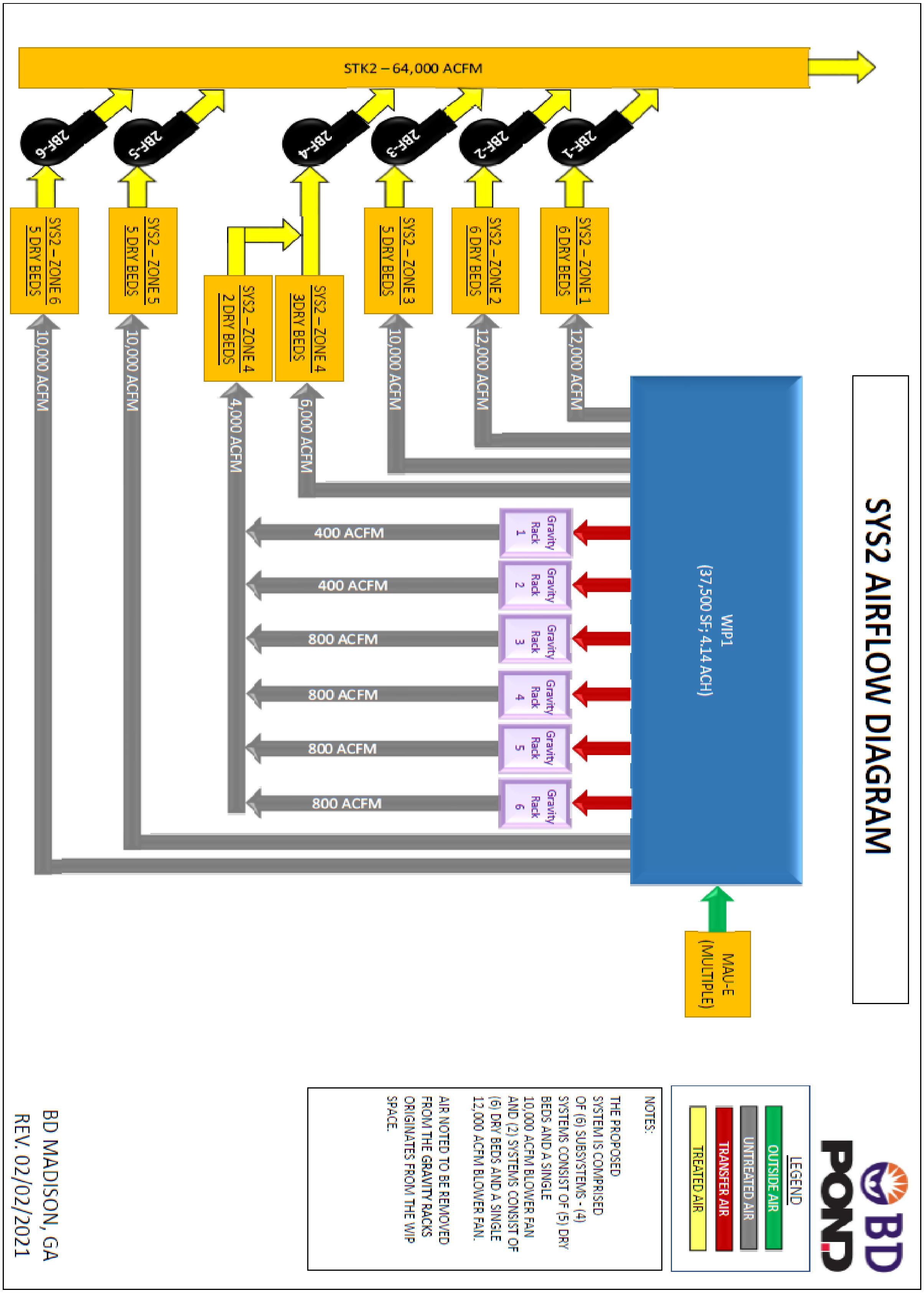


BD Madison SIP Application

System 2 Description/Flow Diagram

System Two (SYS2) will capture emissions from the Work in Progress Area (WIP1) where product is stored after EO sterilization and prior to shipment. All SYS2 exhaust will be manifolded into a single Dry Bed System with multiple variable speed exhaust fans for a capacity of 64,000 cfm. Gravity conveyors within the WIP1 space will be enclosed on three sides and provided designated exhaust ducts within SYS2 to assist in managing indoor air quality for facility employees.

All SYS2 exhaust fans will be routed to a common Stack (STK2). The system will maintain negative pressure, with respect to outside, in the WIP1 area. The area pressure will be monitored with pressure sensors and fans will modulated to maintain a negative pressure in the space. Administrative controls will be implemented to ensure building integrity is preserved, doorways are managed, and air flows/pressures are maintained per design.


SYS2 AIRFLOW DIAGRAM
STK2 – 64,000 ACFM
2BF-1
2BF-2
2BF-3
2BF-4
2BF-5
2BF-6
SYS2 – ZONE 1
6 DRY BEDS
SYS2 – ZONE 2
6 DRY BEDS
SYS2 – ZONE 3
5 DRY BEDS
SYS2 – ZONE 4
3DRY BEDS
SYS2 – ZONE 4
2 DRY BEDS
SYS2 – ZONE 5
5 DRY BEDS
SYS2 – ZONE 6
5 DRY BEDS
12,000 ACFM
12,000 ACFM
10,000 ACFM
6,000 ACFM
4,000 ACFM
10,000 ACFM
10,000 ACFM
WIP1
(37,500 SF; 4.14 ACH)
Gravity Rack 1
Gravity Rack 2
Gravity Rack 3
Gravity Rack 4
Gravity Rack 5
Gravity Rack 6
400 ACFM
400 ACFM
800 ACFM
800 ACFM
800 ACFM
800 ACFM
MAU-E
(MULTIPLE)
BD
POND
LEGEND
OUTSIDE AIR
UNTREATED AIR
TRANSFER AIR
TREATED AIR
NOTES:
THE PROPOSED SYSTEM IS COMPRISED OF (6) SUBSYSTEMS - (4) SYSTEMS CONSIST OF (5) DRY BEDS AND A SINGLE 10,000 ACFM BLOWER FAN AND (2) SYSTEMS CONSIST OF (6) DRY BEDS AND A SINGLE 12,000 ACFM BLOWER FAN.
AIR NOTED TO BE REMOVED FROM THE GRAVITY RACKS ORIGINATES FROM THE WIP SPACE.
BD MADISON, GA
REV. 02/02/2021

ATTACHMENT E		Page 1 of 2			12 February 2021	
Becton, Dickinson and Company						
Mass Balance Calculations for SIP Application **(PTE)**						
Facility:	Madison, GA					
Input data:						
		Cycle Info	Cycle Info[7]	Total		Info for two cycles is shown as they have alternate absorption & aeration factors
Pallets/yr				101,700		Maximum based on full usage 24/7/365
Lb/pallet		[redacted]	[redacted]	n/a		Based on historical usage rates for 24 pallet vessel
Ethylene oxide usage		[redacted]	[redacted]	588,160	lb/yr	Total usage based on Mass Balance
Sterilizer removal efficency[1]		99.9%	99.9%	n/a		Based on partial pressure calculation estimate
RTO efficiency, aeration		99.7%	99.7%	n/a		Based on 2018 Source Test Report Review 25 Jan 18
RTO efficiency, vessels		99.9990%	99.9990%	n/a		Based on 2018 Source Test Report Review 25 Jan 18
Product transfer time, sterilizer to aeration		5	5	n/a	min	
Aeration time		16	16	n/a	hr	16 hrs. is the shortest time; differs by product/cycle
Aeration Unload time		5	5	n/a	min	
System 1 removal efficiency		95%	95%	n/a		Based on modeling results[6]
System 2 removal efficiency		95%	95%	n/a		Based on modeling results[6]
System 1,2 Safety Factor[5]		4.00	4.00	n/a		
Assumptions:						
Product/packaging absorption[2]		[redacted]	[redacted]	n/a		Indicates EO in product/packaging entering aeration
EO lbs/min (per pallet) during transfer from Vessel to Aeration A[3]		[redacted]	[redacted]	n/a	lbs/min	Degassing for transfer from vessel to aeration
% removed Product/Packaging @ 16 hrs HA[3]		[redacted]	[redacted]	n/a	%	Degassing during aeration
EO lbs/min (per pallet) transfer Aeration B to WIP[3]		[redacted]	[redacted]	n/a	lbs/min	Degassing for transfer from aeration to WIP
% EO reduction after 24 hrs in WIP[3]		[redacted]	[redacted]	n/a	%	Degassing in WIP- captures by System 2
Miscellaneous fugitive loss[4]		100	0	100	lb	Estimated - captured in System 1
Leak Detection and Repair (LDAR) related fugitive loss		0.047	0	0.047	lb	Estimated based on LDAR program data
Calculations:						
Sterilizer:						
EO into sterilizers		522,400	65,660	588,060	lb	Total usage based on Mass Balance minus miscellaneous fugitive loss
EO absorbed by product/packaging		10,646.5	1,149.1	11,795.6	lb	
EO in sterilizer not absorbed by product/package		511,753.5	64,511.0	576,264.4	lb	
EO exhausted to RTO from vac/air wash		511,241.7	64,446.4	575,688.1	lb	
EO exhausted to RTO from back vent		511.8	64.5	576.3	lb	
Sterilizer exhaust to RTO		511,753.5	64,511.0	576,264.4	lb	
Sterilizer exhaust removed by RTO		511,748.4	64,510.3	576,258.7	lb	
Sterilizer exhaust to atmosphere after RTO		5.1	0.6	5.8	lb	
LDAR related fugitive loss		0.047	0.000	0.047	lb	
Total sterilizer to atmosphere		5.2	0.6	5.8	lb	
Transfer:						
EO offgas during product transfer to aeration		58.0	5.0	63.0	lb	This will be captured by System 1
Aeration:						
EO remaining in product/package entering aeration		10588.6	1144.0	11,732.6	lb	
Offgas during aeration		6980.0	701.9	7,681.8		
Offgas during unloading		19.8	2.0	21.7		
To RTO during aeration		6980.0	701.9	7,681.8	lb	
To RTO during aeration unload		19.8	2.0	21.7	lb	
Total aeration to RTO		6999.8	703.8	7,703.6	lb	
Aeration removed by RTO		6978.8	701.7	7,680.5	lb	
Aeration exhaust to atmosphere after RTO		21.0	2.1	23.1	lb	
EO entering WIP		3588.8	440.2	4,029.0		EO in product/packaging after aeration
EO offgas in WIP		1650.8	246.5	1,897.4		From product/packaging
System1:						
EO into System 1		331.8	20.1	351.9	lb	Includes Safety Factor
EO removed by System 1		315.2	19.1	334.3	lb	
System 1 exhaust to atmosphere		16.6	1.0	17.6	lb	
	or	0.0019	0.0001	0.0020	lb/hr	
System2:						
EO into System 2		6,603.4	986.1	7,589.5	lb	Includes Safety Factor
EO removed by System 2		6,273.2	936.8	7,210.0	lb	
System 2 EO exhaust to atmosphere		330.2	49.3	379.5	lb.	
	or	0.038	0.006	0.0433	lb/hr	
EO still in product/package @ 24 hrs in WIP		1,937.9	193.7	2,131.6	lb	
Exhausted before Modification:						
EO exhausted to atmosphere from RTO		26.1	2.8	28.9	lb	
EO Exhausted to atmosphere by System 1		331.8	20.1	351.9	lb	Includes Safety Factor
EO Exhausted to atmosphere by System 2		6,603.4	986.1	7,589.5	lb	Includes Safety Factor
Total EO exhausted to atmosphere		6,961.3	1,008.9	7,970.2	lb	Before Modifications
	or	0.79	0.12	0.91	lb/hr	
	or	3.5	0.5	4.0	Tons	
Exhausted after Modification:						
EO exhausted to atmosphere from RTO		26.2	2.8	28.9	lb	
EO Exhausted to atmosphere by System 1		16.6	1.0	17.6	lb	Includes Safety Factor
EO Exhausted by to atmosphere System 2		330.2	49.3	379.5	lb	Includes Safety Factor
Total EO exhausted to atmosphere		372.9	53.1	426.0	lb	After Modifications
	or	0.043	0.006	0.049	lb/hr	
	or	0.19	0.03	0.21	Tons	

Note 1	This estimates how much EO is removed during post exposure vacuum washes but does not include EO in the product at the time it transfers to aeration.
Note 2	Estimates the amount of EO in the product when it starts the transfer to aeration.
Note 3	An estimate based on product EO residue testing performed by BD laboratory personnel and provided to the EPD.
Note 4	An estimate of potential EO emissions from pump/valve packaging losses, flange losses, EO supply drum changes, and non-routine operational events.
Note 5	To be conservative the mass balance calculations include a 4x safety factor. The safety factor was updated from the value used in the previous application based on new information, including stack testing and EO residual studies for pallets and product packaging at Covington. This conservative approach is employed because the manufacturing processes at Covington include a number of variables, such as EO usage rates, processing times, and products sterilized.
Note 6	The 95% value corresponds with in-stack concentrations, at the minimum air flow setpoint, determined to result in ground level concentrations at the closest residential receptors to below the EPA-Derived Risk Value (defined above), based on computer dispersion modeling as described in Attachment H.
Note 7	Information in this column pertains to a specialized sterilization cycle utilized in connection with products of specific quality-control characteristics. The cycle is employed only at the Madison facility and limited to an eight-pallet and one-pallet processing line.

ATTACHMENT E		Page 2 of 2			12Febuary 2021	
Becton, Dickinson and Company						
Mass Balance Calculations for SIP Application **(Actual)**						
Facility:	Madison, GA					
Input data:						
		Cycle Info	Cycle Info[7]	Total		Info for two cycles is shown as they have alternate absorption & aeration factors
Pallets/yr		[redacted]	[redacted]	[redacted]		Based on actual EO usage (CY 2018)
Lb/pallet						Based on historical usage rates for 24 pallet vessel
Ethylene oxide usage					lb/yr	Total usage based on Mass Balance
Sterilizer removal efficency[1]		99.9%	99.9%	n/a		Based on partial pressure calculation estimate
RTO efficiency, aeration		99.7%	99.7%	n/a		Based on 2018 Source Test Report Review 25 Jan 18
RTO efficiency, vessels		99.9990%	99.9990%	n/a		Based on 2018 Source Test Report Review 25 Jan 18
Product transfer time, sterilizer to aeration		5	5	n/a	min	
Aeration time		16	16	n/a	hr	16 hrs. is the shortest time; differs by product/cycle
Aeration Unload time		5	5	n/a	min	
System 1 removal efficiency		95%	95%	n/a		Based on modeling results[6]
System 2 removal efficiency		95%	95%	n/a		Based on modeling results[6]
System 1,2 Safety Factor[5]		4.00	4.00	n/a		
Assumptions:						
Product/packaging absorption[2]		[redacted]	[redacted]	n/a		Indicates EO in product/packaging entering aeration
EO lbs/min (per pallet) during transfer from Vessel to Aeration A[3]		[redacted]	[redacted]	n/a	lbs/min	Degassing for transfer from vessel to aeration
% removed Product/Packaging @ 16 hrs HA[3]		[redacted]	[redacted]	n/a	%	Degassing during aeration
EO lbs/min (per pallet) transfer Aeration B to WIP[3]		[redacted]	[redacted]	n/a	lbs/min	Degassing for transfer from aeration to WIP
% EO reduction after 24 hrs in WIP[3]		[redacted]	[redacted]	n/a	%	Degassing in WIP- captures by System 2
Miscellaneous fugitive loss[4]		100	0	100	lb	Estimated - captured in System 1
Leak Detection and Repair (LDAR) related fugitive loss		0.047	0	0.047	lb	Estimated based on LDAR program data
Calculations:						
Sterilizer:						
EO into sterilizers		198,857	25,774	224,631	lb	Total usage based on Mass Balance minus miscellaneous fugitive loss
EO absorbed by product/packaging		4,052.7	451.0	4,503.8	lb	
EO in sterilizer not absorbed by product/package		194,804.3	25,323.0	220,127.2	lb	
EO exhausted to RTO from vac/air wash		194,609.4	25,297.6	219,907.1	lb	
EO exhausted to RTO from back vent		194.9	25.3	220.2	lb	
Sterilizer exhaust to RTO		194,804.3	25,323.0	220,127.2	lb	
Sterilizer exhaust removed by RTO		194,802.3	25,322.7	220,125.0	lb	
Sterilizer exhaust to atmosphere after RTO		1.9	0.3	2.2	lb	
LDAR related fugitive loss		0.047	0.000	0.047	lb	
Total sterilizer to atmosphere		2.0	0.3	2.2	lb	
Transfer:						
EO offgas during product transfer to aeration		22.1	2.0	24.0	lb	This will be captured by System 1
Aeration:						
EO remaining in product/package entering aeration		4030.6	449.1	4,479.7	lb	
Offgas during aeration		2657.0	275.5	2,932.5		
Offgas during unloading		7.5	0.8	8.3		
To RTO during aeration		2657.0	275.5	2,932.5	lb	
To RTO during aeration unload		7.5	0.8	8.3	lb	
Total aeration to RTO		2664.5	276.3	2,940.8	lb	
Aeration removed by RTO		2656.5	275.4	2,932.0	lb	
Aeration exhaust to atmosphere after RTO		8.0	0.8	8.8	lb	
EO entering WIP		1366.1	172.8	1,538.9		EO in product/packaging after aeration
EO offgas in WIP		628.4	96.8	725.2		From product/packaging
System1:						
EO into System 1		188.3	7.9	196.2	lb	Includes Safety Factor
EO removed by System 1		178.9	7.5	186.3	lb	
System 1 exhaust to atmosphere		9.4	0.4	9.8	lb	
	or	0.0011	0.0000	0.0011	lb/hr	
System2:						
EO into System 2		2,513.6	387.1	2,900.7	lb	Includes Safety Factor
EO removed by System 2		2,388.0	367.7	2,755.7	lb	
System 2 EO exhaust to atmosphere		125.7	19.4	145.0	lb.	
	or	0.014	0.002	0.0166	lb/hr	
EO still in product/package @ 24 hrs in WIP		737.7	76.0	813.7	lb	
Exhausted before Modification:						
EO exhausted to atmosphere from RTO		9.9	1.1	11.0	lb	
EO Exhausted to atmosphere by System 1		188.3	7.9	196.2	lb	Includes Safety Factor
EO Exhausted to atmosphere by System 2		2,513.6	387.1	2,900.7	lb	Includes Safety Factor
Total EO exhausted to atmosphere		2,711.8	396.0	3,107.9	lb	Before Modifications
	or	0.31	0.05	0.35	lb/hr	
	or	1.4	0.2	1.6	Tons	
Exhausted after Modification:						
EO exhausted to atmosphere from RTO		10.0	1.1	11.1	lb	
EO Exhausted to atmosphere by System 1		9.4	0.4	9.8	lb	Includes Safety Factor
EO Exhausted by to atmosphere System 2		125.7	19.4	145.0	lb	Includes Safety Factor
Total EO exhausted to atmosphere		145.1	20.8	165.9	lb	After Modifications
	or	0.017	0.002	0.019	lb/hr	
	or	0.07	0.01	0.083	Tons	

Note 1	This estimates how much EO is removed during post exposure vacuum washes but does not include EO in the product at the time it transfers to aeration.
Note 2	Estimates the amount of EO in the product when it starts the transfer to aeration.
Note 3	An estimate based on product EO residue testing performed by BD laboratory personnel and provided to the EPD.
Note 4	An estimate of potential EO emissions from pump/valve packaging losses, flange losses, EO supply drum changes, and non-routine operational events.
Note 5	To be conservative the mass balance calculations include a 4x safety factor. The safety factor was updated from the value used in the previous application based on new information, including stack testing and EO residual studies for pallets and product packaging at Covington. This conservative approach is employed because the manufacturing processes at Covington include a number of variables, such as EO usage rates, processing times, and products sterilized.
Note 6	The 95% value corresponds with in-stack concentrations, at the minimum air flow setpoint, determined to result in ground level concentrations at the closest residential receptors to below the EPA-Derived Risk Value (defined above), based on computer dispersion modeling as described in Attachment H.
Note 7	Information in this column pertains to a specialized sterilization cycle utilized in connection with products of specific quality-control characteristics. The cycle is employed only at the Madison facility and limited to an eight-pallet and one-pallet processing line.

BD has not identified a US EPA or GA EPD-approved stack test method that will measure the concentrations of fugitive emissions of ethylene oxide (EO), which are expected to be less than 0.2 ppmv, that will enter the dry bed system inlets or the resulting, reduced concentrations of EO at the dry bed system outlets or the combined stacks. For these reasons, BD proposes to demonstrate the control efficiency of the dry bed systems using the following sample collection and analysis methods, which are based on EPA Method TO-15.

Based upon available information, BD anticipates the (EO) concentrations at the inlet and outlet of the proposed systems will be very low (i.e., typically less than 0.2 ppmv) and essentially not reliably detected by standard EPA stack testing methods (e.g., EPA Method No. 18). To overcome this limitation, the approach described below employs a gas sampling technique capable of achieving lower detection limits.

When the inlet and outlet concentrations are close to the limits of detection of the analytical equipment, it becomes mathematically and technically challenging to establish the specified removal efficiency with available technologies. Our intent is to be able to initially confirm a ≥ 99% EO reduction for SYS1 and SYS2 but, given this calculation highly depends on inlet concentration, this is not the most appropriate method to determine ongoing acceptable performance of the control equipment.[1] Outlet concentration monitoring for SYS1 and SYS2 will provide measurable data that the air quality control equipment (SYS1 and SYS2) is operating as intended. The proposed engineering decision value for operation and media change out was determined by dispersion modeling results (attachment H) and selected to meet or remain below the EPA-derived risk factor (0.02 µg/m3) at the closest residential receptors. Our modeling analyses indicates that exhaust concentrations of 26.4 µg/m3 for SYS 1 and 192.1 µg/m3 for SYS 2 at the respective exhaust stack outlet and minimum air flow rates result in predicted modeled impacts that are well below this level at the closest residential receptors. BD proposes that the initial compliance tests and subsequent monthly monitoring of SYS1 and SYS2 as follows:

Initial Compliance Testing:

Within 60 days of the installation of the equipment and its commencement of operations, major system modification, or media change out, BD shall conduct an initial test of the performance of (SYS1) and (SYS2) to confirm ethylene oxide removal efficiency of at least 99% on a concentration basis or EtO emission concentrations less than or equal to 26.4 µg/m3 for SYS 1 and 192.1 µg/m3 for SYS 2 at the system outlets.

Removal efficiency across each system (SYS 1 and SYS2) shall be demonstrated on a concentration reduction basis using simultaneous samples of inlet and outlet gases by Summa Canisters using EPA Method TO-15 with analysis by GC/MS in the Selective Ion Monitoring (SIM) acquisition mode.

During sampling of the inlet and outlet concentrations across System 1 and System 2, the outlet stack airflows will be measured using EPA Methods 1, 2, and 4 for determination of volumetric flow rate and moisture content, and calculation of mass emission rate of EO. The above testing will be repeated annually, for the impacted system, in the event of a major system modification or following media changeout.

<u>Routine Monitoring</u>:

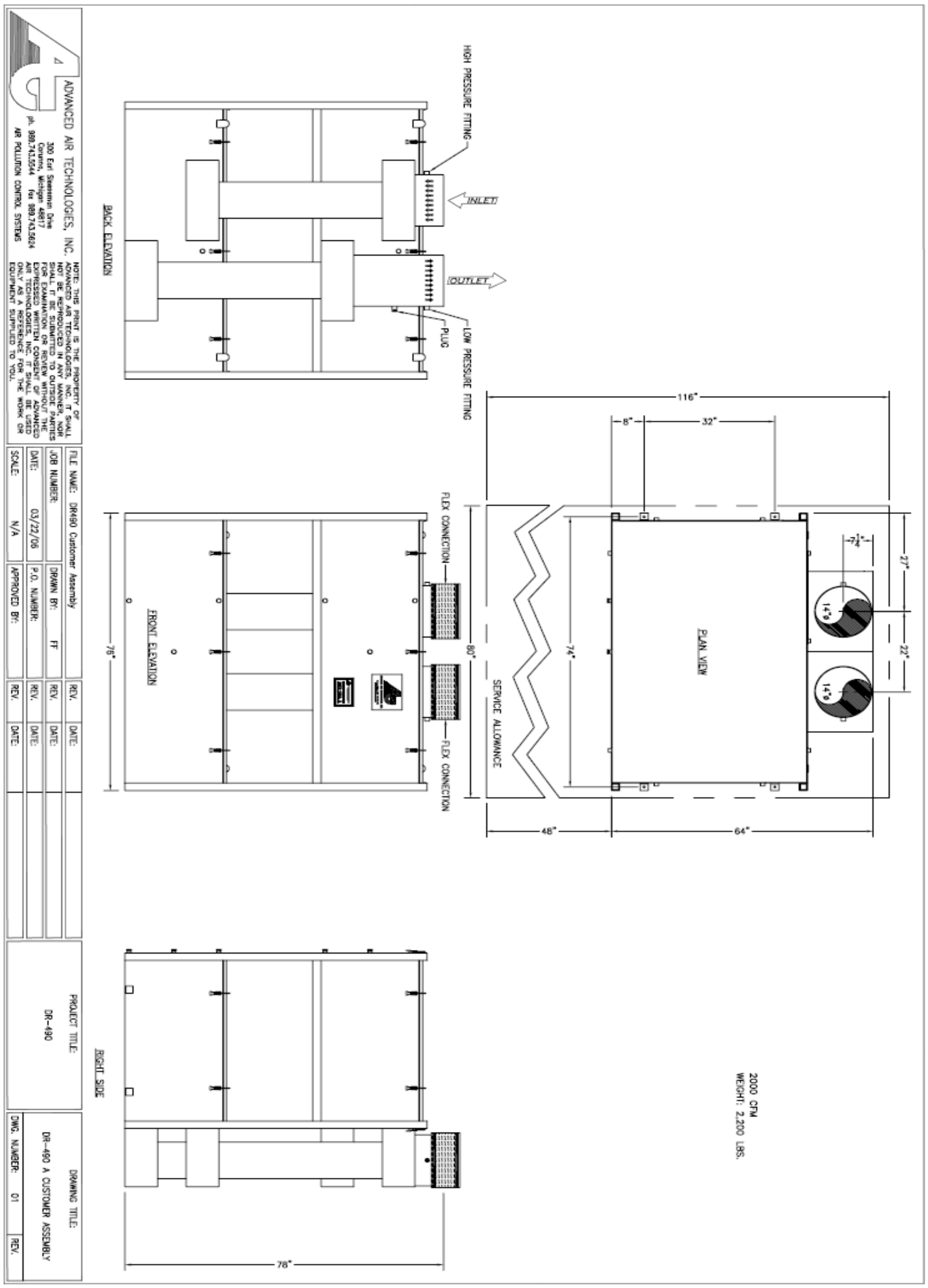
After the initial performance tests, BD will ensure effective ongoing performance of SYS1 and SYS2 by conducting a monthly sampling of the stack outlet gases from SYS 1 and SYS 2 to verify that the measured concentrations of EO are less than or equal to 26.4 $\mu g/m^3$ for SYS 1 and 192.1 $\mu g/m^3$ for SYS 2. The concentration sampling duration shall be 24 hours. If the measured exhaust concentration from either unit exceeds the specified maximum, > 26.4 $\mu g/m^3$ for SYS 1 and > 192.1 $\mu g/m^3$ for SYS 2, BD will replace the dry bed media in each unit of the respective system within 30 days of receipt of such sampling results.

[1]Ambient air quality impact thresholds are concerned with outdoor air exposure. Thus, outlet concentration is a technically more appropriate measure of system performance.

ATTACHMENT G

BD Madison SIP Application

The abatement method is chemisorption (adsorption accompanied by chemical reaction) by means of Advanced Air Technology dry beds containing sulfonated polymer of styrene.



ATTACHMENT H

EXTHYLENE OXIDE EMISSIONS IMPACT ASSESSMENT

BD / Madison Facility

Prepared By:

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December 2020

Project 191101.0280

TABLE OF CONTENTS

1. ETHYLENE OXIDE EMISSIONS IMPACT ASSESSMENT

EPD regulates the emissions of toxic air pollutants (TAPs) through a program approved under the provisions of GRAQC Rule 391-3-1-.02(2)(a)3(ii). A TAP is defined as any substance that may have an adverse effect on public health, excluding any specific substance that is covered by a State or Federal ambient air quality standard. Procedures governing the EPD's review of toxic air pollutant emissions as part of air permit reviews are contained in EPD's *Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions* (the *Guideline*).[1]

This assessment included dispersion modeling for ethylene oxide (EtO) from the Madison facility.

1.1 Modeling Assessment

Modeling conducted was done with the AERMOD (v19191) dispersion model. Meteorological data utilized for the modeling assessment was obtained from the Georgia EPD website, consistent with the meteorological data recommended for use for the location of the subject facility (Morgan County).[2] Meteorological data utilized was processed using AERMET (v19191), AERSURFACE (v20060), and AERMINUTE (v15272) with the adjusted surface friction velocity option (ADJ_U*). Five consecutive years of meteorological data (2015-2019) were utilized in the modeling assessment, with surface meteorological data from the Athens Ben Epps airport and upper air data from Falcon Field in Peachtree City, Georgia. This assessment was performed in accordance with the *Guideline*.

1.1.1 Source Parameters

Ethylene oxide emissions were modeled as point sources from three specific facility stack locations, and fugitive volume sources from several outdoor piping areas at the facility. For point sources, AERMOD requires the stack height (m), inside stack exit diameter (m), temperature (K), and exit gas velocity (m/s) to be specified. Table 1-1 provides a summary of the location and stack parameters used in the dispersion model for the point sources. For volume sources, AERMOD requires the release height (m), and initial lateral (m) and initial vertical (m) dimensions to be entered. The lateral dimension information was derived based on the approximate length of the areas in question, and the vertical dimension was derived based on the building height as these volume sources were elevated sources on or adjacent to a building. Table 1-2 provides a summary of the location and parameters utilized for modeling the fugitive source for this assessment.

The modeled emission rates for facility point sources are based on current facility potential emission estimates. Modeled emission rates for fugitive volume sources was based on data derived from facility LDAR readings, as provided by BD Bard.

[1] *Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions*. Georgia Department of Natural Resources, Environmental Protection Division, Air Protection Branch, Revised, May 2017.

[2] https://epd.georgia.gov/air-protection-branch-technical-guidance-0/air-quality-modeling/georgia-aermet-meteorological-data

Table 1-1. Point Source Parameters

Source	Easting (meter)	Northing (meter)	Modeled Emissions (lb/yr)	Modeled Emissions (lb/hr)	Modeled Emissions (g/s)	Stack Height (ft)	Stack Height (m)	Stack Temperature (F)	Stack Temperature (K)	Exit Velocity (ft/s)	Exit Velocity (m/s)	Flow (acfm)	Stack Diameter (in)	Stack Diameter (m)
RTO	270,841.6	3,716,317.5	29	3.31E-03	4.17E-04	50	15.24	250	394.26	42.6	13.00	32,150	48	1.2192
System 1	270,875.5	3,716,274.0	18	2.05E-03	2.59E-04	100	30.48	70	294.26	33.5	10.21	23,200	46	1.1684
System 2	270,880.5	3,716,278.5	380	4.34E-02	5.47E-03	100	30.48	70	294.26	50.9	15.51	64,000	62	1.5748

Table 1-2. Volume Source Parameters

Source	Easting (meter)	Northing (meter)	Modeled Emissions (lb/yr)	Modeled Emissions (lb/hr)	Modeled Emissions (g/s)	Release Height (ft)	Release Height (m)	Initial Lateral Dimension (m)	Initial Vertical Dimension (m)
FUG1	270,848.3	3,716,317.2	0.047	5.37E-06	6.76E-07	25	7.62	4.65	3.26

1.1.2 Land Use Classification

Classification of land use in the immediate area surrounding a facility is important in determining the appropriate dispersion coefficients to select for a particular modeling application. The selection of either rural or urban dispersion coefficients for a specific application should follow one of two procedures. These include a land use classification procedure or a population-based procedure to determine whether the area is primarily urban or rural. [3]

Of the two methods, the land use procedure is considered more definitive. The land use within the total area circumscribed by a 3-kilometer (km) radius circle around the facility was classified using the land use typing scheme proposed by Auer. If land use types I1 (Heavy Industrial), I2 (Light Industrial), C1 (Commercial), R2 (Residential; Small Lot Single Family & Duplex), and R3 (Residential; Multi-Family) account for 50% or more of the circumscribed area, urban dispersion coefficients should be used; otherwise, rural dispersion coefficients are appropriate.

AERSURFACE (v13016) was used for the extraction of the land-use values in the domain. Although a more recent version of AERSURFACE has been released (v20060) the v13016 version is sufficient for a continued rural/urban determination for the site. The results of the land use analysis evaluation were as follows.

Each USGS NLCD92 land use class was compared to the most appropriate Auer land use category to quantify the total urban and rural area. Table 1-3 summarizes the results of this land use analysis. As approximately 97% of the area can be classified as rural, rural dispersion coefficients were used. The AERSURFACE files are enclosed in Appendix A.

[3] 40 CFR Part 51, Appendix W, the Guideline on Air Quality Models (January 2017) – Section 7.2.1.1(b)(i)

Table 1-3. Summary of Land Use Analysis

USGS NLCD92		Auer Scheme		Rural/ Urban	Land Area
Land Class	**Land Class Description**	**Land Use Type**	**Land Use Description**		
11	Open Water	A5	Water Surfaces/Rivers/Lakes	Rural	0.6%
12	Perennial Ice/Snow	A5	Water Surfaces/Rivers/Lakes	Rural	0.0%
21	Low Intensity Residential	R1	Common Residential	Rural	4.0%
22	High Intensity Residential	R2 and R3	Compact Residential (Single Family, Multi-Family & Duplex)	Urban	0.5%
23	Commercial/Industrial/ Transportation	I1, I2, and C1	Heavy and Light-Moderate Industrial & Commercial	Urban	2.5%
31	Bare Rock/Sand/Clay	A3	Undeveloped	Rural	0.3%
32	Quarries/Strip Mines/Gravel	A4	Undeveloped Rural	Rural	1.0%
33	Transitional	A3	Undeveloped/Uncultivated	Rural	2.0%
41	Deciduous Forest	A4	Undeveloped Rural	Rural	14.8%
42	Evergreen Forest	A4	Undeveloped Rural	Rural	27.7%
43	Mixed Forest	A4	Undeveloped Rural	Rural	11.1%
51	Shrubland	A3	Undeveloped/Uncultivated	Rural	0.0%
61	Orchards/Vineyard/Other	A2	Agricultural Rural	Rural	0.0%
71	Grasslands/Herbaceous	A3	Undeveloped/Uncultivated	Rural	0.0%
81	Pasture/Hay	A2	Agricultural Rural	Rural	24.9%
82	Row Crops	A2	Agricultural Rural	Rural	8.1%
83	Small Grains	A2	Agricultural Rural	Rural	0.0%
84	Fallow	A2	Agricultural Rural	Rural	0.0%
85	Urban/Recreational Grasses	A1	Metropolitan Natural	Rural	2.3%
91	Woody Wetlands	A4	Undeveloped Rural	Rural	0.2%
92	Emergent Herbaceous Wetlands	A4	Undeveloped Rural	Rural	0.0%

1.1.3 Building Downwash

The effects of building downwash for each of the stack emission points were evaluated in terms of the proximity of the stack to nearby structures. The purpose of this evaluation is to determine if stack discharges might become caught in the turbulent wakes of these structures leading to downwash of the plumes. Wind blowing around a building creates zones of turbulence that are greater than if the building were absent.

For these modeling analyses, the direction-specific building dimensions used as input to the AERMOD model were calculated using the U.S. EPA's BPIP PRIME, version 04274. BPIP PRIME is designed to incorporate the concepts and procedures expressed in the GEP Technical Support document, the Building Downwash Guidance document, and other related documents.[4]

For the BPIP analysis, the structure elevations (buildings and stacks) were estimating using the AERMAP processor (v18081). Terrain elevations from the USGS 1-arc second NED were used for AERMAP processing. In all modeling analysis data files, the location of emission points and structures were represented in the UTM coordinate system, zone 17, NAD 83.

EPA has promulgated stack height regulations that restrict the use of stack heights in excess of "Good Engineering Practice" (GEP) in air dispersion modeling analyses. Under these regulations, that portion of a stack in excess of the GEP height is generally not creditable when modeling to determine source impacts. This essentially prevents the use of excessively tall stacks to reduce ground-level pollutant concentrations.

This equation is limited to stacks located within five times the lesser dimension (5L) of a building structure. Stacks located at a distance greater than 5L from a building structure are not subject to the wake effects of the structure. The wind direction-specific downwash dimensions and the dominant downwash structures used in this analysis are determined using BPIP. In general, the lowest GEP stack height for any source is 65 meters by default.[5] The BPIP evaluation indicates that none of the stacks included within the modeling analysis exceed GEP stack height.

Input and output files from the BPIP downwash analysis are provided in the electronic files included in Appendix A.

1.1.4 Receptor Grid Coordinate System

Modeled concentrations were calculated at ground-level receptors placed along the Madison facility fenceline, and on a variable Cartesian receptor grid. Fenceline receptors were spaced no more than 25 meters apart. Beyond the fenceline, receptors were placed with 100 meters spacing on a Cartesian grid extending outward from the facility. An approximately 10 km by 10 km modeling domain with a receptor spacing of 100 meters was created.

Also, six residential receptors, as identified from review of aerial imagery and data reviewed regarding land use classification information (industrial/commercial) from available online information, were also placed within the receptor grid system to provide predicted modeled impacts at the closest residential areas. [6]

Receptor elevations and hill heights required by AERMOD were determined using the AERMAP terrain preprocessor (v18081). Terrain elevations from the USGS 1-arc second NED were used for AERMAP processing. In all modeling analysis data files, the location of receptors was represented in the UTM coordinate system, zone 17, NAD 83.

[4] U.S. EPA, Office of Air Quality Planning and Standards, Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised), Research Triangle Park, North Carolina, EPA 450/4-80-023R, June 1985.

[5] 40 CFR 51.100(ii)

[6] https://qpublic.schneidercorp.com/

1.1.5 Modeling Results

Using the source parameters specified in Table 1-1 and Table 1-2, and additional model setup as described above, AERMOD was executed for each of the five years of meteorological data to determine the maximum predicted modeled 1-hr, 24-hr, and annual concentrations of ethylene oxide at each receptor location. Table 1-4 below summarizes the MGLC for each averaging period. Hourly concentrations were adjusted to a 15-min averaging period based on the Guideline (15-min MGLC = 1-hr MGLC * 1.32).

Table 1-4. Maximum Predicted Modeled Impacts – Madison Facility[7]

Year	Max Annual Concentration (µg/m^3)	Annual AAC (µg/m^3)	Max 24-hr Concentration (µg/m^3)	24-hr AAC (µg/m^3)	Max Hourly Concentration (µg/m^3)	Max 15-min Concentration (µg/m^3)	15-minute AAC (µg/m^3)
2015	8.26E-03		2.37E-01		5.50	7.27	
2016	9.75E-03		2.22E-01		5.31	7.01	
2017	8.30E-03	3.3E-04	3.25E-01	1.43	7.77	10.26	900
2018	8.98E-03		7.70E-02		1.74	2.30	
2019	8.10E-03		8.01E-02		0.38	0.50	

Analyses were also conducted to evaluate predicted modeled impacts at each of six identified residential receptors near the Madison facility. Table 1-5 below summarizes the annual average maximum predicted modeled impacts at the residential receptor locations identified.

Table 1-5. Maximum Predicted Modeled Impacts at Identified Residential Receptors – Madison Facility

Residential Area	Easting (meter)	Northing (meter)	Max Annual Concentration (µg/m^3)	Averaging Period	Annual AAC (µg/m^3)	Ratio of Result to AAC
R1	270,899.4	3,717,756.1	7.80E-04	Annual	3.3E-04	2.36
R2	271,433.0	3,717,474.5	1.03E-03	Annual	3.3E-04	3.12
R3	271,875.7	3,717,411.6	1.61E-03	Annual	3.3E-04	4.88
R4	272,423.9	3,717,211.9	2.31E-03	Annual	3.3E-04	7.00
R5	272,813.0	3,716,885.3	1.78E-03	Annual	3.3E-04	5.39
R6	273,487.2	3,715,958.2	8.90E-04	Annual	3.3E-04	2.70

Predicted modeled impacts demonstrate that modeled risk from ethylene oxide concentrations at identified residential receptors near the Madison facility do not exceed 100-in-a-million for an individual if that person was exposed to that concentration continuously for a lifetime. The 100-in-a-million risk threshold level referenced is the EPA derived individual risk threshold for determining an acceptable level of risk for annual ethylene oxide exposure (0.02 µg/m^3). [8]

[7] Fugitive source predicted modeled impacts do not currently contribute significantly to overall modeled impacts. Based on source contribution results observed from fugitive sources, fugitive emissions would have to significantly increase before residential receptors would be negatively influenced by those sources to change the conclusions of this assessment.

[8] https://epd.georgia.gov/document/document/bd-covington-modeling-memorandum/download

Modeling results reported above correspond to modeled emissions rates equivalent to in-stack concentration values of 26.4 $\mu g/m^3$ of ethylene oxide for the System 1 stack, and in-stack concentration values of 192.1 $\mu g/m^3$ for the System 2 stack. Therefore, monitoring to those concentration values will be protective of maintaining ambient air impacts resultant from the facility to less than the EPA derived 100-in-a-million risk threshold level within the closest residential areas, based on the modeling results demonstrated above. Continued compliance with 40 CFR 63, Subpart O and monitoring of the facility RTO system, as well as facility LDAR monitoring efforts, will also be protective of maintaining ambient air impacts resultant from the facility to less than the EPA derived 100-in-a-million risk threshold level within the closest residential areas, based on the modeling results demonstrated above.

All air dispersion modeling files are included in Appendix A.

APPENDIX A. ELECTRONIC TOXICS MODELING FILES