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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

JUN 2 0 1984

MEMORANDUM

SUBJECT: Exposure Calculations for Acrylonitrile

FROM: Nancy L. Riley
Pollutant Assessment Branch (MD-12)

TO: Robert Schell
Pollutant Assessment Branch (MD-12)

The attached tables summarize the results of the Human Exposure Model (HEM) for acrylonitrile emitting sources. The source categories modeled include acrylonitrile monomer, ABS/SAN resin, acrylic fiber and nitrile elastomer. The calculations are based on the March 19, 1984 acrylonitrile industry data (attachment 1) that was received from the Acrylonitrile Group, supplemented by the §114 responses in the May 29, 1984 memo from Susan Wyatt, ESED (attachment 2).

The latest health assessment document, September 1983, provides a unit risk number of 6.8×10^{-5}, which was used for these calculations. A 50-kilometer radius was used in the analysis of these sources. Calculations were made assuming "baseline" controls only.

In summary, the analysis indicates that the following three sources pose maximum individual risks in the 10^{-3} range: American Cyanamid, Milton, Florida; Badische, Williamsburg, Virginia; and Borg-Warner, Washington, West Virginia. Also, the total aggregate nationwide annual cancer incidence is .42.

Attachments

cc: D. Patrick
B. Steigerwald

ATTACHMENT 1

A-83-37

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March 19, 1984

Ms. Deborah Taylor
Office of the Assistant Administrator
for Air, Noise and Radiation
Room W937
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Re: The Acrylonitrile Group, Inc. -
1983 Industry Emission Estimates

Dear Deb:

Since my March 14, 1984 letter to you, we have obtained some additional data which has caused us to revise slightly the materials we sent you. The present enclosure should now be regarded as final, complete and exactly that which we have supplied to SRI International.

Very truly yours,

Joseph E. Hadley, Jr.

JEH/gnl
Enclosure

cc: Mr. David R. Patrick
Ms. Susan Wyatt

TABLE I

Emissions from AN Monomer Production

Plant and City	County and State	Air Emissions of AN (Mg/yr) Process	Storage	Fugitive	Total	Source of Information
Am. Cyanamid*/ Westwego	Jefferson LA	22.5	7.0	3.6	33.1	Taggart
du Pont Beaumont	Jefferson TX	20.2-30.2 1/	1.3	17.7	39.2-49.2	Olguin
Monsanto Texas City	Galveston TX	15.3	12.3	10.9	38.5	Jessee
du Pont 2/ Memphis	Shelby TN				0	Olguin
Sohio (Vistron) Lima	Allen OH	40.1	61.7	3.1	104.9	Huff
Sohio (Vistron) Victoria	Calhoun TX	1.5	4.3	1.8	7.6	Huff
Monsanto Alvin	Brazoria TX	61.9	38.8	5.0	105.2	Jessee

1/ Emissions vary depending on method of loading for shipment.

2/ Facility permanently shut-down.

*/ Data reflect control to meet existing state requirement.

TABLE II
Emissions from ABS/SAN Resin Operations

Plant and City	County and State	Air Emissions of AN (Mg/yr) Process	Storage	Fugitive	Total	Source of Information
Abtec (Mobay) 1/ Louisville	Jefferson KY				0	
Borg-Warner Washington	Wood WV	571	22.7	6.5	600	Feeney
Borg-Warner 2/ Ottawa	LaSalle IL	113.7	N/A	2.1	115.8	Feeney
Dow Torrence	Los Angeles CA	0.05	0.01	0.14	0.20	Schumann
Dow Midland	Midland MI	3.2	1.8	0.3	5.3	Thomka
Dow 3/ Pevley	Jefferson MO				0	Thomka
Dow 4/ Allyns Point	New London CT				0	Thomka
Monsanto Dyston	Hamilton OH	14.2	40.4	3.3	57.9	Jessee
Monsanto Muscatine	Muscatine IA	388.0	55.0	2.5	445.5	Jessee
Monsanto 5/ Springfield	Hampden MA				0	Jessee
USS Chemical 6/ Scotts Bluff	E. Baton Rouge LA				0	Weinert
Dow Ironton	Lawrence OH	1.7	0.1	Nil	1.8	Thomka

TABLE II (Continued)
Emissions from ABS/SAN Resin Operations

Plant and City	County and State	Air Emissions of AN (Mg/yr) Process	Storage	Fugitive	Total	Source of Information
Borg-Warner Port Bienville	MS	---	---	---	<1	Feeney

N/A = Not Available

1/ Believed to be out-of-business.

2/ Capacity increased since last report.

3/ Facility used no AN in 1983.

4/ Facility used no AN in 1983.

5/ Facility no longer uses AN as a raw material.

6/ Facility "shut-down forever."

TABLE III

Emissions from Acrylic Fiber Production

Plant and City	County and State	Air Emissions of AN (Mg/yr) Process	Storage	Fugitive	Total	Source of Information
Am. Cyanamid*/ Hilton	Santa Rosa FL	127.5	25.7	17.2	170.4	Taggart
Badische Williamsburg	James City VA	319.0	10.0	15.0	352.0	Charter
Du Pont1/ Camden	Kershaw SC	130.4	32.5	7.2	170.1	Olguin
du Pont Waynesboro	Augusta VA	21.1	28.8	1.6	51.5	Olguin
Tn. Eastman2/ Kingsport	Sullivan TN				0	McIntire
Monsanto Decatur	Morgan AL	43.0	5.9	N/A	48.9	Jessee

N/A Not Available

1/ Facility partly shut-down; capacity reduced to 125 million pounds.

2/ Company advised that "production discontinued."

*/ Capacity increased since last report.

TABLE IV
Emissions from Nitrile Elastomer Operations

Plant and City	County and State	Air Emissions of AN (Mg/yr) Process	Storage	Fugitive	Total	Source of Information
Copolymer Rubber Baton Rouge	E. Baton Rouge LA	3.4	0.9	N/A	4.3	Spence
Goodrich Akron	Summit OH	19.24	N/A	14.8	34.04	Lewis
Goodrich Louisville	Jefferson KY	137.09	N/A	4.25	141.34	Lewis
Goodyear Akron	Summit OH	25.68	0.16	0.39	26.24	Burkett
Goodyear Houston	Harris TX	2.04	Nil	0.32	2.36	Burkett
Reichold Cheswold	Kent DE	1.17	0.04	0.6	1.81	Hadgraft
Uniroyal Painesville	Lake OH	39.0	1.0	Nil	40.0	Kenney

N/A = Not Available

ATTACHMENT 2

Schell

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

MAY 2 9 1984

MEMORANDUM

SUBJECT: 1984 Acrylonitrile Emission Estimates for Nine Plants

FROM: Susan R. Wyatt, Chief SRW
Chemicals and Petroleum Branch (MD-13)

TO: David R. Patrick, Chief
Pollutant Assessment Branch (MD-11)

In an effort to ensure that regulatory decisions for acrylonitrile are based on sound, current data, we recently sent 114 letters requesting acrylonitrile emission updates to nine plants. These nine plants were singled out from among all acrylonitrile emitting plants based on their potential to cause the greatest population exposure. Following is a summary of the responses to our 114 letters.

Table 1 lists the nine plants and corresponding acrylonitrile emission estimates as extracted from three studies. The first column shows EPA's 1983 emission estimates (Crume memo July 19, 1983; emissions were actually for the year 1981) and is included in this discussion as a benchmark for comparison with the most recent data. The second column contains the estimates from a 1984 survey by The Acrylonitrile Group. In the third column are the estimates we put together from 114 letter responses.

Overall, the EPA's 1984 estimate for process, storage, and fugitive emissions is 36 percent lower than that for 1983. Most of the decrease is due to process improvements or increased use of controls; the balance stems from revision to plant estimates or from replacement of calculated emission numbers with new sampling data showing lower emissions. Comparison of the EPA estimates with The Acrylonitrile Group estimates reveals close agreement in most cases. Minor differences in the two sets of numbers arise from two sources: (1) the EPA numbers are based on full capacity operation while The Acrylonitrile Group reports actual emissions expected for 1984, and (2) some companies responded hurriedly to The Acrylonitrile Group request but took more time with our detailed questionnaire, sometimes with the result of differing estimates. The differences for two plants cannot be explained in this manner, namely the B.F. Goodrich plant in Akron, Ohio and the American Cyanamid plant. B.F. Goodrich completed additional process vent control after The Acrylonitrile Group request but before response to our 114 letter. Therefore our estimate is considerably lower. Most of the discrepancy for American Cyanamid's plant comes from removing Cyanamid's estimate for secondary emissions. None of the other plants had included secondary emissions in its estimates until we requested

such information in the 114 letters. Even at that, four plants were unable to predict how much of the acrylonitrile in waste streams is emitted to the atmosphere. Estimates from companies hazarding a guess varied tremendously; none was based on sampling data. Because of the lack of supportable estimates, all secondary emission information is reported separately in Table 2 instead of being incorporated in Table 1.

Examination of Table 2 shows three companies estimate that 20-75 percent of the acrylonitrile in their plant wastewater evaporates to the atmosphere. Yet estimates for two other plants are much lower, presumably because wastewater treatment systems at these plants convert much more of the acrylonitrile before it has an opportunity to be emitted. Because of the wide variability we did not feel comfortable assigning loss estimates ourselves, especially where the company itself declined to do so. We thought it better to separate this information from the other emission estimates and only note that secondary emissions may be significant at some plants.

Table 3 gives the detailed parameters based on the 114 responses necessary to rerun the Human Exposure Model for each plant. I understand that these numbers already have been transmitted informally by Dave Beck to Bob Schell. Let me know if you want to discuss any of this.

2 Attachments

cc: Rick Colyer, ESED (MD-13)
Jack Farmer, ESED (MD-13)
Robert Rosensteel, ESED (MD-13)
Robert Schell, SASD (MD-12)
Bern Steigerwald, OAQPS (MD-10)

Table 1. Comparison of Acrylonitrile Emission Estimates for Nine Plants*

Plant	1983 EPA Estimate (Mg/yr)	1984 Acrylonitrile Group Estimate (Mg/yr)	1984 EPA Estimate (Mg/yr)	Reasons for Emission Increase or Decreases
du Pont Waynesboro, VA	309.1	51.5	52.9	. Major process change instituted . Sampling performed - previous estimates based on emission factors from Camden plant
B.F. Goodrich Akron, OH	112	34.04	1.95	. Added emission control (vents to boiler) . Part of process transferred to Louisville plant
du Pont Camden, SC	457.9	170.1	210.7	. Process improvements . Recent emission measurements
B.F. Goodrich Louisville, KY	63.4	141.34	125.2	. More process units (transferred from Akron)
Badische Williamsburg, VA	354.1	352	352.7	. Essentially no changes
Goodyear Akron, OH	55.2	26.24	28.15	. Added chemical treatment step reducing residual AN in latex
Uniroyal Painesville, OH	36.6	40.0	20.2	. Hurried response to The Acrylonitrile Group, detailed analysis of sampling results revealed lower emissions
Borg-Warner Washington, WV	657.5	599.8	577.0	. Various process improvements
American Cyanamid Milton, FL	144.7	170.4	47.5	. Previous estimates included secondary emissions (see Table 2)
Total	2,190	1,585	1,407	

* Estimates include emissions from process vents, storage tanks and fugitive sources.

Table 2. Secondary Emissions of Acrylonitrile from Nine Plants

Plant	Amount of Acrylonitrile in Plant Wastes (Mg/yr)	Fraction Evaporated To Atmosphere* During Waste Treatment	Secondary Emission Estimate (Mg/yr)
duPont Waynesboro, VA	15	no estimate	(≤ 15)
B.F. Goodrich Akron, OH	56	.05	2.8
duPont Camden, SC	29	no estimate	(≤ 29)
B.F. Goodrich Louisville, KY	210	0.00007	.015
Badische Williamsburg, VA	34	.36	12
Goodyear Akron, OH	15	no estimate	(≤ 15)
Uniroyal Painesville, OH	14	no estimate	(≤ 14)
Borg-Warner Washington, WV	870	0.75	650
American-Cyanamid Milton, FL	206	0.2 - 0.4	41-82

Table 3. Parameters for Human Exposure Model.

Plant	Product	Emission Type	Vent Height(m)	Vent Diameter(m)	Vent Velocity(m/sec)	Vent Temp.(°C)	Acrylonitrile Emissions(kg/yr)	Coordinates & Plant Size
duPont	Acrylic Fibers	Process			14.0	44	21,380	
Waynesboro,		Process			.24	20.5	11,660	38°03'31"
VA		Storage			0.8	13	18,255	78°53'28
		Fugitive			12.9	26	1,600	
B.F.Goodrich	Nitrile	Process	38.1	1.53	7.5	193	1,440	41° 2'42"N
Akron, OH	Elastomers	Storage	3	.1	2.0	20	7	81°32'31"W
		Fugitive	10		.01	20	500	34mx15m
duPont	Acrylic Fibers	Process			0.9	20	640	
Camden, SC		Process			13.3	59.5	135,500	34°14'N
		Storage			7.2	20	41,000	80°39'43"W
		Fugitive			7.9	22.5	24,600	1,400m^2
B.F.Goodrich	Nitrile	Process	18.6	.94	23	102	125,200	38°13'30"N
Louisville,	Elastomers	Storage	(Emit from process) - no breathing losses					85°49'30"W
KY		Fugitive	(In process vent totals)					490mx640m
Badische	Acrylic Fibers	Process	11.1	.78	9.3	27	319,000	
Williamsburg,		Process	21.8	.06	2.9	2	3,600	37°11'30"N
VA		Storage	7.5	.1	2.0	20	5,900	76°37'05"W
		Fugitive	10		.01	20	24,200	400mx150m
Goodyear	Nitrile	Process (ABS)	20.1	.91	11.6	71	4,890	
Akron, OH	Elastomers	Process	16	.96	9.1	30.5	22,200	UTM 4544.0 N
		Storage	7	.1	2.0	20	900	460.0 E
		Fugitive	10		.01	20	160	55mx91m
Uniroyal	Nitrile	Process	20.1	0.6	14.5	28	14,800	
Painesville,	Elastomers	Storage	16.7	.05	7.2	20	640	41°45'22"N
OH		Fugitive	10		.01	20	4,780	81°14'11"W
								19,500m^2
Borg-Warner	ABS/SAN	Process	16.1	.52	25	57	556,000	39°15'25"N
Washington, WV	Resins	Storage	12	.1	2.0	20	11,200	81°40'36"W
		Fugitive	10		.01	20	9,850	1,200mx900m
American	Acrylic Fibers	Process	4.9	.07	3.2	17	13,200	30°34'25"N
Cyanamid		Storage	9.1	.1	14.7	20	14,200	87° 6'45"W
Milton, FL		Fugitive	10		.01	20	20,100	9,370m^2

ATTACHMENT 3

TABLE A-1

IDENTIFICATION OF ACRYLONITRILE MONOMER PLANTS

Plant Number Code	Plant Name and Address
1	American Cyanamid Westwego, LA
2	DuPont Beaumont, TX
3	Monsanto Texas City, TX
4	Vistron Lima, OH
5	Vistron Victoria, TX
6	Monsanto Alvin, TX

Table A-2 Input Data to Exposure Model for Acrylonitrile Monomer Plants
(Assuming Baseline Controls)

Plant	(Emission Point)	Latitude (Degrees Minutes Seconds)	Longtitude (Degrees Minutes Seconds)	Emission Rate (Kg/yr)	Emission Point Elevation (Meters)	Emission Point Diameter (Meters)	Emission Point Cross Sectional Area (m^2)	Emission Point Gas Exit Velocity m/sec	Emission Point Gas Temp. (°K)	Emission Point Type
1	1	295509	901234	22,500	63	1	0	16	273	Stack
	2			7,000	10	0	10,000	0	273	Vent
	3			3,600	10	0	10,000	.01	293	Fugitive
2	1	300323	934514	30,200	63	1	0	16	273	Stack
	2			1,300	10	0	10,000	0	273	Vent
	3			17,700	10	0	10,000	.01	293	Fugitive
3	1	292245	943328	15,300	63	1	0	16	273	Stack
	2			12,300	10	0	10,000	0	273	Vent
	3			10,900	10	0	10,000	.01	293	Fugitive
4	1	404300	840818	40,100	63	1	0	16	273	Stack
	2			61,700	10	0	10,000	0	273	Vent
	3			3,100	10	0	10,000	.01	293	Fugitive
5	1	285500	970000	1,500	63	1	0	16	273	Stack
	2			4,300	10	0	10,000	0	273	Vent
	3			1,800	10	0	10,000	.01	293	Fugitive
6	1	291456	951244	61,900	63	1	0	16	273	Stack
	2			38,800	10	0	10,000	0	273	Vent
	3			5,000	10	0	10,000	.01	293	Fugitive

Table A-3

TOTAL EXPOSURE AND NUMBER OF PEOPLE EXPOSED
(AN Monomer Plants)*

Plant	Total Number of People Exposed	Total Exposure (People -$\mu g/m^3$)
1	1,200,000	21,900
2	398,000	5,500
3	164,000	495
4	335,000	20,500
5	118,000	547
6	837,000	6,990

*A 50-Kilometer radius was used for the analysis of exposure for AN monomer plants.

Table A-4

Maximum Concentration To Which Any People Are Estimated To Be Exposed

Plant	$\mu g/m^3$
1	.92
2	.824
3	.0243
4	3.0
5	.643
6	.261

Table A-5

Public Exposure for AN Monomer Plants
as Calculated by Human Exposure Model

Concentration Level ($\mu g/m^3$)	Population Exposed (Persons)*	Exposure (Persons-$\mu g/m^3$)**
3.51	0	0
2.50	1	4.06
1.00	429	551
.5	3,440	2,320
.25	36,000	12,800
.1	112,000	24,500
.05	179,000	29,100
.025	385,000	35,900
.01	949,000	44,400
.005	2,150,000	52,900
.0025	2,810,000	55,400
.001	3,020,000	55,900
.0005	3,030,000	55,900
.00025	3,040,000	55,900
.0001	3,050,000	55,900
.0000516	3,060,000	55,900

*Column 2 displays the computed value, rounded to the nearest whole number, of the cumulative number of people exposed to the matching and higher concentration levels found in column 1. For example, 0.5 people would be rounded to 0 and 0.51 people would be rounded to 1.

**Column 3 displays the computed value of the cumulative exposure to the matching and higher concentration levels found in column 1.

TABLE A-6

MAXIMUM LIFETIME RISK AND CANCER INCIDENCE
FOR AN MONOMER PLANTS
(Assuming Baseline Controls)

Plant	Maximum Lifetime Risk	Cancer Incidences Per Year	Cancer Incidence (one case in [x] years)
1	6.3×10^{-5}	2.1×10^{-2}	1 in 48 yrs.
2	5.6×10^{-5}	5.3×10^{-3}	1 in 189 yrs.
3	1.7×10^{-6}	4.8×10^{-4}	1 in 2,083 yrs.
4	2.0×10^{-4}	2.0×10^{-2}	1 in 50 yrs.
5	4.4×10^{-5}	5.3×10^{-4}	1 in 1,887 yrs.
6	1.8×10^{-5}	6.8×10^{-3}	1 in 147 yrs.

TOTALS FOR THIS SOURCE CATEGORY

Number of Plants	Total Number of People Exposed (within 50 km)	Highest Individual Risk	Cancer Incidences	
			per year	one case in [x] years
6	3,060,000	2.0×10^{-4} (For Plant 4)	.054	1 in 19 yrs.

TABLE B-1

IDENTIFICATION OF ABS/SAN RESIN PLANTS

Plant Number Code	Plant Name and Address
1	Borg-Warner Washington, WV
2	Borg-Warner Ottawa, ILL.
3	DOW Torrance,CA
4	DOW Midland, MI
5	Monsanto Addyston, OH
6	Monsanto Muscatine, IA
7	Dow Ironton, OH

Table B-2 Input Data to Exposure Model for ABS/SAN Resin Plants
(Assuming Baseline Controls)

Plant (Emission Point)		Latitude (Degrees Minutes Seconds)	Longtitude (Degrees Minutes Seconds)	Emission Rate (Kg/yr)	Emission Point Elevation (Meters)	Emission Point Diameter (Meters)	Emission Point Cross Sectional Area (m^2)	Emission Point Gas Exit Velocity m/sec	Emission Point Gas Temp. (°K)	Emission Point Type
1	1	391525	814036	556,000	16.1	.52	10,000	25	330	Stack
	2			11,200	12	.1	10,000	2.0	273	Storage
	3			9,850	10	0	10,000	.01	293	Fugitive
2	1	412007	884511	113,200	30	1	0	25	338	Stack
	2			2,100	10	0	10,000	.01	293	Fugitive
3	1	335102	1181949	50	30	1	0	25	338	Stack
	2			10	10	0	10,000	0	273	Storage
	3			140	10	0	10,000	.01	293	Fugitive
4	1	433609	841351	3,200	30	1	0	25	338	Stack
	2			1,800	10	0	10,000	0	273	Storage
	3			300	10	0	10,000	.01	293	Fugitive
5	1	390702	844841	14,200	30	1	0	25	338	Stack
	2			40,400	10	0	10,000	0	273	Storage
	3			3,300	10	0	10,000	.01	293	Fugitive
6	1	412059	910444	388,000	30	1	0	25	338	Stack
	2			55,000	10	0	10,000	0	273	Storage
	3			2,500	10	0	10,000	.01	293	Fugitive
7	1	383100	824000	1,700	30	1	0	25	338	Stack
	2			100	10	0	10,000	0	273	Storage

Table B-3

TOTAL EXPOSURE AND NUMBER OF PEOPLE EXPOSED
(ABS/SAN Resin Plants)*

Plant	Total Number of People Exposed	Total Exposure (People - $\mu g/m^3$)
1	283,000	96,200
2	260,000	5,570
3	8,440,000	523
4	512,000	1,000
5	1,480,000	15,100
6	315,000	20,500
7	437,000	389

* A 50-Kilometer radius was used for the analysis of exposure for ABS/SAN Resin plans.

Table B-4

Maximum Concentration To Which Any People Are Estimated To Be Exposed

Plant	$\mu g/m^3$
1	50.0
2	1.63
3	.0175
4	.133
5	2.81
6	6.90
7	.0313

TABLE B-6

MAXIMUM LIFETIME RISK AND CANCER INCIDENCE
FOR ABS/SAN RESIN PLANTS
(Assuming Baseline Controls)

Plant	Maximum Lifetime Risk	Cancer Incidences Per Year	Cancer Incidence (one case in [x] years)
1	3.4×10^{-3}	9.3×10^{-2}	1 in 11 yrs.
2	1.1×10^{-4}	5.4×10^{-3}	1 in 185 yrs.
3	1.2×10^{-6}	5.1×10^{-4}	1 in 1,961 yrs.
4	9.0×10^{-6}	9.7×10^{-4}	1 in 1,031 yrs.
5	1.9×10^{-4}	1.5×10^{-2}	1 in 67 yrs.
6	4.7×10^{-4}	2.0×10^{-2}	1 in 50 yrs.
7	2.1×10^{-6}	3.8×10^{-4}	1 in 2,632 yrs.

TOTALS FOR THIS SOURCE CATEGORY

Number of Plants	Total Number of People Exposed (within 50 km)	Highest Individual Risk	Cancer Incidence	
			per year	one case in [x] years
7	11,700,000	3.4×10^{-3} (For Plant 1)	.13	1 in 8 yrs.

TABLE C-1

IDENTIFICATION OF ACRYLIC FIBER PLANTS

Plant Number Code	Plant Name and Address
1	American Cyanamid Milton, FL
2	Badische Williamsburg, VA
3	Du Pont Camden, SC
4	Du Pont Waynesboro, VA
5	Monsanto Decatur, AL

Table C-2 Input Data to Exposure for Acrylic Fiber Plants
(Assuming Baseline Controls)

Plant (Emission Point)		Latitude (Degrees Minutes Seconds)	Longtitude (Degrees Minutes Seconds)	Emission Rate (Kg/yr)	Emission Point Elevation (Meters)	Emission Point Diameter (Meters)	Emission Point Cross Sectional Area (m^2)	Emission Point Gas Exit Velocity m/sec	Emission Point Gas Temp. (°K)	Emission Point Type
1	1	303425	870645	13,200	4.9	1.07	0	3.2	290	Stack
	2			14,200	9.1	.1	2,500	14.7	293	Storage
	3			20,100	10	0	9,370	.01	293	Fugitive
2	1	371130	763705	319,000	11.1	.78	10,000	9.3	300	Stack
	2			3,600	21.8	.06	60,000	2.9	275	Storage
	3			5,900	7.5	.1	25,000	2.0	293	Storage
	4			24,200	10	0	60,000	.01	273	Fugitive
3	1	341400	803943	640	CBI*	CBI	0	.9	293	Stack
	2			135,500	CBI	CBI	1,400	13.3	332.5	Storage
	3			41,000	CBI	CBI	2,500	7.2	293	Storage
	4			24,600	CBI	CBI	1,400	7.9	295.5	Storage
4	1	380335	785328	21,380	CBI	CBI	0	14.0	317	Stack
	2			11,660	CBI	CBI	10,000	.24	293.5	Storage
	3			18,255	CBI	CBI	2,500	.8	286	Storage
	4			1,600	CBI	CBI	10,000	12.9	299	Storage
5	1	343806	870110	43,000	17	1	10,000	0	273	Stack
	2			5,900	10	0	10,000	0	273	Storage

*CBI - Confidential Business Information

Table C-3

TOTAL EXPOSURE AND NUMBER OF PEOPLE EXPOSED
(Acrylic Fiber Plants)*

Plant	Total Number of People Exposed	Total Exposure (People - $\mu g/m^3$)
1	324,000	7,870
2	793,000	36,900
3	482,000	14,900
4	276,000	9,670
5	370,000	5,650

* A 50-Kilometer radius was used for the analysis of exposure for Acrylic Fiber Plants.

Table C-4

Maximum Concentration To Which Any People Are Estimated To Be Exposed

Plant	$\mu g/m^3$
1	21.1
2	55.6
3	5.46
4	6.52
5	5.75

Table C-5

Public Exposure for Acrylic Fiber Plants
as calculated by the Human Exposure Model

Concentration Level ($\mu g/m^3$)	Population Exposed (Persons)*	Exposure (Persons-$\mu g/m^3$)**
55.6	0	.618
50.0	0	8.06
25.0	1	112
10.0	59	668
5.00	121	5,290
2.5	391	8,770
1.0	2,760	13,600
0.5	12,800	33,900
0.25	43,600	46,300
0.1	140,000	58,300
0.05	250,000	73,000
0.025	524,000	76,000
0.01	1,500,000	76,700
0.005	1,930,000	76,800
0.0025	2,200,000	76,800
0.001	2,240,000	76,800
0.0005	2,250,000	76,800
0.000452	2,250,000	76,800

*Column 2 displays the computed value, rounded to the nearest whole number, of the cumulative number of people exposed to the matching and higher concentration levels found in column 1. For example, 0.5 people would be rounded to 0 and 0.51 people would be rounded to 1.

**Column 3 displays the computed value of the cumulative exposure to the matching and higher concentration levels found in column 1.

TABLE C-6

MAXIMUM LIFETIME RISK AND CANCER INCIDENCE
FOR ACRYLIC FIBER PLANTS

Plant	Maximum Lifetime Risk	Cancer Incidences Per Year	Cancer Incidence (one case in [x] years)
1	1.4×10^{-3}	7.6×10^{-3}	1 in 131 yrs.
2	3.8×10^{-3}	3.6×10^{-2}	1 in 28 yrs.
3	3.7×10^{-4}	1.4×10^{-2}	1 in 71 yrs.
4	4.4×10^{-4}	9.4×10^{-3}	1 in 106 yrs.
5	3.9×10^{-4}	5.5×10^{-3}	1 in 182 yrs.

TOTALS FOR THIS SOURCE CATEGORY

Number of Plants	Total Number of People Exposed (within 50 km)	Highest Individual Risk	Cancer Incidence	
			per year	one case in [x] years
5	2,250,000	3.8×10^{-3} (For Plant 2)	.073	1 in 14 yrs.

TABLE D-1

IDENTIFICATION OF NITRILE ELASTOMER PLANTS

Plant Number Code	Plant Name and Address
1	Copolymer Rubber Baton Rouge, LA
2	B.F. Goodrich Akron, OH
3	B.F. Goodrich Louisville, KY
4	Goodyear Akron, OH
5	Goodyear Houston, TX
6	Reichhold Cheswold, DE
7	Uniroyal Painesville, OH

Table D-2 Input Data to Exposure Model Nitrile Elastomer Plants
(Assuming Baseline Controls)

Plant	(Emission Point)	Latitude (Degrees Minutes Seconds)	Longtitude (Degrees Minutes Seconds)	Emission Rate (Kg/yr)	Emission Point Elevation (Meters)	Emission Point Diameter (Meters)	Emission Point Cross Sectional Area (m^2)	Emission Point Gas Exit Velocity m/sec	Emission Point Gas Temp. (°K)	Emission Point Type
1	1	303016	911035	3,400	17	1	0	0	366	Stack
	2			900	10	0	10,000	0	273	Storage
2	1	410242	813231	1,440	38.1	11.53	0	7.5	466	Stack
	2			7	3	.1	2,500	2.0	293	Storage
	3			500	10	0	510	.01	293	Fugitive
3	1	381330	854930	125,200	18.6	.94	0	23	375	Stack
4	1	410331	812846	4,890	20.1	.91	0	11.6	344	Stack
	2			22,200	16	.96	5,005	9.1	303.5	Storage
	3			900	7	.1	2,500	2	293	Storage
	4			160	10	0	5,005	.01	293	Fugitive
5	1	293915	951541	2,040	17	1	0	0	366	Stack
	2			320	10	0	10,000	.01	293	Fugitive
6	1	391214	753411	1,170	17	1	0	0	366	Stack
	2			40	10	0	10,000	0	273	Storage
	3			600	10	0	10,000	.01	293	Fugitive
7	1	414522	811411	14,800	20.1	.6	0	14.5	305	Stack
	2			640	16.7	.05	2,500	7.2	293	Storage
	3			4,780	10	0	19,500	.01	293	Fugitive

Table D-3

TOTAL EXPOSURE AND NUMBER OF PEOPLE EXPOSED
(Nitrile Elastomer Plants)*

Plant	Total Number of People Exposed	Total Exposure (People $\mu g/m^3$)
1	558,000	2,140
2	2,110,000	1,620
3	1,040,000	125,000
4	2,100,000	29,900
5	2,680,000	3,550
6	288,000	280
7	1,210,000	3,100

* A 50-Kilometer radius was used for the analysis of exposure for Nitrile Elastomer Plants.

Table D-4

Maximum Concentration To Which Any People Are Estimated To Be Exposed

Plant	$\mu g/m^3$
1	1.14
2	.154
3	2.17
4	6.13
5	.675
6	.412
7	1.85

Table D-5

Public Exposure for Nitrile Elastomer Plants
as Calculated by the Human Exposure Model

Concentration Level ($\mu g/m^3$)	Population Exposed (Persons)*	Exposure (Persons-$\mu g/m^3$)**
6.13	2	10.8
5.00	14	78
2.5	92	293
1.0	10,500	13,600
0.5	43,000	36,100
0.25	137,000	69,500
0.1	411,000	112,000
0.05	712,000	133,000
0.025	1,080,000	146,000
0.01	1 570,000	154,000
0.005	2,010,000	157,000
0.0025	2,850,000	160,000
0.001	4,950,000	163,000
0.0005	6,690,000	165,000
0.00025	7,950,000	165,000
0.0001	9,500,000	165,000
0.00005	9,980,000	165,000
0.0000487	9,980,000	165,000

*Column 2 displays the computed value, rounded to the nearest whole number, of the cumulative number of people exposed to the matching and higher concentration levels found in column 1. For example, 0.5 people would be rounded to 0 and 0.51 people would be rounded to 1.

**Column 3 displays the computed value of the cumulative exposure to the matching and higher concentration levels found in column 1.

TABLE D-6

MAXIMUM LIFETIME RISK AND CANCER INCIDENCE
FOR NITRILE ELASTOMER PLANTS
(Assuming Baseline Controls)

Plant	Maximum Lifetime Risk	Cancer Incidences Per Year	Cancer Incidence (one case in [x] years)
1	7.8×10^{-5}	2.1×10^{-3}	1 in 476 yrs.
2	1.0×10^{-5}	1.6×10^{-3}	1 in 635 yrs.
3	1.5×10^{-4}	1.2×10^{-1}	1 in 8 yrs.
4	4.2×10^{-4}	2.9×10^{-2}	1 in 34 yrs.
5	4.6×10^{-5}	3.4×10^{-3}	1 in 294 yrs.
6	2.8×10^{-5}	2.7×10^{-4}	1 in 3,703 yrs.
7	1.2×10^{-4}	3.0×10^{-3}	1 in 333 yrs.

TOTALS FOR THIS SOURCE CATEGORY

Number of Plants	Total Number of People Exposed (within 50 km)	Highest Individual Risk	Cancer Incidence	
			per year	one case in [x] years
7	9,980,000	4.2×10^{-4} (For Plant 4)	.16	1 in 6 yrs.

TABLE E-1

MAXIMUM LIFETIME RISK AND CANCER INCIDENCE FOR
THE FOUR MAJOR AN SOURCE CATEGORIES

Plant Type	Highest Individual Risk	Cancer Incidence	
		per year	one case in [x] years
Monomer	2.0×10^{-4}	.054	1 in 19
ABS/SAN	3.4×10^{-3}	.13	1 in 8
Acrylic Fibers	3.8×10^{-3}	.073	1 in 14
Nitrile Elastomers	4.2×10^{-4}	.16	1 in 6

SUMMARY FOR THE FOUR MAJOR SOURCE CATEGORIES

Number of Plants	Total Number of People Exposed (within 50 km)	Highest Individual Risk	Cancer Incidence	
			per year	one case in [x] years
25	26,990,000	3.8×10^{-3} (For Plant 1- Acrylic Fibers)	.42	1 in 2 years

TABLE E-2

Summary of Estimated Population Exposures* to Atmospheric Acrylonitrile from the Four Major Source Categories.

Annual Average AN Concentration $\mu g/m^3$ **	AN Monomer	ABS/SAN Resins	Acrylic Fibers	Nitrile Elastomers
55.6	-	-	-	-
50.0	-	16	-	-
25	-	132	1	-
10	-	650	59	2
5.0	0	2,470	121	14
2.5	1	6,200	391	92
1.0	429	9,400	2,760	10,500
0.5	3,440	25,000	12,800	43,000
0.25	36,000	107,000	43,600	137,000
0.1	112,000	205,000	140,000	411,000
0.05	179,000	312,000	250,000	712,000
0.025	385,000	661,000	524,000	1,080,000
0.01	949,000	1,110,000	1,500,000	1 570,000
0.005	2,150,000	2,010,000	1,930,000	2,010,000
0.0025	2,810,000	2,440,000	2,200,000	2,850,000
0.001	3,020,000	2,570,000	2,240,000	4,950,000
0.0005	3,030,000	2,880,000	2,250,000	6,690,000
0.00025	3,040,000	3,280,000	2,250,000	7,950,000
0.0001	3,050,000	4,340,000		9,500,000
0.00005	3,060,000	5,700,000		9,980,000
0.000025		7,820,000		9,980,000
0.00001		11,000,000		
0.00000557		11,700,000		

TOTALS FOR ALL SOURCE CATEGORIES

Source Category	Total Exposed	Total Risk (person/$\mu g/m^3$)
Monomer	3,060,000	55,900
ABS/SAN	11,700,000	139,000
Acrylic Fiber	2,250,000	76,800
Nitrile Elastomers	9,980,000	165,000
Total	26,990,000	436,700

*All population numbers are rounded to the nearest whole number and represent the cumulative number of people exposed to the matching and higher concentration levels found in column 1. For example, 0.5 people would be rounded to 0 and 0.51 people would be rounded to 1.

**Total Risk is the computed value of the cumulative exposure to the matching and higher concentrations found in column 1.