January 23, 1991

DRAFT DO NOT CITE OR QUOTE

REVIEW AND COMPARISON OF DETERMINING ACCEPTABLE AMBIENT AIR CONCENTRATIONS FOR VINYL CHLORIDE BASED ON CARCINOGENICITY IN TWO EPA REPORTS

There are two recent EPA documents in which estimates were derived for q1* values for vinyl chloride. In the first document (Health Effects Assessment for Vinyl Chloride, EPA, 1984, Office of Health and Environmental Assessment, EPA/540/1-86-036) the animal q1* was given as 4.23×10^{-3} (mg/kg/day) and the human q1* was given as 2.5×10^{-2} $(mg/kg/day)^{-1}$ (see Appendix 1 for determination of animal q1* value using GLOBAL86). Inhalation studies in rats were used and total tumors were used as the toxicological end point. This q1* value can be converted to units of ppm^{-1} or $(ug/m^3)^{-1}$ as follows by employing the same conversion factors used by EPA in converting animal exposures in ppm to human equivalent exposures in mg/kg/day:

1. Correction for surface area between humans and rats

$[(1/(70\text{-kg human}/.35 \text{ kg rat}))^{1/3}] * 2.5 \times 10^{-2} = 4.27 \times 10^{-3}$ $(mg/kg/day)^{-1}$

2. Adjustment for body weight of rat

$4.27 \times 10^{-3}/.35$ kg rat $= 1.22 \times 10^{-2}$ $(mg/day)^{-1}$

3. Adjustment for breathing rates of rats

$.233\ m^3/d * 1.22 \times 10^{-2} = 2.72 \times 10^{-3}$ $(mg/m^3)^{-1}$ or

2.72×10^{-6} $(ug/m^3)^{-1}$ or

2.56×10^{3} $(ug/m^3 * ppm) * 2.72 \times 10^{-6}$ $(ug/m^3)^{-1} =$

6.96×10^{-3} ppm^{-1} (EPA84 calculation was 6.80×10^{-3} ppm^{-1})

4. It was assumed that all the vinyl chloride inhaled was absorbed into systemic circulation. This is a conservative estimate.

In a more recent update (Health and Environmental Effects Profile for Chloroethene, EPA, 1985, Environmental Criteria and Assessment Office ECAO-Cinn-P155) the rat q1* was determined to be 5.04×10^{-2} (mg/kg/day) (see Appendix 2 for determination of the rat q1* value using GLOBAL86) and the human q1* was determined to be 2.95×10^{-1} $(mg/kg/day)^{-1}$. Animal studies from the same

investigator were used as in the EPA 1984 report; instead of using total tumor incidence, however, angiosarcomas of the liver were used as the only toxicological end point. Corrections to the dose were made since the observation period was extended after exposure stopped and an assumption was made that only 50% of the inhaled vinyl chloride was being absorbed. By using the same conversion factors above and correcting for % uptake the following inhalation q1* was determined.

1. Correction for surface area between humans and rats

$[(1/(70/.35))^{1/3}]*2.95x10^{-1}$ $(mg/kg/d)^{-1}$ = $5.05x10^{-2}$ $(mg/kg/d)^{-1}$

2. Adjustment for body weight and breathing rate of rats

$[5.05x10^{-2}$ $(mg/kg/d)^{-1}/.35kg]*.223$ m^3/d = $3.22x10^{-2}$ $(mg/m^3)^{-1}$

or $3.22x10^{-5}$ $(ug/m^3)^{-1}$

3. In this assessment EPA assumed that only 50% of the vinyl chloride was absorbed through the lungs. To correct for this the q1* value has to be multiplied by .5.

$(.5)*3.22x10^{-5}$ $(ug/m^3)^{-1}$ = $1.61x10^{-5}$ $(ug/m^3)^{-1}$

or $4.12x10^{-2}$ ppm^{-1}

The state of Mississippi is recommending a q1* value of $4.2x10^{-5}$ $(ug/m^3)^{-1}$. This value is derived from the more recent EPA report just described from the q1* value of $2.95x10^{-1}$ $(mg/kg/d)^{-1}$. This number is 2.6-fold greater than the number calculated above (1.61 $x0^{-5}$). Mississippi derived their number as follows.

$[2.95x10^{-1}$ $(mg/kg/d)^{-1}]*(.5)*(20$ $m^3/d)*(10-3mg/ug)/70$ kg = $4.21x10^{-5}$ $(ug/m^3)^{-1}$

This calculation is incorrect, since the same conversion factors used by EPA to convert experimental levels (ppm) to human exposure equivalents (mg/kg/day) were not used by the state of Mississippi to back-calculate from (mg/kg/day) to ppm or ug/m^3.

Analysis of the data used by EPA in determining a human q1* of $2.95x10^{-1}(mg/kg/day)^{-1}$ in their 1985 report

Figure 1 illustrates the relationship between liver angiosarcoma and vinyl chloride exposure in rats. No dose-response relationship is obvious. Furthermore, EPA did not use all the data in determining the q1* value. It only selected data points 0, .172, .344 and .86 mg/kg/day. There was no rationale provided why other data points were omitted. In addition, the data points

are not even taken from the same experiment. For example, data points .344 and .86 were from Maltoni et al. experiment BT15 and data point 1.719 was taken from Maltoni et al. experiment BT1. Therefore, the manner in which the q1* value was calculated is scientifically incorrect and meaningless.

In the 1985 report the length of the experiment was reported to be up to 1029 days, whereas the exposure period to vinyl chloride was for 365 days. In the transformation of experimental doses to human equivalent doses an adjustment factor of 365/1029 was used. From a biological sense this dose-averaging approach may not be appropriate. The actual time to tumor data needs to be obtained in order to make the appropriate adjustments to dose.

The first q1* value established by EPA in 1984 was based on total tumors rather than liver angiosarcomas. Although in some instances total tumors may not provide the most sensitive assessment of cancer risk, the data as shown in figure 2 do show a linear dose response relationship up to 239.1 mg/kg/day. Therefore, these data provide a much better data base to determine a human q1* value, than the data base given in the EPA 1985 report.

Discussions with EPA's Cancer Assessment Group

EPA's Office of Health and Environmental Assessment often has contractors provide health profiles and reports on various chemicals. These documents are used primarily as guidance to provide available information on the toxicity of various environmental agents and to provide the agency scientists and regulators with initial data to determine what chemicals potentially should take greater priority in being regulated. Although these documents have undergone some peer review within EPA they have not undergone the extensive scientific peer review that is usually necessary to support program office regulations. The more recent 1985 EPA report entitled "Health and Environmental Effects Profile for Chloroethene," which is being used by the State of Mississippi, is a first draft report and has the disclaimer that it is "for review purposes only and does not constitute Agency policy." Discussions with EPA scientists in the Cancer Assessment Group revealed that they are aware of the deficiencies in the approach taken in the 1985 EPA report for calculating a q1* value for vinyl chloride and that additional evaluations of the data base are necessary to derive a more scientifically sound quantitative risk assessment.

Discussion

The state of Mississippi elected to use a unit risk factor of 2.95×10^{-1} $(mg/kg/day)^{-1}$ taken from an EPA report "Health and

Environmental Effects Profile for Chloroethene" September 1985. From this value they converted the units to obtain a q1* value of 4.21x10-5 ug/m^3. This value is not appropriate to use to set acceptable ambient exposure levels to vinyl chloride for the following reasons:

1. The conversion from mg/kg/day to ug/m^3 was done incorrectly (see above). The correct conversion would reduce the unit risk by a factor of 2.6.

2. The calculation was performed using a q1* value that EPA has not endorsed. This is stated in the disclaimer in the 1985 document.

3. The data used in calculating the q1* value in the 1985 EPA report are not of sufficient quality to determine a q1* value.

   a. There is no dose-response relationship.

   b. Results from different experiments were pooled in order to get a dose response relationship without any scientific rationale provided.

   c. Only certain data points were selected for determining the unit risk without any scientific rationale provided.

   d. Two of the data points available in the original Maltoni et al. paper were not included in the 1985 EPA report. No scientific rationale was provided.

4. Vinyl chloride is known to require metabolic activation to the proximate carcinogen. These pharmacokinetic considerations were not incorporated into the dose-response data used in determining the unit risk determination in the 1985 EPA report.

5. Many other studies are available than Maltoni et al. to estimate the carcinogenic risk of vinyl chloride. These other studies should be assessed, and pharmacokinetic/biologically based models should be considered to estimate more accurately the human carcinogenic risk of exposure to vinyl chloride gas.

Conclusions

The use of the unit risk presented in the 1985 EPA report entitled "Health and Environmental Effects Profile for Chloroethene" to establish acceptable ambient levels of vinyl chloride in the air is not scientifically justifiable because of

the misuse of the data, lack of critical peer review of the methods employed in the report, and insufficient use of critical data pertinent in considering the carcinogenic risk of vinyl chloride.

Until a more scientifically sound risk assessment is performed the former q1* value of 2.72×10^{-6} $(ug/m^3)^{-1}$ from the 1984 EPA report entitled "Health Effects Assessment for Vinyl Chloride" should be used to estimate cancer risk for vinyl chloride in the air. Although there are also deficiencies in the data on which this q1* value is based, a solid dose-response relationship for total tumors (figure 2) was used to estimate risk.

APPENDIX 1

GLOBAL 86 (MAY 1986)

BY RICHARD B. HOWE AND CYNTHIA VAN LANDINGHAM

CLEMENT ASSOCIATES, INC
1201 GAINES STREET
RUSTON, LA 71270
(318) 255-4800

vinyl chloride: data taken from EPA 1984 report
(total tumors)

POLYNOMIAL DEGREE SELECTED BY PROGRAM, (POLY-DEGREE=0)
CHI-SQUARE TEST USED IN SELECTION

GROUP	DOSE	#RESPONSES OBSERVED/#ANIMALS	#RESPONSES PREDICTED
1	.000000	6/ 58	9.81
2	4.90000	10/ 59	10.69
3	23.9000	16/ 59	13.35
4	47.8000	22/ 59	16.50
5	239.100	32/ 59	34.98

CHI-SQUARE GOODNESS OF FIT STATISTIC IS 5.6876

P-VALUE FOR THE CHI-SQ TEST WITH 3 DEGREES
OF FREEDOM IS .1278379359

FORM OF PROBABILITY FUNCTION:
P(DOSE) = 1 - exp(-Q0 - Q1 * D - Q2 * D^2)

MAXIMUM LIKELIHOOD ESTIMATES OF DOSE COEFFICIENTS

Q(0) = .185324445807
Q(1) = 2.98355597998E-03
Q(2) = .000000000000

MAXIMUM VALUE OF THE LOG-LIKELIHOOD IS -163.144925015

CALCULATIONS ARE BASED UPON EXTRA RISK

GLOBAL 86 UPPER CONFIDENCE LIMITS ON RISK FOR FIXED DOSE

DOSE	MLE RISK	UPPER BOUND ON RISK	CONFIDENCE LIMIT SIZE	COEFFICIENTS FOR CONFIDENCE LIMIT
1.0000	2.97891E-03	4.22255E-03	95.0%	Q(0) = .15535 Q(1) = 4.23149E-03 Q(2) = .00000

NORMAL COMPLETION!

APPENDIX 2

A

GLOBAL 86 (MAY 1986)

BY RICHARD B. HOWE AND CYNTHIA VAN LANDINGHAM

CLEMENT ASSOCIATES, INC
1201 GAINES STREET
RUSTON, LA 71270
(318) 255-4800

vinyl chloride: data taken from EPA 1985 report
(liver angiosarcomas)

POLYNOMIAL DEGREE SELECTED BY PROGRAM, (POLY-DEGREE=0)
CHI-SQUARE TEST USED IN SELECTION

GROUP	DOSE	#RESPONSES OBSERVED/#ANIMALS	#RESPONSES PREDICTED
1	.000000	0/363	.00
2	.344000	1/119	1.17
3	.860000	5/120	2.92
4	1.71900	1/ 60	2.89

CHI-SQUARE GOODNESS OF FIT STATISTIC IS 2.8312

P-VALUE FOR THE CHI-SQ TEST WITH 2 DEGREES
OF FREEDOM IS .2427793524

FORM OF PROBABILITY FUNCTION:
P(DOSE) = 1 - exp(-Q0 - Q1 * D - Q2 * D^2)

MAXIMUM LIKELIHOOD ESTIMATES OF DOSE COEFFICIENTS

Q(0) = .000000000000
Q(1) = 2.867931930907E-02
Q(2) = .000000000000

MAXIMUM VALUE OF THE LOG-LIKELIHOOD IS -33.1407703774

CALCULATIONS ARE BASED UPON EXTRA RISK

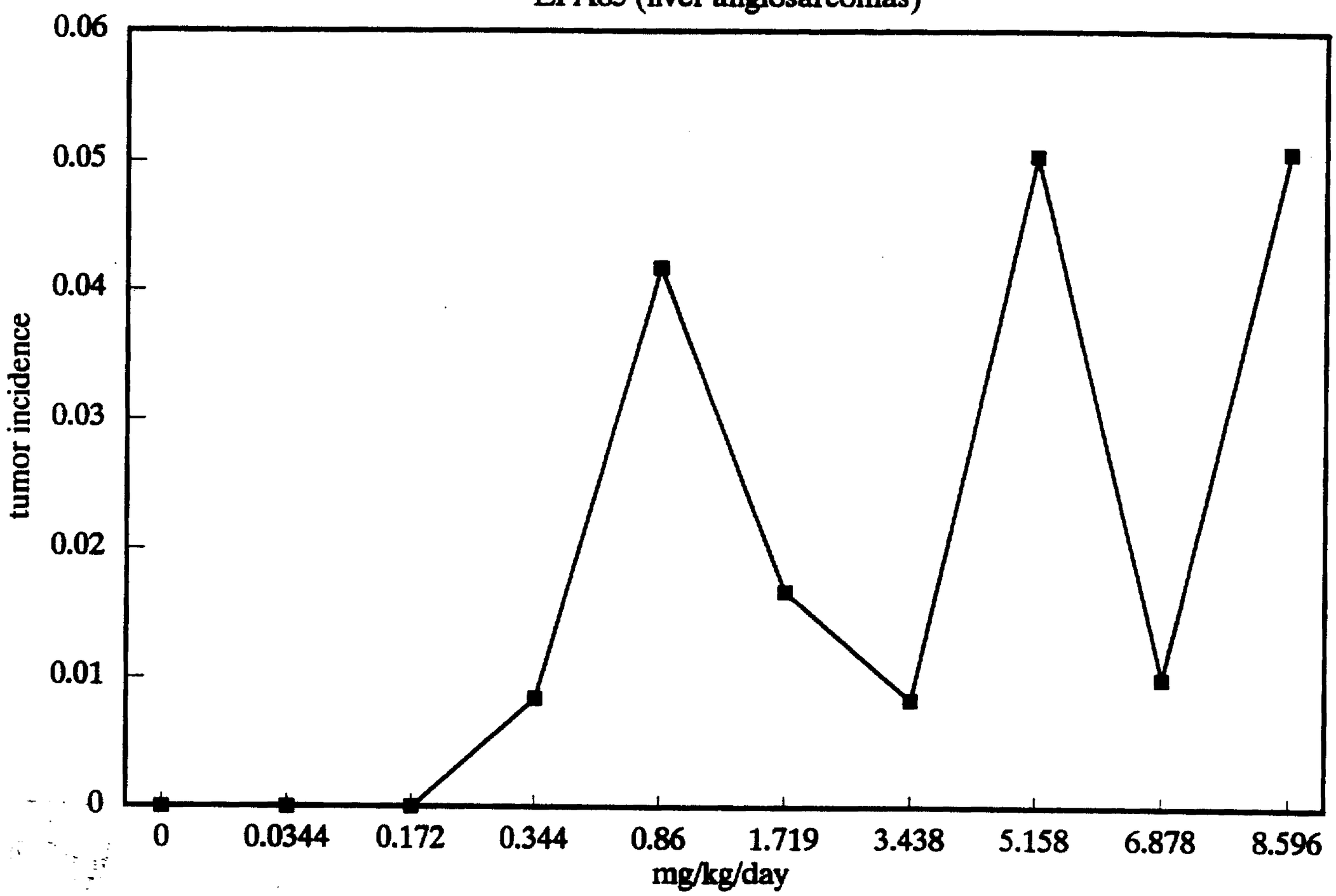
GLOBAL 86 UPPER CONFIDENCE LIMITS ON RISK FOR FIXED DOSE

DOSE	MLE RISK	UPPER BOUND ON RISK	CONFIDENCE LIMIT SIZE	COEFFICIENTS FOR CONFIDENCE LIMIT
1.0000	2.82720E-02	4.91334E-02	95.0%	Q(0) = .00000 Q(1) = 5.03816E-02 Q(2) = .00000

NORMAL COMPLETION!

VAB.0001125523

Figure 1


EPA85 (liver angiosarcomas)
tumor incidence
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.0344
0.172
0.344
0.86
1.719
3.438
5.158
6.878
8.596
mg/kg/day

Clement International Corporation

9300 Lee Highway, Fairfax, Virginia 22031
(703) 934-3500
(703) 934-3278 FAX

Facsimile Message Cover Sheet

/ /90

TO:	Frank Jeanson
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Frank, Please look This over and give me a call.

November 23, 1990

DRAFT DO NOT SITE OR QUOTE

Review and Comparison of Acceptable Ambient Air Concentrations for Vinyl Chloride Based on Carcinogenicity

There are two recent EPA documents in which estimates were derived for q1* values for vinyl chloride. In the first document (Health Effects Assessment for Vinyl Chloride, EPA, 1984, Office of Health and Environmental Assessment, EPA/540/1-86-036) the human q1* was determined to be 2.5×10^{-2} $(mg/kg/day)^{-1}$. Inhalation studies in rats were used and total tumors were used as the toxicological endpoint. This q1* value can be converted to units of ppm^{-1} or $(ug/m^3)^{-1}$ as follows:

1. correction for surface area between humans and rats

$[(1/(70kg\ human/.35\ kg\ rat))^{1/3}] * 2.5 \times 10^{-2} = 4.27 \times 10^{-3}\ (mg/kg/day)^{-1}$

2. adjustment for body weight of rat

$4.27 \times 10^{-3}/.35\ kg\ rat = 1.22 \times 10^{-2}\ (mg/day)^{-1}$

3. adjustment for breathing rates of rats

$.233\ m^3/d * 1.22 \times 10^{-2} = 2.72 \times 10^{-3}\ (mg/m^3)^{-1}$ or

[redacted]

$2.56 \times 10^{3}\ (ug/m^3 * ppm) * 2.72 \times 10^{-6}\ (ug/m^3)^{-1} =$

$6.96 \times 10^{-3}\ ppm^{-1}$

In a more recent update (Health and Environmental Effects Profile for Chloroethene, EPA, 1985, Environmental Criteria and Assessment Office ECAO-Cinn-P155) the human q1* was determined to be 2.95×10^{-1} $(mg/kg/day)^{-1}$. The same animal studies were used, only instead of using total tumor incidence, just angiosarcomas of the liver were used as the toxicological endpoint. Also, corrections to the dose were made since the observation period was extended after exposure stopped and an assumption was made that only 50% of the inhaled vinyl chloride was being absorbed. By using the same conversion factors above and correcting for % uptake the following inhalation q1* was determined.

1. correction for surface area between humans and rats

$[(1/(70/.35))^{1/3}] * 2.95 \times 10^{-1}\ (mg/kg/d)^{-1} = 5.05 \times 10^{-2}\ (mg/kg/d)^{-1}$

2. adjustment for body weight and breathing rate of rats

$[5.05 \times 10^{-2}\ (mg/kg/d)^{-1}/.35kg]*.223\ m^3/d = 3.22 \times 10^{-2}\ (mg/m^3)^{-1}$

or $3.22 \times 10^{-5}\ (ug/m^3)^{-1}$

3. In this assessment EPA assumed that only 50% of the vinyl chloride was absorbed through the lungs. To correct for this the q1* value has't to be multiplied by .5.

$(.5)*3.22 \times 10^{-5}\ (ug/m^3)^{-1}$ = [redacted] $(ug/m^3)^{-1}$

or $4.12 \times 10^{-2}\ ppm^{-1}$

The state of Mississippi is recommending a q1* value of $4.2 \times 10^{-5}\ (ug/m^3)^{-1}$. This value is derived from the more recent EPA report just described from the q1* value of $2.95 \times 10^{-1}\ (mg/kg/d)^{-1}$. As you can see this number is 2.6 fold greater than the number calculated above (1.61×10^{-5}). Mississippi derived their number as follows.

1. $[2.95 \times 10^{-1}\ (mg/kg/d)^{-1}]*(.5)*(20\ m^3/d)*(10\text{-}3mg/ug)/70\ kg$

$= 4.21 \times 10^{-5}\ (ug/m^3)^{-1}$

This calculation is wrong, since they did not back calculate to the original experimental air levels of vinyl chloride.

The Toxic Substances Control Program in the California Department of Health Services is currently recommending a unit risk of $7.14 \times 10^{-2}\ (mg/kg/d)^{-1}$ (personal communication, Dr. John Brantner, staff toxicologist, California Department of Health Services). By using the same calculation procedure that Mississippi used and using California's assumption of 42% retention of vinyl chloride by the lungs, this converts to a q1* of $8.57 \times 10^{-6}\ (ug/m^3)^{-1}$ (I was unable to get enough data to perform the correct calculations which would result in a lower q1*). The California Department of Health Services recommends this unit risk estimate to determine acceptable vinyl chloride levels at toxic waste sites. However, The California Air Resources Board is considering promolgating a q1* value of $20 \times 10^{-3}\ ppb^{-1}$ ($7.81 \times 10^{-3}\ (ug/m^3)^{-1}$). I do not have the information to determine which animal studies were used in this determination. However, the use of this value would result in the lowest acceptable ambient air concentration.

The following table provides the q1* values currently used by various states in setting ambient air concentrations considered to provide an acceptable cancer risk of 10^{-6}.

State	unit risk (q1*) $(ug/mm^3)^{-1}$	acceptable exposure (cancer risk of 10^{-6})

KS	$.26 \times 10^{-6}$	3.85 ug/m^3
KS-KC	4.1	.24
MA	2.6	.38
MI	2.5	.40
NC	2.6	.38
NY	2.5	.40
PA-Phil	0.16	6.25
TX	0.10	10.
VT	5.00	.20
EPA (old)	2.72	.37
EPA (new)	16.1	.06
CA (toxic Substances Control Program)	8.57	.11
CA (proposed by Air Resources Board)	78.1	.01
MS	42	.02

As you can see from this table many of the states are using EPA's old q1* value for determining levels not to exceed a cancer risk of 10^{-6}.

If one uses the new EPA q1* the acceptable levels would have to be reduced by a factor of 6 over the old estimates. In setting the new q1*, however, the data used looks very supicious. For example, q1* was calculated using these data points from the rat inhalation studies;

transformed dose corrected for average dose amount absorbed	incidence (liver angiosarcoma) No. responding/No. tested or examined
0.344 mg/kg/day	1/119
0.860	5/120
1.719	1/60
3.438	1/120

(4

Distribution

J. R. Ganc
January 7, 1991

AIR DISPERSION MODELING OF VCM EMISSIONS

An air dispersion model developed by the EPA was used to determine the concentration of VCM emissions in the vicinity of the Aberdeen plant for current and hypothetical operating conditions. This model was also used to determine the most effective ways to lower VCM concentrations to comply with current and future air permits.

It was shown that lowering the VCM concentration of our slurry does not lower the fenceline concentration linearly, because a significant percentage of the fenceline concentration is made up of fugitive emissions from the sphere. Although the sphere does not emit an overwhelming weight of VCM per year, its closeness to the west fenceline of the plant means its emissions are still concentrated when they reach the fenceline. Lowering the slurry concentration does lower the VCM concentrations far from our plant almost linearly, however.

Because of the location of the sphere, purchasing or otherwise insuring land on the northwest side of the plant is not used for residential purposes lowers our boundary VCM concentrations significantly. Minor alterations of the characteristics of the stacks will have some, but little effect on the fenceline concentrations.

There is still some controversy upon which unit risk factor the state will use when we apply for our newest air permit, and as such, a comprehensive strategy for obtaining this permit cannot be determined at this time.

Joseph R. Ganc
Process Engineer

cc:
Aberdeen: RWS, DCS, JDO, SCH, RBN, FJG
Houston: JCL, WLM, DLC
Austin: DP

JRG

A

Joseph C. Ledvina

VISTA

To MCH
DRB

Date 1/21/91

Attached are comments submitted to DEQ on behalf of the Virgil Institute. Vista, Go-Golf, and BF Goodrich were involved with Keller and Heckman to address the VOC emission factors. Call me if you have questions

JCL

cc: MF, RAC, FGJ ✓

VAB.0001125530

See page 8 - Follow up. A

LAW OFFICES

KELLER AND HECKMAN

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December 28, 1990

Mr. David Hughes
Louisiana Department of Environmental Quality
Office of Air Quality and Radiation Protection
Enforcement and Regulatory Compliance Division
333 Laurel Street
Commerce Building, Room 620
Baton Rouge, Louisiana 70804

Re: VI Comments Concerning a Proposed Rule to Amend the Air Quality Regulations, LAC 33:111, Chapter 51 Subchapters A, C, E, F, J, M, and V, and LAC 33:111. 6511 and 6523 (LOG NUMBER AQ12)

Dear Mr. Hughes:

Keller and Heckman is pleased to submit comments on behalf of the Vinyl Institute (VI), a division of the Society of the Plastics Industry, Inc. (SPI)1/ concerning the Louisiana

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1/ SPI is a 2,000 member not-for-profit trade organization representation all segments of the plastics industry in the United States. The Society's members include processors and manufacturers of plastics and plastic products, suppliers of raw material, processors and converters of plastic resins and manufacturers of accessory equipment for the plastic industry. Founded in 1937, SPI is the major national trade association of the plastics industry.

Members of the Vinyl Institute include the BF Goodrich Company, Borden Chemicals and Plastics Industries, CertainTeed Corporation, The Dow Chemical Company, Georgia Gulf Corporation, Occidental Chemical corporation, PPG Industries,

Department of Environmental Quality's (DEQ) proposed Comprehensive Toxic Air Pollutant Emission Control Program (Proposed Rule).2/

As an initial matter, the VI requests that the period for submission of comments be extended because the VI has not had sufficient time to poll its members concerning an appropriate unit risk factor for vinyl chloride. DEQ did not publish notice concerning the proposed rule until November 28, 1990, and required interested parties to submit comments no later than December 27, 1990. See, La. Reg. Vol. 16, No. 11 (Nov. 20, 1990). The short comment period provided by DEQ did not permit the VI to prepare comprehensive comments. The VI will summit additional comments, after polling its members, which will recommend an appropriate unit risk factor based on existing toxicological data and address other issues.

In the present comments, the VI will address the proposed ambient air standard for vinyl chloride of 1.19 $\mu g/m^3$. LAC 33:III.5105 at Table 51.2. As will be discussed more fully below, this ambient air standard is not supported by the administrative record in this rulemaking. In fact, unit risk factors for vinyl chloride listed in the administrative record result in significantly higher ambient air standards than 1.19 $\mu g/m^3$. Moreover, DEQ did not provide sufficient notice concerning the state's development of a unit risk factor and ambient air standard for vinyl chloride to allow affected parties to adequately comment on these values.

DISCUSSION

A. Regulatory Background

Act 184 requires the Secretary of DEQ to prepare an initial list of 100 toxic air pollutants (TAPs) proposed for regulation under provisions of the Act. See, R.S. 30:2060(a)(1). Vinyl chloride appeared on the proposed list of 100 TAPs to be regulated under Act 1984. See, La. Reg. Vol. 15, p. 73 (January 20, 1990). DEQ published a "Development

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Inc., PW Resins, Shintech, Inc., and Vista Chemical. Members of the Vinyl Institute account for approximately 82% of the domestic production of vinyl chloride and 63% of the domestic production of polyvinyl chloride.

2/ The Proposed Rule amends the Air Quality Regulations at LA ADMIN. Code title 33, Part III, Chapter 51, Subchapters A, C, E, F, J, M, and V and LAC 33: III.6511 and 6523 (AQ12).

Document* on March 27, 1990, which was designed to provide details on the information and procedures employed in developing the initial list of 100 TAPs to be regulated under Act 184.3/ The SARA Title III (Emergency Planning and Community Right-To-Know Act of the Superfund Amendments and Reauthorization Act of 1986) Section 313 list of over 300 substances served as the principal basis for determination of the universe of toxic substances that would be candidates for the list of 100 TAPs. See, D.D. at 4.4/ This list was then reduced to account only for those substances known or reasonable expected to be emitted into the air in Louisiana. See, D.D. at 4. Then, four criteria were used to evaluate whether the remaining substances should be listed. These were: emission levels, human health effects, population exposure, and persistence or accumulation in the environment. See, D.D. at 4.

From the rankings of the three classes of substances, the list was narrowed to the 100 of greatest regulatory concern. The conclusion in the Development Document concerning vinyl chloride and other substances are based on a report by Dr. Barbara Shane and Ms. Suzanne Gardner of Louisiana State University under contract to the DEQ. See, D.D. at 7 and 11.5/

On November 20, 1990, DEQ provided public notice regarding the proposed rule which recommends regulations for the control of emissions of the 100 TAPs, including vinyl chloride, compiled previously. An ambient air standard of 1.19 $\mu g/m^3$ is proposed for vinyl chloride. See, LAC 33:III. 5105 at Table 51.2. No owner or operator of a stationary source may cause, allow, or permit vinyl chloride emissions to cause ambient air concentrations of vinyl chloride off the source's property to exceed this ambient air standard. Id. at § 5105 D.2.

3/ Louisiana Department of Environmental Quality, Office of Air Quality and Nuclear Energy, Development Document for the Initial List of 100 toxic Air Pollutants Proposed to be Regulated Under Act 184 (March 27, 1990).

4/ D.D. refers to the DEQ Development Document.

5/ B. Shane and S. Gardner, Assessment of Air Toxics Released in Louisiana in 1987, (1989) Louisiana State University. Hereinafter, this report will be referred to as the Shane and Gardner Report.

B. The Administrative Record Does Not Support DEQ's Ambient Air Standard For Vinyl Chloride

The administrative record in this rulemaking does not support the ambient air standard for vinyl chloride because the unit risk factors for vinyl chloride discussed in the Shane and Gardner report and the Development Document are significantly greater than the unit risk factor DEQ applied in the proposed rule. In addition, the unit risk factor in the Development Document is based on oral rather than inhalation toxicology studies and is, therefore, inappropriate for regulation of emissions of vinyl chloride to the ambient air.

First, it seems appropriate to discuss the method by which DEQ calculates ambient air standards. DEQ notes in the proposed rule that the ambient air standards are based on unit risk factors and a residual risk of one in ten thousand. See, LAC 33:III.5105 at Table 51.2 (explanatory notes). No unit risk factors are listed in the proposed rule, but they can be found in the Shane and Gardner Report and the Development Document. For example, the unit risk factor for benzene is listed in both the Shane and Gardner Report and the Development Document as 8.3×10^{-6} $\mu g/m^3$. See, Shane and Gardner at 72. and D.D. at 34. When the residual risk of 1×10^{-4} is divided by benzene's unit risk factor, the ambient air standard of 12 $\mu g/m^3$ results. See, LAC 33:III.5105 at Table 51.2.

The Shane and Gardner report lists a unit risk factor of 2.6×10^{-6} $\mu g/m^3$ for vinyl chloride. See, Shane and Gardner at 72. This unit risk factor appears to be derived from a 1984 Environmental Protection Agency (EPA) unit risk factor of 2.5×10^{-2} $(mg/kg/day)^{-1}$ 6/ When the residual risk is divided by this unit risk factor an ambient air standard of 38.5 $\mu g/m^3$ results. Clearly, the Shane and Gardner unit risk factor for vinyl chloride was not used to calculate the ambient air standard for vinyl chloride in the proposed rule.

The Development Document lists a unit risk factor of 4.2×10^{-5} $\mu g/m^3$ for vinyl chloride (D.D. at 34.) which is significantly greater than the Shane and Gardner value. Our review of EPA studies of vinyl chloride indicates that the

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6/ Agency for Toxic Substances and Disease Control Registry, Toxicological Profile for vinyl chloride, 1989, U.S. Public Health Service, at 81.

Development Document unit risk factor for vinyl chloride is derived from an EPA unit risk factor based on oral exposure.7/ It is inappropriate for DEQ to use the Development Document unit risk factor of $4.2x10^{-3}$ $\mu g/m^3$ to develop an ambient air standard for vinyl chloride since the unit risk factor is based on oral rather than inhalation exposure. Moreover, the Development Document unit risk factor for vinyl chloride does not produce the ambient air standard for vinyl chloride listed in the proposed rule.

The most recent unit risk factor for vinyl chloride inhalation which the VI is aware of is $4.1x10^{-6}$ $\mu g/m^3$. This unit risk factor, which appears in a 1989 EPA Office of Air Quality Planning and Standards external review draft,8/ results in an ambient air standard of 24.2 $\mu g/m^3$.

The ambient air standard for vinyl chloride of 1.19 $\mu g/m^3$ is not based on any unit risk factor in the administrative record for this rulemaking since neither the Shane and Gardner or the Development Document unit risk factors for vinyl chloride was used. Furthermore, the Development Document unit risk factor cannot be used since it is based on oral exposure. The unit risk factor necessary to generate DEQ's ambient air standard for vinyl chloride is $8.4x10^{-5}$ $\mu g/m^3$. This unit risk factor does not appear anywhere in the administrative record or in EPA documents concerning vinyl chloride. Consequently, the administrative record does not support DEQ's proposed ambient air standard for vinyl chloride.

C. Procedural Requirements

1. DEQ Must Provide Notice and Comment Rulemaking Procedures

The State of Louisiana must conduct notice and comment rulemaking on the issue of how DEQ derives the unit risk factor and ambient air standard which is the basis for the regulation

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7/ U.S. Environmental Protection Agency, Office of Research and Development, Office of Health and Environmental Assessment. Health Effects Assessment Summary Tables First Quarter FY89 (Jan. 1989); cited in U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Cancer Risk From Outdoor Exposure to Air Toxics (Sep. 1989) at 2-21.

8/ U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Cancer Risk From Outdoor Exposure to Air Toxics (Sep. 1989) at 2-21.

of emissions of vinyl chloride. DEQ cannot rely on unit risk factors developed through non-rulemaking procedures by EPA or other regulatory bodies as the basis for regulating vinyl chloride emissions before submitting any such unit risk factor and the ambient air standard derived therefrom to the notice and comment rulemaking procedures established by Louisiana law and required by the Due Process Clause of the U.S. Constitution. See, R.S. 49:951 et seq; U.S. Const. amend. V and XIV.

DEQ's establishment of a unit risk factor and ambient air standard for vinyl chloride is a rule as that term is defined in the Louisiana Administrative Procedure Act. See R.S. 49:951(6). The Act defines "rule" as:

> [A]n agency statement, guide or requirement for conduct or action ... which has general applicability and the effect of implementing or interpreting substantive law or policy, or which prescribes the procedure or practice requirements of the agency. See, R.S. 49:951(b). DEQ's establishment of a unit risk factor and ambient air standard for vinyl chloride clearly falls within the definition of "rule" since these values regulate vinyl chloride emissions and thereby implement Act 184.

The Louisiana Administrative Procedures Act requires notice and comment rulemaking procedures before an agency adopts a rule. See, R.S. 49:953. Consequently, DEQ must submit the unit risk factor and the ambient air standard for vinyl chloride to the notice and comment rulemaking procedures required by Louisiana law before relying on these values as a basis for regulating vinyl chloride.

Incorporating an EPA unit risk factor by reference will not fulfill Louisiana's notice and comment requirements since such incorporation will fail to present the basis upon which the unit risk factor rests. The affected public must be given the opportunity to comment on the unit risk factor for vinyl chloride used by DEQ and the basis for its development.

In large part, the statutory mandates requiring notice and comment rulemaking procedures stem from the Due Process Clause of the United States Constitution. U.S. Const. amend. V and XIV. Procedural due process means that procedure which is "due" in light of the circumstances and interests involved. Mathews v. Eldredge, 424 U.S. 319, 334-335 (1976). It requires

that, where a right to be heard exists, it must be accommodated at a meaningful time and in a meaningful manner. Union of Concerned Scientists v. Atomic Energy Comm'n, 499 F. 2d 1069, 1081 (D.C. Cir. 1974). In determining whether procedure in a particular case affords due process, a court must consider the interest at stake for the individual, the risk of erroneous deprivation of the interest, the probable value of additional or different safeguards, and the interest of government in using current procedures rather than additional or different procedures. Mathews v. Eldridge, 699 F. 2d 129, 134-135 (3d Cir. 1983), cert. denied 467 U.S. 1259 (1984).

Here, Louisiana law requires that DEQ provide legally adequate notice and an opportunity to comment on DEQ's establishment of a unit risk factor and ambient air standard for vinyl chloride. However; even without these provisions, DEQ is constitutionally required to provide notice and permit affected entities to comment and have a real opportunity to present evidence and arguments that will inform the State's decision makers before they make a final determination.

Moreover, notice and comment procedures are absolutely essential to protect the due process rights of affected entities in this case because DEQ states that it is relying on an EPA unit risk factor for vinyl chloride which did not result from a notice and comment rulemaking process. If DEQ wants to rely on EPA's unit risk factors without subjecting these values to notice and comment rulemaking procedures, then DEQ should only rely on EPA's unit risk factors developed during formal public rulemakings undertaken pursuant to the Clean Air Act. See, 42 U.S.C. §§ 7401-7642 et seq. Such EPA unit risk factors could be legitimately used by DEQ because: (1) notice and comment rulemaking procedures are used by EPA and (2) EPA should develop the unit risk factors based on inhalation effects when considering substances for regulation under the Clean Air Act, and (3) Louisiana would be acting under derivation authority under the Clean Air Act.

If EPA had gone through notice and comment rulemaking procedures concerning a unit risk factor for vinyl chloride, then Louisiana's obligation to implement similar procedures would be reduced. The need for notice and comment on any unit risk factor for vinyl chloride is further emphasized by the fact that there is no unit risk factor for vinyl chloride on EPA's Integrated Risk Information System (IRIS) database, indicating that there is no consensus within EPA as to a unit risk factor for vinyl chloride.

2. Substantial Evidence Requirement

DEQ cannot establish an ambient air standard of 1.19 $\mu g/m^3$ for vinyl chloride since there is a lack of substantial evidence in the administrative record for this rulemaking to support this value. As our previous discussion demonstrates, the Shane and Gardner and Development Document unit risk factors can not be used to generate DEQ's proposed ambient air standard for vinyl chloride. Moreover, the proposed rule does not list a unit risk factor for vinyl chloride or explain where the unit risk factor implemented by DEQ can be found. Consequently, DEQ's establishment of an ambient air standard for vinyl chloride of 1.19 $\mu g/m^3$ based on a unit risk factor of 8.4×10^{-5} $\mu g/m^3$ is arbitrary and capricious since there is a lack of substantial evidence to support such values.

CONCLUSION

The VI opposes the proposed ambient air standard for vinyl chloride because there is a lack of substantial evidence to support this standard. For the reasons discussed above, DEQ must provide full notice and comment rulemaking procedures concerning the development and underlying scientific bases for the unit risk factor for vinyl chloride. VI plans to submit an appropriate unit risk factor for vinyl chloride, based on existing data, in later comments. While the VI does not support the Shane and Gardner Report unit risk factor, it is the only unit risk factor for vinyl chloride in the record which is based on an EPA unit risk factor for inhalation. The Development Document unit risk factor is based on a unit risk factor based on oral exposure and is, therefore, not a valid value for regulation of vinyl chloride emissions.

Finally, the relationship between subchapter F on vinyl chloride and the general provisions of subchapter A are unclear. Given the recent passage of the Clean Air Act Amendments, we strongly urge that Louisiana defer finalizing any air toxics regulations until the regulatory framework of the federal system is in place.

Sincerely,

Peter L. de la Cruz/sse

Peter L. de la Cruz
General Counsel

Vinyl Institute

AIR DISPERSION MODELING OF ABERDEEN VCM EMISSIONS

Our plant has recently had some trouble in obtaining air permits allowing our current operation. This report details some aspects of the theoretical concentrations of VCM in the vicinity of our plant, as determined by the same mathematical model that would be used by a regulatory agency to determine compliance.

VCM SOURCES ON THE PLANT SITE

A great deal of engineering work has been done and will be done to reduce the VCM concentration in the slurry. Reducing VCM in the slurry reduces the emissions of all the equipment downstream from the reactors, i.e. the stacks, but does not affect the emissions from the fugitive sources, i.e. the sphere, ponds, and reactors. piping VCM concentrations for different slurry concentrations are shown in figures 1-3.

To learn the nature of the contributions that different sources make to the VCM concentrations at various locations the sources were divided into logical groups, and the VCM concentrations contributed by each of these were determined. These group contributions are shown in figures 4-7.

Also of interest is the location of residences in the vicinity of our plant. These are shown, with VCM concentrations of the three different slurries overlaid, in figures 8-10.

The highest concentrations at the fenceline and at the residence with the highest concentration are of importance and are tabulated:

source	emissions (lb/yr)	max. fenceline concentration ($\mu g/m^3$)	max. residence concentration ($\mu g/m^3$)
fugitive sources	3000	5.81	0.4
25 ppm			
stacks	12600	2.10	0.7
plant	15600	7.90	1.1
100 ppm			
stacks	50400	7.33	2.6
plant	53400	13.13	3
200 ppm			
stacks	100800	14.30	4.6
plant	103800	20.11	5

Notice that the fugitive sources contribute little to the VCM concentration at the closest residence, but contribute a great deal to the fenceline concentration, especially at low slurry concentrations. The fenceline contributions from the fugitive sources come largely from the sphere; it does not contribute an overwhelming weight of VCM per year *but because its emissions must only travel about fifty feet, they are still highly concentrated when they get to the fence.* Our plant is caught in an unfortunate set of circumstances; the wind often blows to the northwest, the shortest distance for most of the stacks to the fenceline is west, the sphere lies northwest from the stacks, and to the west is one of the few places where our fenceline is our property line.

BEHAVIOR OF THE STACKS

It has been suggested that one of the possible ways to lower our fenceline concentrations was to alter characteristics of the stacks, i.e. their height, diameter, or exit velocity. A model was run where all of the exit velocities of the major stacks (dump screeners and blend tanks) was (arbitrarily) doubled. This model showed that the maximum fenceline concentration dropped to 11.2 $\mu g/m^3$ for a 100 ppm slurry, or a drop of only 15%. Furthermore, since VCM is heavier than air, at longer distances it will eventually settle, and as such, long-range concentrations will not change much. It was assumed that lowering the stack diameter or raising the stack height affected the concentrations in a similar manner.

Each of the stacks on the plant site of course has different characteristics. Currently, the blend tanks and the dump screeners contribute the largest percentage of the emissions. The model was run to determine what percentage of the maximum fenceline concentration each of the major stacks is responsible for. The results are shown in figure 11.

This figure points out that some stacks contribute VCM to the fenceline concentration in disproportionally large or small amounts. The D300 dump screener and the 503 blend tank contribute higher amounts to the fenceline concentration than they should, while the D745 screener contributes considerably less than it should, based on their emission rates. While some of this explanation is due to location (D745 is 250 feet further from the maximum fenceline concentration point than D300) some is also due to stack design. D300 has the shortest stack and the lowest flow of air of the screeners.

Note that only minimal work has been done in this area so far, as there is an almost infinite variety of different combinations of different stack heights, exit velocities and stack diameters to try. Considering altering the stacks could be very expensive, this

does not represent the most efficient way to lower the fenceline concentrations, and is certainly not capable of lowering them by an order of magnitude. However, it might be possible to pursue this further if we are close to a concentration that is desirable. It is also possible that reproportioning the air flow to each blend tanks could lower the fenceline VCM concentrations somewhat.

UNIT RISK FACTORS AND EXCESS CANCER BURDENS

Generally the excess cancer risk to humans for exposure to given concentrations of a certain carcinogen is evaluated by using toxicological studies on laboratory animals. Unfortunately, there is controversy in the interpretation of these studies, and as a result there is tremendous disparity in the unit risk factors for different states. The unit risk factors that may be applicable to us now or in the future are listed below, along with the minimum concentration that gives an unacceptable cancer risk:

State	Unit Risk Factor $(\mu g/m^3)^{-1}$	maximum exposure (cancer risk of 10^{-4}) $(\mu g/m^3)$
Mississippi Current value	$42 \quad 10^{-6}$	2.38
EPA New value	$16.1 \quad 10^{-6}$	6.21
EPA Old Value	$2.72 \quad 10^{-6}$	36.8
California Proposed value	$78.1 \quad 10^{-6}$	1.28

Mississippi's current unit risk factor was given to us by the state and touched off this whole air permit dilemma. Dr. Peter Voytek, an environmental consultant currently employed by our company, insists that Mississippi based their number on a new toxicological study used by the EPA, but that Mississippi's unit risk factor was calculated incorrectly from that study. Voytek thinks that the unit risk factor correctly deduced from this study should be equal to the EPA new value.

Furthermore, Voytek thinks that the study that the EPA bases its new unit risk factor on is severely flawed, and has not undergone sufficient scientific review as yet. He feels that the EPA should use its old unit risk value until its new one has been reviewed and

approved (if in fact it is approved). Although it may be straightforward to convince the state that a mistake in the calculation was made, convincing the EPA that scientific data that it uses are invalid may be another thing entirely.

The unit risk factor for the state of California is currently being proposed. It is included here to point out how low our fenceline concentrations would have to be if this value is later accepted throughout the country.

CONCLUSIONS AND RECOMMENDATIONS

From this report it can be concluded that several possible ways exist to get our air permit. Their effectiveness in meeting this goal varies:

1. Move our "fenceline". This fenceline might be our actual fenceline, our property line, the limit of the property on which we can purchase easements, or the limit of actual residences, and is whatever boundary the state feels will not be populated. In any event, the further you get away from our plant, the lower the concentration of VCM becomes. Buying property off our west fenceline is especially attractive because of the large drop in concentration with increasing distance in that direction.

2. Get the State of Mississippi to agree to lower their unit risk factor. This is discussed in more detail above. I personally cannot judge the effectiveness of haggling with government bureaus. Any effort spent in this area is a gamble; if we can convince the state to lower its unit risks, then we could possibly get our permit with no further effort. If we do not, then the effort is wasted. There is also nothing that prevents the EPA from adopting a new unit risk factor at any time, either.

2. Apply for an air permit with lower slurry VCM levels than the 250 ppm originally proposed. This method is the only real way to lower distant concentrations (concentrations at great distances are linearly related to the slurry concentration). Of course, we must be capable of meeting our permit levels in our standard operations.

3. Lower the emissions of our fugitive sources, especially the sphere. This would present legal difficulties as much as anything since our current reported values are theoretical and are based on the previous determination of the emission rate of an average valve or flange in our plant. I do not know if changing the emission rate of fugitive sources as far as the state is concerned is reasonable. This method would be effective in lowering our fenceline concentrations for the

current location of the fenceline, but would not be good for much else.

4. Change characteristics of the stacks. This could possibly include increasing the height, decreasing the diameter, or increasing or reproportioning the air flow rate in the stacks. Further analysis could be done to identify the most cost-effective ways to lower the fenceline concentrations. This method could only decrease the fenceline concentrations a little bit, and might be employed to "fine tune" the fenceline concentration. This method has a negligible effect on the long range concentration.

INHALATION RISK ASSESSMENT

An inhalation risk assessment was conducted for off-site exposures to vinyl chloride emissions from the Vista Polymers plant in Aberdeen, Mississippi. The potential inhalation risks were calculated by combining a unit risk factor for vinyl chloride with dispersion modeling results of emissions from the Vista Polymers plant. The dispersion modeling was conducted by personnel at the Vista Polymers plant and results were provided to Clement International, Inc. for use in the risk assessment.

Ambient air concentrations associated with vinyl chloride emissions were determined using the Industrial Source Complex Short-Term (ISCST) air dispersion model. ISCST is an EPA recommended model for use in industrial settings such as the Vista Polymers plant. The ISCST model was run in the regulatory default mode which automatically selects model options recommended for use by the EPA. Meteorological data from the Montgomery Alabama National Weather Service station, for the years 1966 to 1970 were used in the ISCST model. A separate model run was conducted for each of the five years of meteorological data using a polar grid with 36 radials (10 degrees of arc per radial) and receptors placed at 100, 150, 200, 300, 400, 500, 750 and 1000 meters from the plant along each radial.

Emissions from the plant were characterized in the ISCST model by 34 separate emission sources. These sources included both controlled stack emissions modeled as point sources, and fugitive emissions modeled as both volume and area sources. Analysis of the ISCST model results for each of the five years of meteorological data indicated that the 1970 data resulted in the highest annual average concentration for off-site receptors. A second ISCST model run was then conducted using the same emissions inputs and model options with a cartesian grid of receptor points at 200, 400, 600, 800, 1000, 1250, 1500, 1750, 2000, 3000, 3500, 4000, and 5000 meters from the plant in all directions. This resulted in model predictions of annual average concentrations at 676 receptors around the plant. The results from this model run were used by Clement International, Inc. in the inhalation risk assessment.

The first step in the inhalation risk assessment was to identify the receptor locations to be evaluated. Two receptor grids were constructed for evaluation. In the first receptor grid model receptors located within the fence line boundaries of the plant were eliminated from the evaluation. In addition, model concentrations for receptors beyond 3500 meters from the plant were also eliminated from the evaluation because the concentrations would result in negligible inhalation risks relative to the closer receptor locations evaluated and in the majority of cases they were beyond the populated areas around the plant. The second grid used in the inhalation risk assessment used the same receptor locations as the first with the exception

that receptors located within the plant boundaries but outside of the fence line were excluded.

For both of the grids evaluated in the inhalation risk assessment the maximum and average model predicted annual average concentrations were used. The average concentration used in the evaluation was the arithmetic average of all model predicted annual average concentrations for the receptors within each grid evaluated. Note that the use of an arithmetic average assumes an equal weighting of all model predicted concentrations. However, the spacing of the receptor grid increased with distance from the plant, while model predicted concentrations decreased with distance from the plant. Thus the average concentration used in this assessment is conservative since a regular spacing of the grid out to 3500 meters from the site would have included many more concentrations with lower values than those predicted for receptors located within 1000 meters of the plant, resulting in a lower arithmetic average concentration.

The ISCST model results used in the inhalation risk assessment were based on a 200 parts per million (ppm) vinyl chloride content in the slurry. The risk assessment however was conducted for a 150 ppm and 400 ppm vinyl chloride slurry concentration. According to VISTA Polymer personnel the model results could be scaled for the changes in vinyl chloride slurry content. VISTA Polymer personnel indicated that emissions from only a portion of the 34 sources evaluated in the ISCST model would be affected by changes in the slurry content. They had configured the ISCST model to calculate receptor concentrations separately for two source groups. One source group represented emissions from the 19 sources (source numbers 1-19) that were affected by slurry content. The second source group represented the 15 remaining sources (source numbers 20-34) whose emissions were unaffected by slurry content. The concentration at a receptor for all modeled vinyl chloride emissions from the plant is then the sum of the concentration at the receptor for each source group. VISTA Polymer personnel provided the following algorithm to convert the 200 ppm slurry results to the desired slurry content:

$$\chi_t(x,y) = \chi_1(x,y) + \chi_2(x,y) * \frac{DSC}{200}$$

where:

χ_t = concentration at a point due to all sources combined, (ug/m^3),

χ_1 = concentration at a point due to source numbers 20 to 34, (ug/m^3),

χ_2 = concentration at a point due to source numbers 1 to 19, (ug/m^3),

DSC = the desired concentration of vinyl chloride in the

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* VCH EMISSIONS SURVEY *
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VISTA CHEMICAL COMPANY
ABERDEEN, MISSISSIPPI

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* VCH EMISSIONS SURVEY *
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EMISSIONS SUMMARY REPORT

UNIT: VCH - ENTIRE PLANT
DATES MONITORED: 11/28/88 - 12/2/88

ESTIMATE OF FUGITIVE EMISSIONS USING ALL AVAILABLE EMISSION FACTORS

EMISSION METHOD USED (ALL IN POUNDS/YEAR)

SOURCE	SER	TOTAL COMPONENTS	AVERAGE SCCM FACTORS	LEAK/NO LEAK FACTORS	STRATIFIED FACTORS	E.P.A. CORRELATIONS USING "DEFAULT ZERO" FACTORS	E.P.A. CORRELATIONS USING "DEFAULT ZERO" FACTORS FROM BAGGING DATA
Valves	Gas	850	91585.8	7879.42	2328.06	[redacted]	0.696 NDA
	LL	757	100448.59	24999.19	4463.87	7280.29	1.16 [redacted]
	NL	0	0	0	0.00	0.00	0.00
Pump Seals	LL	27	25709.72	6257.18	1022.44	[redacted]	NDA
	NL	0	0	0	0.00	0.00	0.00
Compressor Seals	Gas	12	52728.19	29718.23	2523.38	[redacted]	NDA
Relief Valves	Gas	0	0	0	0.00	0.00	0.00
Flanges	All	6994	190281.39	8104.21	4000.99	13098.27	[redacted]
Open-ended lines	All	0	0	0	0.00	0.00	0.00
Total			383754	67958	14532	21293	3007.71

NDA: BAGGING DATA DID NOT YIELD STATISTICALLY DIFFERENT EMISSION RATE FROM THAT OF EPA "DEFAULT ZERO" RATE.

NDA: NO DATA OR NOT ENOUGH DATA AVAILABLE TO MAKE STATISTICAL COMPARISON TO EPA "DEFAULT ZERO" EMISSION RATES.

NOTES:

ALL EMISSION ESTIMATES ASSUMED 8,760 HOURS OF OPERATION ANNUALLY.

ALL EMISSION ESTIMATES BASED ON 100% VCH IN STREAM.

"DEFAULT ZERO" EMISSION RATES BASED ON BAGGING DATA WERE CONSERVATIVE DUE TO THE FACT THAT LEAK RATES DUE TO BACKGROUND WERE NOT ACCOUNTED FOR.