Inventory Certification Form(Title V)
Facility Name: DuPont Company – Fayetteville Works
22828 NC Highway 87 West
Fayetteville, NC 28302

1-7

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 2008

These forms must be completed and returned even if the facility did not operate or emissions were zero

The legally defined "Responsible Official" of record for your facility is Karen Wrigley
This person or one that meets the definition below must sign this certification form.

The official submitting the information must certify that he/she complies with the requirements as specified in Title 15A NCAC 2Q.0520(b) which references and follows the federal definition. 40 CFR Part 70.2 defines a responsible as meaning one of the following:

1. For a corporation: a president, secretary, treasurer, or vice–president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the overall operation of one or more manufacturing, production, or operating facilities applying for a or subject to a permit and either
   i. the facilities employ more than 250 persons or have gross annual sales or expenditures exceeding $25 million(in second quarter 1980 dollars); or
   ii. the delegation of authority to such representatives is approved in advance by the permitting authority;
2. For partnership or sole propietorship; a general partner or the proprietor, respectively;
3. for a muncipality, state, federal, or other public agency includes the chief executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., a Regional Administrator of EPA).

CERTIFICATION STATEMENT:
(Important: Legally Responsible Official, read and sign after all submissions are final.)

I certify that I am the responsible official for this facility, as described above, and hereby certify that the information contained in this air emissions report, including attached calculations and documentation, is true, accurate and complete. (Subject to legal penalities of up to $25,000 per occurrence and possible imprisonment as outlined in G.S.§143–215.3(a)(2))

Responsible Official's Signature Below (**use blue ink**): Date Signed: 06/23/09

Printed Name: Karen Wrigley

Signature: Karen B Wrigley

This form applies to Title V facilities. If this facility is not classified as Title V, please telephone your regional office Emission Inventory contact at once for proper forms.

Email address of Responsible Official: karen.b.wrigley@usa.dupont.com

Information on this Form cannot be held confidential

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Facility Total CY 2008 Emission Summary Recorded in ED **Facility ID #:** 0900009

Facility Name: DuPont Company - Fayetteville Works **Permit #(s):** 03735T34

Green House Gases Pollutants (GHG) Pollutant	CAS	Actual Emissions Tons/Yr CY 2008 from ED	Actual Emissions Tons/Yr CY 2007 from Fees	% Difference
Hydrofluorocarbons		***5.88***		
	HFC	Not Reported	Not Reported	N/A
HFC-23 (Trifluoromethane)	75467	5.88	7.54	-22.0%
Methane (CH4)	74-82-8	0.470000	Not Reported	N/A
Carbon Dioxide (CO2)	124389	51,308.03	50,544.85	1.5%
Nitrous Oxide (N2O)	10024972	0.260000	Not Reported	N/A
CO2 equivalent (sum of individual GHG pollutant emission times their 1995 IPCC Global Warming Potential (GWP), converted to metric tons)		109,040.45	metric tons	

Criteria Pollutants Pollutant	CAS	Actual Emissions (Tons/Year) CY 2008 from ED	Actual Emissions (Tons/Year) CY 2007 from Fees	% Difference
CO	CO	15.13	17.44	**-13.2%**
NOx	NOx	53.95	78.81	**-31.5%**
PM(TSP)	TSP	18.98	39.71	**-52.2%**
PM10	PM10	13.13	32.00	**-59.0%**
PM2.5	PM2.5	9.33	22.43	**-58.4%**
SO2	SO2	118.63	443.03	**-73.2%**
VOC	VOC	312.50	342.24	-8.7%

Hazardous Air Pollutants (HAPs) and/or Toxic Air Pollutants (TAPs) Pollutant	CAS	Actual Emissions (Pounds/Year) CY 2008 from ED	Actual Emissions (Pounds/Year) CY 2007 from Fees	% Difference
Total Reduced Sulfur (TRS)		***180.60***	***180.60***	***0.0%***
Dimethyl sulfide	75-18-3	37.50	37.50	0.0%

Hazardous Air Pollutants (HAPs) and/or Toxic Air Pollutants (TAPs)		Actual Emissions (Pounds/Year)		% Difference
Pollutant	CAS	CY 2008 from ED	CY 2007 from Fees	
Total Reduced Sulfur (TRS)		***180.60***	***180.60***	***0.0%***
Hydrogen sulfide	7783-06-4	140.00	140.00	0.0%
Methyl mercaptan	74-93-1	3.10	3.10	0.0%
Polycyclic Organic Matter (Specific Compounds from OAQPS for TV)		***2.05***	***3.63***	***-43.5%***
Naphthalene (Component of 83329/POMTV)	91-20-3	2.05	3.63	**-43.6%**
Nickel & Compounds, sum total mass includes elemental		***62.55***	***242.22***	***-74.2%***
Nickel Unlisted Compounds (Component of NIC - Specify)	NIC-Other	1.55	2.22	**-30.1%**
Nickel, soluble compounds as nickel (Component of NIC)	NICKSOLCPDS	61.00	240.00	**-74.6%**
Mercury & Compounds - all total mass includes Hg Vapor		***1.63***	***0.841300***	***93.7%***
Mercury Unlisted Compounds - Specify Compound (Component of HGC)	HGC-Other	1.63	0.841300	**94.0%**
Manganese & compounds		***5.30***	***9.49***	***-44.2%***
Manganese Unlisted Compounds - Specify Compound (Component of MNC)	MNC-Other	5.30	9.49	**-44.2%**
Lead & compounds		***3.20***	***4.50***	***-28.9%***
Lead Unlisted Compounds - Specify Compound (Component of PBC)	PBC-Other	3.20	4.50	**-28.9%**
Glycol ethers (total all individual glycol ethers-See http://daq.state.nc.us/toxics/glycol/)		***1,113.00***	***3,640.00***	***-69.4%***
Glycol Ethers, Unlisted - Specify Compound (component of GLYET) (See http://daq.state.nc.us/toxics	GLYET-Other	1,113.00	3,640.00	**-69.4%**
Cobalt & compounds		***4.40***	***17.12***	***-74.3%***
Cobalt Unlisted Compounds - Specify Compound (Component of COC)	COC-Other	4.40	17.12	**-74.3%**

Facility Total CY 2008 Emission Summary Recorded in ED **Facility ID #:** 0900009

Facility Name: DuPont Company - Fayetteville Works **Permit #(s):** 03735T34

Hazardous Air Pollutants (HAPs) and/or Toxic Air Pollutants (TAPs)		Actual Emissions (Pounds/Year)		% Difference
Pollutant	CAS	CY 2008 from ED	CY 2007 from Fees	
Chromium - All/Total (includes Chromium (VI) categories, metal and others)		***2.16***	***2.94***	***-26.5%***
Chromium Unlisted Compounds - Specify Compound (Component of CRC)	CRC-Other	2.16	2.94	**-26.4%**
Cadmium & compounds (total mass includes elemental metal)		***1.84***	***1.63***	***12.9%***
Cadmium Unlisted Compounds - Specify Compound (Component of CDC)	CDC-Other	1.84	1.63	**13.1%**
Beryllium & compounds (Total mass)		***1.57***	***0.597560***	***162.7%***
Beryllium Unlisted Compounds - Specify Compound (Component of BEC)	BEC-Other	1.57	0.597560	**162.7%**
Arsenic & Compounds (total mass of elemental AS, arsine and all inorganic compounds)		***3.00***	***4.42***	***-32.1%***
Arsenic Unlisted Compounds - Specify Compound (Component of ASC)	ASC-Other	3.00	4.42	**-32.1%**
Antimony & Compounds (total mass, inc elemental SB)		***3.80***	***15.11***	***-74.9%***
Antimony Unlisted Compounds - Specify Compound (Component of SBC)	SBC-Other	3.80	15.11	**-74.9%**
Acetic acid	64-19-7	1,105.00	1,281.00	**-13.7%**
Acetonitrile	75-05-8	6,855.00	9,793.00	**-30.0%**
Acrolein	107-02-8	1.00	1.00	0.0%
Ammonia (as NH3)	7664-41-7	822.40	822.10	0.0%
Benzene	71-43-2	17.90	24.11	**-25.8%**
Bromine	7726-95-6	26.00	26.00	0.0%
CFC- 113 (1,1,2-trichloro-1,2,2-trifluoroethane)	76-13-1	Not Reported	739.00	**N/A**
CFC-12 (Dichlorodifluoromethane)	75-71-8	Not Reported	Not Reported	**N/A**
Chlorine	7782-50-5	64.00	64.00	0.0%

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Hazardous Air Pollutants (HAPs) and/or Toxic Air Pollutants (TAPs)		Actual Emissions (Pounds/Year)		% Difference
Pollutant	CAS	CY 2008 from ED	CY 2007 from Fees	
Chloroform	67-66-3	1.00	1.00	0.0%
Dimethyl formamide	68-12-2	484.00	Not Reported	N/A
Dioxane, 1,4-	123-91-1	Not Reported	Not Reported	N/A
Ethyl acetate	141-78-6	17.00	17.00	0.0%
Ethyl benzene	100-41-4	385.05	648.18	-40.6%
Ethylene dichloride (1,2-dichloroethane)	107-06-2	541.00	541.00	0.0%
Ethylene glycol	107-21-1	38.00	56.00	-32.1%
Fluorides (sum of all fluoride compounds as mass of F ion)	16984-48-8	165.00	146.65	12.5%
Formaldehyde	50-00-0	208.00	179.85	15.7%
Hexamethylene-1,6-diisocyanate	822-06-0	2.00	1.00	100.0%
Hexane, n-	110-54-3	95.00	3.00	3,066.7%
Hydrogen chloride (hydrochloric acid)	7647-01-0	133.20	301.32	-55.8%
Hydrogen fluoride (hydrofluoric acid as mass of HF) (Component of 16984488/Fluorides)	7664-39-3	1,999.02	3,499.05	-42.9%
MEK (methyl ethyl ketone, 2-butanone)	78-93-3	88.00	268.00	-67.2%
Methanol (methyl alcohol)	67-56-1	37,277.00	56,824.00	-34.4%
Methyl chloroform	71-55-6	1.04	0.954700	8.9%
Methylene chloride	75-09-2	3,661.00	3,655.00	0.2%
Nitric acid	7697-37-2	109.00	109.00	0.0%
Phosphorus Metal, Yellow or White	7723-14-0	6.90	27.19	-74.6%
Polycyclic Organic Matter (Inc PAH, dioxins, etc. NC & AP 42 historic)	POM	12.97	7.42	74.7%
Selenium Compounds	SEC	8.20	4.46	83.7%
Sulfur trioxide	7446-11-9	133.80	129.10	3.6%

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Hazardous Air Pollutants (HAPs) and/or Toxic Air Pollutants (TAPs)		Actual Emissions (Pounds/Year)		% Difference
Pollutant	CAS	CY 2008 from ED	CY 2007 from Fees	
Sulfuric acid	7664-93-9	216.10	301.50	**-28.3%**
Toluene	108-88-3	6,073.50	4,440.52	**36.8%**
Vinylidene chloride	75-35-4	Not Reported	Not Reported	**N/A**
Xylene (mixed isomers)	1330-20-7	1,086.28	2,635.63	**-58.8%**
Largest Individual HAP	**Methanol (methyl alcohol)**	**37,277.00 lbs**		
Total HAP Emissions		**59,029.62 lbs**		

DAQ's Comments Regarding Inventory

The facility did not process 1,1,2-trichloro-1,2,2-trifluoroethane material in 2008. The criteria pollutants (PM-10, NOx, CO and SO2) emissions were significant less than CY 2007 because the facility combusted less amount of fuel oil. The facility primary combusted natural gas in 2008. The facility also processed less chemical materials in CY 2008. The facility submitted the revised emission calculations for emssion source ID Nos. NS-C, NS-G, and NS-L on 08/31/09.

FUEL OIL COMBUSTION EMISSIONS CALCULATOR REVISION D 6/12/2008 - OUTPUT SCREEN

NCDENR

Instructions: Enter emission source / facility data on the "INPUT" tab/screen. The air emission results and summary of input data are viewed / printed on the "OUTPUT" tab/screen. The different tabs are on the bottom of this screen.

This spreadsheet is for your use only and should be used with caution. DENR does not guarantee the accuracy of the information contained. This spreadsheet is subject to continual revision and updating. It is your responsibility to be aware of the most current information available. DENR is not responsible for errors or omissions that may be contained herein.

SOURCE / FACILITY / USER INPUT SUMMARY (FROM INPUT SCREEN)

COMPANY:	DuPont - Fayetteville Works	MAX HEAT INPUT:	139.40	MMBTU/HR
FACILITY ID NO.:	0900009	FUEL HEAT VALUE:	150,000	BTU/GAL
PERMIT NUMBER:	03735T34	ACTUAL ANNUAL FUEL USAGE:	727,691	GAL/YR
FACILITY CITY:	Duart Township	MAXIMUM ANNUAL FUEL USAGE:	8,140,960	GAL/YR
FACILITY COUNTY:	Bladen	MAXIMUM SULFUR CONTENT:	2.0	%
USER NAME:	Michael E. Johnson	REQUESTED PERMIT LIMITATIONS		
EMISSION SOURCE DESCRIPTION:	No. 6 oil-fired Boiler	MAX. FUEL USAGE:	8,140,960	GAL/YR
EMISSION SOURCE ID NO.:	PS-1	MAX. SULFUR CONTENT:	2.04	%

TYPE OF CONTROL DEVICES	POLLUTANT	CONTROL EFF.
NONE/OTHER	PM	0
NONE/OTHER	SO2	0
NONE/OTHER	NOx	0

CRITERIA AIR POLLUTANT EMISSIONS INFORMATION

	ACTUAL EMISSIONS (AFTER CONTROLS / LIMITS)		POTENTIAL EMSSIONS (BEFORE CONTROLS / LIMITS)		POTENTIAL EMSSIONS (AFTER CONTROLS / LIMITS)		EMISSION FACTOR (lb/10^3 gal)	
AIR POLLUTANT EMITTED	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	uncontrolled	controlled
TOTAL PARTICULATE MATTER (PM) (FPM+CPM)	21.81	8.54	21.81	95.52	21.81	95.52	2.35E+01	2.35E+01
FILTERABLE PM (FPM)	20.42	7.99	20.42	89.42	20.42	89.42	2.20E+01	2.20E+01
CONDENSABLE PM (CPM)	1.39	0.55	1.39	6.11	1.39	6.11	1.50E+00	1.50E+00
FILTERABLE PM<10 MICRONS (PM_{10})	17.69	6.93	17.69	77.48	17.69	77.48	1.90E+01	1.90E+01
FILTERABLE PM<2.5 MICRONS ($PM_{2.5}$)	11.52	4.51	11.52	50.47	11.52	50.47	1.24E+01	1.24E+01
SULFUR DIOXIDE (SO_2)	297.65	116.53	297.65	1303.69	297.65	1303.69	3.20E+02	3.20E+02
NITROGEN OXIDES (NO_x)	43.68	17.10	43.68	191.31	43.68	191.31	4.70E+01	4.70E+01
CARBON MONOXIDE (CO)	4.65	1.82	4.65	20.35	4.65	20.35	5.00E+00	5.00E+00
VOLATILE ORGANIC COMPOUNDS (VOC)	0.26	0.10	0.26	1.14	0.26	1.14	2.80E-01	2.80E-01
LEAD	0.00	0.00	0.00	0.01	0.00	0.01	1.51E-03	1.51E-03

GREENHOUSE GAS EMISSIONS INFORMATION

CARBON DIOXIDE (CO_2)	24220.28	9482.54	24220.28	########	24220.28	########	2.61E+04	2.61E+04
METHANE (CH_4)	0.92	0.36	0.92	4.03	0.92	4.03	9.90E-01	9.90E-01
NITROUS OXIDE (N_2O)	0.09	0.04	0.09	0.41	0.09	0.41	1.00E-01	1.00E-01

TOXIC / HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION

		CAS	ACTUAL EMISSIONS (AFTER CONTROLS / LIMITS)		POTENTIAL EMSSIONS (BEFORE CONTROLS / LIMITS)		POTENTIAL EMSSIONS (AFTER CONTROLS / LIMITS)		EMISSION FACTOR (lb/10^3 gal)	
TOXIC / HAZARDOUS AIR POLLUTANT		NUMBER	lb/hr	lb/yr	lb/hr	lb/yr	lb/hr	lb/yr	uncontrolled	controlled
Antimony & compounds	(H)	SBC	4.9E-03	3.8E+00	4.9E-03	4.3E+01	4.9E-03	4.3E+01	5.25E-03	5.25E-03
Arsenic & compounds	(TH)	ASC	1.2E-03	9.6E-01	1.2E-03	1.1E+01	1.2E-03	1.1E+01	1.32E-03	1.32E-03
Benzene	(TH)	71432	2.0E-04	1.6E-01	2.0E-04	1.7E+00	2.0E-04	1.7E+00	2.14E-04	2.14E-04
Beryllium & compounds	(H)	BEC	2.6E-05	2.0E-02	2.6E-05	2.3E-01	2.6E-05	2.3E-01	2.78E-05	2.78E-05
Cadium & compounds	(TH)	CDC	3.7E-04	2.9E-01	3.7E-04	3.2E+00	3.7E-04	3.2E+00	3.98E-04	3.98E-04
Chromium - All/Total	(H)	CRC	7.9E-04	6.1E-01	7.9E-04	6.9E+00	7.9E-04	6.9E+00	8.45E-04	8.45E-04
Cobalt compounds	(H)	COC	5.6E-03	4.4E+00	5.6E-03	4.9E+01	5.6E-03	4.9E+01	6.02E-03	6.02E-03
Ethylbenzene	(H)	100414	5.9E-05	4.6E-02	5.9E-05	5.2E-01	5.9E-05	5.2E-01	6.36E-05	6.36E-05
Fluorides (sum fluoride compounds)	(T)	16984488	3.5E-02	2.7E+01	3.5E-02	3.0E+02	3.5E-02	3.0E+02	3.73E-02	3.73E-02
Formaldehyde	(TH)	50000	3.9E-02	3.1E+01	3.9E-02	3.5E+02	3.9E-02	3.5E+02	4.25E-02	4.25E-02
Lead and Lead compounds	(H)	PBC	1.4E-03	1.1E+00	1.4E-03	1.2E+01	1.4E-03	1.2E+01	1.51E-03	1.51E-03
Manganese & compounds	(TH)	MNC	2.8E-03	2.2E+00	2.8E-03	2.4E+01	2.8E-03	2.4E+01	3.00E-03	3.00E-03
Mercury & compounds	(TH)	HGC	1.1E-04	8.2E-02	1.1E-04	9.2E-01	1.1E-04	9.2E-01	1.13E-04	1.13E-04
Methyl chloroform	(TH)	71566	2.2E-04	1.7E-01	2.2E-04	1.9E+00	2.2E-04	1.9E+00	2.36E-04	2.36E-04
Napthalene	(H)	91203	1.1E-03	8.2E-01	1.1E-03	9.2E+00	1.1E-03	9.2E+00	1.13E-03	1.13E-03
Nickle & compounds	(H)	NIC	7.9E-02	6.1E+01	7.9E-02	6.9E+02	7.9E-02	6.9E+02	8.45E-02	8.45E-02
Phosphorus Metal, Yellow or White	(H)	7723140	8.8E-03	6.9E+00	8.8E-03	7.7E+01	8.8E-03	7.7E+01	9.46E-03	9.46E-03
POM rates uncontrolled	(H)	POM	1.1E-03	8.7E-01	1.1E-03	9.8E+00	1.1E-03	9.8E+00	1.20E-03	1.20E-03
Selenium compounds	(H)	SEC	6.3E-04	5.0E-01	6.3E-04	5.6E+00	6.3E-04	5.6E+00	6.83E-04	6.83E-04
Toluene	(TH)	108883	5.8E-03	4.5E+00	5.8E-03	5.0E+01	5.8E-03	5.0E+01	6.20E-03	6.20E-03
Xylene	(TH)	1330207	1.0E-04	7.9E-02	1.0E-04	8.9E-01	1.0E-04	8.9E-01	1.09E-04	1.09E-04
Total HAP	(H)		1.5E-01	1.2E+02	1.5E-01	1.3E+03	1.5E-01	1.3E+03	1.6E-01	1.6E-01
Larget HAP	(H)		7.85E-02	6.15E+01	7.85E-02	6.88E+02	7.85E-02	6.88E+02	8.45E-02	8.45E-02

TOXIC AIR POLLUTANT EMISSIONS INFORMATION (FOR PERMITTING PURPOSES)

			EXPECTED ACTUAL EMISSIONS AFTER CONTROLS / LIMITATIONS			EMISSION FACTOR (lb/10^3 gal)	
TOXIC AIR POLLUTANT		CAS Num.	lb/hr	lb/day	lb/yr	uncontrolled	controlled
Arsenic & compounds	(TH)	ASC	1.23E-03	2.94E-02	1.07E+01	1.32E-03	1.32E-03
Benzene	(TH)	71432	1.99E-04	4.77E-03	1.74E+00	2.14E-04	2.14E-04
Cadium & compounds	(TH)	CDC	3.70E-04	8.88E-03	3.24E+00	3.98E-04	3.98E-04
Fluorides (sum fluoride compounds)	(T)	16984488	3.47E-02	8.32E-01	3.04E+02	3.73E-02	3.73E-02
Formaldehyde	(TH)	50000	3.95E-02	9.48E-01	3.46E+02	4.25E-02	4.25E-02
Manganese & compounds	(TH)	MNC	2.79E-03	6.69E-02	2.44E+01	3.00E-03	3.00E-03
Mercury & compounds	(TH)	HGC	1.05E-04	2.52E-03	9.20E-01	1.13E-04	1.13E-04
Methyl chloroform	(TH)	71566	2.19E-04	5.26E-03	1.92E+00	2.36E-04	2.36E-04
Toluene	(TH)	108883	5.76E-03	1.38E-01	5.05E+01	6.20E-03	6.20E-03
Xylene	(TH)	1330207	1.01E-04	2.43E-03	8.87E-01	1.09E-04	1.09E-04

Hydrogen Chloride (HCl) **CAS No. 7647-01-0**

The EPA Industrial Boiler MACT rulemaking emission factor for uncontrolled residual and distillate oil firing is given as 7.1E-5 lb/MMBtu in Docket Document Number II-B-8, Development of Average Emission Factors and Baseline Emission Estimates for the Industrial, Commercial, and Institutional Boilers and Process Heaters NESHAP, October 2002; so that figure is used as the latest information from EPA.

EPA emission factor = **7.1E-05** pounds of HCl per million BTUs generated in the boiler.
= **7.1E-11** pounds of HCl per BTU generated in the boiler.

PS-1 emissions of HCl:

0 gallons of No. 2 fuel oil were burned in 2008

$$0 \text{ gal. No. 2 F.O.} \times \frac{140{,}000 \text{ BTU}}{\text{gal. No. 2 F.O.}} = 0.00\text{E+00 BTU}$$

$$0.00\text{E+00 BTU} \times \frac{7.1\text{E-11 lb HCl}}{\text{BTU}} = \textbf{0.0 lb HCl}$$

727,691 gallons of No. 6 fuel oil were burned in 2008

$$727{,}691 \text{ gal. No. 6 F.O.} \times \frac{150{,}000 \text{ BTU}}{\text{gal. No. 6 F.O.}} = 1.09\text{E+11 BTU}$$

$$1.09\text{E+11 BTU} \times \frac{7.1\text{E-11 lb HCl}}{\text{BTU}} = \textbf{7.7 lb HCl}$$

Total HCl emissions:

0.0 lb HCl from No. 2 F.O.
\+ 7.7 lb HCl from No. 6 F.O.
7.7 lb. HCl emissions

FUEL OIL COMBUSTION EMISSIONS CALCULATOR REVISION D 6/12/2008 - OUTPUT SCREEN

NCDENR

Instructions: Enter emission source / facility data on the "INPUT" tab/screen. The air emission results and summary of input data are viewed / printed on the "OUTPUT" tab/screen. The different tabs are on the bottom of this screen.

This spreadsheet is for your use only and should be used with caution. DENR does not guarantee the accuracy of the information contained. This spreadsheet is subject to continual revision and updating. It is your responsibility to be aware of the most current information available. DENR is not responsible for errors or omissions that may be contained herein.

SOURCE / FACILITY / USER INPUT SUMMARY (FROM INPUT SCREEN)

COMPANY:	DuPont - Fayetteville Works	MAX HEAT INPUT:	88.40	MMBTU/HR
FACILITY ID NO.:	0900009	FUEL HEAT VALUE:	140,000	BTU/GAL
PERMIT NUMBER:	03735T34	ACTUAL ANNUAL FUEL USAGE:	2,005,117	GAL/YR
FACILITY CITY:	Duart Township	MAXIMUM ANNUAL FUEL USAGE:	5,531,314	GAL/YR
FACILITY COUNTY:	Bladen	MAXIMUM SULFUR CONTENT:	0.0	%
USER NAME:	Michael E. Johnson	REQUESTED PERMIT LIMITATIONS		
EMISSION SOURCE DESCRIPTION:	No. 2 oil-fired Boiler	MAX. FUEL USAGE:	5,531,314	GAL/YR
EMISSION SOURCE ID NO.:	PS-2	MAX. SULFUR CONTENT:	0.007	%

TYPE OF CONTROL DEVICES	POLLUTANT	CONTROL EFF.
NONE/OTHER	PM	0
NONE/OTHER	SO2	0
NONE/OTHER	NOx	0

CRITERIA AIR POLLUTANT EMISSIONS INFORMATION

	ACTUAL EMISSIONS (AFTER CONTROLS / LIMITS)		POTENTIAL EMSSIONS (BEFORE CONTROLS / LIMITS)		POTENTIAL EMSSIONS (AFTER CONTROLS / LIMITS)		EMISSION FACTOR (lb/10^3 gal)	
AIR POLLUTANT EMITTED	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	uncontrolled	controlled
TOTAL PARTICULATE MATTER (PM) (FPM+CPM)	2.08	3.31	2.08	9.13	2.08	9.13	3.30E+00	3.30E+00
FILTERABLE PM (FPM)	1.26	2.01	1.26	5.53	1.26	5.53	2.00E+00	2.00E+00
CONDENSABLE PM (CPM)	0.82	1.30	0.82	3.60	0.82	3.60	1.30E+00	1.30E+00
FILTERABLE PM<10 MICRONS (PM_{10})	0.63	1.00	0.63	2.77	0.63	2.77	1.00E+00	1.00E+00
FILTERABLE PM<2.5 MICRONS ($PM_{2.5}$)	0.16	0.25	0.16	0.69	0.16	0.69	2.50E-01	2.50E-01
SULFUR DIOXIDE (SO_2)	0.63	1.00	0.63	2.75	0.63	2.75	9.94E-01	9.94E-01
NITROGEN OXIDES (NO_x)	12.63	20.05	12.63	55.31	12.63	55.31	2.00E+01	2.00E+01
CARBON MONOXIDE (CO)	3.16	5.01	3.16	13.83	3.16	13.83	5.00E+00	5.00E+00
VOLATILE ORGANIC COMPOUNDS (VOC)	0.13	0.20	0.13	0.55	0.13	0.55	2.00E-01	2.00E-01
LEAD	0.00	0.00	0.00	0.00	0.00	0.00	1.26E-03	1.26E-03

GREENHOUSE GAS EMISSIONS INFORMATION

CARBON DIOXIDE (CO_2)	14258.54	22639.18	14258.54	62452.42	14258.54	62452.42	2.26E+04	2.26E+04
METHANE (CH_4)	0.04	0.06	0.04	0.17	0.04	0.17	6.00E-02	6.00E-02
NITROUS OXIDE (N_2O)	0.08	0.12	0.08	0.33	0.08	0.33	1.20E-01	1.20E-01

TOXIC / HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION

		CAS	ACTUAL EMISSIONS (AFTER CONTROLS / LIMITS)		POTENTIAL EMSSIONS (BEFORE CONTROLS / LIMITS)		POTENTIAL EMSSIONS (AFTER CONTROLS / LIMITS)		EMISSION FACTOR (lb/10^3 gal)	
TOXIC / HAZARDOUS AIR POLLUTANT		NUMBER	lb/hr	lb/yr	lb/hr	lb/yr	lb/hr	lb/yr	uncontrolled	controlled
Antimony & compounds	(H)	SBC	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00
Arsenic & compounds	(TH)	ASC	3.5E-04	1.1E+00	3.5E-04	3.1E+00	3.5E-04	3.1E+00	5.60E-04	5.60E-04
Benzene	(TH)	71432	1.7E-03	5.5E+00	1.7E-03	1.5E+01	1.7E-03	1.5E+01	2.75E-03	2.75E-03
Beryllium & compounds	(H)	BEC	2.7E-04	8.4E-01	2.7E-04	2.3E+00	2.7E-04	2.3E+00	4.20E-04	4.20E-04
Cadium & compounds	(TH)	CDC	2.7E-04	8.4E-01	2.7E-04	2.3E+00	2.7E-04	2.3E+00	4.20E-04	4.20E-04
Chromium - All/Total	(H)	CRC	2.7E-04	8.4E-01	2.7E-04	2.3E+00	2.7E-04	2.3E+00	4.20E-04	4.20E-04
Cobalt compounds	(H)	COC	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00
Ethylbenzene	(H)	100414	5.2E-04	1.6E+00	5.2E-04	4.5E+00	5.2E-04	4.5E+00	8.17E-04	8.17E-04
Fluorides (sum fluoride compounds)	(T)	16984488	2.4E-02	7.5E+01	2.4E-02	2.1E+02	2.4E-02	2.1E+02	3.73E-02	3.73E-02
Formaldehyde	(TH)	50000	3.0E-02	9.6E+01	3.0E-02	2.7E+02	3.0E-02	2.7E+02	4.80E-02	4.80E-02
Lead and Lead compounds	(H)	PBC	8.0E-04	2.5E+00	8.0E-04	7.0E+00	8.0E-04	7.0E+00	1.26E-03	1.26E-03
Manganese & compounds	(TH)	MNC	5.3E-04	1.7E+00	5.3E-04	4.6E+00	5.3E-04	4.6E+00	8.40E-04	8.40E-04
Mercury & compounds	(TH)	HGC	2.7E-04	8.4E-01	2.7E-04	2.3E+00	2.7E-04	2.3E+00	4.20E-04	4.20E-04
Methyl chloroform	(TH)	71566	1.5E-04	4.7E-01	1.5E-04	1.3E+00	1.5E-04	1.3E+00	2.36E-04	2.36E-04
Napthalene	(H)	91203	2.1E-04	6.7E-01	2.1E-04	1.8E+00	2.1E-04	1.8E+00	3.33E-04	3.33E-04
Nickle & compounds	(H)	NIC	2.7E-04	8.4E-01	2.7E-04	2.3E+00	2.7E-04	2.3E+00	4.20E-04	4.20E-04
Phosphorus Metal, Yellow or White	(H)	7723140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00
POM rates uncontrolled	(H)	POM	2.1E-03	6.6E+00	2.1E-03	1.8E+01	2.1E-03	1.8E+01	3.30E-03	3.30E-03
Selenium compounds	(H)	SEC	1.3E-03	4.2E+00	1.3E-03	1.2E+01	1.3E-03	1.2E+01	2.10E-03	2.10E-03
Toluene	(TH)	108883	5.0E-02	1.6E+02	5.0E-02	4.4E+02	5.0E-02	4.4E+02	7.97E-02	7.97E-02
Xylene	(TH)	1330207	8.8E-04	2.8E+00	8.8E-04	7.7E+00	8.8E-04	7.7E+00	1.40E-03	1.40E-03
Total HAP	(H)		9.1E-02	2.9E+02	9.1E-02	7.9E+02	9.1E-02	7.9E+02	1.4E-01	1.4E-01
Larget HAP	(H)		5.03E-02	1.60E+02	5.03E-02	4.41E+02	5.03E-02	4.41E+02	7.97E-02	7.97E-02

TOXIC AIR POLLUTANT EMISSIONS INFORMATION (FOR PERMITTING PURPOSES)

			EXPECTED ACTUAL EMISSIONS AFTER CONTROLS / LIMITATIONS			EMISSION FACTOR (lb/10^3 gal)	
TOXIC AIR POLLUTANT		CAS Num.	lb/hr	lb/day	lb/yr	uncontrolled	controlled
Arsenic & compounds	(TH)	ASC	3.54E-04	8.49E-03	3.10E+00	5.60E-04	5.60E-04
Benzene	(TH)	71432	1.74E-03	4.17E-02	1.52E+01	2.75E-03	2.75E-03
Cadium & compounds	(TH)	CDC	2.65E-04	6.36E-03	2.32E+00	4.20E-04	4.20E-04
Fluorides (sum fluoride compounds)	(T)	16984488	2.36E-02	5.65E-01	2.06E+02	3.73E-02	3.73E-02
Formaldehyde	(TH)	50000	3.03E-02	7.27E-01	2.66E+02	4.80E-02	4.80E-02
Manganese & compounds	(TH)	MNC	5.30E-04	1.27E-02	4.65E+00	8.40E-04	8.40E-04
Mercury & compounds	(TH)	HGC	2.65E-04	6.36E-03	2.32E+00	4.20E-04	4.20E-04
Methyl chloroform	(TH)	71566	1.49E-04	3.58E-03	1.31E+00	2.36E-04	2.36E-04
Toluene	(TH)	108883	5.03E-02	1.21E+00	4.41E+02	7.97E-02	7.97E-02
Xylene	(TH)	1330207	8.84E-04	2.12E-02	7.75E+00	1.40E-03	1.40E-03

Hydrogen Chloride (HCl) **CAS No. 7647-01-0**

The EPA Industrial Boiler MACT rulemaking emission factor for uncontrolled residual and distillate oil firing is given as 7.1E-5 lb/MMBtu in Docket Document Number II-B-8, Development of Average Emission Factors and Baseline Emission Estimates for the Industrial, Commercial, and Institutional Boilers and Process Heaters NESHAP, October 2002; so that figure is used as the latest information from EPA.

EPA emission factor = **7.1E-05** pounds of HCl per million BTUs generated in the boiler.
= **7.1E-11** pounds of HCl per BTU generated in the boiler.

PS-2 emissions of HCl:

2,005,117 gallons of No. 2 fuel oil were burned in 2008

$$2{,}005{,}117 \text{ gal. No. 2 F.O.} \times \frac{140{,}000 \text{ BTU}}{\text{gal. No. 2 F.O.}} = 2.81\text{E+11 BTU}$$

$$2.81\text{E+11 BTU} \times \frac{7.1\text{E-11 lb HCl}}{\text{BTU}} = \mathbf{19.9\ lb\ HCl}$$

0 gallons of No. 6 fuel oil were burned in 2008

$$0 \text{ gal. No. 6 F.O.} \times \frac{150{,}000 \text{ BTU}}{\text{gal. No. 6 F.O.}} = 0.00\text{E+00 BTU}$$

$$0.00\text{E+00 BTU} \times \frac{7.1\text{E-11 lb HCl}}{\text{BTU}} = \mathbf{0.0\ lb\ HCl}$$

Total HCl emissions:

19.9 lb HCl from No. 2 F.O.
\+ 0.0 lb HCl from No. 6 F.O.
19.9 lb. HCl emissions

FUEL OIL COMBUSTION EMISSIONS CALCULATOR REVISION D 6/12/2008 - OUTPUT SCREEN

NCDENR

Instructions: Enter emission source / facility data on the "INPUT" tab/screen. The air emission results and summary of input data are viewed / printed on the "OUTPUT" tab/screen. The different tabs are on the bottom of this screen.

SOURCE / FACILITY / USER INPUT SUMMARY (FROM INPUT SCREEN)

COMPANY:	DuPont - Fayetteville Works	MAX HEAT INPUT:	99.00	MMBTU/HR
FACILITY ID NO.:	0900009	FUEL HEAT VALUE:	140,000	BTU/GAL
PERMIT NUMBER:	03735T34	ACTUAL ANNUAL FUEL USAGE:	1,679,628	GAL/YR
FACILITY CITY:	Duart Township	MAXIMUM ANNUAL FUEL USAGE:	6,194,571	GAL/YR
FACILITY COUNTY:	Bladen	MAXIMUM SULFUR CONTENT:	0.0	%
USER NAME:	Michael E. Johnson	REQUESTED PERMIT LIMITATIONS		
EMISSION SOURCE DESCRIPTION:	No. 2 oil-fired Boiler	MAX. FUEL USAGE:	6,194,571	GAL/YR
EMISSION SOURCE ID NO.:	PS-Temp	MAX. SULFUR CONTENT:	0.009	%

TYPE OF CONTROL DEVICES	POLLUTANT	CONTROL EFF.
NONE/OTHER	PM	0
NONE/OTHER	SO2	0
NONE/OTHER	NOx	0

CRITERIA AIR POLLUTANT EMISSIONS INFORMATION

	ACTUAL EMISSIONS (AFTER CONTROLS / LIMITS)		POTENTIAL EMSSIONS (BEFORE CONTROLS / LIMITS)		POTENTIAL EMSSIONS (AFTER CONTROLS / LIMITS)		EMISSION FACTOR (lb/10³ gal)	
AIR POLLUTANT EMITTED	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	uncontrolled	controlled
TOTAL PARTICULATE MATTER (PM) (FPM+CPM)	2.33	2.77	2.33	10.22	2.33	10.22	3.30E+00	3.30E+00
FILTERABLE PM (FPM)	1.41	1.68	1.41	6.19	1.41	6.19	2.00E+00	2.00E+00
CONDENSABLE PM (CPM)	0.92	1.09	0.92	4.03	0.92	4.03	1.30E+00	1.30E+00
FILTERABLE PM<10 MICRONS (PM_{10})	0.71	0.84	0.71	3.10	0.71	3.10	1.00E+00	1.00E+00
FILTERABLE PM<2.5 MICRONS ($PM_{2.5}$)	0.18	0.21	0.18	0.77	0.18	0.77	2.50E-01	2.50E-01
SULFUR DIOXIDE (SO_2)	0.90	1.07	0.90	3.96	0.90	3.96	1.28E+00	1.28E+00
NITROGEN OXIDES (NO_x)	14.14	16.80	14.14	61.95	14.14	61.95	2.00E+01	2.00E+01
CARBON MONOXIDE (CO)	3.54	4.20	3.54	15.49	3.54	15.49	5.00E+00	5.00E+00
VOLATILE ORGANIC COMPOUNDS (VOC)	0.14	0.17	0.14	0.62	0.14	0.62	2.00E-01	2.00E-01
LEAD	0.00	0.00	0.00	0.00	0.00	0.00	1.26E-03	1.26E-03
GREENHOUSE GAS EMISSIONS INFORMATION								
CARBON DIOXIDE (CO_2)	15968.28	18964.18	15968.28	69941.06	15968.28	69941.06	2.26E+04	2.26E+04
METHANE (CH_4)	0.04	0.05	0.04	0.19	0.04	0.19	6.00E-02	6.00E-02
NITROUS OXIDE (N_2O)	0.08	0.10	0.08	0.37	0.08	0.37	1.20E-01	1.20E-01

TOXIC / HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION

		CAS	ACTUAL EMISSIONS (AFTER CONTROLS / LIMITS)		POTENTIAL EMSSIONS (BEFORE CONTROLS / LIMITS)		POTENTIAL EMSSIONS (AFTER CONTROLS / LIMITS)		EMISSION FACTOR (lb/10³ gal)	
TOXIC / HAZARDOUS AIR POLLUTANT		NUMBER	lb/hr	lb/yr	lb/hr	lb/yr	lb/hr	lb/yr	uncontrolled	controlled
Antimony & compounds	(H)	SBC	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00
Arsenic & compounds	(TH)	ASC	4.0E-04	9.4E-01	4.0E-04	3.5E+00	4.0E-04	3.5E+00	5.60E-04	5.60E-04
Benzene	(TH)	71432	1.9E-03	4.6E+00	1.9E-03	1.7E+01	1.9E-03	1.7E+01	2.75E-03	2.75E-03
Beryllium & compounds	(H)	BEC	3.0E-04	7.1E-01	3.0E-04	2.6E+00	3.0E-04	2.6E+00	4.20E-04	4.20E-04
Cadium & compounds	(TH)	CDC	3.0E-04	7.1E-01	3.0E-04	2.6E+00	3.0E-04	2.6E+00	4.20E-04	4.20E-04
Chromium - All/Total	(H)	CRC	3.0E-04	7.1E-01	3.0E-04	2.6E+00	3.0E-04	2.6E+00	4.20E-04	4.20E-04
Cobalt compounds	(H)	COC	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00
Ethylbenzene	(H)	100414	5.8E-04	1.4E+00	5.8E-04	5.1E+00	5.8E-04	5.1E+00	8.17E-04	8.17E-04
Fluorides (sum fluoride compounds)	(T)	16984488	2.6E-02	6.3E+01	2.6E-02	2.3E+02	2.6E-02	2.3E+02	3.73E-02	3.73E-02
Formaldehyde	(TH)	50000	3.4E-02	8.1E+01	3.4E-02	3.0E+02	3.4E-02	3.0E+02	4.80E-02	4.80E-02
Lead and Lead compounds	(H)	PBC	8.9E-04	2.1E+00	8.9E-04	7.8E+00	8.9E-04	7.8E+00	1.26E-03	1.26E-03
Manganese & compounds	(TH)	MNC	5.9E-04	1.4E+00	5.9E-04	5.2E+00	5.9E-04	5.2E+00	8.40E-04	8.40E-04
Mercury & compounds	(TH)	HGC	3.0E-04	7.1E-01	3.0E-04	2.6E+00	3.0E-04	2.6E+00	4.20E-04	4.20E-04
Methyl chloroform	(TH)	71566	1.7E-04	4.0E-01	1.7E-04	1.5E+00	1.7E-04	1.5E+00	2.36E-04	2.36E-04
Napthalene	(H)	91203	2.4E-04	5.6E-01	2.4E-04	2.1E+00	2.4E-04	2.1E+00	3.33E-04	3.33E-04
Nickle & compounds	(H)	NIC	3.0E-04	7.1E-01	3.0E-04	2.6E+00	3.0E-04	2.6E+00	4.20E-04	4.20E-04
Phosphorus Metal, Yellow or White	(H)	7723140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00
POM rates uncontrolled	(H)	POM	2.3E-03	5.5E+00	2.3E-03	2.0E+01	2.3E-03	2.0E+01	3.30E-03	3.30E-03
Selenium compounds	(H)	SEC	1.5E-03	3.5E+00	1.5E-03	1.3E+01	1.5E-03	1.3E+01	2.10E-03	2.10E-03
Toluene	(TH)	108883	5.6E-02	1.3E+02	5.6E-02	4.9E+02	5.6E-02	4.9E+02	7.97E-02	7.97E-02
Xylene	(TH)	1330207	9.9E-04	2.4E+00	9.9E-04	8.7E+00	9.9E-04	8.7E+00	1.40E-03	1.40E-03
Total HAP	(H)		1.0E-01	2.4E+02	1.0E-01	8.9E+02	1.0E-01	8.9E+02	1.4E-01	1.4E-01
Larget HAP	(H)		5.63E-02	1.34E+02	5.63E-02	4.94E+02	5.63E-02	4.94E+02	7.97E-02	7.97E-02

TOXIC AIR POLLUTANT EMISSIONS INFORMATION (FOR PERMITTING PURPOSES)

			EXPECTED ACTUAL EMISSIONS AFTER CONTROLS / LIMITATIONS			EMISSION FACTOR (lb/10³ gal)	
TOXIC AIR POLLUTANT		CAS Num.	lb/hr	lb/day	lb/yr	uncontrolled	controlled
Arsenic & compounds	(TH)	ASC	3.96E-04	9.50E-03	3.47E+00	5.60E-04	5.60E-04
Benzene	(TH)	71432	1.94E-03	4.67E-02	1.70E+01	2.75E-03	2.75E-03
Cadium & compounds	(TH)	CDC	2.97E-04	7.13E-03	2.60E+00	4.20E-04	4.20E-04
Fluorides (sum fluoride compounds)	(T)	16984488	2.64E-02	6.33E-01	2.31E+02	3.73E-02	3.73E-02
Formaldehyde	(TH)	50000	3.39E-02	8.15E-01	2.97E+02	4.80E-02	4.80E-02
Manganese & compounds	(TH)	MNC	5.94E-04	1.43E-02	5.20E+00	8.40E-04	8.40E-04
Mercury & compounds	(TH)	HGC	2.97E-04	7.13E-03	2.60E+00	4.20E-04	4.20E-04
Methyl chloroform	(TH)	71566	1.67E-04	4.01E-03	1.46E+00	2.36E-04	2.36E-04
Toluene	(TH)	108883	5.63E-02	1.35E+00	4.94E+02	7.97E-02	7.97E-02
Xylene	(TH)	1330207	9.90E-04	2.38E-02	8.68E+00	1.40E-03	1.40E-03

Hydrogen Chloride (HCl) **CAS No. 7647-01-0**

The EPA Industrial Boiler MACT rulemaking emission factor for uncontrolled residual and distillate oil firing is given as 7.1E-5 lb/MMBtu in Docket Document Number II-B-8, Development of Average Emission Factors and Baseline Emission Estimates for the Industrial, Commercial, and Institutional Boilers and Process Heaters NESHAP, October 2002; so that figure is used as the latest information from EPA.

EPA emission factor = **7.1E-05** pounds of HCl per million BTUs generated in the boiler.
= **7.1E-11** pounds of HCl per BTU generated in the boiler.

PS-Temp emissions of HCl:

1,679,628 gallons of No. 2 fuel oil were burned in 2008

$$1{,}679{,}628 \text{ gal. No. 2 F.O.} \times \frac{140{,}000 \text{ BTU}}{\text{gal. No. 2 F.O.}} = 2.35\text{E+11 BTU}$$

$$2.35\text{E+11 BTU} \times \frac{7.1\text{E-11 lb HCl}}{\text{BTU}} = \textbf{16.7 lb. HCl emissions}$$

2008 AIR EMISSIONS INVENTORY

BUTYRALDEHYDE STORAGE TANK

(BS-A)

EMISSIONS SUMMARY

PROCESS EMISSIONS:	VOC EMISSIONS (lb. / year)	VOC EMISSIONS (TYP)
BA Condenser	751	0.38

FUGITIVE EMISSIONS:	VOC EMISSIONS Worst case scenario based on AP-42 (lb. / year)	VOC EMISSIONS With 67% Reduction for "Good" control (lb. / year)	VOC EMISSIONS With 67% Reduction for "Good" control (TYP)
Unloading System	2750	908	0.45
Recirculation System	126	42	0.02
BA Storage Tank	1917	633	0.32

TOTAL EMISSIONS		2334	1.17

2008 AIR EMISSIONS INVENTORY

BUTYRALDEHYDE STORAGE TANK

(BS-1)

EMISSIONS DETERMINATION

Butyraldehyde (BA) emissions from Storage Tank Condenser (BCD-1):

BA (breathing losses) to condenser = 2482 lbs. / year

BA Vapor Pressure at 71.37 °F = 1.844 psi

BA Vapor Pressure at 32 °F = 0.558 psi

$$\text{BA emissions from condenser} = \left(2482 \frac{\text{lb.}}{\text{yr.}}\right) \times \left(\frac{0.558 \text{ psi}}{1.844 \text{ psi}}\right) = \mathbf{751} \frac{\text{lb.}}{\text{yr.}}$$

(See information from Title V – Form D6 on the following pages.)

Butyraldehyde (BA) fugitive emissions from BA Storage Tank:

(See information on the following pages.)

2008 EMISSIONS AIR INVENTORY

SECTION D - FORM D6
ENGINEERING ANALYSIS TO SUPPORT PERMIT APPLICATION

Emission Unit ID: BS-1
Emission source Description: Butyraldehyde Storage Tank

A. Emission Estimation Approach

Emissions from this unit are based on EPA Publication AP-42 (using EPA-developed Tanks 2.0 software). Actual working losses are zero because when being loaded, the tank is vented back to the railcar. Breathing losses are calculated form the ambient temperature changes in the tank, and are controlled by an 70% efficient brine cooled condenser. Thus control on working losses is 100% and control on breathing losses is 70%, and as shown by the calculations below, this gives an overall control efficiency of approximately 92 – 94%.

Actual Emission Calculations

BA (Breathing Losses) to Condenser	2482	Lbs. / year
Uncontrolled Working Losses [1] (Actual 2008)	7438	Lbs. / year
Uncontrolled Working Losses [1] (Potential)	9905	
Total Uncontrolled Emissions [2] (Actual 2008)	9920	Lbs. / year
Total Uncontrolled Emissions [2] (Potential)	12387	Lbs. / year
Vapor Pressure [3] at 71.37 °F (21.87 °C)	1.844	Psi
Vapor Pressure [3] at 32 °F (0 °C)	0.558	Psi
Condenser efficiency [4]	70%	Or greater
BA Emissions From Condenser [5] (Annual)	751	Lbs. / year
BA Emissions From Condenser [5] (Hourly Average)	0.086	Lbs. / hour
Actual Working Loss Emissions	0	Lbs. / year
Overall Control Efficiency [6] (Based on Actual 2008 Emissions)	92%	Or greater
Overall Control Efficiency [6] (Based on Potential Emissions)	94%	Or greater

SECTION D - FORM D6
ENGINEERING ANALYSIS TO SUPPORT PERMIT APPLICATION

Emission Unit ID: BS-1
Emission source Description: Butyraldehyde Storage Tank

Note:

1. Actual 2008 uncontrolled working losses based on 34 turnover.
   Potential uncontrolled working losses based on 95 turnovers.

2. Total uncontrolled emissions equal breathing losses plus working losses.

3. Vapor pressure calculated using Antoine Equation

   $\text{Log } p^*(T°C) = A - [B / (T°C + C)]$

   Where p^* = vapor pressure
   A = 6.3854
   B = 913.590
   C = 185.480

4. Condenser control efficiency is calculated:
   1 – (vapor pressure at 32 / vapor pressure at 71.4)
   This is based o the assumption that the condenser exit temperature will be at 32°F (because of the low flow associated with breathing losses the gas will be completely chilled to the coolant temperature in the condenser and 32°F is the upper value of the condenser temperature; 71.37°F is the average surface temperature in the BA storage tank – See Tanks 2.0 Output).

5. Emissions from condenser calculated as: Uncontrolled BA to condenser x (1 – control efficiency)
   Hourly emissions calculated by dividing annual emissions by 8760.

6. Overall Control Efficiency = 1 – [(annual breathing losses from condenser + actual working loss emissions) / total uncontrolled emissions]

2008 BUTYRALDEHYDE

FUGITIVE EMISSIONS CALCULATIONS

I. FIXED LOSSES (assumes 100% utility)

A. Unloading System

Leak Rate = (pump losses + liquid valve losses + gas valve losses + flange losses) x (weight fraction BA) x (total hours)

= [(1) (0.109) + (9) (0 .016) + (1) (0.012) + (27) (0.0018)] (1.0) (8760 hours – worst case scenario)

= [0.109 + 0.144 + 0.012 + 0.049] (1.0) (8760)

= (0.314 lbs. / hr.) (8760 hrs. / yr.)

= **2750** lbs. / year

B. Vapor Return System

Area Average Temperature = 75°F
BA Vapor Pressure = 110 mmHg (from Hercules vapor pressure curve)

BA mole fraction in vapor

= Vapor pressure of BA / Total Pressure

= Vapor Pressure of BA / Gauge Pressure + Atmospheric Pressure

= (110 mmHg) (1 atm / 760 mmHg) / (4 in H_2O = 406.8 in H_2O) (1 atm / 406.8 inch H_2O)

= 0.143 mole BA / mole of gas

Leak Rate = [gas valve losses + flange losses] (fraction BA)(total operating hours)

$$= [(2) (0.015) + (5) (0.0018)] \left(\frac{0.143 \text{ mol BA}}{\text{mole BA}} \right) \left(\frac{72 \text{ lbs. BA}}{28 \text{ lbs. gas}} \right) \left(\frac{\text{mole gas}}{\text{yr.}} \right) (8760 \text{ hr.})$$

= (0.030) + 0.0090) (0.0143) (2.57) (8760)

= **125.6** lbs. / year

C. Storage Tank

1. Liquid Flanges / Valves

Leak Rate = (liquid valve losses + flange losses) (weight fraction BA) (total operating hours)

= [2 (0.016) + (8) (0.0018)] (1.0) (8760)

= [0.032 + 0.014] (1) (8760)

= **406** lbs. / year

2. Vapor Flanges / Conservation Vents

Leak Rate = (C / V losses + vapor flange losses) (weight fraction BA) (total operating hours)

= [(2) (0.224) + (12) (0.0018)] (0.143) (2.57) (8760)

= [0.448 + 0.0216] (0.143) (2.57) (8760)

= **1511** lbs. / year

3. Total Leak Rate

= 406 + 1511 = **1917** lbs. / year

CY 2001 Facility ID# 0900009 Source ID# BS-B

Actual Emissions per Pollutant Listed for Source/Process Identified Above:
Attach calculations and documentation of emission factors or other estimation methods used.

"Per Ton" Pollutant:	PM	PM-10	MP-2.5	SO2	Nox	VOC	CO
Actual Emissions: Tons/year						3.9	

All Other HAPs/TAPs Per Instructions (use additional sheets if necessary)

Pollutant	CAS #	Emitted (lbs./yr.)	Comments
Chlorine	7782-50-5		
Fluorine	7782-41-4		
Hydrazine	302-01-2		
Hydrogen Chloride (As weight of HCl in solutions)	7647-01-0		
Hydrogen Fluoride (As weight of HF in solutions)	7664-39-3		
Hydrogen Sulfide	7783-06-4		
Lead (As metal or compounds – mass of total	LEADCPDS		
Methyl Chloroform (Not a VOC, by rule	71-55-6		
Methylene Chloride (Not a VOC, by rule	75-09-2		
Ozone (Not expected as a facility emission)	10028-15-6		
Perchloroethylene (Not a VOC, by rule)	127-18-4		
Phosphine	7803-51-2		
List all other HAP/TAPs below IN ALPHABETICAL ORDER, Per Instructions. Use more sheets as needed.			
Methanol	67-56-1	13.1	

Information of Form D cannot be held confidential.

2008 AIR EMISSIONS INVENTORY

BUTACITE® CHEMICAL REACTOR LINE

(BS-B)

EMISSIONS SUMMARY

PROCESS EMISSIONS:	VOC EMISSIONS (lb. / year)	VOC EMISSIONS (TYP)
BA Scrubbers	367.5	0.18

FUGITIVE EMISSIONS:	VOC EMISSIONS Worst case scenario based on AP-42 (lb. / year)	VOC EMISSIONS With 67% Reduction for "Good" control (lb. / year)	VOC EMISSIONS With 67% Reduction for "Good" control (TYP)
Condensation Reactors / Vent System	642	214	0.11
Charging System	16474	5438	2.72
Recirculation System	5207	1718	0.86
TOTAL EMISSIONS		7738	3.87

Point Source Emission Determination For the year of 2008

Dimethylformamide **CAS No. 68-12-2**
DMF

Emissions of dimethylformamide (DMF) from the Butacite® Tinting Process are reported as both a Volatile Organic Compound (VOC) and as a Hazardous Air Pollutant (HAP). All emissions of DMF are from the multi-stage horizontal spray water scrubber (BCD-D1) that has a documented DMF control efficiency of 97%.

DMF Before-Control Emissions:

The before-control DMF emission rate is determined by the hours that each of the various tinted bandwidths are produced during the year. The hours of production for a specific bandwidth is then multiplied by the DMF emission factor for that bandwidth to determine the before-contol quantity of DMF that would have been emitted from the tinting process. The emitted DMF quantities for each bandwidth is then summed to obtain the total before-control DMF emission quantity. That determination is shown in the preceeding Butacite® Tinting Process DMF Emissions Report.

For 2008, the before-control DMF emission to the scrubber was 14331 lbs.

DMF After-Control Emissions:

Before-control DMF emissions = **14,331.8** pounds

DMF control efficiency of the Tinting water scrubber (BCD-D1) = **97%**

After-control emissions utilizing the 97% control efficient water scrubber (BCD-D1):

After-control DMF emissions would be: 100% – 97% = **3%** of the incoming DMF

Therefore, after-control emissions = **14,331.8** pounds
X **3%**
430.0 pounds DMF

Fugitive and Equipment Emissions Determination (Non-point Source):

The Butacite Tinting Process is wholly contained in a Permanent Total Enclosure. As such, all emissions are ultimately discharged to and through the horizontal spray water scrubber (BCD-D1). Therefore, there are no non-point source emissions from this process.

Accidental Releases to Atmosphere

For 2008, there were no accidental releases from the Tinting Process.

Emission Summary for 2008

A. VOC Emissions by Compound and Source

Butacite® Compound	CAS Chemical Name	CAS No.	Point Source Emissions (lbs)	Fugitive Emissions (lbs)	Equipment Emissions (lbs)	Accidental Emissions (lbs)	Total VOC Emissions (lbs)
DMF	Dimethylformamide	68-12-2	430.0	0	0	0	430.0
	Total VOC Emissions in 2008		**430.0**	**0**	**0**	**0**	**430.0**
					Total VOC (Tons)		**0.21**

B. Hazardous Air Polluntant Summary

Butacite® Compound	CAS Chemical Name	CAS No.	Point Source Emissions (lbs)	Fugitive Emissions (lbs)	Equipment Emissions (lbs)	Accidental Emissions (lbs)	Total Emissions (lbs)
DMF	Dimethylformamide	68-12-2	430	0.0	0	0	430.0

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	1,664	1	1,664
PAF	Trifluoroacetyl Fluoride	354-34-7	1,204	1	1,204
A/F Solvent (TFF)	Perfluoro-3,5,7,9,11-pentaoxadodecanoyl fluoride	690-43	421	0	421
A/F Solvent (TAF)	Trifluoromethyl ester of carbonofluoridic acid	3299-24-9	421	0	421
HFP	Hexafluoropropylene	116-15-4	47,848	1	47,849
HFPO	Hexafluoropropylene Epoxide	428-59-1	12,717	988	13,704
Benzene	Benzene	71-43-2	3	0	3
Toluene	Methylbenzene	108-88-3	3,582	0	3,582
				Total VOC Emissions (lbs)	**68,849**
				Total VOC Emissions (tons)	**34.42**

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)
782,420	3,430	785,850	48,751	2,189	50,940

785,850 lb VOC generated
- 50,940 lb VOC emitted
734,910 lb VOC removed in control device

734,910 lb VOC removed in control device / 785,850 lb VOC generated = **93.52% VOC control efficiency**

C. Toxic Air Pollutant 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	1,167.93	154.07		1,322.00
Benzene	Benzene	71-43-2		2.64		2.64
Toluene	Methylbenzene	108-88-3		3,582.00		3,582.00

D. HF Control Efficiency

1,168 lb HF emitted from Point Sources
(100%-99.6%) Stack Efficiency
= 291,983 lb HF sent to control device from Point Sources

291,983 lb HF sent to control device from Point Sources
- 1,322 lb HF emitted
= 290,661 lb HF removed in control device

291,983 lb HF sent to control device from Point Sources
+ 154 lb HF from Non-point Sources inside buildings
= 292,137 lb HF generated

290,661 lb HF removed in control device
292,137 lb HF generated
= **99.49% 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

Nafion Compound Name		Before Control VOC Generated		After Control Stack Emissions		After Control Stack Emissions	
		kg/month VOC	lb/month VOC	lb/month VOC	lb/month HF	ton/month VOC	Ton/month HF
A.	COF2	149,844	330,347	1,321	801	1	0
B.	PAF	108,420	239,023	956	164	0	0
C.	Acid Fluoride Solvent (TFF)	37,931	83,623	334	202.7	0	0
	Acid Fluoride Solvent (TAF)	37,931	83,623	334		0	
D.	HFP	16,950	37,368	37,368		19	
E.	HFPO	3,826	8,436	8,436		4	
	Total	**354,903**	**782,420**	**48,751**	**1,168**	**24**	**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	8784 hr/month**31-day month
x	0.880 lb. A/F VOC/lb. EE
=	712.699 lb/month VOC generated

	712.699 lb VOC generated
x	(100%-95%) scrubber efficiency
=	35.635 lb/month VOC emitted

From non-acid fluorides:

	0.092 lb. EE/hr
x	8784 hr/month**31-day month
x	0.070 lb. Non-A/F VOC/lb. EE
=	56.692 lb/month VOC

Total Barricade VOC Emissions:

	35.635 lb/month VOC
+	56.692 lb/month VOC
=	92.327 **lb/month VOC**

Barricade HF:

	0.092 lb. EE/hr
x	8784 hr/month
x	0.504 lb. HF/lb. EE
x	(100%-95%) scrubber efficiency
=	**20.409 lb/month 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:		HF:	
	0.045 lb. EE/hr		0.045 lb. EE/hr
x	8784 hr/month	x	8784 hr/month
x	0.950 lb. VOC/lb. EE	x	0.121 lb. HF/lb. EE
=	**375.516 lb/month VOC**	=	**47.829 lb/month 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:		HF:	
	0.125 lb. EE/hr		0.125 lb. EE/hr
x	8784 hr/month	x	8784 hr/month
x	0.570 lb. VOC/lb. EE	x	0.008 lb. HF/lb. EE
	626.611 lb/month VOC	=	**8.795 lb/month 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	8784 hr/month	x	8784 hr/month
x	1.00 lb. VOC/lb. FE	x	0.0 lb. HF/lb. FE
=	**1015.43 lb/month VOC** (assume all is toluene)	=	**0.00 lb/month 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	8784 hr/month	x	8784 hr/month
x	1.00 lb. VOC/lb. FE	x	0.0 lb. HF/lb. FE
=	**624.54 lb/month VOC**	=	**0.00 lb/month 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:

(2002)		(Future)
1.92 lbs benezene	=	3.61 lbs Toluene
1126145 kg fresh HFP		2,117,586 kg fresh HFP

Benzene introduced to process: 510.380952 lbs

Benzene emissions:

510.380952 lbs x (1.90 lb emission / 368 lb benzene) = 2.64 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 first day of month:	+	3715 lb		
Toluene added to process:	+	14076 lb		
Toluene inventory in process as of last day of month:	-	4479 lb		
Toluene destroyed in process:	-	0 lb		
Toluene shipped off with product:	-	128 lb injected into product		
Toluene removed from process as a solid waste:	-	9602 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:	=	3582 lb toluene	=	3582 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

		Inside Emissions (Stack Emissions)		Outside Emissions (Fugitive Emissions)	
Emission Source		lb VOC	lb HF	lb VOC	lb HF
A-1	Reactor, Distillation Columns, #1 Recycle Tank	92.33	20.41		
A-2	Distillation System #1	375.52	47.83		
A-3	Scrubbing, Dryers, Stripper Column	626.61	8.795		
B-1	Distillation System #2			1015	
B-2	HFP Storage and Feed			624.54	
B-4	Toluene System			3582.00	
	Total	1094.45	77.03	5221.97	0.00

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

	Inside Emissions (Stack Emissions)		Outside Emissions (Fugitive Emissions)	
	lb/month VOC	lb/month HF	lb/month VOC	lb/month HF
Conservative amount (total x 2)	2,189	154	10,444	0

Total HF emissions:

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

Total VOCs generated inside building:

712.70 lb VOC from Reactor, Distillation Column, #1 Recycle Tank
\+ 375.52 lb VOC from Scrubber, Dryers, Stripper Column
\+ 626.61 lb VOC from Scrubber, Dryers, Stripper Column
= 1714.83 lb VOC generated (before control device)

Conservative amount (total x 2) 3430 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	ft3
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-ft3/lbmol/R

n = PV/RT

$$n = \frac{24.7 \text{ psia}}{10.7 \text{ psia-ft3/lbmol/R}} \times \frac{401 \text{ ft3}}{537 \text{ R}} = 1.72 \text{ lbmol HFP}$$

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

Clearings/year: Each tank scheduled once per year; two tanks is two clearings/year scheduled; Here, any scheduled cleanings will be recorded. This will usually occur during the annual outage.

	258	lb HFP
x	0	cleanings/year
=	0	lb/month HFP

VOC from HFP Storage Tank =	258	lb VOC per cleaning
x	0	cleanings/year
=	**0**	**lb/month VOC**

B. 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	ft3
Contents =	50	% HFP (MW=150 lb/lbmol)
(Conservative approximation based off of	40	% HFPO (MW=166 lb/lbmol)
vessel contents and volatility of compounds)	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-ft3/lbmol/R

n = PV/RT

$$n = \frac{34.7 \text{ psia}}{10.7 \text{ psia-ft3/lbmol/R}} \times \frac{441 \text{ ft3}}{490 \text{ R}} = 2.91 \text{ lbmol material}$$

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

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

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

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; All scheduled cleanings will be recorded here. This will usually occur during the annual outage.

	218 lb HFP			193 lb HFPO
x	2 cleanings/year		x	2 cleanings/year
=	437 lb/yr HFP		=	387 lb/yr HFPO

VOC from Distillation system #2 =

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

C. "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 ft3	
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-ft3/lbmol/R	

n = PV/RT

$$n = \frac{100\ \text{psia}}{10.7\ \text{psia-ft3/lbmol/R}} \times \frac{147\ \text{ft3}}{537\ \text{R}} = 2.55\ \text{lbmol material}$$

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

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

Total VOC per cleaning:

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

Clearings/year: Each tank scheduled once per year; All scheduled cleanings will be recorded here. This will usually occur during the annual outage.

180 lb HFP
x 2 cleanings/year
= **360 lb/yr HFP**

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

VOC from "Rest of the Process" =

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

E. Total fugitive Emissions from Maintenance Work

Source		lb/month HFP	lb/month HFPO	lb/month VOC
II-A	HFP Storage and Feed	0		0
II-B	Distillation System #2	437	1,646	2,083
II-C	"Rest of the System"	360	449	809
II-D	HFPO Storage System	0	0	0
	Total	**796**	**2,095**	**2,891**

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	1,321	59	283		1,664
PAF	956	43	205		1,204
TFF	334	15	72		421
TAF	334	15	72		421
HFP	37,368	1678	8006	796	47,848
HFPO	8,436	379	1807	2095	12,717
Benzene			2.64		3
Toluene			3582		3,582
Total	48,751	2,189	14,029	2,891	**67,860**

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 956 lbs
with the total stack emission of VOCs being 48,751 lbs
The total outside fugitive emission (minus benzene & toluene) was 10,443.95 lbs VOC

$$\frac{956 \text{ lbs PAF}}{48{,}751 \text{ lbs VOC}} \times 10{,}443.95 \text{ fugitive VOC} = 205 \text{ lb fugitive PAF emissions}$$

D. HFPO Storage System

The HFPO Storage section consists of two HFPO Storage Tanks and the associated equipment to contain final product. When maintenance clearing is required for these tanks, the liquid inventory is transferred to other tanks, 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 HFPO vapors remaining at 10 psig.

#1 HFPO Storage Tank Calculations:

PV = nRT

Tank Volume = 6640 gal =	888 ft3
Contents =	100 % HFPO (MW=166 lb/lbmol)
Tank pressure = 10 psig =	24.7 psia
Tank temperature = ambient = 0 deg C =	490 R
R =	10.73 psia-ft3/lbmol/R

n = PV/RT

$$n = \frac{24.7 \text{ psia}}{10.73 \text{ psia-ft3/lbmol/R}} \times \frac{888 \text{ ft3}}{490 \text{ R}} = 4.17 \text{ lbmol HFPO}$$

$$4.17 \text{ lbmol HFPC} \times \frac{166 \text{ lb HFPO}}{\text{lbmol HFPO}} = 693 \text{ lb HFPO} = 693 \text{ lb VOC per cleaning}$$

#2 HFPO Storage Tank Calculations:

PV = nRT

Tank Volume = 19970 gal =	2670 ft3
Contents =	100 % HFPO (MW=166 lb/lbmol)
Tank pressure = 10 psig =	24.7 psia
Tank temperature = ambient = 0 deg C =	490 R
R =	10.73 psia-ft3/lbmol/R

n = PV/RT

$$n = \frac{24.7 \text{ psia}}{10.73 \text{ psia-ft3/lbmol/R}} \times \frac{2670 \text{ ft3}}{490 \text{ R}} = 12.54 \text{ lbmol HFP}$$

$$12.54 \text{ lbmol HFP} \times \frac{166 \text{ lb HFP}}{\text{lbmol HFP}} = 2082 \text{ lb HFP} = 2082 \text{ lb VOC per cleaning}$$

Total HFPO Storage Tank VOC Emissions:

693 lb HFPO from #1 Storage Tank
x 0 cleanings/month
= 0 lb/month HFP

2082 lb HFPO from #2 Storage Tank
x 0 cleanings/month
= 0 lb/month HFP

0 lb/month VOC from HFPO Stroage Tank Cleaning

Accidental Releases to Atmosphere

A. **IR-2008-085** Date: 6/28/2008

Material Released: Hexafluoroproplyene Epoxide (HFPO) CAS No. 428-59-1
Quantity Released: 11 lbs

HFPO is a VOC without the potential to form HF.

Quantity VOC Released:

11.0 lbs HFPO
= **11.0 lb VOC**

B. **IR-2008-078** Date: 6/28/2008

Material Released: Hexafluoroproplyene Epoxide (HFPO) CAS No. 428-59-1
Quantity Released: 3 lbs

HFPO is a VOC without the potential to form HF.

Quantity VOC Released:

3.0 lbs HFPO
= **3.0 lb VOC**

C. **IR-2008-079** Date: 6/28/2008

Material Released: Hexafluoroproplyene Epoxide (HFPO) CAS No. 428-59-1
Quantity Released: 0.5 lbs

Material Released: Hexafluoroproplyene Epoxide (HFP) CAS No. 116-15-4
Quantity Released: 0.5 lbs

HFPO is a VOC without the potential to form HF.

Quantity VOC Released:

0.5 lbs HFPO 0.5 lbs HFP
= **1.0 lb VOC**

D. **IR-2008-083** Date: 7/2/2008

Material Released: Hexafluoroproplyene Epoxide (HFPO) CAS No. 428-59-1
Quantity Released: 165 lbs

HFPO is a VOC without the potential to form HF.

Quantity VOC Released:

165.0 lbs HFPO
= **165.0 lb VOC**

Accidental Releases to Atmosphere (continued)

E. IR-2008-130 Date: 8/27/2008

Material Released: Hexafluoropropylene Epoxide (HFPO) CAS No. 428-59-1
Quantity Released: 798 lbs

HFPO is a VOC without the potential to form HF.

Quantity VOC Released:

798.0 lbs HFPO
= **798.0 lb VOC**

F. IR-2008-155 Date: 10/5/2008
Manifold Filter Leak
Material Released: Hexafluoropropylene Epoxide (HFPO) 0 CAS No.
Quantity Released: 10 lbs

Quantity VOC Released:

10.0 lbs HFPO
= **10.0 lb VOC**

G. IR-2008-161 Date: 10/7/2008
Vacuum pump leak
Material Released: COF2/PAF 0 CAS No.
Quantity Released: 1 lbs total 0

Quantity VOC Released:

0.5 lbs COF2
0.5 lbs PAF
= **1.0 lb VOC**

= **0.4 lb HF**

H. Total Emissions from Accidental Releases

Source	Month	lb HFP	lb HFPO	lb COF2	lb PAF	lb/yr VOC	lb/yr HF
A.	June		11.0			11.0	
B.	June		3.0			3.0	
C.	June	0.5	0.5			1.0	
D.	July		165.0			165.0	
E.	August		798.0			798.0	
F.	October		10.0			10.0	
G.	October			0.5	0.5	1.0	0.4
	Total	**1**	**988**	**1**	**1**	**989**	**0**

2008 Emissions 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	0	8,284	10,138		18,422
HFPO	Hexafluoropropylene oxide	428-59-1	0	16,738	1,824		18,561
HFPO-Dimer	Perfluoro-2-Propoxy Propionyl Fluoride	2062-98-8	0	42	0		42
EVE	Propanoic Acid, 3-[1-[Difluoro [(Trifluoroethenyl oxy] Methyl]-1,2,2,2-Tetrafluoroethoxy] -2,2,3,3-Tetrafluoro-, Methyl Ester	63863-43-4	8	0	0		8
PPVE	Perfluoropropyl vinyl ether	1623-05-8	0	5,587	0		5,587
PSEPVE	Perfluoro-2-(2-Fluorosulfonylethoxy) Propyl Vinyl Ether	16090-14-5	0	0	219		219
PPF	Perfluoropropionyl fluoride	422-61-7	0	45	0		46
TFE	Tetrafluoroethylene	116-14-3	0	7,018	29		7,047
C4	Perfluoro-2-butene	360-89-4	0	650	1,522		2,173
C5	Perfluoropentene	376-87-4	0	62	0		62
Diglyme	Diethylene Glycol Dimethyl Ether	111-96-6	0	0	1,113		1,113
AN	Acetonitrile	75-05-8	0	6,739	0		6,739
ADN	Adiponitrile	111-69-3	0	0	0		0
TTG	Tetraglyme	143-24-8	0	0	0		0
DA	Tetrafluoro-2[Hexafluoro-2-(Tetrafluoro-2-{Fluorosulfonyl}Ethoxy) Propoxy Propionyl Fluoride	4089-58-1	0	0	13		13
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	6		6
TA	Perfluoro(11-(fluorosulfonyl)-2,5,8-trimethyl-3,6,9-trioxanundecanoyl Fluoride	4628-44-8	0	0	0		0
RSU	Fluorosulfonyl difluoroacetyl fluroride	677-67-8	0	0	0		0
MAE	Methyl Perfluoro (5-(Fluoroformyl)-4-Oxahexanoate)	69116-72-9	0	0	0		0
DAE	Methyl Perfloro (8-(Fluoroformyl)-5-methyl-4,7-Dioxanonanoate)	69116-73-0	0	0	0		0
TAE	Methyl Perfluoro (11-(Fluoroformyl)-5,8-Dimethyl-4,7,10-Trioxadodecanoate)	69116-67-2	0	0	0		0
hydro-EVE	Methyl Perfloro-5-methyl-4.7-dioxanon-8-hydroaneoate	87483-34-9	0	0	0		0
iso-EVE	Methyl Perfluoro-6-Methyl-4,7-Dioxanon-8 Eneoate	73122-14-2	0	0	0		0
MMF	Methyl-2,2-Difluoromalonyl Fluoride	69116-71-8	0	0	0		0
HFPO Trimer	Perfluoro-2,5-Dimethyl-3,6-Dioxanonanoyl	2641-34-1	0	1	0		1
Iso-PSEPVE	Perfluoro-1-Methyl-2-(2 Fluorosulfonyl Ethoxy) Ethyl	34805-58-8	0	0	2		2
	Total VOC Emissions (lbs)		**8**	**45,166**	**14,868**	**0**	**60,042**
	Total VOC Emissions (tons)		**0.0**	**22.6**	**7.4**	**0.0**	**30.0**

B. VOC Control Device Efficiency

VOCs Generated Before Control (lbs)					VOCs After Control (lbs)
Process Emissions	Equipment Emissions (lbs)	Maintenance Emissions	Accidental Releases	Generated (lbs)	Total VOC Emitted (lbs)
69,293	2,235	1,267	5	72,795	60,042

72,795 lb VOC generated
60,042 lb VOC emitted
12,753 lb VOC removed in control device

12,753 lb VOC removed in control device / 72,795 lb VOC generated = **17.52% 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	0.04	8.0	13.1	0	21.1
Diglyme	Diethylene Glycol Dimethyl Ether	111-96-6			1,113		1,113
Acetonitrile	Acetonitrile	75-05-8		6,739			6,739

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	0	4,111	4,189	8,300	4.1

Report Created By: Debra Luttrell
Report Created: 3/25/2009

2008 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/2008/VEN Air Emissions 2008.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: $\frac{0.17\ kg\ HFP}{0.50\ kg\ CondRxVentFlo}$

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

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

HFP vented based on 0 kg total Condensation Reactor vent stream (22266FG).
HFP vented based on 0 kg total Crude Receiver vent stream (22701FG).
HFP vented based on 110 kg total Foreshots Receiver vent stream (22826FG).

HFP vented from Condensation Reactor:

$$\frac{0.17\ kg\ HFP}{0.50\ kg\ CndRx} \times 0\ kg\ CndRx = 0\ kg\ HFP$$

HFP vented from Crude Receiver

$$\frac{0.00\ kg\ HFP}{15.91\ kg\ CrRec} \times 0\ kg\ CrRec = 0\ kg\ HFP$$

HFP vented from Foreshots Receiver

$$\frac{0.00\ kg\ HFP}{0.14\ kg\ FsRec} \times 110\ kg\ FsRec = 0\ kg\ HFP$$

VOC Emissions

0 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= **0** kg HFP = 0 kg VOC
0 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 0 kg total Condensation Reactor vent stream (22266FG).
HFPO vented based on 0 kg total Crude Receiver vent stream (22701FG).
HFPO vented based on 110 kg total Foreshots Receiver vent stream (22826FG).

HFPO vented from Condensation Reactor:

$$\frac{0.13\ kg\ HFPO}{0.50\ kg\ CndRx} \times 0\ kg\ CndRx = 0\ kg\ HFPO$$

HFPO vented from Crude Receiver

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

HFPO vented from Foreshots Receiver

$$\frac{0.00\ kg\ HFPO}{0.14\ kg\ FsRec} \times 110\ kg\ FsRec = 0\ kg\ HFPO$$

VOC Emissions

0 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 0 kg HFPO = 0 kg VOC
0 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).

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

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: $\frac{0.05\ kg\ HFPO Dimer}{0.50\ kg\ Cond\ Rx\ Vent\ Flow}$

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

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

HFPO Dimer vented based on 0 kg total Condensation Reactor vent stream (22266FG).
HFPO Dimer vented based on 0 kg total Crude Receiver vent stream (22701FG).
HFPO Dimer vented based on 110 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 0 kg CndRx = 0 kg HFPO Dimer

HFPO Dimer vented from Crude Receiver

$\frac{0.00 \text{ kg HFPO Dimer}}{15.91 \text{ kg CrRec}}$ x 0 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 110 kg FsRec = 0 kg HFPO Dimer

Total before-control HFPO Dimer vented = 0 kg HFPO Dimer

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

VOC Emissions

Waste Gas Scrubber: 0 kg Dimer x (100%-99.6%) = 0.00 kg Dimer = 0.00 kg VOC = **0.00 lb. VOC**

HF Equivalent Emissions

0.00 kg Dimer x 0.060 kg HF/kg Dimer = 0.00 kg HF **0.00 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: $\frac{0\ kg\ TFE}{0.50\ kg\ Cond\ Rx\ Vent\ Flow}$

Vented from the Crude Receiver $\frac{0.18\ kg\ TFE}{15.91\ kg\ Crude\ Receiver\ Vent}$

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

TFE vented based on 0 kg total Condensation Reactor vent stream (22266FG).
TFE vented based on 0 kg total Crude Receiver vent stream (22701FG).
TFE vented based on 110 kg total Foreshots Receiver vent stream (22826FG).

TFE vented from Condensation Reactor:

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

TFE vented from Crude Receiver

$\frac{0.18}{15.91\ \frac{kg\ TFE}{kg\ CrRec}}$ x 0 kg CrRec = 0 kg TFE

TFE vented from Foreshots Receiver

$\frac{0.00}{0.14\ \frac{kg\ TFE}{kg\ FsRec}}$ x 110 kg FsRec = 0 kg TFE

VOC Emissions

0 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 0 kg TFE = 0 kg VOC
0 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 0 kg total Condensation Reactor vent stream (22266FG).
MAE vented based on 0 kg total Crude Receiver vent stream (22701FG).
MAE vented based on 110 kg total Foreshots Receiver vent stream (22826FG).

Before control MAE vented from Condensation Reactor:

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

MAE vented from Crude Receiver

$\frac{0.00\ kg\ MAE}{15.91\ kg\ CrRec}$ x 0 kg CrRec = 0 kg MAE

MAE vented from Foreshots Receiver

$\frac{0.04\ kg\ MAE}{0.14\ kg\ FsRec}$ x 110 kg FsRec = 29 kg MAE

Total before-control MAE vented = 29 kg MAE

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

VOC Emissions

Waste Gas Scrubber: 29 kg MAE x (100%-99.6%) = 0.12 kg MAE = 0.12 kg VOC = **0.26 lb. VOC**

HF Equivalent Emissions

0.12 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 0 kg total Condensation Reactor vent stream (22266FG).
EVE vented based on 0 kg total Crude Receiver vent stream (22701FG).
EVE vented based on 110 kg total Foreshots Receiver vent stream (22826FG).

EVE vented from Condensation Reactor:

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

EVE vented from Crude Receiver

$$\frac{0.00}{15.91\ \frac{kg\ EVE}{kg\ CrRec}} \times 0\ kg\ CrRec = 0\ kg\ EVE$$

EVE vented from Foreshots Receiver

$$\frac{0.005}{0.14\ \frac{kg\ EVE}{kg\ FsRec}} \times 110\ kg\ FsRec = 4\ kg\ EVE$$

VOC Emissions

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

G. Tetraglyme (TTG)

CAS No. 143-24-8

The emissions of Tetraglyme is based on a mass balance.

Quantity Released

=	0	kg TTG introduced into processes
=	0	kg TTG transferred to H/C waste tank
=	0	kg TTG unaccounted for and assumed emitted
=	**0**	**lb. Tetraglyme**

Emissions of TTG from EVE = **0** **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 0 kg total Condensation Reactor vent stream (22266FG).
CO vented based on 0 kg total Crude Receiver vent stream (22701FG).
CO vented based on 110 kg total Foreshots Receiver vent stream (22826FG).

CO vented from Condensation Reactor:

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

CO vented from Crude Receiver

$\frac{0.59\ kg\ CO}{15.91\ kg\ CrRec}$ x 0 kg CrRec = 0 kg CO

CO vented from Foreshots Receiver

$\frac{0.00\ kg\ CO}{0.14\ kg\ FsRec}$ x 110 kg FsRec = 0 kg CO

CO Emissions

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

I. 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 0 kg ADN fed

VE North ADN Sent to waste Hydrocarbon tank = 0 kgs H/C waste

VOC Emission

$$0 \text{ kg ADN fed} - \frac{0 \text{ kg ADN to H/C waste}}{0 \text{ kg ADN lost}} = 0 \text{ kg VOC}$$

0 lb VOC

ADN only used during an EVE Campaign

J. VOC Summary

Nafion Compound Name		Before Control Generated		After Control Stack Emissions
		kg/yr	lb/yr	VOC lb/yr
A.	HFP	0	0	0
B.	HFPO	0	0	0
C.	HFPO-Dimer	0	0	0
D.	TFE	0	0	0
E.	MAE	29	65	0.3
F.	EVE	4	8	8.1
G.	TTG	0	0	0
K.	ADN	0	0	0
	Total	**33**	**73**	**8.3**

K. 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	0	0	0	0
B.	HFPO	0	0	0	0
C.	HFPO-Dimer	0	0	0	0
D.	TFE	0	0	0	0
E.	MAE	0	0	0	0
F.	EVE	8	0	0	8
G.	TTG	0	0	0	0
H.	CO (not a VOC)				0
I.	ADN		0	0	0
*	DAE		0	0	0
*	TAE		0	0	0
*	MMF		0	0	0
*	hydro-EVE		0	0	0
*	iso-EVE		0	0	0
	Total	**8**	**0**	**0**	**8**

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

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

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

L. 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	0.000	0.000	0.000	0.000
E.	MAE	0.000	0.000	0.000	0.000
*	DAE		0.000	0.000	0.000
*	TAE		0.000	0.000	0.000
*	MMF		0.000	0.000	0.000
	Total	**0.00**	**0.00**	**0.00**	**0.00**

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

The estimated HF equivalent emissions were determined by multiplying the total emission quantity of an acid fluoride by the ratio of the molecular weight of HF divided by the molecular weight of the specific acid fluoride. This is based on the fact that one mole of an acid fluoride will generate one mole of HF.

For example, if 100 lb. of MAE was emitted:

$$\frac{20 \text{ lb/mol HF}}{332 \text{ lb/mol MAE}} \times 100 \text{ lb/yr Equipment MAE} = 6.0 \text{ lb/yr HF}$$

2008 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/2008/VEN Air Emissions 2008.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: $\frac{0.05\ kg\ HFP}{2.35\ kg\ Cond\ Rx\ Vent\ Flow}$

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

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

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

HFP vented based on 4,143 kg total Condensation Reactor vent stream (22266FG).
HFP vented based on 5,814 kg total Crude Receiver vent stream (22701FG).
HFP vented based on 1,636 kg total Foreshots Receiver vent stream (22826FG).
HFP vented based on 12,085 kg in the Stripper vent stream (22231FC).

HFP vented from Condensation Reactor:

$$\frac{0.05\ kg\ HFP}{2.35\ kg\ CndRx} \times 4{,}143\ kg\ CndRx = 96\ kg\ HFP$$

HFP vented from Crude Receiver

$$\frac{0.01\ kg\ HFP}{3.97\ kg\ CrRec} \times 5{,}814\ kg\ CrRec = 20\ kg\ HFP$$

HFP vented from Foreshots Receiver

$$\frac{0.01\ kg\ HFP}{1.06\ kg\ FsRec} \times 1{,}636\ kg\ FsRec = 14\ kg\ HFP$$

HFP vented from Stripper

$$\frac{30\ kg\ HFP}{100\ kg\ Strpr} \times 12{,}085\ kg\ Strpr = 3{,}626\ kg\ HFP$$

VOC Emissions

96 kg from Condensation Reactor
\+ 20 kg from Crude Receiver
\+ 14 kg from Foreshots Receiver
3,626 kg from Stripper

	=	3,756 kg HFP	=	3,756 kg VOC
				8,280 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 4,143 kg total Condensation Reactor vent stream (22266FG).
HFPO vented based on 5,814 kg total Crude Receiver vent stream (22701FG).
HFPO vented based on 1,636 kg total Foreshots Receiver vent stream (22826FG).
HFP vented based on 12,085 kg in the Stripper vent stream (22231FC).

HFPO vented from Condensation Reactor:

$\frac{0.11\ kg\ HFPO}{2.35\ kg\ CndRx}$ x 4,143 kg CndRx = 200 kg HFPO

HFPO vented from Crude Receiver

$\frac{0.00\ kg\ HFPO}{3.97\ kg\ CrRec}$ x 5,814 kg CrRec = 0 kg HFPO

HFPO vented from Foreshots Receiver

$\frac{0.00\ kg\ HFPO}{1.06\ kg\ FsRec}$ x 1,636 kg FsRec = 0 kg HFPO

HFP vented from Stripper

$\frac{60\ kg\ HFPO}{100\ kg\ Strpr}$ x 12,085 kg Strpr = 7,251 kg HFPO

VOC Emissions

200 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
\+ 7,251 kg from Stripper
= 7,452 kg HFPO = 7,452 kg VOC
16,428 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 4,143 kg total Condensation Reactor vent stream (22266FG).
PPF vented based on 5,814 kg total Crude Receiver vent stream (22701FG).
PPF vented based on 1,636 kg total Foreshots Receiver vent stream (22826FG).
PPF vented based on 12,085 kg in the Stripper vent stream (22231FC).

Before control PPF vented from Condensation Reactor:

$\frac{2.14\ kg\ PPF}{2.35\ kg\ CndRx}$ x 4,143 kg CndRx = 3,766 kg PPF

PPF vented from Crude Receiver

$\frac{0.00\ kg\ PPF}{3.97\ kg\ CrRec}$ x 5,814 kg CrRec = 0 kg PPF

PPF vented from Foreshots Receiver

$\frac{0.00\ kg\ PPF}{1.06\ kg\ FsRec}$ x 1,636 kg FsRec = 0 kg PPF

PPF vented from Stripper

$\frac{10\ kg\ PPF}{100\ kg\ Strpr}$ x 12,085 kg Strpr = 1,209 kg PPF

Total before-control PPF vented = 4,975 kg PPF

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

VOC Emissions
Waste Gas Scrubber: 4,975 kg PAF x (100%-99.6%) = 20 kg PAF = 20 kg VOC = **44 lb. VOC**

HF Equivalent Emissions
20 kg PAF x 0.120 kg HF/kg PAF = 2 kg HF = **5.3 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 4,143 kg total Condensation Reactor vent stream (22266FG).
TFE vented based on 5,814 kg total Crude Receiver vent stream (22701FG).
TFE vented based on 1,636 kg total Foreshots Receiver vent stream (22826FG).
TFE vented based on 12,085 kg in the Stripper vent stream (22231FC).

TFE vented from Condensation Reactor:

$$\frac{0.00\ kg\ TFE}{2.35\ kg\ CndRx} \times 4{,}143\ kg\ CndRx = 0\ kg\ TFE$$

TFE vented from Crude Receiver

$$\frac{2.17\ kg\ TFE}{3.97\ kg\ CrRec} \times 5{,}814\ kg\ CrRec = 3{,}176\ kg\ TFE$$

TFE vented from Foreshots Receiver

$$\frac{0.0045\ kg\ TFE}{1.06\ kg\ FsRec} \times 1{,}636\ kg\ FsRec = 7\ kg\ TFE$$

TFE vented from Stripper

$$\frac{0\ kg\ TFE}{100\ kg\ Strpr} \times 12{,}085\ kg\ Strpr = 0\ kg\ TFE$$

VOC Emissions

0 kg from Condensation Reactor
\+ 3,176 kg from Crude Receiver
\+ 7 kg from Foreshots Receiver
\+ 0 kg from Stripper
= 3,183 kg TFE = 3,183 kg VOC
7,018 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 4,143 kg total Condensation Reactor vent stream (22266FG).
PPVE vented based on 5,814 kg total Crude Receiver vent stream (22701FG).
PPVE vented based on 1,636 kg total Foreshots Receiver vent stream (22826FG).
PPVE vented based on 12,085 kg in the Stripper vent stream (22231FC).

PPVE vented from Condensation Reactor:

$$\frac{0.00\ kg\ PPVE}{2.35\ kg\ CndRx} \times 4{,}143\ kg\ CndRx = 0\ kg\ PPVE$$

PPVE vented from Crude Receiver

$$\frac{0.50\ kg\ PPVE}{3.97\ kg\ CrRec} \times 5{,}814\ kg\ CrRec = 739\ kg\ PPVE$$

PPVE vented from Foreshots Receiver

$$\frac{0.88\ kg\ PPVE}{1.06\ kg\ FsRec} \times 1{,}636\ kg\ FsRec = 1{,}357\ kg\ PPVE$$

PPVE vented from Stripper

$$\frac{0\ kg\ PPVE}{100\ kg\ Strpr} \times 12{,}085\ kg\ Strpr = 0\ kg\ PPVE$$

VOC Emissions

0 kg from Condensation Reactor
\+ 739 kg from Crude Receiver
\+ 1,357 kg from Foreshots Receiver
\+ 0 kg from Stripper
= 2,096 kg PPVE = 2,096 kg VOC
4,620 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 4,143 kg total Condensation Reactor vent stream (22266FG).
C4s vented based on 5,814 kg total Crude Receiver vent stream (22701FG).
C4s vented based on 1,636 kg total Foreshots Receiver vent stream (22826FG).
C4s vented based on 12,085 kg in the Stripper vent stream (22231FC).

C4s vented from Condensation Reactor:

$$\frac{0.00\ kg\ C4s}{2.35\ kg\ CndRx} \times 4{,}143\ kg\ CndRx = 0\ kg\ C4s$$

C4s vented from Crude Receiver

$$\frac{0.01\ kg\ C4s}{3.97\ kg\ CrRec} \times 5{,}814\ kg\ CrRec = 13\ kg\ C4s$$

C4s vented from Foreshots Receiver

$$\frac{0.15\ kg\ C4s}{1.06\ kg\ FsRec} \times 1{,}636\ kg\ FsRec = 231\ kg\ C4s$$

C4s vented from Stripper

$$\frac{0\ kg\ C4s}{100\ kg\ Strpr} \times 12{,}085\ kg\ Strpr = 0\ kg\ C4s$$

VOC Emissions

	0 kg	from Condensation Reactor
+	13 kg	from Crude Receiver
+	231 kg	from Foreshots Receiver
+	0 kg	from Stripper
=	244 kg C4s	= 244 kg VOC
		538 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	4,143	kg total Condensation Reactor vent stream (22266FG).
C5s vented based on	5,814	kg total Crude Receiver vent stream (22701FG).
C5s vented based on	1,636	kg total Foreshots Receiver vent stream (22826FG).
C5s vented based on	12,085	kg in the Stripper vent stream (22231FC).

C5s vented from Condensation Reactor:

$$\frac{0.00\ kg\ C5s}{2.35\ kg\ CndRx} \times 4{,}143\ kg\ CndRx = 0\ kg\ C5s$$

C5s vented from Crude Receiver

$$\frac{0.00\ kg\ C5s}{3.97\ kg\ CrRec} \times 5{,}814\ kg\ CrRec = 0\ kg\ C5s$$

C5s vented from Foreshots Receiver

$$\frac{0.02\ kg\ C5s}{1.06\ kg\ FsRec} \times 1{,}636\ kg\ FsRec = 28\ kg\ C5s$$

C4s vented from Stripper

$$\frac{0\ kg\ C5s}{100\ kg\ Strpr} \times 12{,}085\ kg\ Strpr = 0\ kg\ C5s$$

VOC Emissions

	0 kg	from Condensation Reactor
+	0 kg	from Crude Receiver
+	28 kg	from Foreshots Receiver
+	0 kg	from Stripper
=	28 kg C5s	= 28 kg VOC
		62 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 4,143 kg total Condensation Reactor vent stream (22266FG).
CO vented based on 5,814 kg total Crude Receiver vent stream (22701FG).
CO vented based on 1,636 kg total Foreshots Receiver vent stream (22826FG).
CO vented based on 12,085 kg in the Stripper vent stream (22231FC).

CO vented from Condensation Reactor:

$$\frac{0.00\ kg\ CO}{2.35\ kg\ CndRx} \times 4{,}143\ kg\ CndRx = 0\ kg\ CO$$

CO vented from Crude Receiver

$$\frac{1.27\ kg\ CO}{3.97\ kg\ CrRec} \times 5{,}814\ kg\ CrRec = 1{,}865\ kg\ CO$$

CO vented from Foreshots Receiver

$$\frac{0.00\ kg\ CO}{1.06\ kg\ FsRec} \times 1{,}636\ kg\ FsRec = 0\ kg\ CO$$

CO vented from Stripper

$$\frac{0\ kg\ CO}{100\ kg\ Strpr} \times 12{,}085\ kg\ Strpr = 0\ kg\ CO$$

CO Emissions

0 kg from Condensation Reactor
\+ 1,865 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
\+ 0 kg from Stripper
= 1,865 kg CO = **4,111 lb CO** **(not a VOC)**

I. 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 8,066 kg AN fed

Hydrocarbon waste sent to Hydrocarbon waste tank = 4,936 kgs H/C waste

PPVE generated during the year 134,322 kg PPVE

Assume that: **5%** of spent acetonitrile are fluorocarbons.

AN portion of hydrocarbon waste stream:

4,936 kg to H/C waste
x (1-(.1))
= 4,689 kg AN to H/C waste

Material Balance

Based on total Vinyl ether produced 134,322 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 ppm AN / 1,000,000

Therefore: 134,322 kg PPVE
\ 0.90 Crude
\ 0.70 AF
x 0.0015 ppm AN
= 320 kg AN in Feed to ABR

VOC Emission

8,066 kg AN fed
4,689 kg AN to H/C waste
- 320 kg AN to ABR
3,057 kg AN

3,057 **kg VOC**
6,739 lb VOC

AN only used during a PPVE Campaign

Total AN 6,739 **lb VOC**

J. VOC Summary

Nafion Compound Name		Before Control Generated		After Control Stack Emissions
		kg/yr	lb/yr	VOC lb/yr
A.	HFP	3,756	8,280	8,280
B.	HFPO	7,452	16,428	16,428
C.	PPF	4,975	10,967	44
D.	TFE	3,183	7,018	7,018
E.	PPVE	2,096	4,620	4,620
F.	C4	244	538	538
G.	C5	28	62	62
I.	AN	3,057	6,739	6,739
	Total	24,790	54,652	**43,729**

K. 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	8,280	4	0	8,284
B.	HFPO	16,428	292	17	16,738
C.	PPF	44	0	1	45
D.	TFE	7,018	0	0	7,018
E.	PPVE	4,620	480	487	5,587
F.	C4	538	46	66	650
G.	C5	62	0	0	62
H.	CO (not a VOC)		0	0	4,111
I.	AN		120	7	6,739
*	HFPO-Dimer		6	36	42
*	HFPO Trimer		0	1	1
	Total	**36,990**	**949**	**615**	**49,276**

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

L. HF Equivalent Emissions

Nafion Compound Name		Process Emissions lb/yr	Equipment Emissions lb/yr	Maintenance Emissions lb/yr	Total Emissions lb/yr
C.	PPF	5.3	0.0	0.15	5.44
*	HFPO-Dimer		0.4	2.15	2.52
*	HFPO Trimer		0.0	0.03	0.03
	Total	**5.3**	**0**	**2.33**	**7.99**

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

The estimated HF equivalent emissions were determined by multiplying the total emission quantity of an acid fluoride by the ratio of the molecular weight of HF divided by the molecular weight of the specific acid fluoride. This is based on the fact that one mole of an acid fluoride will generate one mole of HF.

For example, if 100 lb. of PPF was emitted:

$$\frac{20 \text{ lb/mol HF}}{166 \text{ lb/mol PPF}} \times 100 \text{ lb/yr Equipment PPF} = 12.0 \text{ lb/yr HF}$$

2008 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/2008/VEN Air Emissions 2008.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 $\frac{3.12\ kg\ HFP}{18.76\ kg\ CrudeReceiverVent}$

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

HFP vented based on 866 kg total Condensation Reactor vent stream (22266FG).
HFP vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
HFP vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

HFP vented from Condensation Reactor:

$$\frac{0.15\ kg\ HFP}{3.66\ kg\ CndRx} \times 866\ kg\ CndRx = 34\ kg\ HFP$$

HFP vented from Crude Receiver

$$\frac{3.12\ kg\ HFP}{18.76\ kg\ CrRec} \times 27{,}329\ kg\ CrRec = 4{,}542\ kg\ HFP$$

HFP vented from Foreshots Receiver

$$\frac{0.00\ kg\ HFP}{0.33\ kg\ FsRec} \times 21\ kg\ FsRec = 0\ kg\ HFP$$

VOC Emissions

34 kg from Condensation Reactor
\+ 4,542 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 4,576 kg HFP = 4,576 kg VOC
10,067 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 866 kg total Condensation Reactor vent stream (22266FG).
HFPO vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
HFPO vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

HFPO vented from Condensation Reactor:

$$\frac{3.28\ kg\ HFPO}{3.66\ kg\ CndRx} \times 866\ kg\ CndRx = 776\ kg\ HFPO$$

HFPO vented from Crude Receiver

$$\frac{0.00\ kg\ HFPO}{18.76\ kg\ CrRec} \times 27{,}329\ kg\ CrRec = 0\ kg\ HFPO$$

HFPO vented from Foreshots Receiver

$$\frac{0.00\ kg\ HFPO}{0.33\ kg\ FsRec} \times 21\ kg\ FsRec = 0\ kg\ HFPO$$

VOC Emissions

776 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 776 kg HFPO = 776 kg VOC
1,706 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 866 kg total Condensation Reactor vent stream (22266FG).
PPF vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
PPF vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

Before control PPF vented from Condensation Reactor:

$\frac{0.20\ kg\ PPF}{3.66\ kg\ CndRx}$ x 866 kg CndRx = 48 kg PPF

PPF vented from Crude Receiver

$\frac{0.00\ kg\ PPF}{18.76\ kg\ CrRec}$ x 27,329 kg CrRec = 0 kg PPF

PPF vented from Foreshots Receiver

$\frac{0.00\ kg\ PPF}{0.33\ kg\ FsRec}$ x 21 kg FsRec = 0 kg PPF

Total before-control PPF vented = 48 kg PPF

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

VOC Emissions

Waste Gas Scrubber: 48 kg PPF x (100%-99.6%) Control Efficiency = 0.19 kg PAF = **0.19** kg VOC = **0.43** **lb. VOC**

HF Equivalent Emissions

0 kg PPF x 0.120 kg HF/kg PPF = 0.02 kg HF **0.05 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 866 kg total Condensation Reactor vent stream (22266FG).
TFE vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
TFE vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

TFE vented from Condensation Reactor:

$$\frac{0.00\ \text{kg TFE}}{3.66\ \text{kg CndRx}} \times 866\ \text{kg CndRx} = 0\ \text{kg TFE}$$

TFE vented from Crude Receiver

$$\frac{0.01\ \text{kg TFE}}{18.76\ \text{kg CrRec}} \times 27{,}329\ \text{kg CrRec} = 13\ \text{kg TFE}$$

TFE vented from Foreshots Receiver

$$\frac{0.00\ \text{kg TFE}}{0.33\ \text{kg FsRec}} \times 21\ \text{kg FsRec} = 0\ \text{kg TFE}$$

VOC Emissions

0 kg from Condensation Reactor
\+ 13 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 13 kg TFE = 13 kg VOC
29 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: $\frac{0\ kg\ PSEPVE}{3.66\ kg\ Cond\ Rx\ Vent\ Flow}$

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

Vented from the Foreshots Receiver $\frac{0.07\ kg\ PSEPVE}{0.33\ kg\ Foreshots\ Receiver\ Vent}$

PSEPVE vented based on 866 kg total Condensation Reactor vent stream (22266FG).
PSEPVE vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
PSEPVE vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

PSEPVE vented from Condensation Reactor:

$$\frac{0.00}{3.66\ \frac{kg\ PSEPVE}{kg\ CndRx}} \times 866\ kg\ CndRx = 0\ kg\ PSEPVE$$

PSEPVE vented from Crude Receiver

$$\frac{0.00}{18.76\ \frac{kg\ PSEPVE}{kg\ CrRec}} \times 27{,}329\ kg\ CrRec = 0\ kg\ PSEPVE$$

PSEPVE vented from Foreshots Receiver

$$\frac{0.07}{0.33\ \frac{kg\ PSEPVE}{kg\ FsRec}} \times 21\ kg\ FsRec = 4.38\ kg\ PSEPVE$$

VOC Emissions

0 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 4.38 kg from Foreshots Receiver
= 4.38 kg PSEPVE = 4.38 kg VOC
9.64 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: 0 kg C4 / 3.66 kg Cond Rx Vent Flow

Vented from the Crude Receiver 0.46 kg C4 / 18.76 kg Crude Receiver Vent

Vented from the Foreshots Receiver 0.10 kg C4 / 0.33 kg Foreshots Receiver Vent

C4s vented based on 866 kg total Condensation Reactor vent stream (22266FG).
C4s vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
C4s vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

C4s vented from Condensation Reactor:

$$\frac{0.00 \text{ kg C4s}}{3.66 \text{ kg CndRx}} \times 866 \text{ kg CndRx} = 0 \text{ kg C4s}$$

C4s vented from Crude Receiver

$$\frac{0.46 \text{ kg C4s}}{18.76 \text{ kg CrRec}} \times 27{,}329 \text{ kg CrRec} = 669 \text{ kg C4s}$$

C4s vented from Foreshots Receiver

$$\frac{0.10 \text{ kg C4s}}{0.33 \text{ kg FsRec}} \times 21 \text{ kg FsRec} = 6 \text{ kg C4s}$$

VOC Emissions

0 kg from Condensation Reactor
\+ 669 kg from Crude Receiver
\+ 6 kg from Foreshots Receiver
= 675 kg C4s = 675 kg VOC
1,485 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 866 kg total Condensation Reactor vent stream (22266FG).
HFPO Trimer vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
HFPO Trimer vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

Before control HFPO Trimer vented from Condensation Reactor:

$\frac{0.00}{3.66\ \frac{kg\ HFPO\ Trimer}{kg\ CndRx}}$ x 866 kg CndRx = 0 kg HFPO Trimer

HFPO Trimer vented from Crude Receiver

$\frac{0.00}{18.76\ \frac{kg\ HFPO\ Trimer}{kg\ CrRec}}$ x 27,329 kg CrRec = 0 kg HFPO Trimer

HFPO Trimer vented from Foreshots Receiver

$\frac{0.01}{0.33\ \frac{kg\ HFPO\ Trimer}{kg\ FsRec}}$ x 21 kg FsRec = 0.88 kg HFPO Trimer

Total before-control HFPO Trimer vented 0.88 kg VOC

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

VOC Emissions

Waste Gas Scrubber: 0.88 kg HFPO Trimer x (100%-99.6%) Control Efficiency = 0.0035 kg HFPO Trimer = 0.0035 kg VOC = **0.008 lb. VOC**

HF Equivalent Emissions

0.0035 kg HFPO Trimer x 0.040 kg HF/kg HFPO Trimer = 0.00014 kg HF **0.00031 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 866 kg total Condensation Reactor vent stream (22266FG).
MA vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
MA vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

Before control MA vented from Condensation Reactor:
0.00 kg MA / 3.66 kg CndRx x 866 kg CndRx = 0 kg MA

MA vented from Crude Receiver
0.00 kg MA / 18.76 kg CrRec x 27,329 kg CrRec = 0 kg MA

MA vented from Foreshots Receiver
0.0045 kg MA / 0.33 kg FsRec x 21 kg FsRec = 0.292 kg MA

Total before-control MA vented = 0.292 kg MA

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

VOC Emissions — Waste Gas Scrubber
0.292 kg MA x (100%-99.6%) Control Efficiency
= 0.00117 kg MA = 0.00117 kg VOC
= **0.003 lb. VOC**

HF Equivalent Emissions
0.00117 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 866 kg total Condensation Reactor vent stream (22266FG).
DA vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
DA vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

Before control DA vented from Condensation Reactor:

$\frac{0.00\ kg\ DA}{3.66\ kg\ CndRx}$ x 866 kg CndRx = 0 kg DA

DA vented from Crude Receiver

$\frac{0.00\ kg\ DA}{18.76\ kg\ CrRec}$ x 27,329 kg CrRec = 0 kg DA

DA vented from Foreshots Receiver

$\frac{0.13\ kg\ DA}{0.33\ kg\ FsRec}$ x 21 kg FsRec = 8.47 kg DA

Total before-control DA vented = 8.47 kg DA

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

VOC Emissions

Waste Gas Scrubber: 8.47 kg DA x (100%-99.6%) Control Efficiency = 0.0339 kg DA = 0.034 kg VOC = **0.075 lb. VOC**

HF Equivalent Emissions

0.0339 kg DA x 0.039 kg HF/kg DA = 0.00132 kg HF = **0.00 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 866 kg total Condensation Reactor vent stream (22266FG).
Hydro-PSEPVE vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
Hydro-PSEPVE vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

Hydro-PSEPVE vented from Condensation Reactor:

$$\frac{0.00\ kg\ Hydro\text{-}PSEPVE}{3.66\ kg\ CndRx} \times 866\ kg\ CndRx = 0\ kg\ Hydro\text{-}PSEPVE$$

Hydro-PSEPVE vented from Crude Receiver

$$\frac{0.00\ kg\ Hydro\text{-}PSEPVE}{18.76\ kg\ CrRec} \times 27{,}329\ kg\ CrRec = 0\ kg\ Hydro\text{-}PSEPVE$$

Hydro-PSEPVE vented from Foreshots Receiver

$$\frac{0.0045\ kg\ Hydro\text{-}PSEPVE}{0.33\ kg\ FsRec} \times 21\ kg\ FsRec = 0.292\ kg\ Hydro\text{-}PSEPVE$$

VOC Emissions

0 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 0.292 kg from Foreshots Receiver
= 0.292 kg Hydro-PSEPV = 0.292 kg VOC
0.643 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 866 kg total Condensation Reactor vent stream (22266FG).
Iso-PSEPVE vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
Iso-PSEPVE vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

Iso-PSEPVE vented from Condensation Reactor:

$$\frac{0.00\ kg\ Iso\text{-}PSEPVE}{3.66\ kg\ CndRx} \times 866\ kg\ CndRx = 0\ kg\ Iso\text{-}PSEPVE$$

Iso-PSEPVE vented from Crude Receiver

$$\frac{0.00\ kg\ Iso\text{-}PSEPVE}{18.76\ kg\ CrRec} \times 27{,}329\ kg\ CrRec = 0\ kg\ Iso\text{-}PSEPVE$$

Iso-PSEPVE vented from Foreshots Receiver

$$\frac{0.014\ kg\ Iso\text{-}PSEPVE}{0.33\ kg\ FsRec} \times 21\ kg\ FsRec = 0.877\ kg\ Iso\text{-}PSEPVE$$

VOC Emissions

0 kg from Condensation Reactor
\+ 0 kg from Crude Receiver
\+ 0.877 kg from Foreshots Receiver
= 0.877 kg Iso-PSEPVE = 0.877 kg VOC
1.928 lb VOC

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 866 kg total Condensation Reactor vent stream (22266FG).
SOF2 vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
SOF2 vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

Before control SOF2 vented from Condensation Reactor:

$$\frac{0.00\ kg\ SOF2}{3.66\ kg\ CndRx} \times 866\ kg\ CndRx = 0\ kg\ SOF2$$

SOF2 vented from Crude Receiver

$$\frac{2.04\ kg\ SOF2}{18.76\ kg\ CrRec} \times 27{,}329\ kg\ CrRec = 2{,}973\ kg\ SOF2$$

SOF2 vented from Foreshots Receiver

$$\frac{0.00\ kg\ SOF2}{0.33\ kg\ FsRec} \times 21\ kg\ FsRec = 0\ kg\ SOF2$$

Total before-control SOF2 vented = 2,973 kg SOF2

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

SOF2 Emissions

Waste Gas Scrubber: 2,973 kg SOF2 x (100%-99.6%) Control Efficiency = 12 kg SOF2 — 26 lb. SOF2

HF Equivalent Emissions

12 kg SOF2 x 0.465 kg HF/kg SOF2 = 5.53 kg HF — **12.19 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 866 kg total Condensation Reactor vent stream (22266FG).
CO vented based on 27,329 kg total Crude Receiver vent stream (22701FG).
CO vented based on 21 kg total Foreshots Receiver vent stream (22826FG).

CO vented from Condensation Reactor:

$$\frac{0.00}{3.66\ \frac{kg\ CO}{kg\ CndRx}} \times 866\ kg\ CndRx = 0\ kg\ CO$$

CO vented from Crude Receiver

$$\frac{1.30}{18.76\ \frac{kg\ CO}{kg\ CrRec}} \times 27{,}329\ kg\ CrRec = 1{,}900\ kg\ CO$$

CO vented from Foreshots Receiver

$$\frac{0.00}{0.33\ \frac{kg\ CO}{kg\ FsRec}} \times 21\ kg\ FsRec = 0\ kg\ CO$$

CO Emissions

0 kg from Condensation Reactor
\+ 1,900 kg from Crude Receiver
\+ 0 kg from Foreshots Receiver
= 1,900 kg CO = **4,189 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	4,576	10088	10,088	
B.	HFPO	776	1710	1,710	
C.	PPF	48	107	0.43	0.05
D.	TFE	13	29	29	
E.	PSEPVE	4	10	10	
F.	C4	675	1488	1,488	
G.	HFPO Trimer	0.88	2	0.01	0.00
H.	MA	0.29	1	0.003	0.00
I.	DA	8.47	19	0.07	0.01
J.	Hydro PSEPVE	0.29	0.6	0.6	
K.	Iso PSEPVE	0.88	2	2	
L.	Diglyme	505	1113	1,113	
M.	SOF2 (not a VOC)				
N.	CO (not a VOC)				
	Total	**6,608**	**14,568**	**14,440**	**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	10,088	23	26	10,138
B.	HFPO	1,710	107	6	1,824
C.	PPF	0.43	0	0	0
D.	TFE	29	0	0	29
E.	PSEPVE	10	210	0	219
F.	C4	1,488	16	19	1,522
G.	HFPO Trimer	0.01	0	0	0
H.	MA	0.00	0	5	6
I.	DA	0.07	2	12	13
J.	Hydro-PSEPVE	0.6	0	0	1
K.	Iso-PSEPVE	1.9	0	0	2
L.	Diglyme		53	3	1,113
M.	SOF2 (not a VOC)	26.2			26
N.	CO (not a VOC)				4,189
*	TA		0	0	0
*	RSU		0	0	0
*	HFPO-Dimer		0	0	0
	Total	13,354	412	73	**19,083**

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	0.05	0.00	0.01	0.06
G.	HFPO Trimer	0.00	0.00	0.01	0.01
H.	MA	0.00	0.02	0.30	0.32
I.	DA	0.00	0.06	0.46	0.52
M.	SOF2	12.19			12.19
*	TA		0.00	0.01	0.01
*	RSU		0.00	0.00	0.01
*	HFPO-Dimer		0.00	0.02	0.02
	Total	**12.25**	**0.09**	**0.78**	**13.11**

The estimated HF equivalent emissions were determined by multiplying the total emission quantity of an acid fluoride by the ratio of the molecular weight of HF divided by the molecular weight of the specific acid fluoride. This is based on the fact that one mole of an acid fluoride will generate one mole of HF.

For example, if 100 lb. of PPF was emitted:

$$\frac{20 \text{ lb/mol HF}}{166 \text{ lb/mol PPF}} \times 100 \text{ lb/yr Equipment PPF} = 12.0 \text{ lb/yr HF}$$

2008 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

Condensation Tower (vents to stack) * Emission Factors found on Fugitive Emission Leak rates worksheet

Valve emissions:	462	valves	X	0.00039	lb/hr/valve	=	0.180 lb/hr VOC from EE
Flange emissions:	924	flanges	X	0.00018	lb/hr/flange	=	0.166 lb/hr VOC from EE
Pump emissions:	0	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	0	2,862	1,342
Total VOC generated per campaign	0	992	465

Component	EVE	After control**	PPVE	After control**	PSEPVE	After control**
	lb	lb	lb	lb	lb	lb
HFP	0	0	4	4	1	1
HFPO	0	0	292	292	107	107
HFPO-Dimer	0	**0**	541	**2**	6	**0**
PPF	0	**0**	20	**0**	1	**0**
Diglyme	0	0	0	0	53	53
AN	0	0	120	120	0	0
ADN	0	0	0	0	0	0
TTG	0	0	0	0	0	0
DA	0	**0**	0	**0**	196	**1**
MA	0	**0**	0	**0**	88	**0**
TA	0	**0**	0	**0**	7	**0**
RSU	0	**0**	0	**0**	1	**0**
MAE	0	**0**	0	**0**	0	**0**
MMF	0	**0**	0	**0**	0	**0**
DAE	0	**0**	0	**0**	0	**0**
TAE	0	**0**	0	**0**	0	**0**
HFPO Trimer	0	**0**	13	**0**	4	**0**
Total	**0**	**0**	**992**	**419**	**465**	**163**

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	X	0.00039	lb/hr/valve	=	0.033 lb/hr VOC from EE
Flange emissions:	170	flanges	X	0.00018	lb/hr/flange	=	0.031 lb/hr VOC from EE
Pump emissions:	0	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	0	2,862	1,342
Total VOC per campaign	0	182	86

Component	EVE	PPVE	PSEPVE
	lb	lb	lb
HFP	0	0	6
HFPO-Dimer	0	2	0
EVE	0	0	0
PPVE	0	175	0
DA	0	0	1
DAE	0	0	0
PSEPVE	0	0	74
hydro-EVE	0	0	0
iso-EVE	0	0	0
C4	0	5	4
Total	**0**	**182**	**86**

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	X	0.00039	lb/hr/valve	=	0.063 lb/hr VOC from EE
Flange emissions:	324	flanges	X	0.00018	lb/hr/flange	=	0.058 lb/hr VOC from EE
Pump emissions:	0	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	0	2,862	1,342
Total VOC per campaign	0	348	163

Component	EVE	PPVE	PSEPVE
	lb	lb	lb
HFP	0	0	16
HFPO-Dimer	0	2	0
EVE	0	0	0
PPVE	0	305	0
PSEPVE	0	0	135
hydro-EVE	0	0	0
iso-EVE	0	0	0
C4	0	41	12
Total	**0**	**348**	**163**

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	0	4	23
HFPO	0	292	107
HFPO-Dimer	0	6	0
PPF	0	0	0
Diglyme	0	0	53
AN	0	120	0
ADN	0	0	0
TTG	0	0	0
DA	0	0	2
MA	0	0	0
TA	0	0	0
RSU	0	0	0
MAE	0	0	0
MMF	0	0	0
DAE	0	0	0
TAE	0	0	0
HFPO Trimer	0	0	0
EVE	0	0	0
PPVE	0	480	0
PSEPVE	0	0	210
hydro-EVE	0	0	0
iso-EVE	0	0	0
C4	0	46	16

2008 Maintenance Emission Determination

A. Background

Periodically, the process vessels in the VE-North plant are emptied for campaign switches and for maintenance. During the deinventory process, the liquid is transferred to another process vessel and then the gases are evacuated to the division waste gas scrubber. The amount of gasses from the condensation reactor, crude receiver and foreshots receiver are already included in the vent flowmeter readings used to calculate emissions in previous sections. This section estimates maintenance emissions for the rest of the major process vessels.

B. Condensation Tower

Assume the following:

(a) void fraction in distillation columns is 40%
(b) ideal gas behavior
(c) vessels are at atmospheric pressure
(d) ambient temperature (25 deg C)
(e) gases are 67% acid fluorides and 33% non-acid fluorides
(f) average molecular weight (MW) for acid fluoride component based on the average computed from composite composition as shown on "Vessel Compositions" worksheet. Therfore the average molecular weight for condensation is 349
(g) average MW for non-acid fluoride component = 166 (average of HFPO & HFP)
(h) number of deinventory events = 7

D. Component Summary - All maintenance emissions

Component	EVE	PPVE	PSEPVE
	lb	lb	lb
HFP	0	0	26
HFPO	0	17	6
HFPO-Dimer	0	36	0
PPF	0	1	0
Diglyme	0	0	3
AN	0	7	0
ADN	0	0	0
TTG	0	0	0
DA	0	0	12
MA	0	0	5
TA	0	0	0
RSU	0	0	0
MAE	0	0	0
MMF	0	0	0
DAE	0	0	0
TAE	0	0	0
HFPO Trimer	0	1	0
EVE *	0	0	0
PPVE	0	487	0
PSEPVE **	0	0	0
hydro-EVE	0	0	0
iso-EVE	0	0	0
C4	0	66	19

Composite compositions for each area, Condensation, ABR, and Refining, were determined on the Vessel Composition worksheet, taking into account run hours on each campaign and approximate compositions. The mass fraction for each component was then multiplied by the VOC from these areas.

Campaign	EVE	PPVE	PSEPVE
Campaign Fract'n	0.00	0.68	0.32
Cond VOC	0	59	28
Refining VOC	0	556	261

Pre-control VOC	0	862	404

Total before control VOC (lb.)	1267
Total after control VOC	902

* this is very conservative, since EVE will be liquid at ambient temp

** this is very conservative, since PSEPVE will be liquid at ambient temp

2008 Accidental Releases to Atmosphere

A. 2008-005 Date: 1/9/2008

Material Released: **Trimer Vinyl Ether**

Quantity Released: 5 lbs

HF Potential:

TVE is a VOC without the potential to form HF

Total VOC 5 lbs VOC

C. Total Emissions from Accidental Releases

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

Source		TVE lb		lb/yr VOC Before Control	lb/yr VOC After Control	lb/yr HF
A.	2008-005	5.0		5.0	5.0	
B.						
	Total	**5.000**		**5**	**5**	**0.0**

2008 AIR EMISSIONS INVENTORY SUPPORTING DOCUMENTATION

Emission Source ID No: NS-C

Emission Source Description: VE-South PE/PM Manufacturing Process

Process and Emission Description:

The VE-South PE/PM manufacturing process is a continuous chemical reaction. All emissions from the process are vented through the VE-South Waste Gas Scrubber (Control Device ID No. NCD-Hdr2) 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 PE/PM process in VE-South 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:

- A process flowsheet, developed from operating data during a typical month, May 2005, is the basis for relative concentrations of before-control emissions of gaseous wastes.
- The flowsheet is available under the "flowsheet" tab for reference and includes the basis for ratios used in this calculation.
- Because an overall material balance for the year is used for calculation of emissions, "maintenance emissions" related to turnarounds are assumed to be included with the calculated emissions. The usual practice is to deinventory liquids and then vent vessels to the Waste Gas Scrubber.
- All emission determination calculations are available on the EXCEL spreadsheet found at: P:/Emissions/VE-S Emissions