STATE OF NEW HAMPSHIRE

Department of Environmental Services

Air Resources Division

Intra-office Memorandum

TO: Cathy Beahm, SIP Planning Administrator
Director's Office

DATE: February 2, 2023

FROM: David Healy, Senior Scientist
Atmospheric Science & Analysis Section

AFS #: 3301100165
App #: 21-0198, 22-0092

SUBJ: Saint-Gobain Performance Plastics

UTMs: 298802, 4752015

Modeling Project Summary
■ **Purpose:** Air deposition modeling for PFAS and air dispersion modeling for RTAPs for evaluation of bypass and as-built RTO
■ **Initial assumptions (modeling input):** Bypass - 175 hours/year; RTO - 8,760 hours/year
■ **Pass/Fail (if failed for what):** Pass
■ **Limits Based on Modeling:**

In 2019, Saint-Gobain Performance Plastics (SGPP) in Merrimack submitted a temporary permit application to install a regenerative thermal oxidizer (RTO) to control emissions of per- and polyfluoroalkyl substances (PFAS). This was done in response to a determination by the New Hampshire Department of Environmental Services (NHDES) pursuant to NH Statute Chapter 125-C:10-e, *Requirements for Air Emissions of Per and Polyfluoroalkyl Substances Impacting Soil and Water*. More recently, on December 28, 2021, C.T. Male, on behalf of SGPP, applied for a significant amendment to Temporary Permit TP-0256. Specifically, this amendment application addresses the installation and operation of a bypass to the RTO. The amendment application contains two distinct modeling efforts:

- Item 4 in NHDES' November 18, 2021 Letter of Deficiency requires that emissions for the bypass stack be evaluated to address RSA 125-C:10-e; and Table 8, Item 6 of TP-0256 requires these emissions be evaluated for Env-A 1400.
- Table 8, Item 5 of TP-0256 requires that emissions from the as-built RTO be evaluated for RSA 125-C:10-e and Env-A 1400.

As part of the amendment application, Barr Engineering (Barr) submitted two technical memorandums, each dated December 16, 2021 documenting the air quality modeling that was done in support of the amendment application (see Attachment C to C.T. Male's December 18, 2021 Supporting Documentation). Since issuance of TP-0256, HB 1264 was signed into law establishing PFAS maximum contaminant levels (MCLs) for PFOA, PFOS, PFNA, and PFHxS. Under NH law, Ambient Groundwater Quality Standards are required to be the same value as any MCL established. Therefore, NHDES determined that two additional PFAS compounds (PFNA and PFHxS) needed to be evaluated for deposition from both the RTO and the bypass stack. Also, since the bypass stack emits some similar RTAPs as another emission source at the facility, NHDES determined that additional RTAPs needed to be addressed for a complete Env-A 1400 evaluation. Since some of these additional RTAPs are emitted from the antenna coating lines, the antenna coating line exhaust points were added to the modeling. To this end, Barr submitted two revised technical memorandums as well as updated modeling files. NHDES has performed a review of Barr's technical memorandums and the associated modeling files that they submitted by email on July 27, 2022.

Following the general structure of Barr's Attachment C to the amendment application, this NHDES modeling memo is broken down into sections as follows:

1) As-Built Bypass Stack
    a. RSA 125-C:10-e Evaluation
    b. Env-A 1400 Evaluation
2) As-Built RTO
    a. RSA 125-C:10-e Evaluation
    b. Env-A 1400 Evaluation

1) As-Built Bypass Stack

Modeled parameters for the bypass stack are shown in Table 1.

Table 1
SGPP, Modeling Parameters for the Bypass

Parameter	Value
Stack Height	63.52 ft
Exit Diameter	5 ft
Exit Temp	236 F
Exhaust Flow Rate	76,868 acfm
Discharge	Horizontal

a. RSA 125-C:10-e Evaluation

Deposition modeling was performed to address the requirements of NH Statute Chapter 125-C:10-e, *Requirements for Air Emissions of Per and Polyfluoroalkyl Substances Impacting Soil and Water*. NHDES used the Method 1 deposition modeling method in its review of the Barr modeling. Since the time of the original modeling, the U.S. EPA downgraded Method 2 to an Alpha modeling option, meaning that it can only be used for research and testing purposes. Deposition modeling requires specific inputs regarding particle size deposition and particle density. For Method 1, the user is required to specify a particle size distribution and particle density. The inputs for Method 1 are shown in Table 2 below and were taken from a reference titled *Characterizing Perfluorooctanoate in Ambient Air near the Fence Line of a Manufacturing Facility: Comparing Modeled and Monitored Values*, Barton, C. A. et al., Journal of the Air & Waste Management Association, Volume 56, January 2006 (Barton). The particle density used for Method 1 deposition modeling was 1.8 grams per cubic centimeter (g/cm^3) and came from the Centers for Disease Control and Prevention National Institute for Occupational Safety and Health (NIOSH) International Chemical Safety Cards (ICSC) (https://www.cdc.gov/niosh/ipcsneng/neng1613.html).

Table 2 – Barton Particle Size Distribution and NIOSH Density Used in the SGPP Deposition Modeling Analysis

Particle Size (microns)	Mass Fraction (%)	Density (g/cm^3)
<0.28	59.8	1.8
0.3	5.3	
0.5	7.2	
0.8	9.2	
1.7	12.9	
>4.4	5.6	

This modeling addressed the following PFAS:

1. Perfluorooctanoic acid (PFOA)
2. Perfluorooctanesulfonic acid (PFOS)
3. Perfluorononanoic acid (PFNA)
4. Perfluorohexane sulfonate (PFHxS)

Based on emission rates from stack testing conducted in September 2021, the predicted maximum unit impact rate (UIR) obtained from the deposition modeling results, and the Best Available Control Technology (BACT) limit of 175 hours per year, emissions from the bypass stack do not cause or contribute to an exceedance of ground or surface water quality standards. Please see Table 3 below.

Table 3
SGPP, Maximum Predicted Deposition Rates for the Bypass Stack

Compound	Emission Rate (lb/hr)	Emission Rate (g/s)	Max Predicted Dep Rate ($g/m^2/yr$)	Max Allowable Dep Rate ($g/m^2/yr$)	Pass/Fail
PFOA	2.06E-05	2.60E-06	4.71E-08	1.8E-06	Pass
PFOS	2.77E-07	3.49E-08	6.32E-10	2.3E-06	Pass
PFNA	7.26E-06	9.15E-07	1.66E-08	2.5E-06	Pass
PFHxS	2.23E-08	2.81E-09	5.09E-11	2.0E-06	Pass

Notes: 1) Maximum allowable deposition rates were calculated using the methodology shown in Comment #16 of the Findings of Fact for the 2019 Temporary Permit (S:\ARD-Stationary Source\3301100165\III Permit Information\18-0227\FINALS\330110016518-0227TypeFindingsOfFact.pdf).
2) The maximum predicted unitized deposition rate (at 1 g/s) for the bypass was 9.06E-01 $g/m^2/yr$.

The maximum UIR of 9.06E-01 $g/m^2/yr$ per g/s can be used as a scaling tool to calculate maximum predicted deposition rates for other compounds using the following formula:

Max. predicted deposition rate ($g/m^2/yr$) = Emission rate (g/s) x max. predicted UIR ($g/m^2/yr$ per g/s) x (175/8,760)

b. Env-A 1400 Evaluation

The bypass was also evaluated for Env-A 1400. Since some RTAPs from the bypass overlap with RTAP emissions from the antenna coating lines, the exhaust points for the antenna coating lines were also included the modeling. Modeling parameters for the antenna coating lines are shown in Table 4. There are three identical exhaust points for antenna coating; the parameters in Table 4 are for each exhaust point. RTAP emission rates for the bypass and the antenna coating lines are shown in Table 5. The emission rates in Table 5 for the antenna coating lines are the total emission rate. The total emission rate was distributed equally among the three antenna coating line exhaust points. Maximum predicted RTAP impacts for the bypass and antenna coating lines are shown in Table 6. All maximum predicted impacts are below the respective ambient air limits (AALs).

Table 4
SGPP, Modeling Parameters for the Antenna Coating Lines

Parameter	Value
Stack Height	3 ft
Exit Diameter	2.8 ft
Exit Temp	62 F
Exhaust Flow Rate (Measured)	3,400 acfm
Discharge	Horizontal

Note: There are three identical exhaust points for the antenna coating lines. The parameters shown above are for each exhaust point.

Table 5
SGPP, RTAP Emission Rates for the Bypass and the Antenna Coating Lines (lb/hr)

RTAP	Bypass	Antenna Coating Lines
APFO	2.14E-05	--
HF	1.20E-02	--
Ethylene Glycol	9.37E-01	--
Toluene	3.34E-01	4.90E-01
Isopropanol	3.34E-02	--
Ethanol	8.81E-04	--
1,4-Dioxane	1.68E-03	--
Benzene	1.10E-05	2.00E-05
Polyethylene Glycol	1.82E-01	--
Tetrafluoroethylene	3.02E-01	--
Methanol	3.70E-02	--
MEK	1.63E-02	1.20E-01
n-Methyl-2-Pyrrolidone	1.42E-02	--
Hexane	8.69E-04	1.50E-02
Ammonia	1.01E-01	--
Ethyl Acetate	--	7.50E-03
Xylene	--	9.40E-04
Ethyl Benzene	--	2.00E-04

Note: Emission rates for the antenna coating lines represent the total. Total emissions were distributed equally among the three identical exhaust points.

Table 6
SGPP, Maximum Predicted RTAP Impacts for the Bypass and Antenna Coating (μg/m³)

RTAP	Max 24-hr Impact	24-hr AAL	Max Annual Impact	Annual AAL	Pass/Fail
APFO	1.10E-04	0.050	2.00E-05	0.024	Pass
HF	6.15E-02	1.5	9.83E-03	0.98	Pass
Ethylene Glycol	5	319	1	213	Pass
Toluene	22	5,000	5	5,000	Pass
Isopropanol	1.71E-01	1,757	2.74E-02	1,171	Pass
Ethanol	4.51E-03	6,714	7.20E-04	4,476	Pass
1,4-Dioxane	8.60E-03	258	1.38E-03	30	Pass
Benzene	8.90E-04	5.7	2.10E-04	3.8	Pass
Polyethylene Glycol	9.32E-01	50	1.49E-01	24	Pass
Tetrafluoroethylene	1.55	171	2.47E-01	81	Pass
Methanol	1.90E-01	20,000	3.03E-02	20,000	Pass
MEK	5	5,000	1	5,000	Pass
n-Methyl-2-Pyrrolidone	7.27E-02	1,429	1.16E-02	952	Pass
Hexane	6.62E-01	885	1.51E-01	700	Pass
Ammonia	5.17E-01	500	8.28E-02	500	Pass
Ethyl Acetate	3.31E-01	10,141	7.53E-02	4,829	Pass
Xylene	4.14E-02	1,550	9.42E-03	100	Pass
Ethyl Benzene	8.87E-03	1,000	2.02E-03	1,000	Pass

2) As-Built RTO

Modeled parameters for the RTO stack are shown in Table 7. Two scenarios were modeled: A "PFAS Deposition" scenario and an "RTAP" scenario. There were only slight differences in exit temp and exhaust flow between the two scenarios.

Table 7
SGPP, Modeling Parameters for the RTO

Parameter	Value
Stack Height	60 ft
Exit Diameter	6 ft
Exit Temp (PFAS Deposition)	350 F
Exit Temp (RTAP)	351 F
Exhaust Flow Rate (PFAS Deposition)	98,300 acfm
Exhaust Flow Rate (RTAP)	103,600 acfm
Discharge	Vertical

a. RSA 125-C:10-e Evaluation

Similar to the bypass stack, the as-built RTO was evaluated for RSA 125-C:10-e. As with the bypass stack, Method 1 was used for NHDES's review of the deposition modeling. The Method 1 modeling inputs (particle size distribution and particle density) are described above in the description of the bypass deposition modeling.

Based on emission rates from stack testing conducted in September 2021 and the maximum UIR from the modeling results, emissions from the RTO do not cause or contribute to an exceedance of ground or surface water quality standards. Please see Table 8 below.

Table 8
SGPP, Maximum Predicted Deposition Rates for the As-Built RTO

Compound	Emission Rate (lb/hr)	Emission Rate (g/s)	Max Predicted Dep Rate ($g/m^2/yr$)	Max Allowable Dep Rate ($g/m^2/yr$)	Pass/Fail
PFOA	2.54E-06	3.20E-07	5.70E-08	1.8E-06	Pass
PFOS	6.80E-08	8.57E-09	1.53E-09	2.3E-06	Pass
PFNA	6.66E-07	8.39E-08	1.49E-08	2.5E-06	Pass
PFHxS	0		--	2.0E-06	--

Notes: 1) Maximum allowable deposition rates were calculated using the methodology shown in Comment #16 of the Findings of Fact for the 2019 Temporary Permit.
2) The maximum predicted unitized deposition rate (at 1 g/s) for the RTO was 1.78E-01 $g/m^2/yr$.

The maximum predicted UIR of 1.78E-01 $g/m^2/yr$ per g/s can be used as a scaling tool to calculate maximum predicted deposition rates for other compounds using the following formula:

Max. predicted deposition rate ($g/m^2/yr$) = Emission rate (g/s) x max. predicted UIR ($g/m^2/yr$ per g/s)

b. Env-A 1400 Evaluation

The as-built RTO was also evaluated for Env-A 1400. Since some RTAPs from the as-built RTO overlap with RTAP emissions from the antenna coating lines, the exhaust points for the antenna coating lines were also included in the modeling. Modeling parameters for the antenna coating lines are shown in Table 4 above. RTAP emission rates for the as-built RTO and the antenna coating lines are shown in Table 9. As described earlier, the emission rates for the antenna coating lines are the total emission rate and the total emission rate was distributed equally among the three antenna coating line exhaust points. Maximum predicted RTAP impacts for the as-built RTO and antenna coating lines are shown in Table 10. All maximum predicted impacts are below the respective ambient air limits (AALs).

Table 9
SGPP, RTAP Emission Rates for the As-Built RTO and the Antenna Coating Lines (lb/hr)

RTAP	As-Built RTO	Antenna Coating Lines
APFO	2.64E-06	--
HF	1.20E-02	--
Ethylene Glycol	9.37E-01	--
Toluene	3.34E-01	4.90E-01
Isopropanol	3.34E-02	--
Ethanol	8.81E-04	--
1,4-Dioxane	1.68E-03	--
Benzene	1.10E-05	2.00E-05
Polyethylene Glycol	1.82E-01	--
Tetrafluoroethylene	3.02E-01	--
Methanol	3.70E-02	--
MEK	1.63E-02	1.20E-01
n-Methyl-2-Pyrrolidone	1.42E-02	--
Hexane	8.69E-04	1.50E-02
Ammonia	1.01E-01	--
Ethyl Acetate	--	7.50E-03
Xylene	--	9.40E-04
Ethyl Benzene	--	2.00E-04

Note: Emission rates for the antenna coating lines represent the total. Total emissions were distributed equally among the three identical exhaust points. Antenna coating line emission rates were also shown earlier in Table 5.

Table 10
SGPP, Maximum Predicted RTAP Impacts for the As-Built RTO and Antenna Coating (μg/m^3)

RTAP	Max 24-hr Impact	24-hr AAL	Max Annual Impact	Annual AAL	Pass/Fail
APFO	0	0.050	0	0.024	Pass
HF	3.32E-02	1.5	2.75E-03	0.98	Pass
Ethylene Glycol	2.59	319	0.21	213	Pass
Toluene	22	5,000	5	5,000	Pass
Isopropanol	9.23E-02	1,757	7.65E-03	1,171	Pass
Ethanol	2.43E-03	6,714	2.00E-04	4,476	Pass
1,4-Dioxane	4.64E-03	258	3.80E-04	30	Pass
Benzene	8.90E-04	5.7	2.00E-04	3.8	Pass
Polyethylene Glycol	5.03E-01	50	4.17E-02	24	Pass
Tetrafluoroethylene	8.34E-01	171	6.92E-02	81	Pass
Methanol	1.02E-01	20,000	8.48E-03	20,000	Pass
MEK	5	5,000	1	5,000	Pass
n-Methyl-2-Pyrrolidone	3.92E-02	1,429	3.25E-03	952	Pass
Hexane	6.62E-01	885	1.51E-01	700	Pass
Ammonia	2.79E-01	500	2.32E-02	500	Pass
Ethyl Acetate	3.31E-01	10,141	7.53E-02	4,829	Pass
Xylene	4.14E-02	1,550	9.42E-03	100	Pass
Ethyl Benzene	8.87E-03	1,000	2.02E-03	1,000	Pass

Project Tracking and Details

- **Modeler(s):** Barr/D. Healy   **Reviewer:** K. Errington
- **Model:** AERMOD v. 22112   **Profile Base Elevation:** 229ft
- **Met data:** 22112v1_Adj.U***** (12 sector) 2017-21   **Met site:** Manchester
- **Analysis details:** Permit amendment application for bypass and as-built RTO. NHDES and Barr modeling results differ somewhat because different met data sets were used.