STATE OF NEW HAMPSHIRE
Department of Environmental Services
Air Resources Division
Intra-office Memorandum

TO: Cathy Beahm, SIP Program Mgr.
SIP Planning & Rulemaking Bureau

DATE: August 1, 2019

FROM: David Healy, Air Quality Analyst/Modeler
Atmospheric Science & Analysis Section

AFS #: 3301100165
App #: 18-0227

SUBJ: Saint-Gobain Performance Plastics

UTMs: 298802, 4752015

Modeling Project Summary

- **Purpose:** Air dispersion modeling for RTAPs and air deposition for PFCs for evaluation of proposed RTO
- **Initial assumptions (modeling input):** 8,760 hours/year, 90% destruction efficiency
- **Pass/Fail (if failed for what):** Pass
- **Limits Based on Modeling:** N/A

Saint-Gobain Performance Plastics (SGPP) in Merrimack has submitted a temporary permit application to install a regenerative thermal oxidizer (RTO) to control emissions of perfluorinated compounds (PFCs). This is being 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 Perfluorinated Compounds Impacting Soil and Water*. As part of the temporary permit application, Barr Engineering (Barr) submitted an Air Dispersion Modeling Report. Both the modeling report and temporary permit application are dated May 2019.

In their modeling report, Barr estimated maximum and average deposition rates of PFCs in the vicinity of the SGPP facility. NHDES performed a review of Barr's modeling report and the electronic modeling files that were submitted. In addition, NHDES performed its own modeling to evaluate emissions of hydrogen fluoride (HF) from the RTO using Barr's modeling files as a basis. For both of these modeling exercises, a range of potential operating scenarios for the RTO were evaluated. The stack parameters associated with each scenario are shown below in Table 1.

The regulated toxic air pollutants (RTAPs) dispersion modeling that NHDES performed and the Barr deposition modeling that NHDES reviewed are discussed separately in the sections that follow.

Table 1 – SGPP, Stack Parameters Used in the Modeling Analysis

Scenario	Stack Height (ft)	Temp (°F)	Diam. (ft)	Flow (ACFM)
A	45	250	5	53,585
B	45	300	5	57,358
C	60	250	5	53,585
D	60	300	5	57,358
E	45	250	6	53,585
F	45	300	6	57,358
G	45	250	5	93,774
H	45	300	5	100,377
I	60	250	5	93,774
J	60	300	5	100,377
K	60	250	6	93,774
L	60	300	6	100,377
M	45	250	6	93,774
N	45	300	6	100,377
O	60	250	6	53,585
P	60	300	6	57,358

NHDES Modeling for HF

Per the 06/21/2019 Modeling Referral Form, NHDES modeled emissions of HF from the proposed RTO at a rate of **0.228 lb/hr**. This emission rate was modeled in conjunction with each of the stack parameter scenarios shown in Table 1. Maximum predicted HF impacts are shown in Table 2 and are below the respective ambient air limits (AALs).

Table 2 – SGPP, Maximum Predicted HF Impacts at 0.228 lb/hr ($\mu g/m^3$)

Ave. Period	Impact	AAL	Max. Impact Scenario	Pass/Fail
24-hr	1.18	1.5	E	Pass
Annual	0.15	0.98	A	Pass

The unit rate (1 lb/hr) impacts shown below can be used as a scaling tool to calculate maximum predicted impacts for other RTAPs using the following formula:

Max. predicted RTAP impact ($\mu g/m^3$) = RTAP emission rate (lb/hr) x max. predicted unitized impact ($\mu g/m^3$ per lb/hr)

Max. predicted unitized 24-hr impact = 5.1754 $\mu g/m^3$ per lb/hr
Max. predicted unitized annual impact = 0.6579 $\mu g/m^3$ per lb/hr

Maximum predicted unitized (1 lb/hr) impacts for modeling Scenarios A through P are provided in Attachment A.

Barr performed two separate rounds of deposition modeling: the first incorporated AERMOD deposition "Method 1" and the second incorporated the model's "Method 2". 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 3 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 3 – 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	

Method 2 simply requires a fine mass (<2.5 microns) fraction and a representative mass mean particle diameter. For Method 2, a fine mass fraction of 0.61 and a mass mean particle diameter of 2.5 microns were used. These figures were taken from a reference titled *A Site Specific Screening Comparison of Modeled and Monitored Air Dispersion and Deposition for Perfluorooctanoate*, Barton, C.A. et. al., Journal of the Air & Waste Management Association, Volume 60, April 2010.

Barr addressed the following four PFCs:

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

Modeled emission rates for these compounds are summarized in Table 4 below. Controlled emissions reflect an assumed destruction efficiency of 90% for PFCs.

Table 4 – SGPP, Modeled Emission Rates for PFCs

Compound	Emissions (lb/yr)	Controlled Emissions (lb/yr)	Modeled Annualized Emission Rate (lb/hr)	Modeled Annualized Emission Rate (g/s)
PFOA	0.74	0.074	8.45E-6	1.06E-6
PFNA	0.19	0.019	2.17E-6	2.73E-7
PFHxS	0.041	0.0041	4.68E-7	5.90E-8
PFOS	0.045	0.0045	5.14E-7	6.47E-8

For each compound and stack parameter scenario (see Table 1), Barr modeled maximum and average annual deposition rates using both Method 1 and Method 2. For the maximum predicted deposition rate, Barr extracted the single highest predicted annual deposition rate (i.e., the max. receptor) for each of the five modeled met years and took the highest of those. For the average deposition rate, Barr extracted the maximum deposition rate across all modeled met years for each receptor and took the average of those across the entire receptor grid.

Summaries of the predicted maximum and average deposition rates are shown in Table 5 for the Reasonably Likely Design (Scenario C) and in Table 6 for the maximum predicted deposition scenario (Scenario E). Note that the results in these tables reflect the results of NHDES's verification runs. NHDES's Method 1 results differ somewhat from those reported by Barr (see Table 2 of their modeling report) for the following reason: NHDES used the Barton particle size distribution (see Table 3 above) explicitly, while Barr truncated the first particle size bin from <0.28 to <0.2 microns. They also increased the last particle size bin from >4.4 to >5 microns.

The modeled deposition rates in Tables 5 and 6 below can be used in conjunction with other information to draw conclusions about how air emissions of PFCs from SGPP impact soil and water in the vicinity of the facility. These tables also provide unit rate impacts, based on 1 g/s, that can be used to calculate deposition rates for other emission rates with the following formula:

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

NHDES' model predicted unitized (1 g/s) deposition rates for modeling scenarios A through P are provided in Attachments B and C for Method 1 and Method 2, respectively. The tables in these attachments show the predicted unitized deposition rates for both the maximum (i.e., the highest of the overall maximum predicted deposition rates for each of the five met years) and the average (i.e., the highest predicted deposition rate for each receptor over the five met years averaged across the entire receptor grid).

Table 5 – SGPP, NHDES Model Predicted Maximum and Average Deposition Rates ($g/m^2/yr$) for the Reasonably Likely Design (Scenario C)

Method 1

Compound	Maximum	Average
PFOA	8.13E-8	8.22E-9
PFNA	2.09E-8	2.11E-9
PFHxS	4.50E-9	4.56E-10
PFOS	4.94E-9	5.00E-10
Unit (1 g/s)	7.64E-2	7.72E-3

Method 2

Compound	Maximum	Average
PFOA	3.01E-7	4.37E-8
PFNA	7.72E-8	1.12E-8
PFHxS	1.67E-8	2.42E-9
PFOS	1.83E-8	2.66E-9
Unit (1 g/s)	2.82E-1	4.11E-2

Table 6 – SGPP, NHDES Model Predicted Maximum and Average Deposition Rates ($g/m^2/yr$) for the Maximum Predicted Deposition Scenario (Scenario E)

Method 1

Compound	Maximum	Average
PFOA	1.52E-7	9.67E-9
PFNA	3.90E-8	2.48E-9
PFHxS	8.42E-9	5.36E-10
PFOS	9.24E-9	5.88E-10
Unit (1 g/s)	1.43E-1	9.09E-3

Method 2

Compound	Maximum	Average
PFOA	4.11E-7	4.94E-8
PFNA	1.05E-7	1.27E-8
PFHxS	2.28E-8	2.74E-9
PFOS	2.50E-8	3.00E-9
Unit (1 g/s)	3.86E-1	4.64E-2

Project Tracking and Details

- **Modeler(s):** Barr/D. Healy **Reviewer:** J. Underhill
- **Model:** AERMOD v. 18081 **Profile Base Elevation:** 229ft
- **Met data:** 18081v1_Adj.U***** (12 sector) 2013-17 **Met site:** Manchester
- **Analysis details:** Temporary permit application for RTO. 90% destruction efficiency was assumed.

Attachment A: NHDES Model Max. Predicted Unit Rate RTAP Impacts (μg/m^3 per lb/hr)

Scenario	24-hr	Annual
A	4.9561	0.6579
B	4.4298	0.5702
C	4.0351	0.5702
D	3.6842	0.4825
E	5.1754	0.6579
F	4.6053	0.5702
G	3.4649	0.4825
H	3.2018	0.3947
I	3.5526	0.3947
J	3.3772	0.3509
K	3.5088	0.3947
L	3.3333	0.3509
M	3.4649	0.4825
N	3.2018	0.3947
O	4.0789	0.5702
P	3.7281	0.4825

The unit rate (1 lb/hr) impacts shown above can be used to calculate maximum predicted impacts for other RTAPs using the following formula:

Max. predicted RTAP impact (μg/m^3) = RTAP emission rate (lb/hr) x max. predicted unitized impact (μg/m^3 per lb/hr)

Attachment B: NHDES Model Predicted Maximum and Average Deposition Rates for Method 1 ($g/m^2/yr$ per g/s)

Scenario	Max.	Ave.
A	1.35E-01	8.96E-03
B	1.17E-01	8.12E-03
C	7.64E-02	7.72E-03
D	6.54E-02	7.03E-03
E	1.43E-01	9.09E-03
F	1.24E-01	8.21E-03
G	7.43E-02	6.79E-03
H	6.51E-02	6.12E-03
I	4.57E-02	5.97E-03
J	4.06E-02	5.38E-03
K	4.84E-02	6.04E-03
L	4.23E-02	5.44E-03
M	8.03E-02	6.89E-03
N	6.95E-02	6.20E-03
O	8.16E-02	7.82E-03
P	6.91E-02	7.09E-03

Notes:

1) The unit rate (1 g/s) impacts shown above can be used to calculate 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 unitized deposition rate ($g/m^2/yr$ per g/s)

2) For the maximum predicted deposition rate, Barr/NHDES extracted the highest predicted deposition rate (i.e. the max receptor) for each of the five modeled met years and took the highest of those.

3) For the average predicted deposition rate, Barr/NHDES extracted the highest predicted deposition rate for each receptor over the five modeled met years and then took the average of those across the entire receptor grid.

Attachment C: NHDES Model Predicted Maximum and Average Deposition Rates for Method 2 ($g/m^2/yr$ per g/s)

Scenario	Max.	Ave.
A	3.57E-01	4.60E-02
B	2.99E-01	4.09E-02
C	2.82E-01	4.11E-02
D	2.47E-01	3.67E-02
E	3.86E-01	4.64E-02
F	3.23E-01	4.12E-02
G	2.22E-01	3.38E-02
H	1.93E-01	2.98E-02
I	2.10E-01	3.07E-02
J	1.80E-01	2.71E-02
K	2.10E-01	3.10E-02
L	1.80E-01	2.73E-02
M	2.25E-01	3.42E-02
N	1.93E-01	3.02E-02
O	2.80E-01	4.14E-02
P	2.47E-01	3.69E-02

Notes:

1) The unit rate (1 g/s) impacts shown above can be used to calculate 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 unitized deposition rate ($g/m^2/yr$ per g/s)

2) For the maximum predicted deposition rate, Barr/NHDES extracted the highest predicted deposition rate (i.e. the max receptor) for each of the five modeled met years and took the highest of those.

3) For the average predicted deposition rate, Barr/NHDES extracted the highest predicted deposition rate for each receptor over the five modeled met years and then took the average of those across the entire receptor grid.