Maryland
Department of the Environment

Wes Moore, Governor
Aruna Miller, Lt. Governor

Serena McIlwain, Secretary
Suzanne E. Dorsey, Deputy Secretary

SENT VIA E-MAIL CORRESPONDENCE

December 13, 2024

Ms. Karen Melvin, Director
EPA Region 3
Enforcement and Compliance Assurance Division
melvin.karen@epa.gov

Ms. Cristina Fernandez, Director
EPA Region 3
Air and Radiation Division
fernandez.cristina@epa.gov

Dear Director Melvin and Director Fernandez:

I am writing to you on behalf of the Maryland Department of the Environment's Air and Radiation Administration (ARA) to request an applicability determination regarding a proposed pilot plant to be located in Howard County, Maryland and the Standards of Performance for Other Solid Waste Incineration (OSWI) Units for Which Construction is Commenced After December 9, 2004, or for Which Modification or Reconstruction is Commenced on or After June 16, 2006 at 40 CFR 60, Subpart EEEE.

Background

On September 21, 2023 W.R. Grace & Co.-Conn ("Grace") submitted an air quality application for a permit to construct a new pilot plant in Howard County, MD. The pilot plant will be used to research the scaling up of an innovative process to convert 1 kg/hr of plastics back to their original components. The reactor in this proposed process will use a catalyst and heat in the form of steam to carry out this reaction. The product from the reactor is a vapor. The vapor is sent via pipe to a condenser. The vapor that is liquified in the condenser is the product, which is then stored in drums. The drums are sent off site for disposal once data is collected. Non-condensables from the condenser are sent via pipe to an electric flameless thermal oxidizer to control any VOC that may be present in the gas stream.

The project will have two phases of testing. In the first phase, the feed will consist of virgin plastic pellets from commercial suppliers. Grace plans to use a variety of types of pellets to assess the potential reaction products from different types of plastics. In addition, Grace may also add non-hazardous materials, such as calcium carbonate, to test the impact of these materials on the reaction output. If the results of the first phase indicate that the process is technologically feasible and commercially viable, Grace hopes to conduct a second phase of the project to test recycled plastics. The pilot plant can not directly process plastic waste. During the second phase of the project, Grace will need to clean and pelletize recycled plastic or purchase cleaned, pelletized recycled plastic.

The process in the pilot plant reactor is a catalytic chemical conversion, or catalytic pyrolysis. 40 CFR, Part 60, Subpart EEEE includes pyrolysis units as OSWI units by definition. The reactor in the proposed Grace pilot plant would be subject to the requirements of 40 CFR 60, Subpart EEEE as a pyrolysis unit unless otherwise exempt.

Laboratory Analysis Unit Exemption

40 CFR §60.2887 lists combustion units that are exempt from Subpart EEEE. Specifically, §60.2887(j) states the following:

"Laboratory Analysis Units. Your unit is excluded if it burns samples of materials only for the purpose of chemical or physical analysis."

Grace's proposed pilot plant only serves to gather and analyze data for research. There is no product being manufactured for sale from this operation. This is further detailed in the air quality permit to construct application, enclosed as Appendix A, and supplemental letter submitted by Grace, enclosed as Appendix B. ARA requests a determination from EPA regarding whether the proposed pilot plant's pyrolysis unit is exempt from 40 CFR 60, Subpart EEEE as a laboratory analysis unit.

Furthermore, Grace's proposed pilot plant will use both virgin plastic pellets and recycled plastic pellets as raw materials for their process. 40 CFR 60, Subpart EEEE applies to OSWI units if the units combust municipal solid waste. Virgin pellets are not solid waste, and as such the first phase of the project is exempt from the requirements of 40 CFR 60, Subpart EEEE. If the pilot plant's pyrolysis unit is not exempt from Subpart EEEE as a laboratory analysis unit, it is necessary to determine if the pellets used in the second phase of the project meet the definition of municipal solid waste.

Non-Solid Waste Exemption

In order to determine if the pellets originating from recycled material meet the definition of municipal solid waste, a review of the RCRA rules for Non-Hazardous Secondary Materials (NHSM) is required. Although many EPA guidelines refer to the use of NHSM as fuel, this does not directly apply to the Grace pilot plant. The recycled pellets will be used as an ingredient, not a fuel, in the proposed process.

Examining 40 CFR §241.3, *Standards and procedures for identification of non-hazardous secondary materials that are solid wastes when used as fuels or ingredients in combustion units,* §241.3(b)(3) states that NHSM used as an ingredient in a combustion unit that meet the legitimacy criteria of §241.3(d)(2), listed below, are not solid wastes when combusted.

"Legitimacy criteria for non-hazardous secondary materials used as an ingredient in combustion units include the following:

(i) The non-hazardous secondary material must be managed as a valuable commodity based on the following factors:

   (A) The storage of the non-hazardous secondary material prior to use must not exceed reasonable time frames;

   (B) Where there is an analogous ingredient, the non-hazardous secondary material must be managed in a manner consistent with the analogous ingredient or otherwise be adequately contained to prevent releases to the environment;

   (C) If there is no analogous ingredient, the non-hazardous secondary material must be adequately contained to prevent releases to the environment;

(ii) The non-hazardous secondary material must provide a useful contribution to the production or manufacturing process. The non-hazardous secondary material provides a useful contribution if it contributes a valuable ingredient to the product or intermediate or is an effective substitute for a commercial product.

(iii) The non-hazardous secondary material must be used to produce a valuable product or intermediate. The product or intermediate is valuable if:

(A) The non-hazardous secondary material is sold to a third party, or

(B) The non-hazardous secondary material is used as an effective substitute for a commercial product or as an ingredient or intermediate in an industrial process.

(iv) The non-hazardous secondary material must result in products that contain contaminants at levels that are comparable in concentration to or lower than those found in traditional products that are manufactured without the non-hazardous secondary material."

Although the pellets originated from recycled materials, they are cleaned and re-processed to be used as a feedstock. The pellets have not been discarded or abandoned in a landfill and are expected to be processed in the pilot plant in a reasonable amount of time. The pellets from recycled material will be handled in the same way as the analogous virgin plastic pellets. The pellets will be used as the primary ingredient of the proposed process, providing an essential and useful contribution as a research feedstock.

The process intends to reduce the pellets to the original components of plastic and would only contain contaminants comparable to those found in traditional plastic. If the pilot plant's pyrolysis unit is not exempt from Subpart EEEE as a laboratory analysis unit, ARA requests a determination from EPA regarding whether the recycled plastic pellets used in proposed pilot plant's pyrolysis unit qualify as a NHSM used as an ingredient and therefore, not subject to the requirements of 40 CFR 60, Subpart EEEE.

Thank you for your consideration of this request. Should you have any questions regarding this letter, please contact me at 410-537-4129 or by email at suna.sariscak@maryland.gov.

Sincerely,

Suna Yi Sariscak

Suna Yi Sariscak, Manager
Air Quality Permits Program
Air and Radiation Administration

cc: Kris Hall, Chief Air Section, Air and RCRA Branch, Enforcement & Compliance Assurance Division, EPA Region 3

Mary Cate Opila, Air Permits Branch Manager, EPA Region 3

Enclosures

APPENDIX A

W.R. Grace &Co.-CONN
Air Quality Permit to Construct Application
Received September 2023 and
Revised January 2024

August 3, 2023

Suna Yi Sariscak, Manager
Air Quality Permits Program
Maryland Department of the Environment
Air and Radiation Management Administration
1800 Washington Boulevard, Suite 720
Baltimore, Maryland 21230-1720
MDE.Submit-AirPermits@maryland.gov

Re: Permit to Construct (PTC) Application to Install Research Pilot Scale Test Catalytic Chemical Conversion of Plastics Process

Dear Ms. Sariscak:

W.R. Grace & Company – Conn. (Grace) is submitting this PTC application to construct a research pilot scale test catalytic chemical conversion of plastics process at the Columbia, Maryland facility. This test process will use Grace's innovative catalyst technology to convert commercially available plastic pellets into potentially usable energy-containing liquids and gas. This test process will evaluate the desired new technologies including catalyst and process conditions as well as resultant liquid/gas properties for research and development purposes only. As presented in the PTC application the reactor gases will be controlled by a very high efficiency electric, flameless thermal oxidizer prior to exhausting to the atmosphere. Atmospheric emissions from this test process will be low.

Enclosed are the completed MDE Forms 5, 5EP, 5T and 6, supporting flow diagram, plot plans and emissions calculations, and a TAP compliance demonstration.

Your prompt attention to our application would be appreciated. Grace would like to request a meeting/call with you in the next few weeks to discuss our planned process and to answer any initial questions you may have on our application. If you need anything additional or have any questions, do not hesitate to contact me at 410-531-4570 or at daniel.resca@grace.com.

Sincerely,

Recoverable Signature

X Daniel Resca

Daniel Resca
Project Manager
Signed by: Daniel Resca

Enclosures
Cc:

W. R. Grace & C0.-Conn. Columbia, MD Facility

Application to Install a Research Pilot Scale Test Catalytic Chemical Conversion of Plastics Process

Introduction

W. R. Grace & Co.-Conn.'s (Grace's) research facility located in Columbia, Maryland performs research and development (R&D) activities involving proprietary processes and materials. Grace proposes to install, in Building 30, a pilot-scale test catalytic chemical conversion process (the Project), using Grace's innovative catalyst technology, to convert commercially available plastics pellets into potentially usable energy-containing liquids and gas. This proposed pilot plant will be used to evaluate the desired new technologies including catalyst and process conditions as well as resultant liquid/gas properties for research and development only.

The following comprises the application for a permit-to-construct (PTC) the proposed Project, and includes a project description as well as several attachments, namely:

Attachment 1 Simplified Process Flow Diagram

Attachment 2 List of Key Project Equipment

Attachment 3 Site Plan

Attachment 4 MDE PTC Application Checklist and Forms 5, 5T, 5EP (two) and 6

Attachment 5 Emissions – Calculations, Engineering Estimates and Assumptions

Attachment 6 TAP Compliance Demonstration

Attachment 7 Safety Data Sheet of Example Plastic Feedstock

Attachment 8 Vendor Information for Electric Flameless Thermal Oxidizer

Project Description

The proposed Project will involve four key systems: 1) reaction; 2) product recovery; 3) catalyst circulation/regeneration; and 4) steam generation. Attachment 1 is a simplified process flow diagram of the proposed Project.

The proposed Project is designed to process 1 kg/hr of commercially available plastic pellet feedstock (the benchmark feedstock can be 100% homogeneous polypropylene (PP). However, a typical mixed plastic also can include low density polyethylene (LDPE), high density polyethylene (HDPE), polyethylene terephthalate (PET), polystyrene (PS), polyvinyl chloride (PVC), and others). The plastic feedstock will be manually transferred to a feed system that

meters the feedstock into the reaction system. The catalytic chemical conversion reaction occurs at high temperature, in an oxygen-free environment. A catalyst circulation/regeneration system will be used to supply fresh and regenerated catalyst to the reaction system as well as supply heat required for the reaction. The catalytic chemical conversion reaction produces a product vapor comprised of non-condensable gas and condensable liquid. Residual catalyst in the product vapor will be recovered by a process cyclone and returned to the reactors. Then, the product vapor will go through a product recovery system involving vapor condensation and gas/liquid separation. The separated non-condensable gas will go through an electric flameless thermal oxidizer prior to venting to the atmosphere. The separated condensed liquid will be collected in two, 3-gal tanks. The collected liquid will be transferred, daily, to 55-gal drums in the warehouse, and ultimately shipped to a 3rd party waste treatment facility.

Spent catalyst from the reaction system will go through a steam stripper, then transferred with N_2 gas to the top of the catalyst regenerator. Combustion air will be introduced to the regenerator to burn off the spent catalyst coke. The regenerator is designed to provide excess air sufficient for complete combustion. Hot, regenerated catalyst is withdrawn from the regenerator and transferred, through risers, back to the reaction system with steam and N_2 gas. As mentioned above, the hot regenerated catalyst provides the heat for the reaction. Electric heating at the regenerator, the transfer lines to the risers, and the risers will heat the catalyst transferred from the regenerator to the reaction system and will be the prime source of heat during process startup. Regenerator hot combustion flue gas will be treated prior to venting to the atmosphere. The flue gas will go through a knock-out filter pot (to remove residual catalyst) and a gas/liquid separator (to remove water and cool the gas).

Steam used in the proposed process will be produced by electric steam generating units.

Being a pilot scale test installation for research and development there will be handling of samples of gas and liquid products, feedstock and catalyst for testing/analysis all at bench scale.

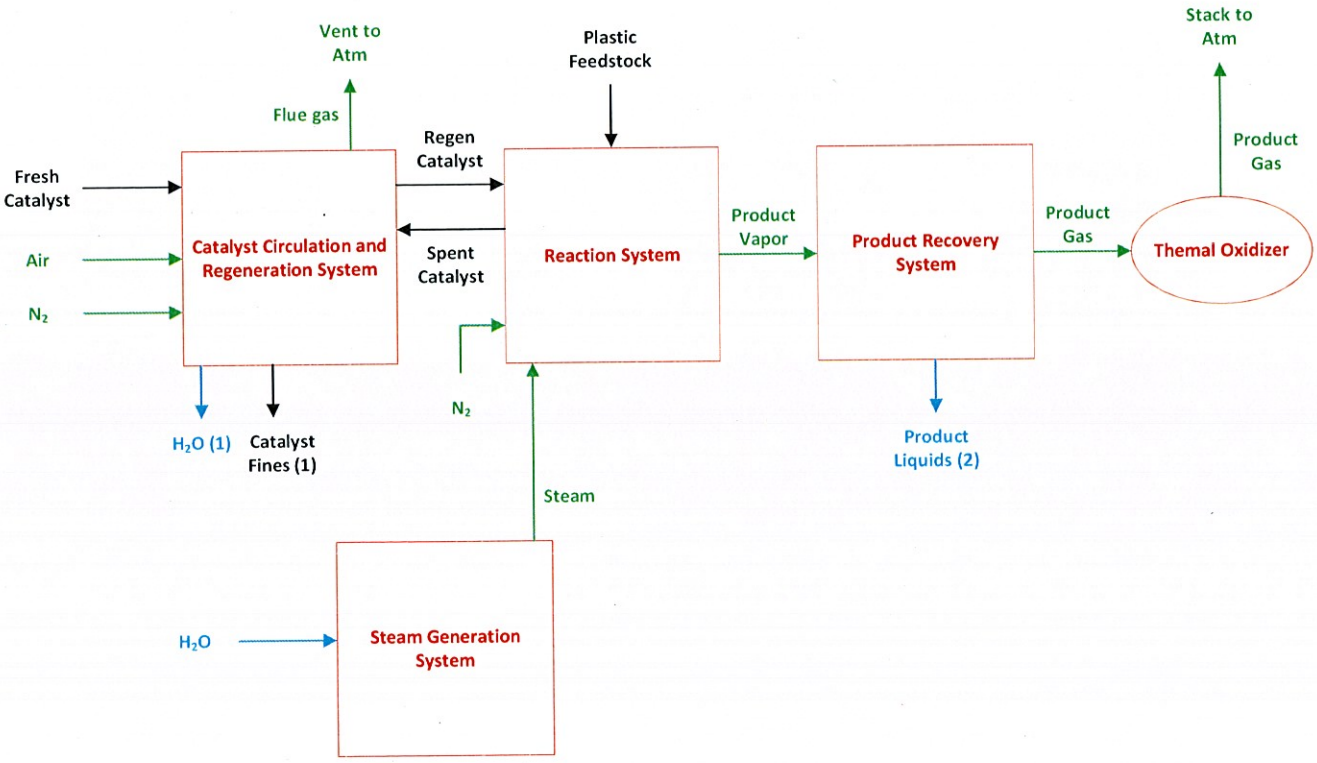
Attachment 2 lists the key process equipment proposed for the Project.

The proposed installation is scheduled to operate over two shifts on a given workday, with start-up activities, continuous reactor operation, shut-down activities and regular maintenance all occurring over 16 hours. Yearly operation is expected to be less than or equal to 4000 hr/yr.

ATTACHMENT 1

Simplified Process Flow Diagram

Simplified Process Flow Diagram for Proposed Research Pilot Scale Test Catalytic Chemical Conversion Process



Notes:
(1) Non-hazardous waste disposal
(2) Transfer to 3rd party treatment facility

ATTACHMENT 2

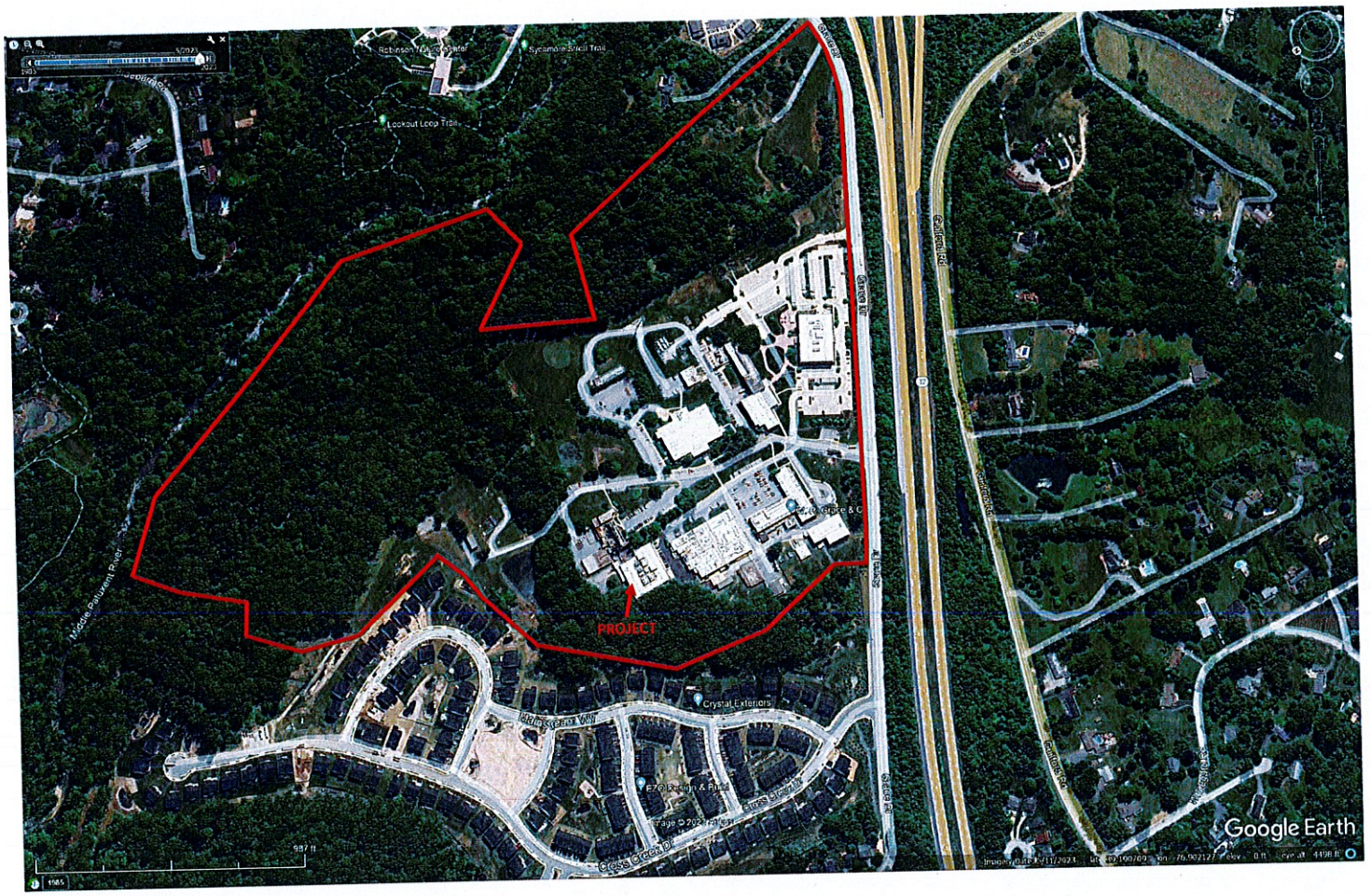
List of Key Project Equipment

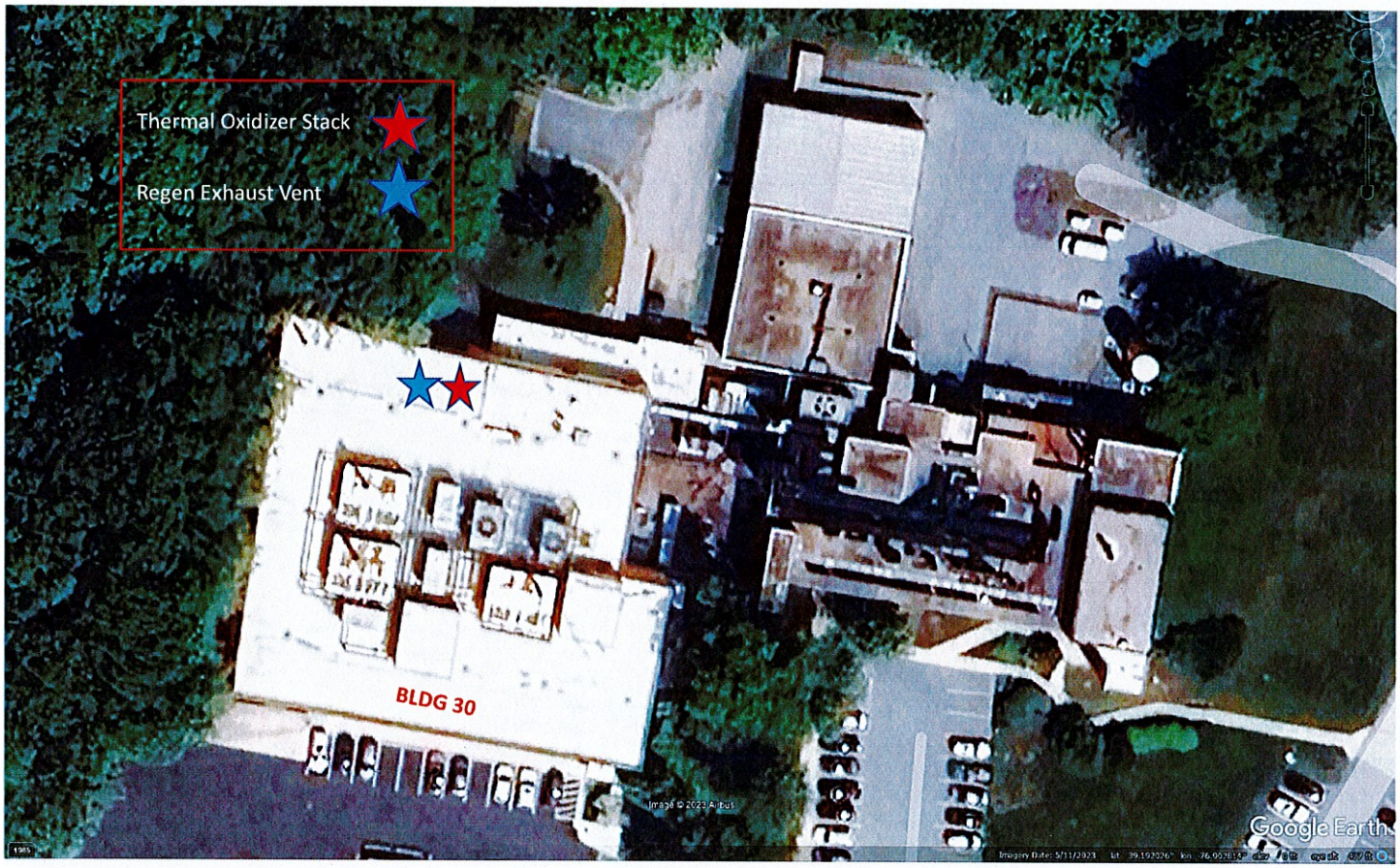
List of Key Equipment for Planned Project

- Reactors and risers
- Reactor gas cyclone
- Reactor gas stabilization column
- Electric flameless thermal oxidizer
- Spent catalyst stripper
- Spent catalyst regenerator
- Steam generators
- Associated hoppers, vessels/tanks, heat exchangers, coolers, electric heating units, conveyance systems, piping, analyzers and instrumentation

ATTACHMENT 3

Site Plan


PROJECT
Middle Patuxent River
Lookout Loop Trail
Sycamore Stroll Trail
Crystal Exteriors
Google Earth


Thermal Oxidizer Stack
Regen Exhaust Vent
BLDG 30
Image © 2023 Airbus
Google Earth

ATTACHMENT 4

MDE PTC Application Checklist and Forms 5, 5T, 5EP (two) and 6

AIR QUALITY PERMIT TO CONSTRUCT APPLICATION CHECKLIST

OWNER OF EQUIPMENT/PROCESS	
COMPANY NAME:	W.R. Grace & Co - Conn
COMPANY ADDRESS:	7500 Grace Drive, Columbia, MD 21044
LOCATION OF EQUIPMENT/PROCESS	
PREMISES NAME:	W.R. Grace Corporate Headquarters
PREMISES ADDRESS:	7500 Grace Drive, Columbia, MD 21044
CONTACT INFORMATION FOR THIS PERMIT APPLICATION	
CONTACT NAME:	Dan Resca
JOB TITLE:	Project Manager, Columbia
PHONE NUMBER:	410-531-4570
EMAIL ADDRESS:	daniel.resca@grace.com
DESCRIPTION OF EQUIPMENT OR PROCESS	
Catalytic Chemical Conversion of Plastics R&D Process	

Application is hereby made to the Department of the Environment for a Permit to Construct for the following equipment or process as required by the State of Maryland Air Quality Regulation, COMAR 26.11.02.09.

Check each item that you have submitted as part of your application package.

☒ Application package cover letter describing the proposed project

☒ Complete application forms (Note the number of forms included or NA if not applicable.)

No. 1 Form 5
No. 1 Form 5T
No. 2 Form 5EP
No. 1 Form 6
No. _____ Form 10
No. _____ Form 11
No. _____ Form 41
No. _____ Form 42
No. _____ Form 44

☒ Vendor/manufacturer specifications/guarantees

☒ Evidence of Workman's Compensation Insurance

☒ Process flow diagrams with emission points

☒ Site plan including the location of the proposed source and property boundary

☒ Material balance data and all emissions calculations

☒ Material Safety Data Sheets (MSDS) or equivalent information for materials processed and manufactured.

☐ Certificate of Public Convenience and Necessity (CPCN) waiver documentation from the Public Service Commission (1)

☐ Documentation that the proposed installation complies with local zoning and land use requirements (2)

(1) Required for emergency and non-emergency generators installed on or after October 1, 2001 and rated at 2001 kW or more.

(2) Required for applications subject to Expanded Public Participation Requirements.

MARYLAND DEPARTMENT OF THE ENVIRONMENT
Air and Radiation Management Administration ▪ Air Quality Permits Program
1800 Washington Blvd ▪ Baltimore, Maryland 21230
(410) 537-3230 ▪ 1-800-633-6101 ▪ www.mde.state.md.us

APPLICATION FOR FUEL BURNING EQUIPMENT

Information Regarding Public Outreach

For Air Quality Permit to Construct applications subject to public review, applicants should consider the following information in the initial stages of preparing a permit application.

If you are not sure at the time you are applying for a permit whether public review of your application is required or for information on steps you can take to engage the surrounding community where your planned project will be located, please contact the Air Quality Permits Program at 410-537-3225 and seek their advice.

Communicating and engaging the local community as early as possible in your planning and development process is an important aspect of your project and should be considered a priority. Environmental Justice or "EJ" is a movement to inform, involve, and engage communities impacted by potential and planned environmental projects by affording citizens opportunities to learn about projects and discuss any concerns regarding impacts.

Although some permit applications are subject to a formal public review process prescribed by statute, the Department strongly encourages you to engage neighboring communities separate from and well ahead of the formal permitting process. Sharing your plans by way of community meetings, informational outreach at local gatherings or through local faith-based organizations can initiate a rewarding and productive dialogue that will reduce anxiety and establish a permanent link with your neighbors in the community.

All parties benefit when there is good communication. The Department can assist applicants in developing an outreach plan that fits the needs of both the company and the public.

MARYLAND DEPARTMENT OF THE ENVIRONMENT

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Air and Radiation Management Administration ▪ Air Quality Permits Program

APPLICATION FOR PROCESSING/MANUFACTURING EQUIPMENT

Permit to Construct ☑ Registration Update ☐ Initial Registration ☐

1A. Owner of Equipment/Company Name
W.R. Grace & Company - Conn.

Mailing Address
7500 Grace Drive
Street Address

Columbia | Maryland | 21044
City | State | Zip

Telephone Number
(410) 531-8300

Signature

Matt Meixell, Facilities Site Manager
Print Name and Title

8/4/2023
Date

DO NOT WRITE IN THIS BLOCK
2. REGISTRATION NUMBER

County No. (1-2) | Premises No. (3-6)
Registration Class (7) | Equipment No. (8-11)
Data Year (12-13) | Application Date

1B. Equipment Location and Telephone Number (if different from above)
Same as above
Street Number and Street Name

City/Town | State | Zip | ( ) Telephone Number

Premises Name (if different from above)

3. Status (A= New, B= Modification to Existing Equipment, C= Existing Equipment)

Status	New Construction Begun (MM/YY)	New Construction Completed (MM/YY)	Existing Initial Operation (MM/YY)
A	0124	0824	
15	16-19	20-23	20-23

4. Describe this Equipment: Make, Model, Features, Manufacturer (include Maximum Hourly Input Rate, etc.)
Research-scale catalytic chemical conversion of plastics process for Research & Development

5. Workmen's Compensation Coverage 792878903 (Binder/Policy Number) 11/15/2023 (Expiration Date)
Company Zurich American Insurance Company
NOTE: Before a Permit to Construct may be issued by the Department, the applicant must provide the Department with proof of worker's compensation coverage as required under Section 1-202 of the Worker's Compensation Act.

6A. Number of Pieces of Identical Equipment Units to be Registered/Permitted at this Time See Attach 2

6B. Number of Stack/Emission Points Associated with this Equipment 2

7. Person Installing this Equipment (if different from Number 1 on Page 1)

Name _____ Title _____

Company _____

Mailing Address/Street _____

City/Town _____ State _____ Telephone (_____) _____

8. Major Activity, Product or Service of Company at this Location

Research & Development

9. Control Devices Associated with this Equipment

None ☐ 24-0

Simple/Multiple Cyclone	Spray/Adsorb Tower	Venturi Scrubber	Carbon Adsorber	Electrostatic Precipitator	Baghouse	Thermal/Catalytic Afterburner	Dry Scrubber
☐ 24-1	☐ 24-2	☐ 24-3	☐ 24-4	☐ 24-5	☐ 24-6	☐ 24-7	☐ 24-8

Other

☑ Describe Electric flameless thermal oxidizer

24-9

10. Annual Fuel Consumption for this Equipment

OIL-1000 GALLONS	SULFUR %	GRADE	NATURAL GAS-1000 FT^3	LP GAS-100 GALLONS	GRADE
26-31	32-33	34	35-41	42-45	

COAL- TONS	SULFUR %	ASH%	WOOD-TONS	MOISTURE %
46-52	53-55	56-58	59-63	64-65

OTHER FUELS (Specify Type) ☐ 66-1 ANNUAL AMOUNT CONSUMED (Specify Units of Measure)

OTHER FUEL (Specify Type) ☐ 66-2 ANNUAL AMOUNT CONSUMED (Specify Units of Measure)

1= Coke 2= COG 3=BFG 4=Other

11. Operating Schedule (for this Equipment)

Continuous Operation	Batch Process	Hours per Batch	Batch per Week	Hours per Day	Days Per Week	Days per Year
☐ 67-1	☑ 67-2	16 68-69		16 70-71	☐ 72	250 73-75

Seasonal Variation in Operation:

No Variation	Winter Percent	Spring Percent	Summer Percent	Fall Percent	(Total Seasons= 100%)
☑ 76	77-78	79-80	81-82	83-84	

12. Equivalent Stack Innformation- is Exhaust through Doors, Windows, etc. Only? (Y/N) N (85)
See Form 5EP

If not, then	Height Avove Ground (FT)	Inside Diameter at Top	Exit Temperature (°F)	Exit Velocity (FT/SEC)
	86-88	89-91	92-95	96-98

NOTE: See Attach 1 and Attach 3
Attach a block diagram of process/process line, indicating new equipment as reported on this form and all existing equipment, including control devices and emission points.

13. Input Materials (for this equipment only)
Is any of this data to be considered confidential? N (Y or N)

	NAME	CAS NO. (IF APPLICABLE)	INPUT RATE PER HOUR	UNITS	PER YEAR	UNITS
1.	Commercial plastic pellet feedstock		1000	g	4000	kg
2.	Catalyst					
3.						
4.						
5.						
6.						
7.						
8.						
9.						
TOTAL						

14. Output Materials (for this equipment)
Process/Product Stream

	NAME	CAS NO. (IF APPLICABLE)	OUTPUT RATE PER HOUR	UNITS	PER YEAR	UNITS
1.	Gas stream (H2. CO2 C4 hydrocarbons)		647	g	2588	kg
2.	Liquid stream (C5+ organic, H2O, HCl)		320	g	1280	kg
3.	Char		33	g	132	kg
4.						
5.						
6.						
7.						
8.						
9.						
TOTAL						

15. Waste Streams- Solid and Liquid

	NAME	CAS NO. (IF APPLICABLE)	OUTPUT RATE PER HOUR	UNITS	PER YEAR	UNITS
1.	Liquid stream (C5+ organic, H2O HC)		320	g	1280	kg
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
TOTAL						

16. Total Stack Emissions (for this equipment only) in Pounds Per Operating Day

Particulate Matter	Oxides of Sulfur	Oxides of Nitrogen
0.000	0.000	0.011
99-104	105-110	111-116

Carbon Monoxide	Volatile Organic Compounds	PM-10
0.002	0.218	0.000
177-122	123-128	129-134

17. Total Fugitive Emissions (for this equipment only) in Pounds Per Operating Day

Particulate Matter	Oxides of Sulfur	Oxides of Nitrogen
135-139	140-144	145-149

Carbon Monoxide	Volatile Organic Compounds	PM-10
150-154	155-159	160-164

Method Used to Determine Emissions **(1= Estimate 2= Emission Factor 3= Stack Test 4= Other)**

TSP	SOX	NOX	CO	VOC	PM10
4	4	4	4	4	4
165	166	167	168	169	170

AIR AND RADIATION MANAGEMENT ADMINISTRATION USE ONLY

18. Date Rec'd. Local _____ **Date Rec'd. State** _____ **Return to Local Jurisdiction** Date_____ By_____

Reviewed by Local Jurisdiction Date_____ By_____ **Reviewed by State** Date_____ By_____

19. Inventory Date **Month/Year** (171-174) **Equipment Code** (175-177) **SCC Code** (178-185)

20. **Annual Operating Rate** (186-192) **Maximum Design Hourly Rate** (193-199) **Permit to Operate Month** (200-201) **Transaction Date (MM/DD/YR)** (202-207)

Staff Code (208-210) **VOC Code** (211 212) **SIP Code** (213 214) **Regulation Code** (215-218) **Confidentiality** (219)

Point Description (220-238) **Action** (239) A: Add C: Change

MARYLAND DEPARTMENT OF THE ENVIRONMENT
Air and Radiation Management Administration • Air Quality Permits Program
1800 Washington Boulevard • Baltimore, Maryland 21230
(410)537-3225 • 1-800-633-6101• www.mde.maryland.gov

FORM 5EP: Emission Point Data

Complete one (1) Form 5EP for EACH emission point (stack or fugitive emissions) related to the proposed installation.

Applicant Name: W.R. Grace & Company - Conn.

1. Emission Point Identification Name/Number

List the applicant assigned name/number for this emission point and use this value on the attached required plot plan:
TO Stack

2. Emission Point Description

Describe the emission point including all associated equipment and control devices:
Reactor output gas stream controlled by thermal oxidizer

3. Emissions Schedule for the Emission Point

Continuous or Intermittent (C/I)?	I	**Seasonal Variation** Check box if none: ☒ Otherwise estimate seasonal variation:	
Minutes per hour:	60	Winter Percent	
Hours per day:	16	Spring Percent	
Days per week:	5	Summer Percent	
Weeks per year:	50	Fall Percent	

4. Emission Point Information

Height above ground (ft):	59'-1"	Length and width dimensions at top of rectangular stack (ft):	Length:	Width:	
Height above structures (ft):	30'-5"				
Exit temperature (°F):	1600	Inside diameter at top of round stack (ft):		0.833	
Exit velocity (ft/min):	200.4	Distance from emission point to nearest property line (ft):		280	
Exhaust gas volumetric flow rate (acfm):	109.3	Building dimensions if emission point is located on building (ft)	Height 28'-8"	Length 163'	Width 144'

5. Control Devices Associated with the Emission Point

Identify each control device associated with the emission point and indicate the number of devices. ***A Form 6 is also required for each control device***. If none check none:

- ☐ None
- ☐ Baghouse No. _____
- ☐ Cyclone No. _____
- ☐ Elec. Precipitator (ESP) No. _____
- ☐ Dust Suppression System No. _____
- ☐ Venturi Scrubber No. _____
- ☐ Spray Tower/Packed Bed No. _____
- ☐ Carbon Adsorber No. _____
  - ☐ Cartridge/Canister
  - ☐ Regenerative
- ☐ Thermal Oxidizer No. _____
  - ☐ Regenerative
- ☐ Catalytic Oxidizer No. _____
- ☐ Nitrogen Oxides Reduction No. _____
  - ☐ Selective ☐ Non-Selective
  - ☐ Catalytic ☐ Non-Catalytic
- ☒ Other No. _____
  Specify: Electric Flameless Thermal Oxidizer

FORM 5EP: Emission Point Data

6. Estimated Emissions from the Emission Point

Criteria Pollutants	At Design Capacity (lb/hr)	At Projected Operations (lb/hr)	At Projected Operations (lb/day)	At Projected Operations (ton/yr)
Particulate Matter (filterable as PM10)		0.000	0.000	0.000
Particulate Matter (filterable as PM2.5)		0.000	0.000	0.000
Particulate Matter (condensables)				
Volatile Organic Compounds (VOC)		0.014	0.218	0.027
Oxides of Sulfur (SOx)				
Oxides of Nitrogen (NOx)				
Carbon Monoxide (CO)				
Lead (Pb)				

Greenhouse Gases (GHG)	At Design Capacity (lb/hr)	At Projected Operations (lb/hr)	At Projected Operations (lb/day)	At Projected Operations (ton/yr)
Carbon Dioxide (CO_2)		4.31	68.90	8.61
Methane (CH_4)		0.000	0.001	0.000
Nitrous Oxide (N_2O)				
Hydrofluorocarbons (HFCs)				
Perfluorocarbons (PFCs)				
Sulfur Hexafluoride (SF6)				
Total GHG (as CO_2e)		4.31	68.93	8.62

List individual federal Hazardous Air Pollutants (HAP) below:	At Design Capacity (lb/hr)	At Projected Operations (lb/hr)	At Projected Operations (lb/day)	At Projected Operations (ton/yr)
1,3-Butadiene		0.000	0.001	0.000

(Attach additional sheets as necessary.)

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FORM 5EP: Emission Point Data

Complete one (1) Form 5EP for EACH emission point (stack or fugitive emissions) related to the proposed installation.

Applicant Name: W.R. Grace & Company - Conn.

1. Emission Point Identification Name/Number

List the applicant assigned name/number for this emission point and use this value on the attached required plot plan:
TO Stack

2. Emission Point Description

Describe the emission point including all associated equipment and control devices:
Reactor output gas stream controlled by thermal oxidizer

3. Emissions Schedule for the Emission Point

Continuous or Intermittent (C/I)?	I	**Seasonal Variation** Check box if none: ☒ Otherwise estimate seasonal variation:	
Minutes per hour:	60	Winter Percent	
Hours per day:	16	Spring Percent	
Days per week:	5	Summer Percent	
Weeks per year:	50	Fall Percent	

4. Emission Point Information

Height above ground (ft):	59'-1"	Length and width dimensions at top of rectangular stack (ft):	Length:	Width:	
Height above structures (ft):	30'-5"				
Exit temperature (°F):	1600	Inside diameter at top of round stack (ft):		0.833	
Exit velocity (ft/min):	200.4	Distance from emission point to nearest property line (ft):		280	
Exhaust gas volumetric flow rate (acfm):	109.3	Building dimensions if emission point is located on building (ft)	Height 28'-8"	Length 163'	Width 144'

5. Control Devices Associated with the Emission Point

Identify each control device associated with the emission point and indicate the number of devices. ***A Form 6 is also required for each control device***. If none check none:

- ☐ None
- ☐ Baghouse No. _____
- ☐ Cyclone No. _____
- ☐ Elec. Precipitator (ESP) No. _____
- ☐ Dust Suppression System No. _____
- ☐ Venturi Scrubber No. _____
- ☐ Spray Tower/Packed Bed No. _____
- ☐ Carbon Adsorber No. _____
  - ☐ Cartridge/Canister
  - ☐ Regenerative
- ☐ Thermal Oxidizer No. _____
  - ☐ Regenerative
- ☐ Catalytic Oxidizer No. _____
- ☐ Nitrogen Oxides Reduction No. _____
  - ☐ Selective ☐ Non-Selective
  - ☐ Catalytic ☐ Non-Catalytic
- ☒ Other No. _____
  Specify: Electric Flameless Thermal Oxidizer

1/12/24 Replaced per Jan 11, 2024 Email from D. Rescia to S. Nash IZN

FORM 5EP: Emission Point Data

6. Estimated Emissions from the Emission Point

Criteria Pollutants	At Design Capacity (lb/hr)	At Projected Operations (lb/hr)	At Projected Operations (lb/day)	At Projected Operations (ton/yr)
Particulate Matter (filterable as PM10)		0.000	0.000	0.000
Particulate Matter (filterable as PM2.5)		0.000	0.000	0.000
Particulate Matter (condensables)				
Volatile Organic Compounds (VOC)		0.014	0.218	0.027
Oxides of Sulfur (SOx)				
Oxides of Nitrogen (NOx)				
Carbon Monoxide (CO)				
Lead (Pb)				

Greenhouse Gases (GHG)	At Design Capacity (lb/hr)	At Projected Operations (lb/hr)	At Projected Operations (lb/day)	At Projected Operations (ton/yr)
Carbon Dioxide (CO_2)		4.31	68.90	136.61
Methane (CH_4)		0.000	0.001	0.000
Nitrous Oxide (N_2O)				
Hydrofluorocarbons (HFCs)				
Perfluorocarbons (PFCs)				
Sulfur Hexafluoride (SF6)				
Total GHG (as CO_2e)		4.31	68.93	136.61

List individual federal Hazardous Air Pollutants (HAP) below:	At Design Capacity (lb/hr)	At Projected Operations (lb/hr)	At Projected Operations (lb/day)	At Projected Operations (ton/yr)
1,3-Butadiene		0.000	0.001	0.000

(Attach additional sheets as necessary.)

1/12/24
Replaced per Jan 11, 2024 email from D. Rescu to S. Nash /sc

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FORM 5EP: Emission Point Data

Complete one (1) Form 5EP for EACH emission point (stack or fugitive emissions) related to the proposed installation.

Applicant Name: W.R. Grace & Company - Conn.

1. Emission Point Identification Name/Number

List the applicant assigned name/number for this emission point and use this value on the attached required plot plan:
Regen Exhaust Vent

2. Emission Point Description

Describe the emission point including all associated equipment and control devices:
Regenerator flue gas stream

3. Emissions Schedule for the Emission Point

Continuous or Intermittent (C/I)?	I	**Seasonal Variation** Check box if none: ☒ Otherwise estimate seasonal variation:	
Minutes per hour:	60	Winter Percent	
Hours per day:	16	Spring Percent	
Days per week:	5	Summer Percent	
Weeks per year:	50	Fall Percent	

4. Emission Point Information

Height above ground (ft):	39.0	Length and width dimensions at top of rectangular stack (ft):	Length:	Width:	
Height above structures (ft):	10.3				
Exit temperature (°F):	80	Inside diameter at top of round stack (ft):		0.833	
Exit velocity (ft/min):	1835	Distance from emission point to nearest property line (ft):		280	
Exhaust gas volumetric flow rate (acfm):	1000	Building dimensions if emission point is located on building (ft)	Height 28'-8"	Length 163'	Width 144'

5. Control Devices Associated with the Emission Point

Identify each control device associated with the emission point and indicate the number of devices. ***A Form 6 is also required for each control device***. If none check none:

- ☒ None
- ☐ Baghouse No. _____
- ☐ Cyclone No. _____
- ☐ Elec. Precipitator (ESP) No. _____
- ☐ Dust Suppression System No. _____
- ☐ Venturi Scrubber No. _____
- ☐ Spray Tower/Packed Bed No. _____
- ☐ Carbon Adsorber No. _____
  - ☐ Cartridge/Canister
  - ☐ Regenerative
- ☐ Thermal Oxidizer No. _____
  - ☐ Regenerative
- ☐ Catalytic Oxidizer No. _____
- ☐ Nitrogen Oxides Reduction No. _____
  - ☐ Selective ☐ Non-Selective
  - ☐ Catalytic ☐ Non-Catalytic
- ☐ Other No. _____
  Specify:

FORM 5EP: Emission Point Data

6. Estimated Emissions from the Emission Point

Criteria Pollutants	At Design Capacity (lb/hr)	At Projected Operations (lb/hr)	At Projected Operations (lb/day)	At Projected Operations (ton/yr)
Particulate Matter (filterable as PM10)		0.000	0.000	0.000
Particulate Matter (filterable as PM2.5)		0.000	0.000	0.000
Particulate Matter (condensables)				
Volatile Organic Compounds (VOC)				
Oxides of Sulfur (SOx)				
Oxides of Nitrogen (NOx)		0.001	0.011	0.001
Carbon Monoxide (CO)		0.000	0.002	0.000
Lead (Pb)				

Greenhouse Gases (GHG)	At Design Capacity (lb/hr)	At Projected Operations (lb/hr)	At Projected Operations (lb/day)	At Projected Operations (ton/yr)
Carbon Dioxide (CO_2)		.....	4.019	0.502
Methane (CH_4)				
Nitrous Oxide (N_2O)				
Hydrofluorocarbons (HFCs)				
Perfluorocarbons (PFCs)				
Sulfur Hexafluoride (SF6)				
Total GHG (as CO_2e)		0.251	4.019	0.502

List individual federal Hazardous Air Pollutants (HAP) below:	At Design Capacity (lb/hr)	At Projected Operations (lb/hr)	At Projected Operations (lb/day)	At Projected Operations (ton/yr)

(Attach additional sheets as necessary.)

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FORM 5T: Toxic Air Pollutant (TAP) Emissions Summary and Compliance Demonstration

Applicant Name: W.R. Grace & Co. - Conn.

Step 1: Quantify premises-wide emissions of Toxic Air Pollutants (TAP) from new and existing installations in accordance with COMAR 26.11.15.04. Attach supporting documentation as necessary.

Toxic Air Pollutant (TAP)	CAS Number	Class I or Class II?	Screening Levels (µg/m^3)			Estimated Premises Wide Emissions of TAP			
						Actual Total Existing TAP Emissions	Projected TAP Emissions from Proposed Installation	Premises Wide Total TAP Emissions	
			1-hour	8-hour	Annual	(lb/hr)	(lb/hr)	(lb/hr)	(lb/yr)
ex. ethanol	*64175*	*II*	*18843*	*3769*	*N/A*	*0.60*	*0.15*	*0.75*	*1500*
ex. benzene	*71432*	*I*	*80*	*16*	*0.13*	*0.5*	*0.75*	*1.00*	*400*
See Attach 5 and Attach 6									

(attach additional sheets as necessary.)

Note: Screening levels can be obtained from the Department's website (http://www.mde.maryland.gov) or by calling the Department.

Step 2: Determine which TAPs are exempt from further review. A TAP that meets either of the following Class I or Class II small quantity emitter exemptions is exempt from further TAP compliance demonstration requirements under Step 3 and Step 4.

Class II TAP Small Quantity Emitter Exemption Requirements (COMAR 26.11.15.03B(3)(a))
A Class II TAP is exempt from Step 3 and Step 4 if the Class II TAP meets the following requirements: Premises wide emissions of the TAP shall not exceed 0.5 pounds per hour, and any applicable 1-hour or 8-hour screening level for the TAP must be greater than 200 µg/m^3.

Class I TAP Small Quantity Emitter Exemption Requirements (COMAR 26.11.15.03B(3)(b))
A Class I TAP is exempt from Step 3 and Step 4 if the Class I TAP meets the following requirements: Premises wide emissions of the TAP shall not exceed 0.5 pounds per hour and 350 pounds per year, any applicable 1-hour or 8-hour screening level for the TAP must be greater than 200 µg/m^3, and any applicable annual screening level for the TAP must be greater than 1 µg/m^3.

If a TAP meets either the Class I or Class II TAP Small Quantity Emitter Exemption Requirements, no further review under Step 3 and Step 4 are required for that specific TAP.

FORM 5T: Toxic Air Pollutant (TAP) Emissions Summary and Compliance Demonstration

Step 3: Best Available Control Technology for Toxics Requirement (T-BACT, COMAR 26.11.15.05)
In the following table, list all TAP emission reduction options considered when determining T-BACT for the proposed installation. The options should be listed in order beginning with the most effective control strategy to the least effective strategy. Attach supporting documentation as necessary.

Target Pollutants	Emission Control Option	% Emission Reduction	Costs		T-BACT Option Selected? (yes/no)
			Capital	Annual Operating	
ex. ethanol and benzene	*Thermal Oxidizer*	*99*	*$50,000*	*$100,000*	*no*
ex. ethanol and benzene	*Low VOC materials*	*80*	*0*	*$100,000*	*yes*
VOC	Electric Flameless TO	99.99			Yes

(attach additional sheets as necessary)

Step 4: Demonstrating Compliance with the Ambient Impact Requirement (COMAR 26.11.15.06)
Each TAP not exempt in Step 2 must be individually evaluated to determine that the emissions of the TAP will not adversely impact public health. The evaluation consists of a series of increasingly non-conservative (and increasingly rigorous) tests. Once a TAP passes a test in the evaluation, no further analysis is required for that TAP. "Demonstrating Compliance with the Ambient Impact Requirement under the Toxic Air Pollutant (TAP) Regulations (COMAR 26.11.15.06)" provides guidance on conducting the evaluation. Summarize your results in the following table. Attach supporting documentation as necessary.

Toxic Air Pollutant (TAP)	CAS Number	Screening Levels ($\mu g/m^3$)			Premises Wide Total TAP Emissions		Allowable Emissions Rate (AER) per COMAR 26.11.16.02A		Off-site Concentrations per Screening Analysis ($\mu g/m^3$)			Compliance Method Used?
		1-hour	8-hour	Annual	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	1-hour	8-hour	Annual	AER or Screen
ex. ethanol	*64175*	*18843*	*3769*	*N/A*	*0.75*	*1500*	*0.89*	*N/A*	*N/A*	*N/A*	*N/A*	*AER*
ex. benzene	*71432*	*80*	*16*	*0.13*	*1.00*	*400*	*0.04*	*36.52*	*1.5*	*1.05*	*0.12*	*Screen*
See Attach 6												

(attach additional sheets as necessary)

If compliance with the ambient impact requirement cannot be met using the allowable emissions rate method or the screening analysis method, refined dispersion modeling techniques may be required. Please consult with the Department's Air Quality Permit Program prior to conducting dispersion modeling methods to demonstrate compliance.

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Air and Radiation Management Administration ▪ Air Quality Permits Program

APPLICATION FOR PERMIT TO CONSTRUCT
GAS CLEANING OR EMISSION CONTROL EQUIPMENT

1. Owner of Installation	Telephone No.	Date of Application
W.R. Grace & Co. - Conn.	(410) 531-4570	8/3/23

2. Mailing Address	City	Zip Code	County
7500 Grace Drive	Columbia	21044	Howard

3. Equipment Location	City/Town or P.O.	County
7500 Grace Drive	Columbia, MD	Howard

4. Signature of Owner or Operator	Title	Print or Type Name

5. Application Type: Alteration ☐ New Construction ☑

6. Date Construction is to Start: 1/24 **Completion Date (Estimate):** 8/24

7. Type of Gas Cleaning or Emission Control Equipment:

Simple Cyclone ☐ Multiple Cyclone ☐ Afterburner ☐ Electrostatic Precipitator ☐

Scrubber ☐ _____ (type) Other ☑ Electric Flameless TO (type)

8. Gas Cleaning Equipment Manufacturer	Model No.	Collection Efficiency (Design Criteria)
PCC	EFTO25	> 99.99%

9. Type of Equipment which Control Equipment is to Service:

Catalyst Chemical Conversion Reactor System

10. Stack Test to be Conducted:

Yes ☐ No ☑ _____ (Stack Test to be Conducted By) _____ (Date)

11. Cost of Equipment _____

Estimated Erection Cost _____

Form number: 6
Revision date: 0/2000
TTY Users 1-800-735-2258

Recycled Paper

12. The Following Shall Be Design Criteria:

	INLET	OUTLET
Gas Flow Rate	_____ ACFM*	109.3 ACFM*
Gas Temperature	_____ °F	1600 °F
Gas Pressure	_____ INCHES W.G.	_____ INCHES W.G.
	PRESSURE DROP _____	
Dust Loading	_____ GRAINS/ACFD**	_____ GRAINS/ACFD**
Moisture Content OR Wet Bulb Temperature	_____ % _____ °F	_____ % _____ °F
Liquid Flow Rate (Wet Scrubber)	_____ GALLONS/MINUTE	

(WHEN SCRUBBER LIQUID OTHER THAN WATER INDICATE COMPOSITION OF SCRUBBING MEDIUM IN WEIGHT %)

*= ACTUAL CUBIC FEET PER MINUTE **= ACTUAL CUBIC FEET DRY

WHEN APPLICATION INVOLVES THE REDUCTION OF GASEOUS POLLUTANTS, PROVIDE THE CONCENTRATION OF EACH POLLUTANT IN THE GAS STREAM IN VOLUME PERCENT. INCLUDE THE COMPOSITION OF THE GASES ENTERING THE CLEANING DEVICE AND THE COMPOSITION OF EXHAUSTED GASES BEING DISCHARGED INTO THE ATMOSPHERE. USE AVAILABLE SPACE IN ITEM 15 ON PAGE 3.

13. Particle Size Analysis

Size of Dust Particles Entering Cleaning Unit	% of Total Dust	% to be Collected
0 to 10 Microns	_____	_____
10 to 44 Microns	_____	_____
Larger than 44 Microns	_____	_____

14. For Afterburner Construction Only:

Volume of Contaminated Air _____ CFM (DO NOT INCLUDE COMBUSTION AIR)

Gas Inlet Temperature _____ °F

Capacity of Afterburner _____ BTU/HR

Diameter (or area) of Afterburner Throat _____

Combustion Chamber _____ (diameter) _____ (length) Operating Temperature at Afterburner _____ °F

Retention Time of Gases _____

15. Show Location of Dust Cleaning Equipment in the System. Draw or Sketch Flow Diagram Showing Emission Path from Source to Exhaust Point to Atmosphere.

See Attach 1

Date Received: Local _____ State _____

Acknowledgement Date: _____

By _____

Reviewed By:

Local _____

State _____

Returned to Local:

Date _____

By _____

Application Returned to Applicant:

Date _____

By _____

REGISTRATION NUMBER OF ASSOCIATED EQUIPMENT: ☐ ☐☐☐☐

PREMISES NUMBER: ☐☐ ☐☐☐☐

Emission Calculations Revised By _____ Date _____

ATTACHMENT 5

Emissions – Calculations, Engineering Estimates and Assumptions

Table 1. Reactor Product Gas Emissions

Operation 16 hr/dy 4000 hr/yr

Pollutant	CAS	C	VOC?	HAP?	From Reactor (1)		Control Efficiency	Emissions (3)			
					Other C4 Speciation (% Other C4) (4)	Mass (g/hr)	(%)	(lb/hr)	(lb/dy)	(lb/yr)	(tpy)
CO_2						18	0	0.040	0.635	158.733	0.079
PM (5)						0.375	99	0.000	0.000	0.033	0.000
Methane	74-82-8	C1	No	No		3	99	0.000	0.001	0.265	0.000
Ethane	74-84-0	C2	No	No		8	99	0.000	0.003	0.705	0.000
Ethylene	74-85-1	C2	Yes	No		79	99	0.002	0.028	6.967	0.003
Propane	74-98-6	C3	Yes	No		66	99	0.001	0.023	5.820	0.003
Propylene	115-07-1	C3	Yes	No		246	99	0.005	0.087	21.694	0.011
Butane	106-97-8	C4	Yes	No		60	99	0.001	0.021	5.291	0.003
Other C4		C4				167					
Isobutene	115-11-7	C4	Yes	No	36	60.12	99	0.001	0.021	5.302	0.003
1-Butene	106-98-9	C4	Yes	No	20	33.4	99	0.001	0.012	2.945	0.001
t-2-Butene	624-64-6	C4	Yes	No	23	38.41	99	0.001	0.014	3.387	0.002
c-2-Butene	590-18-1	C4	Yes	No	20	33.4	99	0.001	0.012	2.945	0.001
1,3-Butadiene	106-99-0	C4	Yes	Yes	1	1.67	99	0.000	0.001	0.147	0.000
Total VOC			Yes				99	0.014	0.218	54.498	0.027

(1) Based on engineering estimates

(2) For VOC, the proposed electric flameless thermal oxidizer is designed for a VOC control efficiency of greater than 99.99% (i.e., meets requirements of COMAR 26.11.19.30 of at least 90% control overall). For PM, assume 99% particulate control for process cyclone

(3) Assumed 16 hr/dy and 4000 hr/yr operation

(4) Based on typical distribution for catalyitic cracking

(5) Based on regenerator outlet particulate fines equal to 0.3% /dy of catalyst inventory. The catalyst inventory for the regenerator is about 2000 g, and daily operation is 16 hr/dy

Reactor Outlet PM g/hr = 0.3 g PM/dy/100 g catalyst inventory X 2000 g catalyst / 16 hr/dy

Table 2. Additional Thermal Oxidizer CO_2 Emissions From Controlling Hydrocarbons

Operation	16	hr/dy	4000 hr/yr
TO CE	99	%	
CO_2 MW	44.01	g/mol	

Pollutant	CAS	# of C	MW (g/mol)	TO Inlet Mass Rate (g/hr)	Mass Rate Controlled by TO (g/hr)	Mol Rate Controlled by TO (mol/hr)	Equiv Mol C Rate (mol/hr)	Mass Rate CO_2 (g/hr)	
Methane	74-82-8	1	16.04	3	2.97	0.1851621	0.185162	8.148984	
Ethane	74-84-0	2	30.07	8	7.92	0.2633854	0.526771	23.18319	
Ethylene	74-85-1	2	28.05	79	78.21	2.7882353	5.576471	245.4205	
Propane	74-98-6	3	44.097	66	65.34	1.4817335	4.4452	195.6333	
Propylene	115-07-1	3	42.08	246	243.54	5.7875475	17.36264	764.1299	
Butane	106-97-8	4	58.12	60	59.4	1.0220234	4.088094	179.917	
Isobutene	115-11-7	4	56.11	60.12	59.5188	1.0607521	4.243008	186.7348	
1-Butene	106-98-9	4	56.11	33.4	33.066	0.5893067	2.357227	103.7416	
t-2-Butene	624-64-6	4	56.11	38.41	38.0259	0.6777027	2.710811	119.3028	
c-2-Butene	590-18-1	4	56.11	33.4	33.066	0.5893067	2.357227	103.7416	
1,3-Butadiene	106-99-0	4	54.09	1.67	1.6533	0.0305657	0.122263	5.38079	
				629				1935.334	
								4.266685	lb/hr
								68.26696	lb/dy
								17066.74	lb/yr
								8.53337	tpy

Table 2. Additional Thermal Oxidizer CO_2 Emissions From Controlling Hydrocarbons

Operation	16 hr/dy	4000 hr/yr
TO CE	99 %	
CO_2 MW	44.01 g/mol	

Pollutant	CAS	# of C	MW (g/mol)	TO Inlet Mass Rate (g/hr)	Mass Rate Controlled by TO (g/hr)	Mol Rate Controlled by TO (mol/hr)	Equiv Mol C Rate (mol/hr)	Mass Rate CO_2 (g/hr)	
Methane	74-82-8	1	16.04	3	2.97	0.1851621	0.185162	8.148984	
Ethane	74-84-0	2	30.07	8	7.92	0.2633854	0.526771	23.18319	
Ethylene	74-85-1	2	28.05	79	78.21	2.7882353	5.576471	245.4205	
Propane	74-98-6	3	44.097	66	65.34	1.4817335	4.4452	195.6333	
Propylene	115-07-1	3	42.08	246	243.54	5.7875475	17.36264	764.1299	
Butane	106-97-8	4	58.12	60	59.4	1.0220234	4.088094	179.917	
Isobutene	115-11-7	4	56.11	60.12	59.5188	1.0607521	4.243008	186.7348	
1-Butene	106-98-9	4	56.11	33.4	33.066	0.5893067	2.357227	103.7416	
t-2-Butene	624-64-6	4	56.11	38.41	38.0259	0.6777027	2.710811	119.3028	
c-2-Butene	590-18-1	4	56.11	33.4	33.066	0.5893067	2.357227	103.7416	
1,3-Butadiene	106-99-0	4	54.09	1.67	1.6533	0.0305657	0.122263	5.38079	
				629				1935.334	
								4.266685	lb/hr
								68.26696	lb/dy
								273067.9	lb/yr
								136.5339	tpy

1/12/24
Replaced per Jan 11, 2024 email from D. Rescia to S. Nash / EM

Table 3. Regenerator Flue Gas Emissions

Operation 16 hr/dy 4000 hr/yr

Pollutant	Control Efficiency (1) (%)	Emissions (2) (lb/hr)	(lb/dy)	(tpy)
CO_2 (3)		0.251	4.019	0.502
CO (4)		0.0001	0.0017	0.0002
NO (5) (6)		0.0007	0.0107	0.0013
PM (7)	99	0.0000	0.0001	0.0000

(1) Assume 99% particulate control for process knockout pot
(2) Assume 16 hr/dy and 4000 hr/yr operation
(3) Assume engineering estimate of CO_2 flow rate equal to 33 NL/hr

CO_2 g/hr = 44 g CO_2/mol CO_2 X 58 NL CO_2/hr / 22.4 NL/mol

(4) Assume lean burn (excess oxygen) conditions resulting in 0.01 vol% CO in flue gas (detection limit of CO analyzer) and flue gas flow rate of 377 NL/hr

CO g/hr = 28 g CO/mol CO X 0.01 NL CO/100 NL flue gas X 377 NL flue gas/hr / 22.4 NL/mol

(5) Assume the mass of nitrogen in the composite plastic feedstock is equal to the mass of nitrogen in the fraction of the feedstock that is Nylon, the constituent with the highest nitrogen content. Nylon has a nitrogen content of 12.3 wt% and the fraction of Nylon in the composite feedstaock is less than 2 wt%

N content of feed wt% = (12.3 g N/ 100 g Nylon X 2 g Nylon/ 100 g feed) X 100 = 0.246

(6) Based on 600 ppmv (dry basis) NO in flue gas from Xinjin Zhao et. al., 1997, Nitrogen Chemistry and NOx Control in a Fluid Catalytic Cracking Regenerator (Ind. Eng. Chem. Res., 1997, 36, 11, 4535-4542) for a similar N content feed and lean combustion, and a flue gas flow rate of 377 NL/hr

NO g/hr = 30 g NO/mol NO X 600 NL NO/1000000 NL flue gas X 377 NL flue gas/hr / 22.4 NL/mol

(7) Based on engineering estimate of regenerator outlet particulate fines equal to 0.3% /dy of catalyst inventory. The catalyst inventory for the regenerator is about 1500 g, and daily operation is 16 hr/dy

Regenerator Outlet PM g/hr = 0.3 g PM/100 g catalyst inventory/dy X 1500 g catalyst / 16 hr/dy

ATTACHMENT 6

TAP Compliance Demonstration

TAP Compliance Demonstration

MARYLAND TAP REQUIREMENTS

The proposed Project has the potential to discharge to the atmosphere several non-criteria substances which include Toxic Air Pollutants (TAPs) and, pursuant to COMAR 26.11.15.03 A (1), is subject to the Maryland TAP requirements (under COMAR 26.11.15 and 26.11.16) because the proposed installation is required to obtain a permit to construct (PTC) under COMAR 26.11.02.09.

COMAR 26.11.15.06 requires a demonstration that TAP emissions will not unreasonably endanger human health. Grace is demonstrating compliance with this ambient impact requirement using a screening analysis as specified under COMAR 26.11.15.07. According to COMAR 26.11.16.02 A, such a demonstration is made by showing that TAP emissions from the premises will not cause increases in ambient levels that exceed the applicable risk-based screening level for a Class I TAP and the applicable TLV-/threshold-based screening level for a Class II TAP (MDE Screening Levels).

The proposed Project will be a new installation/source as defined under COMAR 26.11.15.01 B (10). For new installations, COMAR 26.11.15.06 A (1) requires that the total emissions from the premises of each TAP discharged by the new installation be used in demonstrating compliance with the TAP impact requirements. COMAR 26.11.15.06 A (2) does not require the accounting of other premise-wide emissions from existing installations/sources on the existing premises (as defined under COMAR 26.11.15.01 B (7)) for a TAP that is not listed in COMAR 26.11.16.07. Except for 1,3-Butadiene, all TAPs expected to be discharged from the proposed Project (see Table 1 (Attachment 5)) are not listed in COMAR 26.11.16.07. However, several of the registered installations/sources at the existing premises are considered new installations (not existing installations).

EMISSIONS

Proposed Project TAP Emissions

Several non-criteria pollutants are expected to be discharged into the ambient air from the proposed Project's new thermal oxidizer stack (see Table 1 (Attachment 5)). Methane (CAS 74-82-8), ethane (CAS 74-84-0), ethylene (CAS 74-85-1), propane (CAS 74-98-6), and propylene (CAS 115-07-1) are listed as simple asphyxiants under COMAR 26.11.16.08 and are excluded from the definition of Toxic Air Pollutants (TAPs), as defined under COMAR 26.11.15.01 B (20). 1,3-butadiene (CAS 106-99-0) is a Class I TAP while the remaining non-criteria pollutants in Table 1 (Attachment 5) are Class II TAPs.

Other Premise-Wide TAP Emissions

Other new installations on the existing premises discharge a TAP that is expected to be discharged from the proposed Project; namely, butene (CAS 106-98-9).

The Test Polymerization Process (controlled by the existing thermal oxidizer) constructed in 2014 (ARA Registration Number 027-0013-7-0084) and the Test Gas-Phase Polymerization Process constructed in 2017 (ARA Registration Number 027-0013-7-0086) are permitted to emit butene. The maximum combined hourly butene emissions from these two installations is 0.03 lb/hr. For the Test Polymerization Process the maximum hourly butene emissions is expected to be 0.01 lb/hr (based on the supplement to the permit to Construct application (dated November 21, 2014), if butene is used as an additive). For the Test Gas-Phase Polymerization Process the maximum hourly butene emissions is expected to be 0.02 lb/hr (assuming butene from one linear low density polyethylene (LLDPE) batch run is released in one hour].

EXEMPTION FROM TAP REGULATIONS

The anticipated emissions of butane, isobutene (CAS 115-11-7), 1-butene, t-2-butene (CAS 624-64-6), and c-2-butene (CAS 590-18-1) from the premises are exempt from the Maryland TAP regulations (specifically COMAR 26.11.15.05 and COMAR 26.11.15.06) because of the small quantity of discharge from this proposed Project and other permitted installations.

Under COMAR 26.11.15.03 B (3) (a):

> "The emissions of a Class II TAP from a premises are exempt from the requirements of Regulations .05 and .06 of this chapter, if:
>
> (i) The total allowable emissions of the TAP from the premises are 0.5 pound per hour (0.23 kilogram per hour) or less; and
>
> (ii) All applicable TLV-based, threshold-based, or special screening levels for the TAP are greater than 200 micrograms/cubic meter."

After construction of the proposed Project, the maximum hourly emissions of butane from the premises will be about 0.001 lb/hr. This premises value includes the anticipated emissions due to the proposed Project. These emissions are well below the 0.5 lb/hr level for Class II TAPs in section (i) above. In addition, the screening level for butane is 23770.96 $\mu g/m^3$ (8-hour). This screening level is well above the minimum set forth in (ii) above.

After construction of the proposed Project, the maximum hourly emissions of isobutene from the premises will be about 0.001 lb/hr. This value includes the anticipated emissions due to the proposed Project. These emissions are well below the 0.5 lb/hr level for Class II TAPs in section (i) above. In addition, the screening level for isobutene is 5737.22 $\mu g/m^3$ (8-hour). This screening level is well above the minimum set forth in (ii) above.

After construction of the proposed Project, the maximum hourly emissions of 1-butene (butene) from the premises will be about 0.03 lb/hr (0.001 lb/hr + 0.03 lb/hr). This premises value includes the anticipated emissions due to the proposed Project and the possible emissions due to the Test Polymerization Process and the Test Gas-Phase Polymerization Process (see Other Premise-Wide TAP Emissions above). These emissions are well below the 0.5 lb/hr level for Class II TAPs in section (i) above. In addition, the screening level for butane is 5737.22 $\mu g/m^3$ (8-hour). This screening level is well above the minimum set forth in (ii) above.

After construction of the proposed Project, the maximum hourly emissions of t-2-butene from the premises will be about 0.001 lb/hr. This value includes the anticipated emissions due to the proposed Project. These emissions are well below the 0.5 lb/hr level for Class II TAPs in section (i) above. In addition, the screening level for isobutene is 5737.22 $\mu g/m^3$ (8-hour). This screening level is well above the minimum set forth in (ii) above.

After construction of the proposed Project, the maximum hourly emissions of c-2-butene from the premises will be about 0.001 lb/hr. This value includes the anticipated emissions due to the proposed Project. These emissions are well below the 0.5 lb/hr level for Class II TAPs in section (i) above. In addition, the screening level for isobutene is 5737.22 $\mu g/m^3$ (8-hour). This screening level is well above the minimum set forth in (ii) above.

Because the total allowable butane, isobutene, butene, t-2-butene and c-2-butene (Class II TAPs) emissions from the premises are each below 0.5 lb/hr, and the applicable screening levels are well above 200 $\mu g/m^3$, these emissions qualify for the small-emitter exemption from TAP compliance demonstration requirements.

Under COMAR 26.11.15.03 B (3) (b):

> "The emissions of a Class I TAP from a premises are exempt from the requirements of Regulations .05 and .06 of this chapter, if:
>
> (i) The total allowable emissions of the TAP from the premises are 0.5 pound per hour (0.23 kilogram per hour) or less;
> (ii) The total allowable emissions of the TAP from the premises are 350 pounds per year (159 kilograms per year) or less;
> (iii) All applicable TLV-based, threshold-based, or special screening levels for the TAP are greater than 200 micrograms/cubic meter; and
> (iv) The applicable risk-based screening level is greater than 1 microgram/cubic meter."

Because the risk-based screening level for 1,3-butadiene (i.e., 0.03 $\mu g/m^3$) is not greater than 1 $\mu g/m^3$, the 1,3-butadiene emissions do not qualify for the small-emitter exemption from TAP compliance demonstration requirements.

SCREENING ANALYSIS

For the screening analysis, estimates of TAP emissions are compared to the conservative Allowable Emission Rates (AERs) consistent with the Table provided under COMAR 26.11.16.02 A (4) (MDE AER). Compliance with the TAP impact requirements is demonstrated if the TAP emissions are less than the respective AERs.

MDE-Based AER

The AERs given in the Table under COMAR 26.11.16.02 (4), for non-stack or downwash sources, can be generalized as follows:

Short-term (1-hr/8-hr) AER (lb/hr) = SL/279

Long-term (annual) AER (lb/yr) = SL/0.00274

where SL is the applicable MDE Screening Level ($\mu g/m^3$).

This is based on discussions in "An Example of Demonstrating Compliance with Ambient Impact Requirement. (COMAR 26.11.15.06) – Fact Sheet" on MDE's website.

Screening Compliance Demonstration

Since many of the expected non-criteria pollutants from the proposed Project are not TAPs and of the TAPs 1,3-butadiene (CAS 106-99-0, a Class I TAP) is the only TAP not exempt from the TAP requirements under COMAR 26.11.15.05 and 26.11.05.06, a TAP screening analysis was performed for 1,3-butadiene. The screening analysis presented in Table 4 demonstrates TAP compliance for 1,3-butadiene.

Table 4. TAP Demonstration Screening Analysis

Substance	Substance Alternate Name	CAS Number	MDE TAP (1)	MDE Screenling Level (2)			TAP Emissions						Small Quantity Exemption (5)	MDE AER (6)			Compliance		
				1-hr	8-hr	Annual	Project TAP Hourly (3)	Project TAP Annual (3)	Other TAP Hourly (4)	Other TAP Annual	Sitewide TAP Hourly	Sitewide TAP Annual		1-hr	8-hr	Annual	1-hr	8-hr	Annual
				($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)		(lb/hr)	(lb/hr)	(lb/yr)			
Methane		74-82-8	No				0.000066	0.264555			0.000066	0.26455493							
Ethane		74-84-0	No				0.0001764	0.70548			0.00017637	0.705479814							
Ethylene		74-85-1	No				0.0017417	6.966613			0.001741653	6.966613168							
Propane		74-98-6	No				0.0014551	5.820208			0.001455052	5.820208469							
Propylene		115-07-1	No				0.0054234	21.6935			0.005423376	21.69350429							
Butane		106-97-8	Class II		23770.9611		0.0013228	5.291099			0.001322775	5.291098608	Yes	0	85.20057742	0		Yes	
Isobutene	Isobutylene	115-11-7	Class II		5737.2188		0.0013254	5.301681			0.00132542	5.301680806	Yes	0	20.56350824	0		Yes	
1-Butene	Butene, isomers	106-98-9	Class II		5737.2188		0.0007363	2.945378	0.03		0.030736345	2.945378225	Yes	0	20.56350824	0		Yes	
t-2-Butene	Butene, isomers	624-64-6	Class II		5737.2188		0.0008468	3.387185			0.000846796	3.387184959	Yes	0	20.56350824	0		Yes	
c-2-Butene	Butene, isomers	590-18-1	Class II		5737.2188		0.0007363	2.945378			0.000736345	2.945378225	Yes	0	20.56350824	0		Yes	
1,3-Butadiene		106-99-0	Class I		44.2454	3.00E-02	0.000037	0.147269			0.000037	0.147268911	No	0	0.158585663	10.94890511		Yes	Yes

(1) COMAR 26.11.15.01 and COMAR 26.11.16.08

(2) MDE's Toxic Air Pollutant Regulations Assistance web page; Screening Levels

(3) See Table 1 (Attachment 5)

(4) Other sitewide emissions: Butene emissions based on PTC application for Gas Phase Polymerization Process submitted on May 26, 2016 (accounting for GPP emissions and RSPP controlled emissions)

(5) COMAR 26.11.15.03 B (3) (a) and (b)

(6) Based on "An Example of Demonstrating Compliance with Ambient Impact Requirement. (COMAR 26.11.15.06 - Fact Sheet" on MDE's website