Operating Scenario: OS – 9 **Emission Source/Group ID:** BS–E1

10. Operating Schedule: (Source/Operating Scenario that best characterizes Calendar Year 2007)
Hours per Day (24) Days per Week (7) Weeks per Year (52)

11. Typical Start & End Times For Operating Scenario: Start: 0 End: 2359

12. Seasonal Periods Percent Annual Throughput:

Jan–Feb + Dec 2007	25%	March–May 2007	25%	June–Aug. 2007	25%	Sept.–Nov. 2007	25%

13. Actual Emissions per Pollutant Listed :
Attach calculations and documentation of emission factors or other estimation methods used.

GHG Pollutants	CAS	Emissions–GHG Pollutants (Tons/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	Ef Control
		2007				

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions–Criteria Pollutants (Tons/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	Ef Control
		2007				
CO	CO		08			
NOx	NOx		08			
TSP	TSP		08			
PM10	PM10		08			
PM2.5	PM2.5		08			
SO2	SO2		08			
VOC	VOC	1.73	02			

HAP/TAP Pollutants (In Alphabetical Order)	CAS (see instructions)	Emissions HAP/TAPS (Pounds/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	EF Control
		2007				

CONFIDENTIAL INFORMATION

Supporting documentation for the determination of air emissions from this emission source contains DuPont Confidential Business Information, which if made public would divulge the manufacturing method, process, and/or capacity, and has therefore been intentionally excluded from the Public Copy of this Air Emissions Inventory as allowed by North Carolina General Statutes §132-1.2, §143-215.3C(a), and §143-215.65.

As entered in AERO

Facility Name: DuPont Company – Fayetteville Works
22828 NC Highway 87 West
Fayetteville, NC 28302

Facility ID : 0900009
Permit : 03735
County : Bladen
DAQ Region : FRO

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory – Calendar Year 2007

1. Emission Source ID (from permit) or Emission Source Group ID BS–E2

2. Emission Source Description: Butacite Line No. 4 Sheeting Extrusion Process, including four (4) extruders

3. Operating Scenario ID/Description: OS – 10/Butacite extruder system – line no. 4

4. SCC Number/Description: 30199998/*Other Organic Chemica Manufacture Not Listed

5. Throughput/units in 2007:
(e.g. production or fuel use):

6. Fuel Information (If fuel is used)

% Sulfur		% Ash		Heat Content (Btu/units)	

7. Capture Efficiency
(% of Emissions from this Process Vented to Control Device or Stack):

8. Control Device Information :None

Order	CS–ID	CD ID (as listed in permit)	Control Device Description

9. Emission Release Point (ERP) Information: (Sources vented to more than one ERP use additional entry lines):

ERP ID	ERP Type	Height (in feet)	Diameter Circle (enter #): Rectangle (L x W) (in 0.1 feet)	Temperature (F)	Velocity (Feet/sec)	Volume Flow Rate (Acfm)	ERP Description
EP–EXT	VERTICAL STACK	50	1	100	0.98	46.18	Butacite extruder systems

Operating Scenario: OS – 10 **Emission Source/Group ID:** BS–E2

10. Operating Schedule: (Source/Operating Scenario that best characterizes Calendar Year 2007)
Hours per Day (24) Days per Week (7) Weeks per Year (52)

11. Typical Start & End Times For Operating Scenario: Start: 0 End: 2359

12. Seasonal Periods Percent Annual Throughput:

Jan–Feb + Dec 2007	25%	March–May 2007	25%	June–Aug. 2007	25%	Sept.–Nov. 2007	25%

13. Actual Emissions per Pollutant Listed :
Attach calculations and documentation of emission factors or other estimation methods used.

GHG Pollutants	CAS	Emissions–GHG Pollutants (Tons/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	Ef Control
		2007				

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions–Criteria Pollutants (Tons/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	Ef Control
		2007				
CO	CO		08			
NOx	NOx		08			
TSP	TSP		08			
PM10	PM10		08			
PM2.5	PM2.5		08			
SO2	SO2		08			
VOC	VOC	1.73	02			

HAP/TAP Pollutants (In Alphabetical Order)	CAS (see instructions)	Emissions HAP/TAPS (Pounds/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	EF Control
		2007				

CONFIDENTIAL INFORMATION

Supporting documentation for the determination of air emissions from this emission source contains DuPont Confidential Business Information, which if made public would divulge the manufacturing method, process, and/or capacity, and has therefore been intentionally excluded from the Public Copy of this Air Emissions Inventory as allowed by North Carolina General Statutes §132-1.2, §143-215.3C(a), and §143-215.65.

As entered in AERO

Facility Name: DuPont Company – Fayetteville Works
22828 NC Highway 87 West
Fayetteville, NC 28302

Facility ID : 0900009
Permit : 03735
County : Bladen
DAQ Region : FRO

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory – Calendar Year 2007

1. Emission Source ID (from permit) or Emission Source Group ID BS–E3

2. Emission Source Description: Butacite Line No. 3 Back–End Processes, including a quencher, dryer/relaxer, and wind–up area

3. Operating Scenario ID/Description: OS – 46/Fabrication of PVB plastic sheeting.

4. SCC Number/Description: Not required by facility, will be completed by DAQ

5. Throughput/units in 2007:
(e.g. production or fuel use):

6. Fuel Information (If fuel is used)

% Sulfur		% Ash		Heat Content (Btu/units)	

7. Capture Efficiency
(% of Emissions from this Process Vented to Control Device or Stack):

8. Control Device Information :None

Order	CS–ID	CD ID (as listed in permit)	Control Device Description

9. Emission Release Point (ERP) Information: (Sources vented to more than one ERP use additional entry lines):

ERP ID	ERP Type	Height (in feet)	Diameter Circle (enter #): Rectangle (L x W) (in 0.1 feet)	Temperature (F)	Velocity (Feet/sec)	Volume Flow Rate (Acfm)	ERP Description
BEP–E	VERTICAL STACK	32	3.33	100	17.6	9200	Butacite Sheeting Stack

Operating Scenario: OS – 46 **Emission Source/Group ID:** BS–E3

10. Operating Schedule: (Source/Operating Scenario that best characterizes Calendar Year 2007)
Hours per Day (24) Days per Week (7) Weeks per Year (52)

11. Typical Start & End Times For Operating Scenario: Start: 0 End: 2359

12. Seasonal Periods Percent Annual Throughput:

Jan–Feb + Dec 2007	25%	March–May 2007	25%	June–Aug. 2007	25%	Sept.–Nov. 2007	25%

13. Actual Emissions per Pollutant Listed :
Attach calculations and documentation of emission factors or other estimation methods used.

GHG Pollutants	CAS	Emissions–GHG Pollutants (Tons/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	Ef Control
		2007				

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions–Criteria Pollutants (Tons/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	Ef Control
		2007				
CO	CO		08			
NOx	NOx		08			
TSP	TSP		08			
PM10	PM10		08			
PM2.5	PM2.5		08			
SO2	SO2		08			
VOC	VOC	8.5	02			

HAP/TAP Pollutants (In Alphabetical Order)	CAS (see instructions)	Emissions HAP/TAPS (Pounds/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	EF Control
		2007				

CONFIDENTIAL INFORMATION

Supporting documentation for the determination of air emissions from this emission source contains DuPont Confidential Business Information, which if made public would divulge the manufacturing method, process, and/or capacity, and has therefore been intentionally excluded from the Public Copy of this Air Emissions Inventory as allowed by North Carolina General Statutes §132-1.2, §143-215.3C(a), and §143-215.65.

As entered in AERO

Facility Name: DuPont Company – Fayetteville Works
22828 NC Highway 87 West
Fayetteville, NC 28302

Facility ID : 0900009
Permit : 03735
County : Bladen
DAQ Region : FRO

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory – Calendar Year 2007

1. Emission Source ID (from permit) or Emission Source Group ID BS–E4

2. Emission Source Description: Butacite Line No. 4 Back–End Processes, including a quencher, dryer/relaxer, and wind–up area

3. Operating Scenario ID/Description: OS – 47/Fabrication of PVB sheeting

4. SCC Number/Description: Not required by facility, will be completed by DAQ

5. Throughput/units in 2007:
(e.g. production or fuel use):

6. Fuel Information (If fuel is used)

% Sulfur		% Ash		Heat Content (Btu/units)	

7. Capture Efficiency
(% of Emissions from this Process Vented to Control Device or Stack):

8. Control Device Information :None

Order	CS–ID	CD ID (as listed in permit)	Control Device Description

9. Emission Release Point (ERP) Information: (Sources vented to more than one ERP use additional entry lines):

ERP ID	ERP Type	Height (in feet)	Diameter Circle (enter #): Rectangle (L x W) (in 0.1 feet)	Temperature (F)	Velocity (Feet/sec)	Volume Flow Rate (Acfm)	ERP Description
BEP–E	VERTICAL STACK	32	3.33	100	17.6	9200	Butacite Sheeting Stack

Operating Scenario: OS – 47 **Emission Source/Group ID:** BS–E4

10. Operating Schedule: (Source/Operating Scenario that best characterizes Calendar Year 2007)
Hours per Day (24) Days per Week (7) Weeks per Year (52)

11. Typical Start & End Times For Operating Scenario: Start: 0 End: 2359

12. Seasonal Periods Percent Annual Throughput:

Jan–Feb + Dec 2007	25%	March–May 2007	25%	June–Aug. 2007	25%	Sept.–Nov. 2007	25%

13. Actual Emissions per Pollutant Listed :
Attach calculations and documentation of emission factors or other estimation methods used.

GHG Pollutants	CAS	Emissions–GHG Pollutants (Tons/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	Ef Control
		2007				

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions–Criteria Pollutants (Tons/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	Ef Control
		2007				
CO	CO		08			
NOx	NOx		08			
TSP	TSP		08			
PM10	PM10		08			
PM2.5	PM2.5		08			
SO2	SO2		08			
VOC	VOC	8.5	02			

HAP/TAP Pollutants (In Alphabetical Order)	CAS (see instructions)	Emissions HAP/TAPS (Pounds/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	EF Control
		2007				

CONFIDENTIAL INFORMATION

Supporting documentation for the determination of air emissions from this emission source contains DuPont Confidential Business Information, which if made public would divulge the manufacturing method, process, and/or capacity, and has therefore been intentionally excluded from the Public Copy of this Air Emissions Inventory as allowed by North Carolina General Statutes §132-1.2, §143-215.3C(a), and §143-215.65.

As entered in AERO

Facility Name: DuPont Company – Fayetteville Works
22828 NC Highway 87 West
Fayetteville, NC 28302

Facility ID : 0900009
Permit : 03735
County : Bladen
DAQ Region : FRO

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory – Calendar Year 2007

1. Emission Source ID (from permit) or Emission Source Group ID NS–A

2. Emission Source Description: Nafion Hexfluoropropylene epoxide process (HFPO) [MACT FFFF]

3. Operating Scenario ID/Description: OS – 11/Manufacture of hexafluoropropylene epoxide

4. SCC Number/Description: 30199998/*Other Organic Chemica Manufacture Not Listed

5. Throughput/units in 2007:
(e.g. production or fuel use):

6. Fuel Information (If fuel is used)

% Sulfur		% Ash		Heat Content (Btu/units)	

7. Capture Efficiency
(% of Emissions from this Process Vented to Control Device or Stack): 63

8. Control Device Information :

Order	CS–ID	CD ID (as listed in permit)	Control Device Description
1	CS–6	NCD–Hdr–1	Baffle–plate scrubber (7,000 kilogram/hour liquid injection rate averaged over a 3–hour period)

9. Emission Release Point (ERP) Information: (Sources vented to more than one ERP use additional entry lines):

ERP ID	ERP Type	Height (in feet)	Diameter Circle (enter #): Rectangle (L x W) (in 0.1 feet)	Temperature (F)	Velocity (Feet/sec)	Volume Flow Rate (Acfm)	ERP Description
EP–NEP–Hdr1	VERTICAL STACK	85	3	75	58	24598.67	Nafion scrubber Hdr1

Operating Scenario: OS – 11 **Emission Source/Group ID:** NS–A

10. Operating Schedule: (Source/Operating Scenario that best characterizes Calendar Year 2007)
Hours per Day (24) Days per Week (7) Weeks per Year (52)

11. Typical Start & End Times For Operating Scenario: Start: 0 End: 2359

12. Seasonal Periods Percent Annual Throughput:

Jan–Feb + Dec 2007	24%	March–May 2007	28%	June–Aug. 2007	29%	Sept.–Nov. 2007	19%

13. Actual Emissions per Pollutant Listed :
Attach calculations and documentation of emission factors or other estimation methods used.

GHG Pollutants	CAS	Emissions–GHG Pollutants (Tons/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	Ef Control
		2007				

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions–Criteria Pollutants (Tons/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	Ef Control
		2007				
CO	CO		08			
NOx	NOx		08			
TSP	TSP		08			
PM10	PM10		08			
PM2.5	PM2.5		08			
SO2	SO2		08			
VOC	VOC	55.87	08	90.5		

HAP/TAP Pollutants (In Alphabetical Order)	CAS (see instructions)	Emissions HAP/TAPS (Pounds/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	EF Control
		2007				
Benzene	71–43–2	1.92	02	0		
Hydrogen fluoride (hydrofluoric acid as mass of HF–Component of Fluorides)	7664–39–3	1981.3	02	99.6		
Toluene	108–88–3	2143	02	0		

CONFIDENTIAL INFORMATION

Supporting documentation for the determination of air emissions from this emission source contains DuPont Confidential Business Information, which if made public would divulge the manufacturing method, process, and/or capacity, and has therefore been intentionally excluded from the Public Copy of this Air Emissions Inventory as allowed by North Carolina General Statutes §132-1.2, §143-215.3C(a), and §143-215.65.

Emission Summary

A. VOC Compound Summary

Nafion® Compound	CAS Chemical Name	CAS No.	Point Source and Non-point Source Emissions (lbs)	Accidental Emissions	Total Emissions (lbs)
COF2	Carbonyl Fluoride	353-50-4	2,372	0	2,372
PAF	Trifluoroacetyl Fluoride	354-34-7	1,680	0	1,680
A/F Solvent (TFF)	Perfluoro-3,5,7,9,11-pentaoxadodecanoyl fluoride	690-43	471	0	471
A/F Solvent (TAF)	Trifluoromethyl ester of carbonofluoridic acid	3299-24-9	471	0	471
HFP	Hexafluoropropylene	116-15-4	73,410	0	73,410
HFPO	Hexafluoropropylene Epoxide	428-59-1	31,187	0	31,187
Benzene	Benzene	71-43-2	2	0	2
Toluene	Methylbenzene	108-88-3	2,143	0	2,143
				Total VOC Emissions (lbs)	**111,736**
				Total VOC Emissions (tons)	**55.87**

B. VOC Control Efficiency

VOCs Generated			VOCs Emitted from Stack		
Point Source Generated (lbs)	Equipment Emissions Inside Buildings (lbs)	Total VOC Generated	Point Source Emissions (lbs)	Non-point Source Emissions (lbs)	Total VOC Emitted (lbs)
1,226,156	3,420	1,229,577	96,544	2,183	98,727

1,229,577 lb VOC generated
- 98,727 lb VOC emitted
= 1,130,849 lb VOC removed in control device

1,130,849 lb VOC removed in control device / 1,229,577 lb VOC generated = 91.97% **VOC control efficiency**

C. Toxic Air Polluntant Summary

Nafion® Compound	CAS Chemical Name	CAS No.	Point Source Emissions (lbs)	Non-point Source Emissions (lbs)	Accidental Emissions	Total Emissions (lbs)
HF	Hydrogen Fluoride	7664-39-3	1,827.60	153.64	0	1,981.25
Benzene	Benzene	71-43-2		1.92		1.92
Toluene	Methylbenzene	108-88-3		2,143.00		2,143.00

D. HF Control Efficiency

Total Emissions (tons) **57.93**

1,828 lb HF emitted from Point Sources
(100%-99.6%) Stack Efficiency
= 456,901 lb HF sent to control device from Point Sources

456,901 lb HF sent to control device from Point Sources
- 1,981 lb HF emitted
= 454,920 lb HF removed in control device

456,901 lb HF sent to control device from Point Sources
+ 154 lb HF from Non-point Sources inside buildings
= 457,055 lb HF generated

454,920 lb HF removed in control device
457,055 lb HF generated
= 99.53% **HF control efficiency**

F. Perfluoromethylcyclopropane (PMCP) **CAS No. 379-16-8**
Oxygen (O_2) **CAS No. 7782-44-7**
Fluoroform (CF_3H) **CAS No. 75-46-7**
Carbon Dioxide (CO_2) **CAS No. 124-38-9**

PMCP, O_2, CF_3H, and CO_2 are not VOCs nor do they have potential to make HF. Since they are not reportable emissions, the calculations are not shown here.

G. Point Source Summary

		Before Control VOC Generated		After Control Stack Emissions		After Control Stack Emissions	
Nafion Compound Name		kg/yr VOC	lb/yr VOC	lb/yr VOC	lb/yr HF	ton/yr VOC	Ton/yr HF
A.	COF2	244,367	538,733	2,155	1306	1	1
B.	PAF	173,088	381,590	1,526	263	1	0
C.	Acid Fluoride Solvent (TFF)	48,495	106,913	428	259.2	0	0
	Acid Fluoride Solvent (TAF)	48,495	106,913	428		0	
D.	HFP	29,600	65,256	65,256		33	
E.	HFPO	12,134	26,751	26,751		13	
	Total	556,181	1,226,156	**96,544**	**1,828**	**48**	**1**

Non-point Source Emission Determination:

Non-point source emissions include equipment emissions and maintenance emissions. Equipment emissions are due to leaks from valves, flanges, and pumps. If these leaks occur outside of a building, they are considered fugitive emissions. Maintenance emissions are due to opening up vessels for maintenance and though some of this equipment is located indoors, to be conservative it will be assumed that all maintenance emissions are fugitive emissions.

I. Equipment Emissions

Equipment Emissions are a function of the number of emission points in the plant (valves, flanges, pump seals). For the equipment emission calculations the inventory shown below is conservative and based on plant and process diagrams. Note that the calculations below include equipment emissions (EE) inside buildings (which become stack emissions or SE) as well as equipment emissions outside buildings (fugitive emissions or FE).

A. Equipment Emissions Inside Buildings (Stack Emissions)

1. Equipment Emissions from Reactor, Distillation Column, #1 Recycle Tank:

Emissions are vented from equipment located in the barricade and are vented through the barricade scrubber. Barricade scrubber is 95% efficient for control of acid fluorides. From W1208078 HFPO Flowsheet:

Material	VOC	HF	Average Vessel Contents (kg/hr)				% of contents	% VOC	% HF	HF Potential	% overall HF Potential			
			Line 6	Line 6	Line 4	Total					0.606	0.172	0.11	0.081
O2			2.4	2.4		4.8	0.1%							
COF2	x	x	33.7	33.7		67.4	1.4%	1.4%	1.4%	0.606	1.4%			
PAF	x	x	25.5	25.5		51	1.0%	1.0%	1.0%	0.172		1.0%		
HFP	x		76.4	76.4		152.8	3.1%	3.1%						
HFPO	x		100.1	100.1		200.2	4.1%	4.1%						
HFA	x		1	1		2	0.0%	0.0%						
PMFF	x	x	9.6	9.6		19.2	0.4%	0.4%	0.4%	0.606	0.4%			
PMAF	x	x	18.4	18.4	14.5	51.3	1.1%	1.1%	1.1%	0.11			1.1%	
PMCP			86.6	86.6	80.5	253.7	5.2%							
TFF	x	x	50.3	50.3	50	150.6	3.1%	3.1%	3.1%	0.081				3.1%
TAF	x	x	500	500	495.9	1495.9	30.6%	30.6%	30.6%	0.606	30.6%			
TAF	x	x	335	335	332	1002	20.5%	20.5%	20.5%	0.606	20.5%			
TAF	x	x	479	479	476.3	1434.3	29.4%	29.4%	29.4%	0.606	29.4%			
Total						4885.2		94.7%	87.4%		82.3%	1.0%	1.1%	3.1%
											Average HF Potential			0.504

Assume that: 95% of process materials are VOCs;
88% are acid fluorides with 95% controlled in the barricade scrubber;
7% are non-acid fluorides with 0% controlled in the barricade scrubber.
100% of the liquid is 0.504 weight fraction HF.

Barricade:

Valve emissions:	119 valves x 0.00039 lb/hr/valve	= 0.046 lb/hr EE
Flange emissions:	248 flanges x 0.00018 lb/hr/flange	= 0.045 lb/hr EE
Pump emissions:	1 pump x 0.00115 lb/hr/pump	= 0.001 lb/hr EE
Total equipment emission rate		= 0.092 lb/hr EE

Barricade VOC:

From acid fluorides:
0.092 lb. EE/hr
x 8760 hr/year
x 0.880 lb. A/F VOC/lb. EE
= 710.751 lb/yr VOC generated

710.751 lb VOC generated
x (100%-95%) scrubber efficiency
= 35.538 lb/yr VOC emitted

From non-acid fluorides: 0.092 lb. EE/hr
x 8760 hr/year
x 0.070 lb. Non-A/F VOC/lb. EE
= 56.537 lb/yr VOC

Total Barricade VOC Emissions:

35.538 lb/yr VOC
+ 56.537 lb/yr VOC
= 92.075 **lb/yr VOC**

Barricade HF:
0.092 lb. EE/hr
x 8760 hr/year
x 0.504 lb. HF/lb. EE
x (100%-95%) scrubber efficiency

= [redacted] 20.353 lb/yr HF

2. Fugitive Emissions From Distillation System #1

Emissions are vented from equipment located in tower and are vented through stack.
From W1208078 HFPO Flowsheet:

Material	VOC	HF	Average Vessel Contents Line 8 (kg/hr)	% of contents	% VOC	% HF	HF Potential	% overall HF Potential 0.606	0.172	0.11
O2			2.4	0.93%						
COF2	x	x	33.7	13.09%	13.1%	13.1%	0.606	13.1%		
PAF	x	x	25.5	9.91%	9.9%	9.9%	0.172		9.9%	
HFP	x		76.4	29.68%	29.7%					
HFPO	x		99.9	38.81%	38.8%					
HFA	x		1	0.39%	0.4%					
PMFF	x	x	9.6	3.73%	3.7%	3.7%	0.606	3.7%		
PMAF	x	x	3.8	1.48%	1.5%	1.5%	0.110			1.5%
PMCP			5.1	1.98%						
TFF	x	x								
TAF	x	x								
TAF	x	x								
TAF	x	x								
Total			257.4		94.7%	87.4%		82.3%	1.0%	1.5%
								Average HF Potential		0.121

Assume that : 95 wt. % of the process material are VOCs;
100% of the liquid is 0.121 weight fraction HF.

Valve emissions:	60 valves x 0.00039 lb/hr/valve	=	0.023 lb/hr EE
Flange emissions:	120 flanges x 0.00018 lb/hr/flange	=	0.022 lb/hr EE
Total equipment emission rate		=	0.045 lb/hr EE

VOC:
0.045 lb. EE/hr
x 8760 hr/year
x 0.950 lb. VOC/lb. EE
= **374.490 lb/yr VOC**

HF:
0.045 lb. EE/hr
x 8760 hr/year
x 0.121 lb. HF/lb. EE
= **47.698 lb/yr HF**

3. Equipment Emissions From Scrubber, Dryers, and Stripper Column

Emissions are vented from equipment located in tower and are vented through stack.
From W1208078 HFPO Flowsheet:

Material	VOC	HF	Average Vessel Contents (kg/hr) Line 6	Line 11	Line 12	Total	% of contents	% VOC	% HF	HF Potential	% overall HF Potential 0.606	0.172	0.11
O2													
COF2													
PAF	x	x	6.5			6.5	0.68%	0.68%	0.68%	0.172	0.68%		
HFP	x		75.8	75.8	75.8	227.4	23.90%	23.90%					
HFPO	x		99.6	96.7	96.7	293	30.79%	30.79%					
HFA	x		1			1	0.11%	0.11%					
PMFF	x	x	9.6			9.6	1.01%	1.01%	1.01%	0.606		1.01%	
PMAF	x	x	3.8			3.8	0.40%	0.40%	0.40%	0.11			0.40%
PMCP			5.1		5.1	10.2	1.07%						
Water			360			360							
KOH			40			40							
Total						951.5		56.9%	2.1%		0.7%	1.0%	0.4%
										Average HF Potential			0.008

Assume that : 57 wt. % of the process material are VOCs;
100% of the liquid is 0.008 weight fraction HF.

Valve emissions:	171 valves x 0.00039 lb/hr/valve	=	0.067 lb/hr EE
Flange emissions:	312 flanges x 0.00018 lb/hr/flange	=	0.056 lb/hr EE
Pump emissions:	2 pumps x 0.00115 lb/hr/pump	=	0.002 lb/hr EE
Total equipment emission rate		=	0.125 lb/hr EE

VOC:
0.125 lb. EE/hr
x 8760 hr/year
x 0.570 lb. VOC/lb. EE
624.899 lb/yr VOC

HF:
0.125 lb. EE/hr
x 8760 hr/year
x 0.008 lb. HF/lb. EE
= **8.771 lb/yr HF**

B. Equipment Emissions Outside Buildings (Fugitive Emissions)

1. Fugitive Emissions From Distillation System #2

From W1208078 HFPO Flowsheet:

Material	VOC	HF	Average Vessel Contents (kg/hr)			% of contents	% VOC	% HF
			Line 18	Line 23	Total			
O2								
COF2	x	x						
PAF	x	x						
HFP	x		74.5	73.8	148.3	3.18%	3.18%	
HFPO	x		95.8	7.7	103.5	2.22%	2.22%	
HFA	x							
PMFF	x	x						
PMAF	x	x						
PMCP			5.1	5.1	10.2	0.22%		
Toluene	x		2200	2200	4400	94.38%	94.38%	
Total					4662		99.78%	0.00%

Assume that : 100 wt. % of the process material are VOCs (most of the mass is toluene CAS No. 108-88-3)
0 wt. % of the liquid is HF.

Valve emissions:	155 valves x 0.00039 lb/hr/valve	=	0.060 lb/hr FE
Flange emissions:	300 flanges x 0.00018 lb/hr/flange	=	0.054 lb/hr FE
Pump emissions:	1 pump x 0.00115 lb/hr/pump	=	0.001 lb/hr FE
Total fugitive emission rate		=	0.116 lb/hr FE

VOC:		HF:	
	0.116 lb. FE/hr		0.116 lb. FE/hr
x	8760 hr/year	x	8760 hr/year
x	1.00 lb. VOC/lb. FE	x	0.0 lb. HF/lb. FE
=	1012.66 **lb/yr VOC** (assume all is toluene)	=	0.00 **lb/yr HF**

2. Fugitive Emissions From HFP Storage and Feed

Assume that : This system contains only HFP, so 100 wt. % of the process material are VOCs
HFP has no potential to form HF, so 0 wt. % of the liquid is HF.

Valve emissions:	120 valves x 0.00039 lb/hr/valve	=	0.047 lb/hr FE
Flange emissions:	135 flanges x 0.00018 lb/hr/flange	=	0.024 lb/hr FE
Total fugitive emission rate		=	0.071 lb/hr FE

VOC:		HF:	
	0.071 lb. FE/hr		0.071 lb. FE/hr
x	8760 hr/year	x	8760 hr/year
x	1.00 lb. VOC/lb. FE	x	0.0 lb. HF/lb. FE
=	622.84 **lb/yr VOC**	=	0.00 **lb/yr HF**

3. Fugitive Emissions From Benzene

Basis: Fugitive emissions are determined via mass balance, i.e. any mass of benzene unaccounted for in the mass balance will be assumed to be air emissions.

Assume that: Benzene introduced into the process is mostly destroyed by reaction.
Ratio of emissions to benzene used = 1.9 lb emission/368 lb benzene used

Calculations:

$$\frac{\text{(2002) } 1.92 \text{ lbs benezene}}{1126145 \text{ kg fresh HFP}} = \frac{\text{(Future) } 4.62 \text{ lbs Toluene}}{2{,}707{,}354 \text{ kg fresh HFP}}$$

Benzene introduced to process: 372 lbs from SARA 313

Benzene emissions:

372 lbs from SARA 313 x $\frac{1.90 \text{ lb emission}}{368 \text{ lb benzene}}$ = 1.92 lb benzene emission

4. Fugitive Emissions From Toluene

Basis: Fugitive emissions are determined via mass balance, i.e. any mass of toluene unaccounted for in the mass balance will be assumed to be air emissions.

Assume that: 95% of raw ingredient becomes waste

Mass Balance:

Toluene inventory in process as of January 1:	+	3184 lb	
Toluene added to process:	+	8786 lb	
Toluene inventory in process as of December 31:	-	3715 lb	
Toluene destroyed in process:	-	0 lb	
Toluene shipped off with product:	-	151 lb injected into product	
Toluene removed from process as a solid waste:	-	5961 lb	
Toluene released to air via permitted stack:	-	0 lb	
Toluene released to process wastewater:	-	0 lb	
Toluene released to the ground (spill):	-	0 lb	
Unaccounted for difference in mass:	=	2143 lb toluene	= 2143 lb VOC

In section B-1, fugitive emissions from distillation system #2, the assumption was made that all of the fugitive emissions were toluene. As the mass balance above shows the unaccounted for toluene, the amount calculated in section 3 is extremely conservative. Therefore, for the purpose of toluene and VOC emissions, the amount actually vented will be reported based on the mass balance calculation.

5. Total Equipment Emissions

	Emission Source	Inside Emissions (Stack Emissions) lb VOC	Inside Emissions (Stack Emissions) lb HF	Outside Emissions (Fugitive Emissions) lb VOC	Outside Emissions (Fugitive Emissions) lb HF
A-1	Reactor, Distillation Columns, #1 Recycle Tank	92.07	20.35		
A-2	Distillation System #1	374.49	47.70		
A-3	Scrubbing, Dryers, Stripper Column	624.90	8.771		
B-1	Distillation System #2			1013	
B-2	HFP Storage and Feed			622.84	
B-4	Toluene System			2143.00	
	Total	1091.46	76.82	3778.49	0.00

In order to be conservative, the calculated values will be multiplied by a factor of 2.

	Inside Emissions (Stack Emissions) lb/yr VOC	Inside Emissions (Stack Emissions) lb/yr HF	Outside Emissions (Fugitive Emissions) lb/yr VOC	Outside Emissions (Fugitive Emissions) lb/yr HF
Conservative amount (total x 2)	2,183	154	7,557	0

Total HF emissions:

	154	lbs HF from outside building
+	0	lbs HF from inside building
=	154	**lbs HF**

Total VOCs generated inside building:

	710.75	lb VOC from Reactor, Distillation Column, #1 Recycle Tank
+	374.49	lb VOC from Scrubber, Dryers, Stripper Column
+	624.90	lb VOC from Scrubber, Dryers, Stripper Column
=	1710.14	lb VOC generated (before control device)

Conservative amount (total x 2) 3420 lb VOC generated (before control device)

II. Maintenance Emissions

Background

During preparation of equipment for maintenance, a vessel is first de-inventoried of liquid (to another process vessel), then de-pressurized (to a vacuum), then nitrogen is used for a series of pressurize/vent-down cycles until a vessel is fume free. For the purpose of estimating emissions from vessel preparation, the plant can be broken down into three sections: HFP Storage and Feed, HFPO Distillation system #2, and everything else. Below are the definitions, assumptions, and calculations of maintenance emissions for each section.

A. HFP Storage and Feed

The HFP Storage section consists of the two HFP Storage Tanks and the associated equipment to transfer HFP into the tanks. When maintenance clearing is required for these tanks (scheduled once per year), the liquid inventory is transferred to the other tank, the vapors are compressed into the tank (down to 10 psig), and then the residue is evacuated to the Nafion® Division Waste Gas Scrubber. The emissions to the atmosphere, therefore, are the HFP vapors remaining at 10 psig.

Calculations:

PV = nRT

Tank Volume = 3000 gal =	401 ft^3
Contents =	100 % HFP (MW=150 lb/lbmol)
Tank pressure = 10 psig =	24.7 psia
Tank temperature = ambient = 77 deg F =	537 R
R =	10.73 psia-ft^3/lbmol/R

n = PV/RT

$$n = \frac{24.7 \text{ psia}}{10.7 \text{ psia-ft}^3\text{/lbmol/R}} \times \frac{401 \text{ ft}^3}{537 \text{ R}} = 1.72 \text{ lbmol HFP}$$

$$1.72 \text{ lbmol HFP} \times \frac{150 \text{ lb HFP}}{\text{lbmol HFP}} = 258 \text{ lb HFP} = 258 \text{ lb VOC per cleaning}$$

Clearings/year: Each tank scheduled once per year; two tanks is two clearings/year scheduled; to be conservative, assume one extra clearing a year, so three clearings performed per year.

258 lb HFP
x 3 clearings/year
= 774 lb/yr HFP

VOC from HFP Storage Tank =

258 lb VOC per cleaning
x 3 clearings/year
= 774 **lb/yr VOC**

B. Disposal of Off-Spec Material

In May 2007, two HFPO cylinders containing high levels of HFA were re-worked through the division WGS (see TA NF-07-1650). HFA was removed in the HDR facility while the HFPO was vented from the process. VOC emissions resulting from this work are recorded here.

Cylinder Number	HFPO (lb)	HFA (lb)	Total Mass (lb)
35459	12.447	448.553	461
414-2-69	888.879	914.121	1803
Total	901.326	1362.674	2264

C. Distillation System #2

When maintenance clearing is required for the column and tanks (scheduled once per year), the liquid inventory is transferred to the other tank, the vapors are compressed into the tank (down to 10 psig), and then the residue is evacuated to the Nafion® Division Waste Gas Scrubber. For the purposes of these calculations, the average operating pressure and total volume are used.

Calculations:

PV = nRT

Tank Volume = 3300 gal =	441 ft^3
Contents =	50 % HFP (MW=150 lb/lbmol)
(Conservative approximation based off of vessel contents and volatility of compounds)	40 % HFPO (MW=166 lb/lbmol)
	10 % Toluene (MW=92 lb/lbmol)
Average system pressure = 20 psig =	34.7 psia
Average system temperature = 30 deg F =	490 R
R =	10.73 psia-ft^3/lbmol/R

n = PV/RT

$$n = \frac{34.7 \text{ psia}}{10.7 \text{ psia-ft}^3\text{/lbmol/R}} \times \frac{441 \text{ ft}^3}{490 \text{ R}} = 2.91 \text{ lbmol material}$$

$$2.91 \text{ lbmol material} \times 50 \text{ \% HFP} \times \frac{150 \text{ lb HFP}}{\text{lbmol HFP}} = 218 \text{ lb HFP}$$

$$2.91 \text{ lbmol material} \times 40 \text{ \% HFPO} \times \frac{166 \text{ lb HFPO}}{\text{lbmol HFPO}} = 193 \text{ lb HFPO}$$

$$2.91 \text{ lbmol material} \times 10 \text{ \% Toluene} \times \frac{92 \text{ lb Toluene}}{\text{lbmol Toluene}} = 27 \text{ lb Toluene}$$

As stated previously, toluene amounts are calculated by mass balance. The amount vented calculated by mass balance will be used for toluene and VOC emisssions.

Total VOC per cleaning:

218 lb HFP
\+ 193 lb HFPO
= 412 lb VOC

Clearings/year: Each tank scheduled once per year; to be conservative, assume one extra clearing a year, so two clearings per year.

218 lb HFP
x 2 clearings/year
= 437 lb/yr HFP

193 lb HFPO
x 2 clearings/year
= 387 lb/yr HFPO

VOC from Distillation system #2 =

412 lb VOC
x 2 clearings/year
= **823 lb/yr VOC**

D. "Rest of the Process"

The rest of the HFPO process contains HFP, HFPO, and both low and high vapor pressure acid fluorides (acid fluorides are organic compounds which release HF when exposed to the atmosphere). The calculations below do not include the low-pressure acid fluorides because at temperatures at which the vessels are prepared for maintenance the concentration of the low vapor pressure acid fluorides is very low. The high vapor pressure acid fluorides are not included because they are assumed to go to the WGS during decontamination. Though some of the process is located inside buildings, to be conservative it will be assumed that all emissions are fugitive emissions.

Assume that: Pressure is vapor pressure of HFP/HFPO at ambient temperature (HFP and HFPO have the same vapor pressures)
Composition HFP to HFPO of vapor space in equipment is equivilant to ratio in line 11 of HFPO Flowsheet W130878 :
44 wt% HFP
56 wt% HFPO

Calculations:

PV = nRT

Tank Volume = 1100 gal = 147 ft^3

Contents = 44 wt% HFP (MW=150 lb/lbmol) = 47 mol% HFP
56 wt% HFPO (MW=166 lb/lbmol) = 53 mol% HFPO

Average system pressure 100 psia

Average system temperature = 77 deg F = 537 R

R = 10.73 psia-ft^3/lbmol/R

n = PV/RT

$$n = \frac{100 \text{ psia}}{10.7 \text{ psia-ft}^3\text{/lbmol/R}} \times \frac{147 \text{ ft}^3}{537 \text{ R}} = 2.55 \text{ lbmol material}$$

$$2.55 \text{ lbmol material} \times 47 \text{ \% HFP} \times \frac{150 \text{ lb HFP}}{\text{lbmol HFP}} = 180 \text{ lb HFP}$$

$$2.55 \text{ lbmol material} \times 53 \text{ \% HFPO} \times \frac{166 \text{ lb HFPO}}{\text{lbmol HFPO}} = 224.5 \text{ lb HFPO}$$

Total VOC per cleaning:

179.9 lb HFP
\+ 224.5 lb HFPO
= 404.3 lb VOC

Clearings/year: Each tank scheduled once per year; to be conservative, assume one extra clearing per year, so two clearings per year.

180 lb HFP
x 2 clearings/year
= 360 lb/yr HFP

224.5 lb HFPO
x 2 clearings/year
= 449 **lb/yr HFPO**

VOC from "Rest of the Process" =

404.3 lb VOC
x 2 clearings/year
= 808.6 **lb/yr VOC**

E. Total fugitive Emissions from Maintenance Work

Source		lb/yr HFP	lb/yr HFPO	lb/yr VOC
II-A	HFP Storage and Feed	774		774
II-B	Off-spec HFPO Disposal	0	901	901
II-C	Distillation System #2	437	387	823
II-D	"Rest of the System"	360	449	809
	Total	1,570	1,737	3,307

III. Non-Point Source VOC Emission Summary

Nafion® Compound	Point-Source Emissions lbs	Stack Emissions Inside Emissions (lbs)	Fugitive Emissions Outside Emissions (lbs)	Fugitive Emissions Maintenance Emissions (lbs)	Total lbs
COF2	2,155	49	169		2,372
PAF	1,526	35	119		1,680
TFF	428	10	33		471
TAF	428	10	33		471
HFP	65,256	1475	5108	1570	73,410
HFPO	26,751	605	2094	1737	31,187
Benzene			1.92		2
Toluene			2143		2,143
Total	96,544	2,183	9,702	3,307	111,736

Note: Speciated emissions (except for benzene, toluene, and maintenance emissions) were estimated by assuming that each compound's emission concentration was equal to the compound's stack emissions fraction of the total stack emissions.

For example: the stack emission of PAF was 1,526 lbs
with the total stack emission of VOCs being 96,544 lbs
The total outside fugitive emission (minus benzene & toluene) was 7,556.98 lbs VOC

$$\frac{1{,}526 \text{ lbs PAF}}{96{,}544 \text{ lbs VOC}} \times 7{,}556.98 \text{ fugitive VOC} = 119 \text{ lb fugitive PAF emissions}$$

Accidental Releases to Atmosphere

A. IR-2007-57 Date: 3/13/2007

Material Released: KOH/Water
Quantity Released: 50 lbs

Quantity VOC Released:

50.0 lbs KOH/water
= **0.0 lb VOC**

B. IR-2007-68 Date: 6/22/2007

Material Released: COF2 CAS No. 353-50-4
Quantity Released: 0.1 lbs

Quantity VOC Released:

0.1 lbs COF2
= **0.1 lb VOC**

F. Total Emissions from Accidental Releases

Source		lb DCM	lb HFP	lb HFPO	lb COF2	lb PAF	lb HFA	lb Toluene	lb/yr VOC	lb/yr HF
A.	IR-2007-57	0.0	0	0.0	0	0	0	0.0	0.0	0
B.	IR-2007-68	0.0	0.1	0.0	0.1	0	0	0	0.1	0
	Total	**0.0**	**0.1**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**

As entered in AERO

Facility Name: DuPont Company – Fayetteville Works
22828 NC Highway 87 West
Fayetteville, NC 28302

Facility ID : 0900009
Permit : 03735
County : Bladen
DAQ Region : FRO

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory – Calendar Year 2007

1. Emission Source ID (from permit) or Emission Source Group ID NS–B

2. Emission Source Description: Nafion Vinyl Ethers North process [MACT FFFF]

3. Operating Scenario ID/Description: OS – 12/Manufacture of perfluoronated vinyl ethers

4. SCC Number/Description: 30199998/*Other Organic Chemica Manufacture Not Listed

5. Throughput/units in 2007:
(e.g. production or fuel use):

6. Fuel Information (If fuel is used)

% Sulfur		% Ash		Heat Content (Btu/units)	

7. Capture Efficiency
(% of Emissions from this Process Vented to Control Device or Stack): 100

8. Control Device Information :

Order	CS–ID	CD ID (as listed in permit)	Control Device Description
1	CS–6	NCD–Hdr–1	Baffle–plate scrubber (7,000 kilogram/hour liquid injection rate averaged over a 3–hour period)

9. Emission Release Point (ERP) Information: (Sources vented to more than one ERP use additional entry lines):

ERP ID	ERP Type	Height (in feet)	Diameter Circle (enter #): Rectangle (L x W) (in 0.1 feet)	Temperature (F)	Velocity (Feet/sec)	Volume Flow Rate (Acfm)	ERP Description
EP–NEP–Hdr1	VERTICAL STACK	85	3	75	58	24598.67	Nafion scrubber Hdr1

Operating Scenario: OS – 12 **Emission Source/Group ID:** NS–B

10. Operating Schedule: (Source/Operating Scenario that best characterizes Calendar Year 2007)
Hours per Day (24) Days per Week (7) Weeks per Year (52)

11. Typical Start & End Times For Operating Scenario: Start: 0 End: 2359

12. Seasonal Periods Percent Annual Throughput:

Jan–Feb + Dec 2007	30%	March–May 2007	22%	June–Aug. 2007	34%	Sept.–Nov. 2007	14%

13. Actual Emissions per Pollutant Listed :
Attach calculations and documentation of emission factors or other estimation methods used.

GHG Pollutants	CAS	Emissions–GHG Pollutants (Tons/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	Ef Control
		2007				

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions–Criteria Pollutants (Tons/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	Ef Control
		2007				
CO	CO	7.3	08	0		
NOx	NOx		08			
TSP	TSP		08			
PM10	PM10		08			
PM2.5	PM2.5		08			
SO2	SO2		08			
VOC	VOC	45.1	08	20.4		

HAP/TAP Pollutants (In Alphabetical Order)	CAS (see instructions)	Emissions HAP/TAPS (Pounds/Year)	Emission Estimation Method Code (See Instructions)	Control Efficiency (Net after all controls)	Emission Factor	EF Control
		2007				
Acetonitrile	75–05–8	9606	02	0		
Glycol Ethers, Unlisted (Specify Component of GLYET) (See http://daq.state.nc.us/toxics/glycol/)	GLYET–Other	3640	02	0		
Hydrogen fluoride (hydrofluoric acid as mass of HF– Component of Fluorides)	7664–39–3	68.5	02	99.6		

2007 **Emission Summary**

A. VOC Emissions Summary

Nafion® Compound	CAS Chemical Name	CAS No.	EVE Process Emissions (lbs)	PPVE Process Emissions (lbs)	PSEPVE Process Emissions (lbs)	Accidental Releases (lbs)	Total Vinyl Ethers North Emissions (lbs)
HFP	Hexafluoroproplyene	116-15-4	672	9,712	20,479		30,864
HFPO	Hexafluoropropylene oxide	428-59-1	589	19,666	2,674		22,929
HFPO-Dimer	Perfluoro-2-Propoxy Propionyl Fluoride	2062-98-8	7	308	5		319
EVE	Propanoic Acid, 3-[1-[Difluoro [(Trifluoroethenyl oxy] Methyl]-1,2,2,2-Tetrafluoroethoxy] -2,2,3,3-Tetrafluoro-, Methyl Ester	63863-43-4	370	0	0		370
PPVE	Perfluoropropyl vinyl ether	1623-05-8	0	5,403	0	924	6,327
PSEPVE	Perfluoro-2-(2-Fluorosulfonylethoxy) Propyl Vinyl Ether	16090-14-5	0	0	736		736
PPF	Perfluoropropionyl fluoride	422-61-7	0	69	1		71
TFE	Tetrafluoroethylene	116-14-3	409	8,042	59		8,510
C4	Perfluoro-2-butene	360-89-4	0	572	3,072		3,644
C5	Perfluoropentene	376-87-4	0	49	0		49
Diglyme	Diethylene Glycol Dimethyl Ether	111-96-6	0	0	3,640		3,640
AN	Acetonitrile	75-05-8	0	9,606	0		9,606
ADN	Adiponitrile	111-69-3	2,573	0	0		2,573
TTG	Tetraglyme	143-24-8	261	0	0		261
DA	Tetrafluoro-2[Hexafluoro-2-(Tetrafluoro-2-{Fluorosulfonyl}Ethoxy) Propoxy Propionyl Fluoride	4089-58-1	0	0	156		156
Hydro-PSEPVE	Tetrafluoro-2-[Trifluoro-2-(1,2,2,2-Tetra-fluoroethoxy)-1-(Trifluoromethyl) Ethoxy]-Ethane Sulfonyl Fluoride	755-02-9	0	0	1		1
MA	Tetrafluoro-2-[Tetrafluoro-2-(Fluorosulfonyl)Ethoxy]-Propanoyl Fluoride	4089-57-0	0	0	69		69
TA	Perfluoro(11-(fluorosulfonyl)-2,5,8-trimethyl-3,6,9-trioxanundecanoyl Fluoride	4628-44-8	0	0	6		6
RSU	Fluorosulfonyl difluoroacetyl fluroride	677-67-8	0	0	1		1
MAE	Methyl Perfluoro (5-(Fluoroformyl)-4-Oxahexanoate)	69116-72-9	38	0	0		38
DAE	Methyl Perfloro (8-(Fluoroformyl)-5-methyl-4,7-Dioxanonanoate)	69116-73-0	58	0	0		58
TAE	Methyl Perfluoro (11-(Fluoroformyl)-5,8-Dimethyl-4,7,10-Trioxadodecanoate)	69116-67-2	3	0	0		3
hydro-EVE	Methyl Perfloro-5-methyl-4.7-dioxanon-8-hydroaneoate	87483-34-9	17	0	0		17
iso-EVE	Methyl Perfluoro-6-Methyl-4,7-Dioxanon-8 Eneoate	73122-14-2	26	0	0		26
MMF	Methyl-2,2-Difluoromalonyl Fluoride	69116-71-8	7	0	0		7
HFPO Trimer	Perfluoro-2,5-Dimethyl-3,6-Dioxanonanoyl	2641-34-1	0	7	4		11
Iso-PSEPVE	Perfluoro-1-Methyl-2-(2 Fluorosulfonyl Ethoxy) Ethyl	34805-58-8	0	0	4		4
	Total VOC Emissions (lbs)		**5,030**	**53,434**	**30,907**	**924**	**90,295**
	Total VOC Emissions (tons)		**2.5**	**26.7**	**15.5**	**0.5**	**45.1**

B. VOC Control Device Efficiency

VOCs Generated Before Control (lbs)					VOCs After Control (lbs)
Process Emissions	Equipment Emissions (lbs)	Maintenance Emissions	Accidental Releases	Total VOC Generated	Total VOC Emitted (lbs)
100,410	3,713	1,917	924	106,041	**90,295**

106,041 lb VOC generated
90,295 lb VOC emitted
15,746 lb VOC removed in control device

15,746 lb VOC removed in control device
106,041 lb VOC generated
= **14.85% VOC control efficiency**

C. Toxic Air Pollutant and Hazardous Air Pollutant Summary (TAPS/HAPS)

Nafion® Compound	CAS Chemical Name	CAS No.	EVE Emissions (lbs)	PPVE Emissions (lbs)	PSEPVE Emissions (lbs)	Accidental Releases (lbs)	Total Emissions (lbs)
HF	Hydrogen Fluoride	7664-39-3	6.22	27.2	35.1	0	68.5
Diglyme	Diethylene Glycol Dimethyl Ether	111-96-6			3,640		3,640
Acetonitrile	Acetonitrile	75-05-8		9,606			9,606

D. Carbon Monoxide (CO) Emissions Summary

Nafion® Compound	CAS Chemical Name	CAS No.	EVE Emissions (lbs)	PPVE Emissions (lbs)	PSEPVE Emissions (lbs)	Total Emissions (lbs)	Total Emissions (tons)
CO	Carbon Monoxide	630-08-0	1,377	4,713	8,487	14,577	7.3

Report Created By: Amy Martin
Report Created: 4/22/2008

2007 **AIR EMISSIONS INVENTORY SUPPORTING DOCUMENTATION**

Emission Source ID No: NS-B

Emission Source Description: VE-North EVE Manufacturing Process

Process & Emission Description: The VE-North EVE manufacturing process is a continuous chemical reaction. All emissions from the process are vented through the Nafion Division Waste Gas Scrubber (Control Device ID No. NCD-Hdr) which has a documented control efficiency of 99.6% for all acid fluoride compounds. Some emitted compounds are assumed to pass completely through the scrubber, so the control efficiency for those compounds is assumed to be 0%. The control of emissions of specific compounds will be addressed and detailed in the following pages.

The EVE process in VE-North emits compounds in the acid fluoride family. In the presence of water (such as in atmospheric moisture), these acid fluorides can eventually hydrolyze to hydrogen fluoride. For the purpose of this emissions inventory, a conservative approach will be taken and the acid fluorides will be reported both as a VOC and as the equivalent quantity of hydrogen fluoride.

Basis and Assumptions:

- The EVE process flowsheet is the basis for relative concentrations of before-control emissions of gaseous wastes.

- Calculations of point source emissions are based on actual vent flow totals taken from the IP21 Historian.

- All emission determination calculations are available on the EXCEL spreadsheet found at : S:/Everyone/martinas/Emissions/2007/VEN Air Emissions 2007.xls.

Point Source Emission Determination

A. Hexafluoropropylene (HFP)

CAS No. 116-15-4

HF Potential:

HFP is a VOC without the potential to form HF

Quantity Released

HFP is a byproduct present in the HFPO feed. It is an inert in VE-North that is vented to the WGS.

HFP vented per the process flowsheet

Vented from the Condensation Reactor: 0.17 kg HFP / 0.50 kg CondRxVentFlo

Vented from the Crude Receiver: 0 kg HFP / 15.91 kg CrudeReceiver Vent

Vented from the Foreshots Receiver: 0 kg HFP / 0.14 kg ForeshotsReceiverVent

HFP vented based on 871 kg total Condensation Reactor vent stream (22266FG).
HFP vented based on 16,876 kg total Crude Receiver vent stream (22701FG).
HFP vented based on 124 kg total Foreshots Receiver vent stream (22826FG).

HFP vented from Condensation Reactor:
0.17 kg HFP / 0.50 kg CndRx x 871 kg CndRx = 304 kg HFP

HFP vented from Crude Receiver
0.00 kg HFP / 15.91 kg CrRec x 16,876 kg CrRec = 0 kg HFP

HFP vented from Foreshots Receiver
0.00 kg HFP / 0.14 kg FsRec x 124 kg FsRec = 0 kg HFP

VOC Emissions

304 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= **304** kg HFP = 304 kg VOC
668 lb VOC

B. Hexafluoropropylene oxide (HFPO) **CAS No. 428-59-1**

HF Potential:

HFPO is a VOC without the potential to form HF

Quantity Released

HFPO unreacted in condensation is vented to the WGS.

HFPO vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0.13\ kg\ HFPO}{0.50\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ HFPO}{15.91\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0\ kg\ HFPO}{0.14\ kg\ Foreshots\ Receiver\ Vent}$

HFPO vented based on 871 kg total Condensation Reactor vent stream (22266FG).
HFPO vented based on 16,876 kg total Crude Receiver vent stream (22701FG).
HFPO vented based on 124 kg total Foreshots Receiver vent stream (22826FG).

HFPO vented from Condensation Reactor:

$$\frac{0.13\ kg\ HFPO}{0.50\ kg\ CndRx} \times 871\ kg\ CndRx = 224\ kg\ HFPO$$

HFPO vented from Crude Receiver

$$\frac{0.00\ kg\ HFPO}{15.91\ kg\ CrRec} \times 16{,}876\ kg\ CrRec = 0\ kg\ HFPO$$

HFPO vented from Foreshots Receiver

$$\frac{0.00\ kg\ HFPO}{0.14\ kg\ FsRec} \times 124\ kg\ FsRec = 0\ kg\ HFPO$$

VOC Emissions

224 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 224 kg HFPO = 224 kg VOC
492 lb VOC

C. Perfluoro-2-Propoxy Propionyl Fluoride (HFPO Dimer) **CAS No. 2062-98-8**

HF Potential:

Each mole of HFPO Dimer (MW = 332) can generate 1 mole of HF (MW = 20).

$$1\,kg\,Dimer \frac{1\,moleDimer}{332g\,Dimer} \cdot \frac{20g\,HF}{1\,moleHF} \cdot \frac{1\,moleHF}{1\,moleDimer} = 0.06kg\,HF$$

Therefore, each 1 kg of HFPO Dimer generates 0.060 kg of HF

Quantity Released

Before-control HFPO Dimer vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0.05\ kg\ HFPODimer}{0.50\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ HFPO\ Dimer}{15.91\ kg\ CrudeReceiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0\ kg\ HFPODimer}{0.14\ kg\ ForeshotsReceiverVent}$

HFPO Dimer vented based on 871 kg total Condensation Reactor vent stream (22266FG).
HFPO Dimer vented based on 16,876 kg total Crude Receiver vent stream (22701FG).
HFPO Dimer vented based on 124 kg total Foreshots Receiver vent stream (22826FG).

Before control HFPO Dimer vented from Condensation Reactor:
$\frac{0.05 \text{ kg HFPO Dimer}}{0.50 \text{ kg CndRx}}$ x 871 kg CndRx = 88 kg HFPO Dimer

HFPO Dimer vented from Crude Receiver
$\frac{0.00 \text{ kg HFPO Dimer}}{15.91 \text{ kg CrRec}}$ x 16,876 kg CrRec = 0 kg HFPO Dimer

HFPO Dimer vented from Foreshots Receiver
$\frac{0.00 \text{ kg HFPO Dimer}}{0.14 \text{ kg FsRec}}$ x 124 kg FsRec = 0 kg HFPO Dimer

Total before-control HFPO Dimer vented = 88 kg HFPO Dimer

After-control emissions utilizing the 99.6% control efficient Waste Gas Scrubber (WGS):

VOC Emissions

Waste Gas Scrubber: 88 kg Dimer x (100%-99.6%) = 0.35 kg Dimer = 0.35 kg VOC = **0.78 lb. VOC**

HF Equivalent Emissions

0.35 kg Dimer x 0.060 kg HF/kg Dimer = 0.02 kg HF : **0.05 lb. HF**

D. Tetrafluoroethylene (TFE) **CAS No. 116-14-3**

HF Potential:

TFE is a VOC without the potential to form HF

Quantity Released

TFE is a byproduct that can be formed in the ABR system. It is an inert in VE-North that is vented to the WGS.

TFE vented per the process flowsheet

Vented from the Condensation Reactor: 0 kg TFE / 0.50 kg Cond Rx Vent Flow

Vented from the Crude Receiver 0.18 kg TFE / 15.91 kg Crude Receiver Vent

Vented from the Foreshots Receiver 0 kg TFE / 0.14 kg Foreshots Receiver Vent

TFE vented based on 871 kg total Condensation Reactor vent stream (22266FG).
TFE vented based on 16,876 kg total Crude Receiver vent stream (22701FG).
TFE vented based on 124 kg total Foreshots Receiver vent stream (22826FG).

TFE vented from Condensation Reactor:

$$\frac{0.00}{0.50\ \frac{\text{kg TFE}}{\text{kg CndRx}}} \times 871\ \text{kg CndRx} = 0\ \text{kg TFE}$$

TFE vented from Crude Receiver

$$\frac{0.18}{15.91\ \frac{\text{kg TFE}}{\text{kg CrRec}}} \times 16{,}876\ \text{kg CrRec} = 186\ \text{kg TFE}$$

TFE vented from Foreshots Receiver

$$\frac{0.00}{0.14\ \frac{\text{kg TFE}}{\text{kg FsRec}}} \times 124\ \text{kg FsRec} = 0\ \text{kg TFE}$$

VOC Emissions

0 kg from Condensation Reactor
\+ 186 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 186 kg TFE = 186 kg VOC
408 lb VOC

E. Methyl Perfluoro (5-(Fluoroformyl) -4-Oxahexanoate) (MAE)

CAS No. 69116-72-9

HF Potential:

Each mole of MAE (MW = 322) can generate 1 mole of HF (MW = 20).

$$1\,kg\,MAE \cdot \frac{1\,mole\,MAE}{322\,g\,MAE} \cdot \frac{20\,g\,HF}{1\,mole\,HF} \cdot \frac{1\,mole\,HF}{1\,mole\,MAE} = 0.062\,kg\,HF$$

Therefore, each 1 kg of MAE generates 0.062 kg of HF

Quantity Released

Before-control MAE vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ MAE}{0.50\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ MAE}{15.91\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0.04\ kg\ MAE}{0.14\ kg\ Foreshots\ Receiver\ Vent}$

MAE vented based on 871 kg total Condensation Reactor vent stream (22266FG).
MAE vented based on 16,876 kg total Crude Receiver vent stream (22701FG).
MAE vented based on 124 kg total Foreshots Receiver vent stream (22826FG).

Before control MAE vented from Condensation Reactor:
$\frac{0.00\ kg\ MAE}{0.50\ kg\ CndRx}$ x 871 kg CndRx = 0 kg MAE

MAE vented from Crude Receiver
$\frac{0.00\ kg\ MAE}{15.91\ kg\ CrRec}$ x 16,876 kg CrRec = 0 kg MAE

MAE vented from Foreshots Receiver
$\frac{0.04\ kg\ MAE}{0.14\ kg\ FsRec}$ x 124 kg FsRec = 33 kg MAE

Total before-control MAE vented = 33 kg MAE

After-control emissions utilizing the 99.6% control efficient Waste Gas Scrubber (WGS):

VOC Emissions

Waste Gas Scrubber: 33 kg MAE x (100%-99.6%) = 0.13 kg MAE = 0.13 kg VOC = **0.29 lb. VOC**

HF Equivalent Emissions

0.13 kg MAE x 0.062 kg HF/kg MAE = 0.01 kg HF **0.02 lb. HF**

F. Propanoic Acid, 3-[1-[Difluoro [(Trifluoroethenyl) oxy] Methyl]-1,2,2,2-Tetrafluoroethoxy]-2,2,3,3 -Tetrafluoro-, Methyl Ester (EVE)

CAS No. 63863-43-4

HF Potential:

EVE is a VOC without the potential to form HF

Quantity Released

EVE vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ EVE}{0.50\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ EVE}{15.91\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0.0 kg\ EVE}{0.14\ kg\ Foreshots Receiver Vent}$

EVE vented based on 871 kg total Condensation Reactor vent stream (22266FG).
EVE vented based on 16,876 kg total Crude Receiver vent stream (22701FG).
EVE vented based on 124 kg total Foreshots Receiver vent stream (22826FG).

EVE vented from Condensation Reactor:

$\frac{0.00}{0.50\ \frac{kg\ EVE}{kg\ CndRx}}$ x 871 kg CndRx = 0 kg EVE

EVE vented from Crude Receiver

$\frac{0.00}{15.91\ \frac{kg\ EVE}{kg\ CrRec}}$ x 16,876 kg CrRec = 0 kg EVE

EVE vented from Foreshots Receiver

$\frac{0.005}{0.14\ \frac{kg\ EVE}{kg\ FsRec}}$ x 124 kg FsRec = 4 kg EVE

VOC Emissions

0 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 4 kg from Foreshots Receiver
= 4 kg EVE = 4 kg VOC
9 lb VOC

G. Tetraglyme (TTG) CAS No. 143-24-8

The emissions of Tetraglyme is based on a mass balance.

Quantity Released

=	326	kg TTG introduced into processes
=	209	kg TTG transferred to H/C waste tank
=	117	kg TTG unaccounted for and assumed emitted
=	**257**	**lb. Tetraglyme**

Emissions of TTG from EVE = **257** **lb. Tetraglyme**

H. Carbon Monoxide (CO)

CAS No. 630-08-0

HF Potential:

CO can not form HF

Quantity Released

CO is a byproduct from the Agitated Bed Reactor system.
vented to the WGS.

CO vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ CO}{0.50\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0.59\ kg\ CO}{14.91\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0\ kg\ CO}{0.14\ kg\ Foreshots\ Receiver\ Vent}$

CO vented based on 871 kg total Condensation Reactor vent stream (22266FG).
CO vented based on 16,876 kg total Crude Receiver vent stream (22701FG).
CO vented based on 124 kg total Foreshots Receiver vent stream (22826FG).

CO vented from Condensation Reactor:

$$\frac{0.00\ kg\ CO}{0.50\ kg\ CndRx} \times 871\ kg\ CndRx = 0\ kg\ CO$$

CO vented from Crude Receiver

$$\frac{0.59\ kg\ CO}{15.91\ kg\ CrRec} \times 16{,}876\ kg\ CrRec = 624\ kg\ CO$$

CO vented from Foreshots Receiver

$$\frac{0.00\ kg\ CO}{0.14\ kg\ FsRec} \times 124\ kg\ FsRec = 0\ kg\ CO$$

CO Emissions

0 kg from Condensation Reactor
\+ 624 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 624 kg CO = **1,377 lb CO**
(not a VOC)

I. VOC Summary

Nafion Compound Name		Before Control Generated		After Control Stack Emissions	
		kg/yr	lb/yr	VOC lb/yr	HF lb/yr
A.	HFP	304	669	669	
B.	HFPO	224	493	493	
C.	HFPO-Dimer	88	194	0.78	0.10
D.	TFE	186	409	409	
E.	MAE	33	73	0.29	0.04
F.	EVE	4	9	9	
G.	TTG	117	257	257	
K.	ADN	1,167	2,573	2,573	
	Total	**2,122**	**4,678**	**4,413**	**0.14**

J. Total Emission Summary**

** All Emissions in this table represent "After Control" emissions.

	Nafion Compound Name	Process Emissions lb/yr	Equipment Emissions (Note 1) lb/yr	Maintenance Emissions (Note 2) lb/yr	Total Emissions lb/yr
A.	HFP	669	3	0	672
B.	HFPO	493	91	4	589
C.	HFPO-Dimer	1	5	1	7
D.	TFE	409	0	0	409
E.	MAE	0	33	4	38
F.	EVE	9	181	179	370
G.	TTG	257	4	0	261
H.	CO (not a VOC)				1,377
K.	ADN		39	2	2,573
*	DAE		52	6	58
*	TAE		2	0	3
*	MMF		7	1	7
*	hydro-EVE		9	8	17
*	iso-EVE		14	12	26
	Total	**1,839**	**440**	**218**	**6,407**

Note 1 - See section titled "Equipment Emissions" for details

Note 2 - See section titled "Maintenance Emissions" for details

H CO not realistically expected through equipment or maintenance emissions. Not a VOC

K ADN total based on material balance, see section K.

* Not normally emitted from the process as a routine stack emission

The estimated HF equivalent emissions were determined by multiplying the
Molecular weight of HF/Molecular weight of the acid fluoride, 1 mole acid fluoride generates 1 mol HF

For Example:

$$\frac{20 \text{ lb/mol HF}}{332 \text{ lb/mol HFPO-Dimer}} \times 5 \text{ lb/yr Equipment HFPO-Dimer} = 0.312 \text{ lb/yr HF}$$

The estimated HF equivalent emissions from Maintenance Emissions were determined by multiplying the
Molecular weight of HF/Molecular weight of the acid fluoride, 1 mole acid fluoride generates 1 mol HF

$$\frac{20 \text{ lb/mol HF}}{332 \text{ lb/mol HFPO-Dimer}} \times 0.64 \text{ lb/yr Maintenance HFPO-Dimer} = 0.038 \text{ lb/yr HF}$$

HF Equivalent Emissions

	Nafion Compound Name	Process Emissions lb/yr	Equipment Emissions lb/yr	Maintenance Emissions lb/yr	Total Emissions lb/yr
C.	HFPO-Dimer	0.103	0.312	0.038	0.453
E.	MAE	0.040	2.066	0.254	2.360
*	DAE		2.117	0.257	2.373
*	TAE		0.069	0.008	0.077
*	MMF		0.847	0.104	0.951
	Total	**0.14**	**5.41**	**0.66**	**6.22**

* Not normally emitted from the process as a routine stack emission

K. Adiponitrile **CAS No. 111-69-3**

HF Potential

ADN is a VOC and Hazardous Air Polluntant without the potential to form HF.

Quantity Released

ADN emissions based on 3,256 kg ADN fed

VE North ADN Sent to waste Hydrocarbon tank = 2,089 kgs H/C waste

VOC Emission

3,256 kg ADN fed
- 2,089 kg ADN to H/C waste
1,167 kg ADN lost = 1,167 **kg VOC**
2,573 lb VOC

ADN only used during an EVE Campaign

2007 **AIR EMISSIONS INVENTORY SUPPORTING DOCUMENTATION**

Emission Source ID No: NS-B

Emission Source Description: VE-North PPVE Manufacturing Process

Process & Emission Description: The VE-North PPVE manufacturing process is a continuous chemical reaction. All emissions from the process are vented through the Nafion Division Waste Gas Scrubber (Control Device ID No. NCD-Hdr) which has a documented control efficiency of 99.6% for all acid fluoride compounds. Some emitted compounds are assumed to pass completely through the scrubber, so the control efficiency for those compounds is assumed to be 0%. The control of emissions of specific compounds will be addressed and detailed in the following pages.

The PPVE process in VE-North emits compounds in the acid fluoride family. In the presence of water (such as in atmospheric moisture), these acid fluorides can eventually hydrolyze to hydrogen fluoride. For the purpose of this emissions inventory, a conservative approach will be taken and the acid fluorides will be reported both as a VOC and as the equivalent quantity of hydrogen fluoride.

Basis and Assumptions:

- The PPVE process flowsheet is the basis for relative concentrations of before-control emissions of gaseous wastes.

- Calculations of point source emissions are based on actual vent flow totals taken from the IP21 Historian.

- All emission determination calculations are available on the EXCEL spreadsheet found at S:/Everyone/martinas/Emissions/2007/VEN Air Emissions 2007.xls.

Point Source Emission Determination

A. Hexafluoropropylene (HFP) **CAS No. 116-15-4**

HF Potential:

HFP is a VOC without the potential to form HF

Quantity Released

HFP is a byproduct present in the HFPO feed. It is an inert in VE-North that is vented to the WGS.

HFP vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0.05\ kg\ HFP}{2.35\ kg\ CondRxVentFlow}$

Vented from the Crude Receiver $\frac{0.01\ kg\ HFP}{3.97\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0.01\ kg\ HFP}{1.06\ kg\ ForeshotsReceiverVent}$

Vented from the Stripper $\frac{30\ kg\ HFP}{100\ kg\ Stripper\ Vent}$

HFP vented based on 5,698 kg total Condensation Reactor vent stream (22266FG).
HFP vented based on 6,666 kg total Crude Receiver vent stream (22701FG).
HFP vented based on 1,308 kg total Foreshots Receiver vent stream (22826FG).
HFP vented based on 14,123 kg in the Stripper vent stream (22231FC).

HFP vented from Condensation Reactor:

$$\frac{0.05\ kg\ HFP}{2.35\ kg\ CndRx} \times 5{,}698\ kg\ CndRx = 132\ kg\ HFP$$

HFP vented from Crude Receiver

$$\frac{0.01\ kg\ HFP}{3.97\ kg\ CrRec} \times 6{,}666\ kg\ CrRec = 23\ kg\ HFP$$

HFP vented from Foreshots Receiver

$$\frac{0.01\ kg\ HFP}{1.06\ kg\ FsRec} \times 1{,}308\ kg\ FsRec = 11\ kg\ HFP$$

HFP vented from Stripper

$$\frac{30\ kg\ HFP}{100\ kg\ Strpr} \times 14{,}123\ kg\ Strpr = 4{,}237\ kg\ HFP$$

VOC Emissions

132 kg from Condensation Reactor
\+ 23 kg from Crude Receiver
\+ 11 kg from Foreshots Receiver
\+ 4,237 kg from Stripper
= 4,403 kg HFP = 4,403 kg VOC
9,707 lb VOC

B. Hexafluoropropylene oxide (HFPO) **CAS No. 428-59-1**

HF Potential:

HFPO is a VOC without the potential to form HF

Quantity Released

HFPO unreacted in condensation is vented to the WGS.

HFPO vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0.11\ kg\ HFPO}{2.35\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ HFPO}{3.97\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0\ kg\ HFPO}{1.06\ kg\ Foreshots Receiver Vent}$

Vented from the Stripper $\frac{60\ kg\ HFPO}{100\ kg\ Stripper\ Vent}$

HFPO vented based on 5,698 kg total Condensation Reactor vent stream (22266FG).
HFPO vented based on 6,666 kg total Crude Receiver vent stream (22701FG).
HFPO vented based on 1,308 kg total Foreshots Receiver vent stream (22826FG).
HFP vented based on 14,123 kg in the Stripper vent stream (22231FC).

HFPO vented from Condensation Reactor:

$\frac{0.11\ kg\ HFPO}{2.35\ kg\ CndRx}$ x 5,698 kg CndRx = 276 kg HFPO

HFPO vented from Crude Receiver

$\frac{0.00\ kg\ HFPO}{3.97\ kg\ CrRec}$ x 6,666 kg CrRec = 0 kg HFPO

HFPO vented from Foreshots Receiver

$\frac{0.00\ kg\ HFPO}{1.06\ kg\ FsRec}$ x 1,308 kg FsRec = 0 kg HFPO

HFP vented from Stripper

$\frac{60\ kg\ HFPO}{100\ kg\ Strpr}$ x 14,123 kg Strpr = 8,474 kg HFPO

VOC Emissions

276 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
\+ 8,474 kg from Stripper
= 8,749 kg HFPO = 8,749 kg VOC
19,288 lb VOC

C. Perfluoropropionyl fluoride (PPF) **CAS No. 422-61-7**

HF Potential:

Each mole of PPF (MW = 166) can generate 1 mole of HF (MW = 20).

$$1\,kg\,PPF \cdot \frac{1\,mole\,PPF}{166\,g\,PPF} \cdot \frac{20\,g\,HF}{1\,mole\,HF} \cdot \frac{1\,mole\,HF}{1\,mole\,PPF} = 0.120\,kg\,HF$$

Therefore, each 1 kg of PPF generates 0.120 kg of HF

Quantity Released

Before-control PPF vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{2.14\ kg\ PPF}{2.35\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ PPF}{3.97\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0\ kg\ PPF}{1.06\ kg\ Foreshots\ Receiver\ Vent}$

Vented from the Stripper $\frac{10\ kg\ PPF}{100\ kg\ Stripper\ Vent}$

PPF vented based on 5,698 kg total Condensation Reactor vent stream (22266FG).
PPF vented based on 6,666 kg total Crude Receiver vent stream (22701FG).
PPF vented based on 1,308 kg total Foreshots Receiver vent stream (22826FG).
PPF vented based on 14,123 kg in the Stripper vent stream (22231FC).

Before control PPF vented from Condensation Reactor:

$\frac{2.14\ kg\ PPF}{2.35\ kg\ CndRx}$ x 5,698 kg CndRx = 5,180 kg PPF

PPF vented from Crude Receiver

$\frac{0.00\ kg\ PPF}{3.97\ kg\ CrRec}$ x 6,666 kg CrRec = 0 kg PPF

PPF vented from Foreshots Receiver

$\frac{0.00\ kg\ PPF}{1.06\ kg\ FsRec}$ x 1,308 kg FsRec = 0 kg PPF

PPF vented from Stripper

$\frac{10\ kg\ PPF}{100\ kg\ Strpr}$ x 14,123 kg Strpr = 1,412 kg PPF

Total before-control PPF vented = 6,593 kg PPF

After-control emissions utilizing the 99.6% control efficient Waste Gas Scrubber (WGS):

VOC Emissions

Waste Gas Scrubber: 6,593 kg PAF x (100%-99.6%) = 26 kg PAF = 26 kg VOC = **58 lb. VOC**

HF Equivalent Emissions

26 kg PAF x 0.120 kg HF/kg PAF = 3 kg HF = **7.0 lb. HF**

D. Tetrafluoroethylene (TFE) **CAS No. 116-14-3**

HF Potential:

TFE is a VOC without the potential to form HF

Quantity Released

TFE is a byproduct that can be formed in the ABR system. It is an inert in VE-North that is vented to the WGS.

TFE vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ TFE}{2.35\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{2.17\ kg\ TFE}{3.97\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0.0045\ kg\ TFE}{1.06\ kg\ Foreshots\ Receiver\ Vent}$

Vented from the Stripper $\frac{0\ kg\ TFE}{100\ kg\ Stripper\ Vent}$

TFE vented based on 5,698 kg total Condensation Reactor vent stream (22266FG).
TFE vented based on 6,666 kg total Crude Receiver vent stream (22701FG).
TFE vented based on 1,308 kg total Foreshots Receiver vent stream (22826FG).
TFE vented based on 14,123 kg in the Stripper vent stream (22231FC).

TFE vented from Condensation Reactor:

$\frac{0.00\ kg\ TFE}{2.35\ kg\ CndRx}$ x 5,698 kg CndRx = 0 kg TFE

TFE vented from Crude Receiver

$\frac{2.17\ kg\ TFE}{3.97\ kg\ CrRec}$ x 6,666 kg CrRec = 3,642 kg TFE

TFE vented from Foreshots Receiver

$\frac{0.0045\ kg\ TFE}{1.06\ kg\ FsRec}$ x 1,308 kg FsRec = 6 kg TFE

TFE vented from Stripper

$\frac{0\ kg\ TFE}{100\ kg\ Strpr}$ x 14,123 kg Strpr = 0 kg TFE

VOC Emissions

0 kg from Condensation Reactor
\+ 3,642 kg from Crude Receiver
\+ 6 kg from Foreshots Receiver
\+ 0 kg from Stripper
= 3,648 kg TFE = 3,648 kg VOC
8,042 lb VOC

E. Perfluoropropyl vinyl ether (PPVE) **CAS No. 1623-5-8**

HF Potential:

PPVE is a VOC without the potential to form HF

Quantity Released

PPVE vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ PPVE}{2.35\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0.50\ kg\ PPVE}{3.97\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0.88\ kg\ PPVE}{1.06\ kg\ Foreshots\ Receiver\ Vent}$

Vented from the Stripper $\frac{0\ kg\ PPVE}{100\ kg\ Stripper\ Vent}$

PPVE vented based on 5,698 kg total Condensation Reactor vent stream (22266FG).
PPVE vented based on 6,666 kg total Crude Receiver vent stream (22701FG).
PPVE vented based on 1,308 kg total Foreshots Receiver vent stream (22826FG).
PPVE vented based on 14,123 kg in the Stripper vent stream (22231FC).

PPVE vented from Condensation Reactor:
$\frac{0.00\ kg\ PPVE}{2.35\ kg\ CndRx}$ x 5,698 kg CndRx = 0 kg PPVE

PPVE vented from Crude Receiver
$\frac{0.50\ kg\ PPVE}{3.97\ kg\ CrRec}$ x 6,666 kg CrRec = 848 kg PPVE

PPVE vented from Foreshots Receiver
$\frac{0.88\ kg\ PPVE}{1.06\ kg\ FsRec}$ x 1,308 kg FsRec = 1,084 kg PPVE

PPVE vented from Stripper
$\frac{0\ kg\ PPVE}{100\ kg\ Strpr}$ x 14,123 kg Strpr = 0 kg PPVE

VOC Emissions

		0 kg from Condensation Reactor		
	+	848 kg from Crude Receiver		
	+	1,084 kg from Foreshots Receiver		
	+	0 kg from Stripper		
	=	1,932 kg PPVE	=	1,932 kg VOC
				4,259 lb VOC

F. Perfluoro-2-butene (C4) **CAS No. 360-89-4**

HF Potential:

C4s are VOCs without the potential to form HF

Quantity Released

C4s are perfluorobutenes that are byproducts from the Agitated Bed Reactor system.
They are inerts in VE-North that are vented to the WGS.

C4s vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ C4s}{2.35\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0.01\ kg\ C4s}{3.97\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0.15\ kg\ C4s}{1.06\ kg\ Foreshots Receiver Vent}$

Vented from the Stripper $\frac{0\ kg\ C4s}{100\ kg\ Stripper\ Vent}$

C4s vented based on 5,698 kg total Condensation Reactor vent stream (22266FG).
C4s vented based on 6,666 kg total Crude Receiver vent stream (22701FG).
C4s vented based on 1,308 kg total Foreshots Receiver vent stream (22826FG).
C4s vented based on 14,123 kg in the Stripper vent stream (22231FC).

C4s vented from Condensation Reactor:

$$\frac{0.00\ kg\ C4s}{2.35\ kg\ CndRx} \times 5{,}698\ kg\ CndRx = 0\ kg\ C4s$$

C4s vented from Crude Receiver

$$\frac{0.01\ kg\ C4s}{3.97\ kg\ CrRec} \times 6{,}666\ kg\ CrRec = 15\ kg\ C4s$$

C4s vented from Foreshots Receiver

$$\frac{0.15\ kg\ C4s}{1.06\ kg\ FsRec} \times 1{,}308\ kg\ FsRec = 184\ kg\ C4s$$

C4s vented from Stripper

$$\frac{0\ kg\ C4s}{100\ kg\ Strpr} \times 14{,}123\ kg\ Strpr = 0\ kg\ C4s$$

VOC Emissions

0 kg from Condensation Reactor
\+ 15 kg from Crude Receiver
\+ 184 kg from Foreshots Receiver
\+ 0 kg from Stripper
= 200 kg C4s = 200 kg VOC
440 lb VOC

G. Perfluoropentene (C5) **CAS No. 376-87-4**

HF Potential:

C5s are VOCs without the potential to form HF

Quantity Released

C5s are perfluoropentenes that are byproducts from the Agitated Bed Reactor system. They are inerts in VE-North that are vented to the WGS.

C5s vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ C5s}{2.35\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ C5s}{3.97\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0.02\ kg\ C5s}{1.06\ kg\ Foreshots\ Receiver\ Vent}$

Vented from the Stripper $\frac{0\ kg\ C5s}{100\ kg\ Stripper\ Vent}$

C5s vented based on	5,698	kg total Condensation Reactor vent stream (22266FG).
C5s vented based on	6,666	kg total Crude Receiver vent stream (22701FG).
C5s vented based on	1,308	kg total Foreshots Receiver vent stream (22826FG).
C5s vented based on	14,123	kg in the Stripper vent stream (22231FC).

C5s vented from Condensation Reactor:

$$\frac{0.00\ kg\ C5s}{2.35\ kg\ CndRx} \times 5{,}698\ kg\ CndRx = 0\ kg\ C5s$$

C5s vented from Crude Receiver

$$\frac{0.00\ kg\ C5s}{3.97\ kg\ CrRec} \times 6{,}666\ kg\ CrRec = 0\ kg\ C5s$$

C5s vented from Foreshots Receiver

$$\frac{0.02\ kg\ C5s}{1.06\ kg\ FsRec} \times 1{,}308\ kg\ FsRec = 22\ kg\ C5s$$

C4s vented from Stripper

$$\frac{0\ kg\ C5s}{100\ kg\ Strpr} \times 14{,}123\ kg\ Strpr = 0\ kg\ C5s$$

VOC Emissions

	0 kg	from Condensation Reactor
+	0 kg	from Crude Receiver
+	22 kg	from Foreshots Receiver
+	0 kg	from Stripper
=	22 kg C5s	= 22 kg VOC
		49 lb VOC

H. Carbon Monoxide (CO) **CAS No. 630-08-0**

HF Potential:
CO can not form HF

Quantity Released

CO is a byproduct from the Agitated Bed Reactor system.
This inert in VE-North that are vented to the WGS.

CO vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ CO}{2.35\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{1.27\ kg\ CO}{3.97\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0\ kg\ CO}{1.06\ kg\ Foreshots\ Receiver\ Vent}$

Vented from the Stripper $\frac{0\ kg\ CO}{100\ kg\ Stripper\ Vent}$

CO vented based on 5,698 kg total Condensation Reactor vent stream (22266FG).
CO vented based on 6,666 kg total Crude Receiver vent stream (22701FG).
CO vented based on 1,308 kg total Foreshots Receiver vent stream (22826FG).
CO vented based on 14,123 kg in the Stripper vent stream (22231FC).

CO vented from Condensation Reactor:

$$\frac{0.00\ kg\ CO}{2.35\ kg\ CndRx} \times 5{,}698\ kg\ CndRx = 0\ kg\ CO$$

CO vented from Crude Receiver

$$\frac{1.27\ kg\ CO}{3.97\ kg\ CrRec} \times 6{,}666\ kg\ CrRec = 2{,}138\ kg\ CO$$

CO vented from Foreshots Receiver

$$\frac{0.00\ kg\ CO}{1.06\ kg\ FsRec} \times 1{,}308\ kg\ FsRec = 0\ kg\ CO$$

CO vented from Stripper

$$\frac{0\ kg\ CO}{100\ kg\ Strpr} \times 14{,}123\ kg\ Strpr = 0\ kg\ CO$$

CO Emissions

0 kg from Condensation Reactor
\+ 2,138 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
\+ 0 kg from Stripper
= 2,138 kg CO = **4,713 lb CO** **(not a VOC)**

I. VOC Summary

Nafion Compound Name		Before Control Generated		After Control Stack Emissions	
		kg/yr	lb/yr	VOC lb/yr	HF lb/yr
A.	HFP	4,403	9,707	9,707	
B.	HFPO	8,749	19,288	19,288	
C.	PPF	6,593	14,534	58	7.0
D.	TFE	3,648	8,042	8,042	
E.	PPVE	1,932	4,259	4,259	
F.	C4	200	440	440	
G.	C5	22	49	49	
K.	AN	4,357	9,606	9,606	
	Total	29,904	65,926	**51,450**	**7.0**

J. Total Emission Summary**

** All Emissions in this table represent "After Control" emissions.

Nafion Compound Name		Process Emissions lb/yr	Equipment Emissions (Note 1) lb/yr	Maintenance Emissions (Note 2) lb/yr	Total Emissions lb/yr
A.	HFP	9,707	5	0	9,712
B.	HFPO	19,288	360	18	19,666
C.	PPF	58	10	1	69
D.	TFE	8,042	0	0	8,042
E.	PPVE	4,259	590	553	5,403
F.	C4	440	57	75	572
G.	C5	49	0	0	49
H.	CO (not a VOC)		0	0	4,713
K.	AN		148	7	9,606
*	HFPO-Dimer		271	37	308
*	HFPO Trimer		7	1	7
	Total	**41,844**	**1,447**	**692**	**58,147**

Note 1 - See section titled "Equipment Emissions" for details

Note 2 - See section titled "Maintenance Emissions" for details

CO not realistically expected through equipment or maintenance emissions

AN total based on material balance, see section K.

* Not normally emitted from the process as a routine stack emission

HF Equivalent Emissions

	Nafion Compound Name	Process Emissions lb/yr	Equipment Emissions lb/yr	Maintenance Emissions lb/yr	Total Emissions lb/yr
C.	PPF	7	1.2	0.15	8.35
*	HFPO-Dimer		16.3	2.20	18.54
*	HFPO Trimer		0.3	0.03	0.29
	Total	**7**	**18**	**2.38**	**27.19**

* Not normally emitted from the process as a routine stack emission

The estimated HF equivalent emissions were determined by multiplying the
Molecular weight of HF/Molecular weight of the acid fluoride, 1 mole acid fluoride generates 1 mol HF
For Example:

$$\frac{20 \text{ lb/mol HF}}{166 \text{ lb/mol PPF}} \times 10 \text{ lb/yr Equipment PPF} = 1.2 \text{ lb/yr HF}$$

The estimated HF equivalent emissions from Maintenance Emissions were determined by multiplying the Molecular weight of HF/Molecular weight of the acid fluoride, 1 mole acid fluoride generates 1 mol HF
For Example:

$$\frac{20 \text{ lb/mol HF}}{166 \text{ lb/mol PPF}} \times 1.23 \text{ lb/yr Maintenance PPF} = 0.15 \text{ lb/yr HF}$$

K. Acetonitrile (AN) **CAS No. 75-05-8**

HF Potential

AN is a VOC and Hazardous Air Polluntant without the potential to form HF.

Quantity Released

AN emissions based on

11,541 kg AN fed

Hydrocarbon waste sent to Hydrocarbon waste tank

= 7,140 kgs H/C waste

PPVE generated during the year

168,387 kg PPVE

Assume that:

5% of spent acetonitrile are fluorocarbons.

AN portion of hydrocarbon waste stream:

7,140 kg to H/C waste
x (1-(.1))
= 6,783 kg AN to H/C waste

Material Balance

Based on total Vinyl ether produced 168,387 kg PPVE

Assume

90% Crude is needed to generage that amount of PPVE
70% of AF going to ABR is needed to create the Crude
Feed going to ABR is 1,500 / 1,000,000 ppm AN

Therefore:

168,387 kg PPVE
\ 0.90 Crude
\ 0.70 AF
x 0.0015 ppm AN in Feed to ABR
= 401 kg AN

VOC Emission

11,541 kg AN fed
- 6,783 kg AN to H/C waste
401 kg AN to ABR
4,357 kg AN = 4,357 **kg VOC**
9,606 lb VOC

AN only used during a PPVE Campaign

Total AN = 9,606 **lb VOC**

2007 **AIR EMISSIONS INVENTORY SUPPORTING DOCUMENTATION**

Emission Source ID No: NS-B

Emission Source Description: VE-North PSEPVE Manufacturing Process

Process & Emission Description: The VE-North PSEPVE manufacturing process is a continuous chemical reaction. All emissions from the process are vented through the Nafion Division Waste Gas Scrubber (Control Device ID No. NCD-Hdr) which has a documented control efficiency of 99.6% for all acid fluoride compounds. Some emitted compounds are assumed to pass completely through the scrubber, so the control efficiency for those compounds is assumed to be 0%. The control of emissions of specific compounds will be addressed and detailed in the following pages.

The PSEPVE process in VE-North emits compounds in the acid fluoride family. In the presence of water (such as in atmospheric moisture), these acid fluorides can eventually hydrolyze to hydrogen fluoride. For the purpose of this emissions inventory, a conservative approach will be taken and the acid fluorides will be reported both as a VOC and as the equivalent quantity of hydrogen fluoride.

Basis and Assumptions:

- The PSEPVE process flowsheet is the basis for relative concentrations of before-control emissions of gaseous wastes.

- Calculations of point source emissions are based on actual vent flow totals taken from the IP21 Historian.

- All emission determination calculations are available on the EXCEL spreadsheet found at S:/Everyone/martinas/Emissions/2007/VEN Air Emissions 2007.xls.

Point Source Emission Determination

A. HFP **CAS No. 116-15-4**

Hexafluoropropylene

HF Potential:

HFP is a VOC without the potential to form HF

Quantity Released

HFP is a byproduct present in the HFPO feed. It is an inert in VE-North that is vented to the WGS.

HFP vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0.15\ kg\ HFP}{3.66\ kg\ CondRxVentFlow}$

Vented from the Crude Receiver $\frac{3.12\ kg\ HFP}{18.76\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0\ kg\ HFP}{0.33\ kg\ ForeshotsReceiverVent}$

HFP vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
HFP vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
HFP vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

HFP vented from Condensation Reactor:

$\frac{0.15\ kg\ HFP}{3.66\ kg\ CndRx}$ x 1,254 kg CndRx = 50 kg HFP

HFP vented from Crude Receiver

$\frac{3.12\ kg\ HFP}{18.76\ kg\ CrRec}$ x 55,372 kg CrRec = 9,202 kg HFP

HFP vented from Foreshots Receiver

$\frac{0.00\ kg\ HFP}{0.33\ kg\ FsRec}$ x 42 kg FsRec = 0 kg HFP

VOC Emissions

50 kg from Condensation Reactor
\+ 9,202 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 9,252 kg HFP = 9,252 kg VOC

20,354 lb VOC

B. HFPO **CAS No. 428-59-1**
Hexafluoropropylene oxide

HF Potential:

HFPO is a VOC without the potential to form HF

Quantity Released

HFPO unreacted in condensation is vented to the WGS.

HFPO vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{3.28\ kg\ HFPO}{3.66\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ HFPO}{18.76\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0\ kg\ HFPO}{0.33\ kg\ Foreshots\ Receiver\ Vent}$

HFPO vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
HFPO vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
HFPO vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

HFPO vented from Condensation Reactor:

$$\frac{3.28\ kg\ HFPO}{3.66\ kg\ CndRx} \times 1{,}254\ kg\ CndRx = 1{,}123\ kg\ HFPO$$

HFPO vented from Crude Receiver

$$\frac{0.00\ kg\ HFPO}{18.76\ kg\ CrRec} \times 55{,}372\ kg\ CrRec = 0\ kg\ HFPO$$

HFPO vented from Foreshots Receiver

$$\frac{0.00\ kg\ HFPO}{0.33\ kg\ FsRec} \times 42\ kg\ FsRec = 0\ kg\ HFPO$$

VOC Emissions

1,123 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 1,123 kg HFPO = 1,123 kg VOC
2,471 lb VOC

C. PPF **CAS No. 422-61-7**

Perfluoropropionyl fluoride

HF Potential:

Each mole of PPF (MW = 166) can generate 1 mole of HF (MW = 20).

$$1\,kg\,PPF \cdot \frac{1\,mole\,PPF}{166\,g\,PPF} \cdot \frac{20\,g\,HF}{1\,mole\,HF} \cdot \frac{1\,mole\,HF}{1\,mole\,PPF} = 0.120\,kg\,HF$$

Therefore, each 1 kg of PPF generates 0.120 kg of HF

Quantity Released

Before-control PPF vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0.20\ kg\ PPF}{3.66\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ PPF}{18.76\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0\ kg\ PPF}{0.33\ kg\ Foreshots\ Receiver\ Vent}$

PPF vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
PPF vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
PPF vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

Before control PPF vented from Condensation Reactor:

$$\frac{0.20\ kg\ PPF}{3.66\ kg\ CndRx} \times 1{,}254\ kg\ CndRx = 70\ kg\ PPF$$

PPF vented from Crude Receiver

$$\frac{0.00\ kg\ PPF}{18.76\ kg\ CrRec} \times 55{,}372\ kg\ CrRec = 0\ kg\ PPF$$

PPF vented from Foreshots Receiver

$$\frac{0.00\ kg\ PPF}{0.33\ kg\ FsRec} \times 42\ kg\ FsRec = 0\ kg\ PPF$$

Total before-control PPF vented = 70 kg PPF

After-control emissions utilizing the 99.6% control efficient Waste Gas Scrubber (WGS):

VOC Emissions

Waste Gas Scrubber: 70 kg PPF × (100%-99.6%) Control Efficiency
= 0.28 kg PAF = **0.28** kg VOC
= **0.62** **lb. VOC**

HF Equivalent Emissions

0 kg PPF × 0.120 kg HF/kg PPF
= 0.03 kg HF **0.07 lb. HF**

D. TFE **CAS No. 116-14-3**
Tetrafluoroethylene

HF Potential:

TFE is a VOC without the potential to form HF

Quantity Released

TFE is a byproduct that can be formed in the ABR system. It is an inert in VE-North that is vented to the WGS.

TFE vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ TFE}{3.66\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0.01\ kg\ TFE}{18.76\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0\ kg\ TFE}{0.33\ kg\ Foreshots\ Receiver\ Vent}$

TFE vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
TFE vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
TFE vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

TFE vented from Condensation Reactor:

$$\frac{0.00}{3.66\ \frac{kg\ TFE}{kg\ CndRx}} \times 1{,}254\ kg\ CndRx = 0\ kg\ TFE$$

TFE vented from Crude Receiver

$$\frac{0.01}{18.76\ \frac{kg\ TFE}{kg\ CrRec}} \times 55{,}372\ kg\ CrRec = 27\ kg\ TFE$$

TFE vented from Foreshots Receiver

$$\frac{0.00}{0.33\ \frac{kg\ TFE}{kg\ FsRec}} \times 42\ kg\ FsRec = 0\ kg\ TFE$$

VOC Emissions

0 kg from Condensation Reactor
\+ 27 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 27 kg TFE = 27 kg VOC
59 lb VOC

E. PSEPVE **CAS No. 1623-5-8**
Perfluoro-2-(2-Fluorosulfonylethoxy) Propyl Vinyl Ether

HF Potential:

PSEPVE is a VOC without the potential to form HF

Quantity Released

PSEPVE vented per the process flowsheet

Vented from the Condensation Reactor: 0 kg PSEPVE / 3.66 kg Cond Rx Vent Flow

Vented from the Crude Receiver 0 kg PSEPVE / 18.76 kg Crude Receiver Vent

Vented from the Foreshots Receiver 0.07 kg PSEPVE / 0.33 kg Foreshots Receiver Vent

PSEPVE vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
PSEPVE vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
PSEPVE vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

PSEPVE vented from Condensation Reactor:
0.00 / 3.66 kg PSEPVE / kg CndRx x 1,254 kg CndRx = 0 kg PSEPVE

PSEPVE vented from Crude Receiver
0.00 / 18.76 kg PSEPVE / kg CrRec x 55,372 kg CrRec = 0 kg PSEPVE

PSEPVE vented from Foreshots Receiver
0.07 / 0.33 kg PSEPVE / kg FsRec x 42 kg FsRec = 8.68 kg PSEPVE

VOC Emissions
0 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 8.68 kg from Foreshots Receiver
= 8.68 kg PSEPVE = 8.68 kg VOC
19.09 lb VOC

F. C4 **CAS No. 360-89-4**
Perfluoro-2-butene

HF Potential:

C4s are VOCs without the potential to form HF

Quantity Released

C4s are perfluorobutenes that are byproducts from the Agitated Bed Reactor system.
They are inerts in VE-North that is vented to the WGS.

C4s vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ C4}{3.66\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0.46\ kg\ C4}{18.76\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0.10\ kg\ C4}{0.33\ kg\ Foreshots\ Receiver\ Vent}$

C4s vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
C4s vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
C4s vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

C4s vented from Condensation Reactor:

$$\frac{0.00}{3.66\ \frac{kg\ C4s}{kg\ CndRx}} \times 1{,}254\ kg\ CndRx = 0\ kg\ C4s$$

C4s vented from Crude Receiver

$$\frac{0.46}{18.76\ \frac{kg\ C4s}{kg\ CrRec}} \times 55{,}372\ kg\ CrRec = 1{,}355\ kg\ C4s$$

C4s vented from Foreshots Receiver

$$\frac{0.10}{0.33\ \frac{kg\ C4s}{kg\ FsRec}} \times 42\ kg\ FsRec = 12\ kg\ C4s$$

VOC Emissions

0 kg from Condensation Reactor
\+ 1,355 kg from Crude Receiver
\+ 12 kg from Foreshots Receiver
= 1,367 kg C4s = 1,367 kg VOC
3,007 lb VOC

G. HFPO Trimer **CAS No. 2641-34-1**
Perfluoro-2,5-Dimethyl-3,6-Dioxanonanoyl

HF Potential:

Each mole of HFPO Trimer (MW = 498) can generate 1 mole of HF (MW = 20).

$$1\,kg\,MA \cdot \frac{1\,mole\,Trimer}{498\,g\,Trimer} \cdot \frac{20\,g\,HF}{1\,mole\,HF} \cdot \frac{1\,mole\,HF}{1\,mole\,Trimer} = 0.0402\,kg\,HF$$

Therefore, each 1 kg of HFPO Trimer generates 0.040 kg of HF

Quantity Released

HFPO Trimer is a byproduct formed in the Condensation Reactor system.

HFPO Trimer vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ HFPO\ Trimer}{3.66\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver: $\frac{0\ kg\ HFPO\ Trimer}{18.76\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver: $\frac{0.01\ kg\ HFPO\ Trimer}{0.33\ kg\ Foreshots\ Receiver\ Vent}$

HFPO Trimer vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
HFPO Trimer vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
HFPO Trimer vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

Before control HFPO Trimer vented from Condensation Reactor:

$$\frac{0.00}{3.66\ \frac{kg\ HFPO\ Trimer}{kg\ CndRx}} \times 1{,}254\ kg\ CndRx = 0\ kg\ HFPO\ Trimer$$

HFPO Trimer vented from Crude Receiver

$$\frac{0.00}{18.76\ \frac{kg\ HFPO\ Trimer}{kg\ CrRec}} \times 55{,}372\ kg\ CrRec = 0\ kg\ HFPO\ Trimer$$

HFPO Trimer vented from Foreshots Receiver

$$\frac{0.01}{0.33\ \frac{kg\ HFPO\ Trimer}{kg\ FsRec}} \times 42\ kg\ FsRec = 1.74\ kg\ HFPO\ Trimer$$

Total before-control HFPO Trimer vented 1.74 kg VOC

After-control emissions utilizing the 99.6% control efficient Waste Gas Scrubber (WGS):

VOC Emissions

Waste Gas Scrubber: 1.74 kg HFPO Trimer x (100%-99.6%) Control Efficiency = 0.0069 kg HFPO Trimer = 0.0069 kg VOC = **0.015 lb. VOC**

HF Equivalent Emissions

0.0069 kg HFPO Trimer x 0.040 kg HF/kg HFPO Trimer = 0.00028 kg HF **0.00061 lb. HF**

H. Monoadduct (MA) **CAS No. 4089-57-0**
Tetrafluoro-2-[Tetrafluoro-2-(Fluorosulfonyl)Ethoxy]-Propanoyl Fluoride

HF Potential:

Each mole of MA (MW = 346) can generate 1 mole of HF (MW = 20).

$$1\,kg\,MA \cdot \frac{1\,mole\,MA}{346\,g\,MA} \cdot \frac{20\,g\,HF}{1\,mole\,HF} \cdot \frac{1\,mole\,HF}{1\,mole\,MA} = 0.058\,kg\,HF$$

Therefore, each 1 kg of MA generates 0.058 kg of HF

Quantity Released

Before-control MA vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ MA}{3.66\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ MA}{18.76\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0.0045\ kg\ MA}{0.33\ kg\ Foreshots\ Receiver\ Vent}$

MA vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
MA vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
MA vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

Before control MA vented from Condensation Reactor:

$$\frac{0.00\ kg\ MA}{3.66\ kg\ CndRx} \times 1{,}254\ kg\ CndRx = 0\ kg\ MA$$

MA vented from Crude Receiver

$$\frac{0.00\ kg\ MA}{18.76\ kg\ CrRec} \times 55{,}372\ kg\ CrRec = 0\ kg\ MA$$

MA vented from Foreshots Receiver

$$\frac{0.0045\ kg\ MA}{0.33\ kg\ FsRec} \times 42\ kg\ FsRec = 0.578\ kg\ MA$$

Total before-control MA vented = 0.578 kg MA

After-control emissions utilizing the 99.6% control efficient Waste Gas Scrubber (WGS):

VOC Emissions

Waste Gas Scrubber: 0.578 kg MA x (100%-99.6%) Control Efficiency = 0.00231 kg MA = 0.00231 kg VOC = **0.005 lb. VOC**

HF Equivalent Emissions

0.00231 kg MA x 0.058 kg HF/kg MA = 0.00 kg HF **0.00 lb. HF**

I. Diadduct (DA) **CAS No. 4089-58-1**

Tetrafluoro-2[Hexafluoro-2-(Tetrafluoro-2-{Fluorosulfonyl}Ethoxy) Propoxy Propionyl Fluoride

HF Potential:

Each mole of DA (MW = 512) can generate 1 mole of HF (MW = 20).

$$1\,kg\,MA \cdot \frac{1\,mole\,DA}{512\,g\,DA} \cdot \frac{20\,g\,HF}{1\,mole\,HF} \cdot \frac{1\,mole\,HF}{1\,mole\,DA} = 0.039\,kg\,HF$$

Therefore, each 1 kg of DA generates 0.039 kg of HF

Quantity Released

Before-control DA vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ DA}{3.66\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ DA}{18.76\ kg\ Crude Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0.13\ kg\ DA}{0.33\ kg\ Foreshots Receiver Vent}$

DA vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
DA vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
DA vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

Before control DA vented from Condensation Reactor:

$\frac{0.00\ kg\ DA}{3.66\ kg\ CndRx}$ x 1,254 kg CndRx = 0 kg DA

DA vented from Crude Receiver

$\frac{0.00\ kg\ DA}{18.76\ kg\ CrRec}$ x 55,372 kg CrRec = 0 kg DA

DA vented from Foreshots Receiver

$\frac{0.13\ kg\ DA}{0.33\ kg\ FsRec}$ x 42 kg FsRec = 16.77 kg DA

Total before-control DA vented = 16.77 kg DA

After-control emissions utilizing the 99.6% control efficient Waste Gas Scrubber (WGS):

VOC Emissions

Waste Gas Scrubber: 16.77 kg DA x (100%-99.6%) Control Efficiency
= 0.0671 kg DA = 0.067 kg VOC
= **0.148 lb. VOC**

HF Equivalent Emissions

0.0671 kg DA x 0.039 kg HF/kg DA
= 0.00262 kg HF = **0.01 lb. HF**

J. Hydro PSEPVE **CAS No. 755-02-9**

Tetrafluoro-2-[Trifluoro-2-(1,2,2,2-Tetra-fluoroethoxy)-1-(Trifluoromethyl) Ethoxy]-Ethane Sulfonyl Fluoride

HF Potential:

Hydro-PSEPVE is a VOC without the potential to form HF

Quantity Released

Hydro-PSEPVE vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ Hydro-PSEPVE}{3.66\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ Hydro-PSEPVE}{18.76\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0.0045\ kg\ Hydro-PSEPVE}{0.33\ kg\ Foreshots\ Receiver\ Vent}$

Hydro-PSEPVE vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
Hydro-PSEPVE vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
Hydro-PSEPVE vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

Hydro-PSEPVE vented from Condensation Reactor:

$$\frac{0.00\ kg\ Hydro\text{-}PSEPVE}{3.66\ kg\ CndRx} \times 1{,}254\ kg\ CndRx = 0\ kg\ Hydro\text{-}PSEPVE$$

Hydro-PSEPVE vented from Crude Receiver

$$\frac{0.00\ kg\ Hydro\text{-}PSEPVE}{18.76\ kg\ CrRec} \times 55{,}372\ kg\ CrRec = 0\ kg\ Hydro\text{-}PSEPVE$$

Hydro-PSEPVE vented from Foreshots Receiver

$$\frac{0.0045\ kg\ Hydro\text{-}PSEPVE}{0.33\ kg\ FsRec} \times 42\ kg\ FsRec = 0.578\ kg\ Hydro\text{-}PSEPVE$$

VOC Emissions

0 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 0.578 kg from Foreshots Receiver
= 0.578 kg Hydro-PSEPV = 0.578 kg VOC
1.272 lb VOC

K. Iso-PSEPVE

CAS No. 34805-58-8

Perfluoro-1-Methyl-2-(2 Fluorosulfonyl Ethoxy) Ethyl Vinyl Ether

HF Potential:

Iso-PSEPVE is a VOC without the potential to form HF

Quantity Released

Iso-PSEPVE vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ Iso-PSEPVE}{3.66\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0\ kg\ Iso-PSEPVE}{18.76\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0.014\ kg\ Iso-PSEPVE}{0.014\ kg\ Foreshots\ Receiver\ Vent}$

Iso-PSEPVE vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
Iso-PSEPVE vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
Iso-PSEPVE vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

Iso-PSEPVE vented from Condensation Reactor:

$$\frac{0.00\ kg\ Iso\text{-}PSEPVE}{3.66\ kg\ CndRx} \times 1{,}254\ kg\ CndRx = 0\ kg\ Iso\text{-}PSEPVE$$

Iso-PSEPVE vented from Crude Receiver

$$\frac{0.00\ kg\ Iso\text{-}PSEPVE}{18.76\ kg\ CrRec} \times 55{,}372\ kg\ CrRec = 0\ kg\ Iso\text{-}PSEPVE$$

Iso-PSEPVE vented from Foreshots Receiver

$$\frac{0.014\ kg\ Iso\text{-}PSEPVE}{0.33\ kg\ FsRec} \times 42\ kg\ FsRec = 1.735\ kg\ Iso\text{-}PSEPVE$$

VOC Emissions

0 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 1.735 kg from Foreshots Receiver
= 1.735 kg Iso-PSEPVE = 1.735 kg VOC

3.817 lb VOC

L. Diglyme

CAS No. 111-96-6

The emissions of diglyme is based on a mass balance

Quantity Released

=	5,080	kg diglyme introduced into processes
=	4,331	kg diglyme transferred to H/C waste tank
=	749	kg diglyme unaccounted for and assumed emitted
=	**1651**	**lb.Diglyme**

Emissions of diglyme from PSEPVE = **1651 lb. Diglyme**

M. Sulfonyl Fluoride (SOF2) **CAS No. 7783-42-8**

HF Potential:

Each mole of SOF2 (MW = 86) can generate 2 mole of HF (MW = 20).

$$1\,kg\,MA \cdot \frac{1\,mole\,SOF2}{86\,g\,SOF2} \cdot \frac{20\,g\,HF}{1\,mole\,HF} \cdot \frac{2\,mole\,HF}{1\,mole\,SOF2} = 0.465\,kg\,HF$$

Therefore, each 1 kg of SOF2 generates 0.465 kg of HF

Quantity Released

Before-control SOF2 vented per the process flowsheet

Vented from the Condensation Reactor: $\frac{0\ kg\ SOF2}{3.66\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{2.04\ kg\ SOF2}{18.76\ kg\ Crude\ Receiver\ Vent}$

Vented from the Foreshots Receiver $\frac{0\ kg\ SOF2}{0.33\ kg\ Foreshots\ Receiver\ Vent}$

SOF2 vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
SOF2 vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
SOF2 vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

Before control SOF2 vented from Condensation Reactor:
$\frac{0.00\ kg\ SOF2}{3.66\ kg\ CndRx}$ x 1,254 kg CndRx = 0 kg SOF2

SOF2 vented from Crude Receiver
$\frac{2.04\ kg\ SOF2}{18.76\ kg\ CrRec}$ x 55,372 kg CrRec = 6,023 kg SOF2

SOF2 vented from Foreshots Receiver
$\frac{0.00\ kg\ SOF2}{0.33\ kg\ FsRec}$ x 42 kg FsRec = 0 kg SOF2

Total before-control SOF2 vented = 6,023 kg SOF2

After-control emissions utilizing the 99.6% control efficient Waste Gas Scrubber (WGS):

SOF2 Emissions

Waste Gas Scrubber: 6,023 kg SOF2 x (100%-99.6%) Control Efficiency = 24 kg SOF2 = 53 lb. SOF2

HF Equivalent Emissions

24 kg SOF2 x 0.465 kg HF/kg SOF2 = 11.21 kg HF **24.70 lb. HF**

SOF2 is not a VOC (no carbon)

N. Carbon Monoxide (CO)

CAS No. 630-08-0

CO is a criteria pollutant

Quantity Released

CO are perfluorobutenes that are byproducts from the Agitated Bed Reactor system.
They are inerts in VE-North that are vented to the WGS.

CO vented per the process flowsheet

Vented from the Condensation Reactor: 0 kg CO / 3.66 kg Cond Rx Vent Flow

Vented from the Crude Receiver 1.30 kg CO / 18.76 kg Crude Receiver Vent

Vented from the Foreshots Receiver 0 kg CO / 0.33 kg Foreshots Receiver Vent

CO vented based on 1,254 kg total Condensation Reactor vent stream (22266FG).
CO vented based on 55,372 kg total Crude Receiver vent stream (22701FG).
CO vented based on 42 kg total Foreshots Receiver vent stream (22826FG).

CO vented from Condensation Reactor:

$$\frac{0.00 \text{ kg CO}}{3.66 \text{ kg CO / kg CndRx}} \times 1{,}254 \text{ kg CndRx} = 0 \text{ kg CO}$$

CO vented from Crude Receiver

$$\frac{1.30 \text{ kg CO}}{18.76 \text{ kg CO / kg CrRec}} \times 55{,}372 \text{ kg CrRec} = 3{,}850 \text{ kg CO}$$

CO vented from Foreshots Receiver

$$\frac{0.00 \text{ kg CO}}{0.33 \text{ kg CO / kg FsRec}} \times 42 \text{ kg FsRec} = 0 \text{ kg CO}$$

CO Emissions

0 kg from Condensation Reactor
\+ 3,850 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 3,850 kg CO = **8,487 lb CO (not a VOC)**

O. VOC Summary

	Nafion Compound Name	Before Control Generated		After Control Stack Emissions	
				VOC	HF
		kg/yr	lb/yr	lb/yr	lb/yr
A.	HFP	9,252	20396	20,396	
B.	HFPO	1,123	2476	2,476	
C.	PPF	70	154	0.62	0.07
D.	TFE	27	59	59	
E.	PSEPVE	9	19	19	
F.	C4	1,367	3014	3,014	
G.	HFPO Trimer	1.74	4	0.02	0.00
H.	MA	0.58	1	0.005	0.00
I.	DA	16.77	37	0.15	0.01
J.	Hydro PSEPVE	0.58	1.3	1.3	
K.	Iso PSEPVE	1.74	4	4	
L.	Diglyme	1,651	3640	3,640	
M.	SOF2 (not a VOC)				
N.	CO (not a VOC)				
	Total	**13,520**	**29,806**	**29,611**	**0.1**

P. Total Emission Summary**

** All Emissions in this table represent "After Control" emissions.

Nafion Compound Name		Stack Emissions lb/yr	Equipment Emissions (Note 1) lb/yr	Maintenance Emissions (Note 2) lb/yr	Total Emissions lb/yr
A.	HFP	20,396	41	42	20,479
B.	HFPO	2,476	188	9	2,674
C.	PPF	0.62	1	0	1
D.	TFE	59	0	0	59
E.	PSEPVE	19	367	350	736
F.	C4	3,014	28	30	3,072
G.	HFPO Trimer	0.02	3	0	4
H.	MA	0.01	62	8	69
I.	DA	0.15	139	17	156
J.	Hydro-PSEPVE	1.3	0	0	1
K.	Iso-PSEPVE	3.8	0	0	4
L.	Diglyme		93	5	3,640
M.	SOF2 (not a VOC)	53.1			53
N.	CO (not a VOC)				8,487
*	TA		5	1	6
*	RSU		1	0	1
*	HFPO-Dimer		4	1	5
	Total	26,023	932	462	**39,447**

Note 1 - See section titled "Equipment Emissions" for details

Note 2 - See section titled "Maintenance Emissions" for details

N CO not realistically expected through equipment or maintenance emissions

L. Diglyme total based on material balance, see section L

* Not normally emitted from the process as a routine stack emission

HF Equivalent Emissions

Nafion Compound Name		Stack Emissions lb/yr	Equipment Emissions lb/yr	Maintenance Emissions lb/yr	Total Emissions lb/yr
C.	PPF	0.07	0.08	0.01	0.17
G.	HFPO Trimer	0.00	0.13	0.02	0.14
H.	MA	0.00	3.57	0.44	4.01
I.	DA	0.01	5.43	0.66	6.09
M.	SOF2	24.70			24.70
*	TA		0.15	0.02	0.17
*	RSU		0.06	0.01	0.06
*	HFPO-Dimer		0.25	0.03	0.28
	Total	**24.78**	**9.20**	**1.12**	**35.11**

The estimated HF equivalent emissions from Equipment Emissions were determined by multiplying the Molecular weight of HF/Molecular weight of the acid fluoride, 1 mole acid fluoride generates 1 mol HF
For Example:

$$\frac{20 \text{ lb/mol HF}}{166 \text{ lb/mol PPF}} \times 0.7 \text{ lb/yr Equipment PPF} = 0.08 \text{ lb/yr HF}$$

The estimated HF equivalent emissions from Maintenance Emissions were determined by multiplying the Molecular weight of HF/Molecular weight of the acid fluoride, 1 mole acid fluoride generates 1 mol HF
For Example:

$$\frac{20 \text{ lb/mol HF}}{166 \text{ lb/mol PPF}} \times 0.08 \text{ lb/yr Maintenance PPF} = 0.01 \text{ lb/yr HF}$$

2007 **Accidental Releases to Atmosphere**

A. 2007-163 Date: 12/4/2007 **CAS No. 1623-5-8**

Material Released: **PPVE**

Quantity Released: 924 lbs

HF Potential:

PPVE is a VOC without the potential to form HF

Total VOC 924 lbs VOC

C. Total Emissions from Accidental Releases

* Note when new chemical added to table below you must update Summary Tab

Source		PPVE lb					lb/yr VOC Before Control	lb/yr VOC After Control	lb/yr HF
A.	2007-163	924.0					924.0	924.0	
B.									
	Total	**924.000**					**924**	**924**	**0.0**

2007 Equipment Emissions Determination

Equipment Emissions (EE) are a function of the number of emission points in the plant (valves, flanges, pump seals). For the equipment emission calculations the inventory shown below is conservative and based on plant and process diagrams.

Note that the division scrubber efficiency is 99.6% for control of acid fluorides.

A. Equipment Emissions from Condensation Reactor System

*Valve and Flange Factors can be found on Fugitive Emission Leak rates worksheet

Condensation Tower (vents to stack)

Valve emissions:	462	valves	×	valves x	0.00039	lb/hr/valve	=	0.180 lb/hr VOC from EE
Flange emissions:	924	flanges	×	flanges x	0.00018	lb/hr/flange	=	0.166 lb/hr VOC from EE
Pump emissions:	0	pumps	×	pumps x	0.00115	lb/hr/pump	=	0.000 lb/hr VOC from EE
				Total fugitive emission rate			=	0.347 lb/hr VOC from EE

Condensation Tower VOC by campaign

Campaign	EVE	PPVE	PSEPVE
Operating Hours	1,110	3,520	2,353
Total VOC generated per campaign	384	1220	815

** Condensation equipment is inside the tower, **Acid fluorides** are scrubbed out utilizing the 99.6% control efficient WGS

Component	EVE	After control**	PPVE	After control**	PSEPVE	After control**
	lb	lb	lb	lb	lb	lb
HFP	3	3	5	5	2	2
HFPO	91	91	360	360	188	188
HFPO-Dimer	13	**5**	666	**266**	11	**4**
PPF	3	**1**	25	**10**	2	**1**
Diglyme	0	0	0	0	93	93
AN	0	0	148	148	0	0
ADN	39	39	0	0	0	0
TTG	4	4	0	0	0	0
DA	0	**0**	0	**0**	344	**137**
MA	0	**0**	0	**0**	154	**62**
TA	0	**0**	0	**0**	13	**5**
RSU	0	**0**	0	**0**	1	**1**
MAE	83	**33**	0	**0**	0	**0**
MMF	17	**7**	0	**0**	0	**0**
DAE	127	**51**	0	**0**	0	**0**
TAE	6	**2**	0	**0**	0	**0**
HFPO Trimer	0	**0**	16	**7**	8	**3**
Total	**384**	**236**	**1,220**	**795**	**815**	**496**

Note: Speciated equipment emissions were estimated by assuming typical volumes of each component in the system, and applying the fraction of each component to the total estimated emissions. The worksheet "vessel compositions" shows the factors used in this calculation.

B. Equipment Emissions from Agitated Bed Reactor System

Valve emissions:	85	valves	×	valves x	0.00039	lb/hr/valve	= 0.033	lb/hr VOC from EE
Flange emissions:	170	flanges	×	flanges x	0.00018	lb/hr/flange	= 0.031	lb/hr VOC from EE
Pump emissions:	0	pumps	×	pumps x	0.00115	lb/hr/pump	= 0.000	lb/hr VOC from EE
				Total fugitive emission rate			= 0.064	lb/hr VOC from EE

ABR/crude VOC by campaign

Campaign	EVE	PPVE	PSEPVE
Operating Hours	1,110	3,520	2,353
Total VOC per campaign	71	224	150

Component	EVE	PPVE	PSEPVE
	lb	lb	lb
HFP	0	0	11
HFPO-Dimer	0	2	0
EVE	60	0	0
PPVE	0	215	0
DA	0	0	2
DAE	1	0	0
PSEPVE	0	0	131
hydro-EVE	4	0	0
iso-EVE	6	0	0
C4	0	7	8
Total	**71**	**224**	**150**

Worst case, assume all acid fluorides are released in the portion of the feed line outside the ABR room and are not removed by the WGS.

C. Equipment Emissions from Refining System

Valve emissions:	162	valves	×	valves x	0.00039	lb/hr/valve	= 0.063	lb/hr VOC from EE
Flange emissions:	324	flanges	×	flanges x	0.00018	lb/hr/flange	= 0.058	lb/hr VOC from EE
Pump emissions:	0	pumps	×	pumps x	0.00115	lb/hr/pump	= 0.000	lb/hr VOC from EE
				Total fugitive emission rate			= 0.122	lb/hr VOC from EE

Refining System VOC by campiagn

Campaign	EVE	PPVE	PSEPVE
Operating Hours	1,110	3,520	2,353
Total VOC per campaign	135	428	286

Component	EVE	PPVE	PSEPVE
	lb	lb	lb
HFP	0	0	29
HFPO-Dimer	0	3	0
EVE	121	0	0
PPVE	0	375	0
PSEPVE	0	0	237
hydro-EVE	5	0	0
iso-EVE	8	0	0
C4	0	50	21
Total	**135**	**428**	**286**

All Refining equipment is located outside of the tower so releases will be directly to atmosphere.

D. Component Summary - All equipment emissions

Component	EVE	PPVE	PSEPVE
	lb	lb	lb
HFP	3	5	41
HFPO	91	360	188
HFPO-Dimer	5	271	4
PPF	1	10	1
Diglyme	0	0	93
AN	0	148	0
ADN	39	0	0
TTG	4	0	0
DA	0	0	139
MA	0	0	62
TA	0	0	5
RSU	0	0	1
MAE	33	0	0
MMF	7	0	0
DAE	52	0	0
TAE	2	0	0
HFPO Trimer	0	7	3
EVE	181	0	0
PPVE	0	590	0
PSEPVE	0	0	367
hydro-EVE	9	0	0
iso-EVE	14	0	0
C4	0	57	28

As entered in AERO

Facility Name: DuPont Company – Fayetteville Works
22828 NC Highway 87 West
Fayetteville, NC 28302

Facility ID : 0900009
Permit : 03735
County : Bladen
DAQ Region : FRO

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory – Calendar Year 2007

1. Emission Source ID (from permit) or Emission Source Group ID NS–C

2. Emission Source Description: Nafion Vinyl Ethers South process [MACT FFFF]

3. Operating Scenario ID/Description: OS – 13/Nafion PEVE/PMVE and PPVE process

4. SCC Number/Description: 30199998/*Other Organic Chemica Manufacture Not Listed

5. Throughput/units in 2007: (e.g. production or fuel use):

6. Fuel Information (If fuel is used)

% Sulfur		% Ash		Heat Content (Btu/units)	

7. Capture Efficiency (% of Emissions from this Process Vented to Control Device or Stack): 100

8. Control Device Information :

Order	CS–ID	CD ID (as listed in permit)	Control Device Description
1	CS–7	NCD–Hdr–2	Baffle–plate scrubber (7,000 kilogram/hour liquid injection rate averaged over a 3–hour period)

9. Emission Release Point (ERP) Information: (Sources vented to more than one ERP use additional entry lines):

ERP ID	ERP Type	Height (in feet)	Diameter Circle (enter #): Rectangle (L x W) (in 0.1 feet)	Temperature (F)	Velocity (Feet/sec)	Volume Flow Rate (Acfm)	ERP Description
EP–NEP–Hdr2	VERTICAL STACK	81	2.3	75	46	11467.12	Nafion scrubber Hdr2