EXHIBIT V-7

USDOL/OSHA

ESTIMATED INDUSTRY COSTS OF ACHIEVING A 50 PPM TARGET VCM CEILING LEVEL
IN PVC PLANTS AS CLAIMED BY INDUSTRY AND ASSESSED BY SNELL

Snell assessment of VCM level potentially achieved[1]. Same as industry claimed.
Total plants in sample: 23
Processes represented[2]: S, E, B, SO
Location of plants in sample[3]: 5W, 18C

Age of plants in sample:	Range, Years	0 - 5	6 - 10	11 - 15	16 - 20	21 - 25	> 26
	No. of Plants	2	10	2	4	2	3

Capacity of sample - millions lbs. per year (percent 1974 U.S. nameplate capacity): 3,750 (69%)
Percent industry claimed capacity from sample for which management will seriously consider plant shutdown at a 50 ppm VCM ceiling: 0%
Snell estimate of percent capacity from sample for which management will seriously consider plant shutdown at a 50 ppm VCM ceiling: Negligible

Direct Costs	Capital ($/1,000 Lb.)	Annual ($/1,000 Lb.)	Percent of Total Annual Cost
I. Engineering Costs[4]	$1.69	0.93[5]	17%
II. Personal Equipment Costs[6]	0.16	0.23[7]	4
III. Monitoring	0.70[8]	0.74[7,8,9]	14
Total Direct Costs	$2.55	$1.90	35%
Productivity Loss[10]	$6.53	$3.48	65%
Total Costs	$9.08	$5.38	100%

Notes: (1) Snell estimate of VCM levels achieved in plants incorporating the level of control effort represented in the Exhibit. Monitoring data is detailed in Appendix B.
(2) S = Suspension, E = Emulsion, Dispersion, B = Bulk, SO = Solution.
(3) W = Sited in warm climate, C = Sited in cold climate (U.S. 26C, 10W).
(4) Includes ventilation, loading, reactor cleaning, stripping and other (piping, general pumps, maintenance, etc.).
(5) Includes capital amortized @ 12% - 10 yrs. and O&M charges.
(6) Includes breathing equipment and clothing.
(7) Includes capital amortized @ 12% - 5 yrs. and O&M charges.
(8) Includes area and personal monitoring equipment.
(9) Includes medical and recordkeeping costs.
(10) Productivity loss is the industry average annual cost of additional capacity, personnel, etc. to maintain industry capacity levels unimpacted by OSHA regulations; an example is shown in Exhibit C-3.

Source: Industry interviews and Snell estimates.

EXHIBIT V-8

USDOL/OSHA

ESTIMATED INDUSTRY COST OF ACHIEVING A 25-40 PPM VCM TARGET CEILING AND 15-25 PPM TWA LEVEL IN PVC PLANTS AS CLAIMED BY INDUSTRY AND ASSESSED BY SNELL

Snell assessment of VCM level potentially achieved[1] same as industry claimed
Total plants in sample: 17[2]
Processes represented[3]: S, E, B
Location of plants in sample[4]: 5W, 12C

Age of plants in sample:	Range, Years	0 - 5	6 - 10	11 - 15	16 - 20	21 - 25	> 26
	No. of Plants	2	8	1	3	2	1

Capacity in Sample - Millions lbs. per year (Percent 1974 U.S. nameplate capacity): 2,801 (52%)
Percent industry claimed capacity from sample for which management will seriously consider plant shutdown at a 25-40 ppm ceiling and 15-25 ppm TWA VCM level: ≈ 4% of original 23 plant sample

Direct Costs	Capital ($/1,000 lb.)	Annual ($/1,000 lb.)	Percent of Total Annual Cost
I. Engineering Costs[5]	$7.18	$2.19[6]	26%
II. Personal Equipment Costs[7]	1.01	0.70[8]	8
III. Monitoring	0.67[9]	0.76[8,9,10]	9
Total Direct Cost	$8.86	$3.65	43%
Productivity Loss[11]	$9.38	$4.87	57%
Total Costs	$18.24	$8.52	100%

Notes:
(1) Snell estimate of VCM levels achievable in plants incorporating the level of control effort represented in the Exhibit. Monitoring data is detailed in Appendix B.
(2) Four plants not in this cost sample did not report cost estimates for these conditions but provided an analysis for a lower target VCM level. Two plants not in this sample did not provide cost estimates for this and lower levels; one reported being endangered, the other had not completed an analysis.
(3) S = Suspension, E = Emulsion, Dispersion, B = Bulk, SO = Solution.
(4) W = Sited in warm climate, C = Sited in cold climate (U. S. 26C, 10W).
(5) Includes ventilation, loading, reactor cleaning, stripping and other (piping, general pumps, maintenance, etc.).
(6) Includes capital amortized @ 12% - 10 yrs. and O&M charges.
(7) Includes breathing equipment, clothing, showers, and eating facilities.
(8) Includes capital amortized @ 12% - 5 yrs. and O&M charges.
(9) Includes area and personal monitoring equipment.
(10) Includes medical and recordkeeping costs.
(11) Productivity loss is the industry average cost of additional capacity, personnel, etc. to maintain industry capacity levels unimpacted by OSHA regulations, excluding plants which reported inability to meet the standard. An example is presented in Exhibit C-3.

Source: Industry interviews and Snell estimates.

EXHIBIT V-9

USDOL/OSHA

ESTIMATED INDUSTRY COST OF ACHIEVING A 15-25 PPM VCM CEILING AND 10-15 TWA PPM TARGET LEVEL IN PVC PLANTS AS CLAIMED BY INDUSTRY AND ASSESSED BY SNELL

Snell assessment of VCM level potentially achieved[1]. Same as industry claimed.
Total plants in sample: 16[2]
Processes represented[3]: S, E, B
Location of plants in sample[4]: 4W, 12C

Age of plants in sample:	Range, Years	0 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26
	No. of Plants	1	7	1	3	2	2

Capacity in sample - millions lbs. per year (percent 1974 U.S. nameplate capacity): 2,600 (48%)
Percent industry claimed capacity from sample for which management will seriously consider plant shutdown at a 25 ppm ceiling and 10-15 ppm TWA VCM level: 28% of original 23 plant sample
Snell estimate of percent capacity from sample for which management will seriously consider plant shutdown at a 25 ppm ceiling and 10-15 ppm TWA VCM level: 28% of original 23 plant sample

Direct Costs	Capital ($/1,000 lb.)	Annual ($/1,000 Lb.)	Percent of Total Annual Cost
I. Engineering Costs[5]	$26.44	$7.30[6]	45%
II. Personal Equipment Costs[7]	0.48	0.76[8]	5
III. Monitoring	0.86[8]	0.95[8, 9, 10]	6
Total Direct Costs	$27.78	$9.01	56%
Productivity Loss[11]	$14.41	$7.03	44%
Total Costs	$42.19	$16.04	100%

Notes: (1) Snell estimate of VCM levels achieved in plants incorporating the level of control effort represented in the Exhibit. Monitoring data is detailed in Appendix B.
(2) The four plants not included in Exhibit V-8 provided cost estimates for this VCM target level. Five additional plants not in this cost sample reported endangered status at this level and did not provide cost estimates.
(3) S = Suspension, E = Emulsion, Dispersion, B = Bulk, SO = Solution.
(4) W = Sited in warm climate, C = Sited in cold climate.
(5) Includes ventilation, loading, reactor cleaning, stripping and other (piping, general pumps, maintenance, etc.)
(6) Includes capital amortized @ 12% - 10 yrs.
(7) Includes breathing equipment, clothing, showers, and eating facilities
(8) Includes capital amortized @ 12% - 5 yrs.
(9) Includes area and personal monitoring equipment.
(10) Includes medical and recordkeeping costs.
(11) Productivity loss is the industry average annual cost of additional capacity, personnel, etc. to maintain industry capacity level, unimpacted by OSHA regulations. This is based on those plants that expected ability to meet the claimed level, shown in the Exhibit. An example is presented in Exhibit C-3.

Source: Industry interviews and Snell estimates.

- At these levels (particularly at the high VCM target levels) engineering controls reported by industry principally addresses OSHA compliance but substantial air pollution control is judged to be an indirect benefit from "buttoning-up" of the plant, improved stripping, etc.

- Snell assessment in these Exhibits of VCM levels potentially achieved is based upon the exposure data in Section VE and Appendix B

- Exhibit V-10 provides cost analyses based on data provided by Firestone for an attempt to reach "no detectable" target VCM levels primarily using engineering controls

  .. Firestone was the only PVC producer reporting an analysis related to a "no detectable" VCM standard primarily using engineering controls

  .. Firestone concluded that meeting a "no detectable" standard primarily using engineering controls is not feasible

  .. The two Firestone plants were not included in the industry summaries for higher VCM target levels based on the findings from the statistical analysis presented in Exhibit C-4 in Appendix C for the 50 ppm ceiling target; at this level Firestone cost estimates are inconsistently high with respect to those provided by therest of the industry, possibly because these estimates include costly environmental protection measures not directly related to OSHA compliance.

- Exhibit V-10 follows page V-8.

EXHIBIT V-10

USDOL/OSHA

COST ANALYSES BASED ON DATA PROVIDED BY FIRESTONE FOR AN ATTEMPT TO REACH "NO DETECTABLE" TARGET VCM LEVELS USING ENGINEERING CONTROLS PRIMARILY

Snell assessment of VCM level potentially achieved[1]. This represents an analysis of an attempt to approach "no detectable" levels with actually achieving the level judged not feasible, based on engineering controls primarily.
Total plants in sample: 2 (Pottstown, Pa. and Perryville, Md.)
Process represented[2]: S and E
Location of plants in sample[3]: 2C

Age of plants in sample: Range, Years	0 - 5	6 - 10	11 - 15	16 - 20	21 - 25	> 26
Plants:		Perryville			Pottstown	

Capacity of plant - millions lbs. per year (percent 1974 U.S. capacity): 507 (9%)

Direct Costs	Capital Pottstown, Pa. ($/1,000 lb.)	Capital Perryville, Md. ($/1,000 lb.)	Annual Pottstown, Pa. ($/1,000 lb.)	Annual Perryville, Md. ($/1,000 lb.)	Two Plant Average Capital ($/1,000 lb.)	Two Plant Average Annual ($/1,000 lb.)
I. Engineering[4]	$142.56	$55.94	$53.60[5]	$25.79[5]	$88.40	$36.21
II. Personal Equipment[6]	8.19	0.32	1.88[7]	1.81[7]	3.27	1.84
III. Monitoring	3.85[8]	1.29[8]	3.20[7,8,9]	1.40[7,8,9]	2.25	2.07
Total Direct Costs	$154.60	$57.55	$58.68	$29.00	$93.92	$40.12
Productivity Loss[10]	$139.84	$30.35	$67.05	$15.79	$63.52	$30.66
Total Costs	$294.44	$87.90	$125.73	$44.79	$157.44	$70.78

Notes: (1) Snell estimates of VCM levels achievable in plants incorporating the level of control effort represented in the Exhibit.
(2) S = Suspension, E = Emulsion, Dispersion.
(3) W = Sited in warm climate, C = Sited in cold climate.
(4) Includes ventilation, loading, reactor cleaning, stripping and other (piping, general pumps, maintenance, etc.)
(5) Includes capital amortized @ 12% - 10 years and O&M charges.
(6) Includes breathing equipment and clothing.
(7) Includes capital amortized @ 12% - 5 years and O&M charges.
(8) Includes area and personal monitoring equipment.
(9) Includes medical and recordkeeping costs.
(10) Productivity loss is the industry average annual cost of additional capacity, personnel, etc. to maintain industry capacity levels unimpacted by OSHA regulations; an example is presented in Exhibit C-3.

Source: Firestone Case 1 (0-1 ppm VCM level) presentation to June 1974 OSHA hearing and Snell estimates of costs of productivity loss.

- Exhibit V-11 presents the PVC industry claimed time requirements for compliance, following page V-9

- Exhibit V-12, following Exhibit V-11, serves as a summary discussion of these findings

4. INCREASINGLY STRICT VCM COMPLIANCE REQUIREMENTS ARE EXPECTED TO RESULT IN SIGNIFICANTLY GREATER PRICE ESCALATIONS FOR PVC THAN FOR VCM

. Price analysis did not include consideration of supply/demand changes due to potential plant shutdowns at lower levels.

. The price analyses are relative to a standardized price pro forma unimpacted by OSHA compliance requirements and assess price sensitivity of OSHA compliance steps based substantially upon engineering controls.

. Exhibit V-13, following Exhibit V-12, presents the estimated impact of selected VCM standards on VCM prices.

. Exhibit V-14, following Exhibit V-13, presents the estimated impact of selected VCM standards on PVC prices.

. Exhibit V-15, following Exhibit V-14, presents estimated capital and annual costs for VCM target levels for the VCM industry.

. Exhibit V-16, following Exhibit V-15, presents estimated capital and annual costs for VCM target levels for the VCM industry.

EXHIBIT V-11

USDOL/OSHA

U. S. INDUSTRY CLAIMED TIME TO REACH SELECTED VCM LEVELS IN PVC PLANTS THROUGH ENGINEERED CONTROLS(1)

VCM Target Levels Claimed By Industry	End of Year 1974 Number of Plants	1974 Percent Capacity	1975 Number of Plants	1975 Percent Capacity	1976 Number of Plants	1976 Percent Capacity	1977 Number of Plants	1977 Percent Capacity	1978 Number of Plants	1978 Percent Capacity
50 ppm ceiling	23	100%								
25 - 40 ppm ceiling and 15 - 25 ppm TWA	-	-	1	3%	7	35%	12	48%	1	5%
15 - 25 ppm ceiling and 10 - 15 ppm TWA	-	-	-	-	5	24%	7	27(1)	4	18%
Attempt to reach "No detectable"	Not feasible based on engineering controls									

Notes: (1) Percent of sample 1974 capacity, 23 plants reporting with a total capacity of 3,750 million lbs. per year.

Source: Industry interviews by Snell

EXHIBIT V-12

USDOL/OSHA

SUMMARY OF PVC INDUSTRY COST IMPACTS, COMPLIANCE TIME AND CAPACITY ENDANGERED BY VCM TARGET LEVEL

VCM Target Level Claimed by Industry	Annual Unit Costs, ¢/Lb.(1) Direct Costs of Compliance	Costs To Made Up for Loss of Productivity	Total Costs(2)	Industry Claimed Compliance Period Required for Engineered Controls	Percent of Industry "Endangered"(3) Based on Sample
50 ppm ceiling	0.19	0.35	0.54 ± 20%	0 to 6 months	Negligible(4)
25 - 40 ppm ceiling with 15 - 25 TWA	0.36	0.49	0.85 ± 35%	2.5 years	4%
15 - 25 ppm ceiling with 10 - 15 TWA	0.90	0.70	1.60 ± 50%	2.5 years	26%
Attempt to reach "No detectable"(5)	4.01	3.07	7.08 ± 75%	2.5 to 4 years	100%

Notes: (1) Does not include additional VCM costs resulting from OSHA standard.

(2) The percentage ranges of total costs represent Snell's estimates based on partial statistical analysis of data.

(3) Endangered = Management will seriously consider plant shutdown.

(4) Temporary shutdowns for installation of controls were reported. In addition, one plant (not in sample) accelerated a planned shutdown by six months resulting in a loss of ≈50 million lbs. of PVC.

(5) Economic data based on average data shown in Exhibit V-10 for the Firestone plants which were not included in the sample for the reason explained in the text. These figures represent the costs estimated for an attempt to reach a "no detectable" VCM level, but reaching this level is judged not feasible based on engineering controls.

Source: Exhibits V-7 through V-11.

EXHIBIT V-13

USDOL/OSHA

ESTIMATED VINYL CHLORIDE ECONOMICS IMPACTED BY SELECTED VCM LEVEL STANDARDS
(1974 DOLLARS)

Item	Unimpacted by OSHA (¢/Lb.)	50 ppm Ceiling (¢/Lb.)	25 ppm Ceiling (¢/Lb.)	10 ppm Ceiling 2 - 5 ppm TWA (¢/Lb.)	Extrapoliated Costs of Attempt To Reach a VCM Level[2]
Plant investment[1]	4.08¢	4.16	4.27	4.48	11.58¢
Cost of manufacture	6.13	6.17	6.27	6.31	9.63
Selling, general and administrative expenses	0.30	0.30	0.30	0.30	0.30
Pretax profit on total investment @ 20% at 1.2 x plant investment)	0.98	1.00	1.02	1.08	2.78
Net selling price (FOB plant)	7.41¢	7.47¢	7.59¢	7.69¢	12.71¢

Notes: (1) Unit production costs for a 500 million lb. ethylene oxychlorination plant of 1974 construction with total fixed capital of $20.4 million unimpacted by OSHA costs include production loss replacement.

(2) Based on log-log straight line extrapolation of existing data to a 1 ppm VCM ceiling. This does not imply technical feasibility of engineering controls. Extrapolated costs are for attempting to reach a "no detectable" level and are used for cost sensitivity analyzing purposes only.

Source: Exhibit IV-4 for basic economics and Snell estimates for compliance levels based on Exhibits V-1 through V-4.

EXHIBIT V-14

USDOL/OSHA

POLYVINYL CHLORIDE ECONOMICS IMPACTED BY
SELECTED VCM LEVEL STANDARDS
(1974 DOLLARS)

Item VCM Standard PVC Standard	Unimpacted by OSHA	50 ppm Ceiling 50 ppm Ceiling 25-40 ppm Ceiling 15-25 ppm TWA	50 ppm Ceiling 25-40 ppm Ceiling 15-25 ppm TWA	25 ppm Ceiling 25-40 ppm Ceiling 15-25 ppm TWA	25 ppm Ceiling 25 ppm Ceiling 10-15 ppm TWA	10 ppm Ceiling 2- 5 ppm TWA 15-25 ppm Ceiling 10-15 ppm TWA	Extrapolated Costs To Attempt To Reach a "No Detectable" VCM Level(1) Firestone Analysis of Attempt To Reach "No Detectable" VCM Level(2)
Designed PVC plant capacity (millions lbs./year)	200	200	200	200	200	200	200
PVC plant investment (dollars millions)(3)	20	21.6	23.3	23.3	27.6	27.6	48.7
PVC production (millions lbs./year @ 90% utilization)	180	180	180	180	180	180	180
Plant investment per unit of production (¢/lb.)	11.1	12.0	12.9	12.9	15.3	15.3	27.0
Cost of Manufacture							
Vinyl chloride monomer(4)	8.5¢	8.5¢	8.5¢	8.6¢	8.6¢	8.7¢	12.7¢
Operating labor and supervision	0.4						
Capital recovery (@ 12% - 10 years)	2.0	6.4	6.6	6.6	7.5	7.5	13.0
All other costs (catalysts, utilities, maintenance, etc.)	3.5						
Total cost of manufacture	14.4¢	14.9¢	15.1¢	15.2¢	16.1¢	16.2¢	25.7¢
Profitability							
Cost of manufacture	14.4¢	14.9¢	15.1¢	15.2¢	16.1¢	16.2¢	25.7¢
Selling, general and administrative	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Pretax profit (@ 20% x 1.2 plant investment)	2.7	2.9	3.1	3.1	3.7	3.7	6.5
Net selling price (FOB plant)	18.6¢	19.3¢	19.7¢	19.8¢	21.3¢	21.4¢	33.7¢

Notes: (1) Based on log-log, straight line extrapolation of existing data to a 1 ppm VCM ceiling. This does not imply technical feasibility of engineering controls. Extrapolated costs are for attempting to reach a "no detectable" level and are used for cost sensitivity analysis purposes only.

(2) Based on Firestone data presented in Exhibit V-10. These figures represent the costs estimated for an attempt to reach a "no detectable" VCM level, but reaching this level is judged not feasible based on engineering controls primarily.

(3) Grass roots plant, located on Gulf Coast, producing general purpose suspension resin.

(4) VCM at price shown on Exhibit V-12 x 1.06 production shrinkage + 0.89¢/lb. transport.

Source: Snell estimates based on industry interviews and prices for VCM presented in Exhibit V-12.

EXHIBIT V-15
USDOL/OSHA
ESTIMATED CAPITAL AND ANNUAL COSTS FOR VCM TARGET LEVELS FOR THE VCM INDUSTRY AT 1974 CAPACITY (1)
(1974 DOLLARS)

Industry Claimed VCM Target Level (2)	Snell Assessed VCM Target Level (3)	Capital Costs (4) ($ Millions)			Annual Costs (4, 5) ($ Millions)		
		Direct Costs	Productivity Loss	Total	Direct Costs	Productivity Loss	Total
50 ppm ceiling	<50 ppm ceiling and 15 ppm TWA	$ 5.2	$ 1.1	$ 7.2	$ 3.0	$ 1.6	$ 4.6
25 ppm ceiling	25 ppm ceiling and 15 ppm TWA	13.0	1.2	14.2	6.3	1.7	8.0
10 ppm ceiling and 2-5 ppm TWA	10 ppm ceiling and 2 - 5 ppm TWA	26.7	7.0	33.7	11.7	9.8	21.5

(1) 1974 capacity estimated at 6,695 million lbs. per year in Exhibit III-1

(2) Compliance actions are based primarily on engineering control methods

(3) Based upon the exposure data in Section VE and Appendix B

(4) Estimates include costs of engineering controls, personal protective and monitoring equipment. Costs presented represent the estimated cumulative compliance costs for the VCM level shown in the Exhibit and were estimated by multiplying the costs presented in Exhibits V-2 through V-4 by the 1974 VCM industry capacity.

(5) Includes capital costs amortized at 12%

Source: Industry interviews and Snell estimates

EXHIBIT V-16
USDOL/OSHA
ESTIMATED CAPITAL AND
ANNUAL COSTS FOR VCM
TARGET LEVELS FOR THE PVC
INDUSTRY AT 1974 CAPACITY(1)
(1974 DOLLARS)

Industry Claimed and Snell Assessed VCM Target Level (2, 5)	Capital Costs (3) ($ Millions)			Annual Costs (3, 4) ($ Millions)		
	Direct Costs	Productivity Loss	Total	Direct Costs	Productivity Loss	Total
50 ppm ceiling	$13.9	$ 35.5	$ 49.4	$ 10.3	$18.9	$29.2
25-40 ppm ceiling and 15-25 ppm TWA	48.1	51.0	99.1	19.8	26.5	46.3
15-25 ppm ceiling and 10-15 ppm TWA	151.0	78.3	229.0	49.0	38.2	87.2

(1) 1974 capacity estimated at 5,435 million lbs. per year from Exhibit III-4.

(2) Compliance actions are based primarily on engineering control methods.

(3) Estimates include costs of engineering controls, personal protective and monitoring equipment. Costs presented represent the estimated cumulative compliance costs for the VCM levels shown in the Exhibit and were estimated by multiplying the costs presented in Exhibits V-7 through V-9 by the 1974 PVC industry capacity.

(4) Includes capital costs amortized at 12%.

(5) If the PVC industry expended the capital funds represented by the Firestone analysis of attempting to reach the infeasible "no detectable" levels, total capital costs are estimated to be of the order of $856 million based on Exhibit V-10 data.

Source: Industry interviews and Snell estimates

5. SHIFTS IN ENGINEERING CONTROL METHODS WERE REPORTED FOR DECREASING VCM TARGET LEVELS IN THE PVC INDUSTRY

- Exhibit V-17 on the following page summarizes the distribution of engineering controls for selected VCM levels.

- Exhibit C-5 in Appendix C provides a detailed discussion of the distribution of engineering controls for selected VCM levels.

* * * * *

This section presented economic impact details. The next section discusses personal protective equipment.

EXHIBIT V-17 (1)

USDOL/OSHA

SUMMARY OF THE DISTRIBUTION OF REPORTED
ENGINEERING CONTROL METHODS ESTIMATED FOR
SELECTED VCM LEVELS IN POLYVINYL CHLORIDE PLANTS

Engineering Control Method	Comments for 50 ppm Ceiling; 25-40 ppm Ceiling with 15-25 ppm TWA; and 15-25 ppm Ceiling with 10-15 ppm TWA
VCM Unloading (1)	. Modification to transport equipment may be completed by VCM supplier
Ventitation (2)	. Ventilation is used at all levels . Substantial costs are estimated to reach all target levels . Most plants have ventilation at the 50 ppm level
Reactor Cleaning (3)	. 5 of 19 plants install reactor cleaning equipment for the 50 ppm level . Most plants have reactor cleaning for the 25-40 ppm ceiling with 15-25 ppm TWA target level
Stripping (4-5)	. Three plants report expenditures > $380,000 at the 50 ppm ceiling level, probably for new systems . Seven plants report expenditures > $70,000 to reach a 25-40 ppm ceiling with 15-25 ppm TWA target level. These expenditures represent improvement to existing equipment. Three plants estimate expenditures > $350,000, probably for new systems. . At the 15-25 ppm ceiling with 10-15 ppm TWA 7 plants report expenditures > $1 million, for R&D and new systems.
Other (6)	. Extensive modification to physical plant are estimated for all levels. . At 15-25 ppm VCM ceiling with 10-15 ppm TWA expenditures of > $400,000 are estimated for such items as emergency reactor pressure relief systems (to VCM recovery) and computerized control systems.

Notes follow (Exhibit V-17 (2)

Notes:

(1) Fans, ducting, etc.

(2) Additions to unloading racks, modifications to VCM piping, unloading pumps and compressors.

(3) High and low pressure water systems and solvent cleaning systems.

(4) Tanks, pumps, piping, compressors and condensers.

(5) At the 50 ppm and 25 ppm ceiling levels stripping expenditures generally address improvements to present system to meet in plant requirements. The much larger expenditures at the 15-25 ppm ceiling and 10-15 ppm TWA levels reflect an effort to also improve the residual free monomer levels in the product.

(6) Non specific pumps, compressors piping, seals, etc.

Source:

Industry Interviews and Snell estimated from Exhibit C-5.

VB. PERSONAL PROTECTIVE EQUIPMENT AVAILABILITY AND COSTS

This section presents the estimated costs, the procurement lead times, and a summary of the available types of equipment as required by the proposed permanent standard.

1. TWO OF THE FOUR TYPES OF RESPIRATORS LISTED UNDER THE PROPOSED PERMANENT STANDARD (PPS) ARE READILY AVAILABLE FROM AT LEAST ONE EQUIPMENT MANUFACTURER

- Two of the types of OSHA listed respirators are normally available from the manufacturer in approximately 60 days from the placement of the order. These types are:

  - pressure demand full-facepiece self-contained breathing apparatus (PD)

  - combination pressure demand full-facepiece respirator and pressure demand self-contained breathing apparatus (CPD)

- If sudden orders were placed for 500 to 700 of these units, a 60 day lead time is quoted by one supplier but another indicated up to 40 weeks.

- The two other types of breathing apparatus listed in the PPS are not currently produced. Interviews with manufacturers indicate that these devices are considered wasteful of compressed air. These types are:

  - positive pressure full-facepiece self-contained breathing apparatus

  - combination continuous flow respirators and a pressure demand self-contained breathing apparatus.

2. THE REQUIRED TYPES OF RESPIRATORS PURCHASED UNDER THE 50 PPM TEMPORARY STANDARD MAY BE USED UNDER LOW VCM CEILING CONCENTRATIONS

- The purchase costs for types PD and CPD from exhibit D-8 are $515 and $615, respectively.

- The operating and maintanance costs from Exhibit D-10 range between $500 to $1,000 per man per year, with an average of data estimated at $900.

- For example, the cost of grade D or better breathable air is $15 per 310 SCF cylinder. With an air flow of 4 CFM, this amounts to a cost of $0.20/minute.

3. INDUSTRY AND THE EMPLOYEES PREFER HALF-MASK AIR LINES, CANISTER OR CARTRIDGE TYPE RESPIRATORS OVER THOSE REQUIRED BY OSHA IN THE PPS

- Industry and worker preferences and human factors are detailed in Exhibits D-1 through D-4.

- Self-contained devices are heavy, bulky, and require highly trained individuals.

- Air line respirators are much lighter than self-contained, but they require a long hose for the air supply and a complicated air distribution system.

- Cartridge and canister types are the lightest and least expensive of the three, but lifetime has not yet been fully established for atmospheres containing VCM.

- Users of cartridge or canister type masks have no way of knowing when their air purifier is no longer effective.

- Half-face mask types are more comfortable to wear than those with full-facepieces, however, they do not provide complete facial protection.

4. THE NUMBER OF COVERED WORKERS NEEDING RESPIRATORY PROTECTION INCREASES WITH A DECREASE IN PERMISSIBLE VCM CONCENTRATION LEVELS OR REQUIRE HIGHER RESPIRATORY WEARING TIMES

The following table summarizes case studies of the percentage of workers needing respiratory protection as a function of VCM permissible levels, climate of plant location, and plant type (VCM or PVC). More data appears in Exhibit D-11 of Appendix.

Plant Type	Climate of Plant Location	Ceiling VCM Level (ppm)	Percent Of Workers Needing Respiratory Protection	Percent Of Time Respiratory Protection Needed	Comments
VCM	Warm	50	15%	50%	With Engineering Controls
		25	15	50	With Engineering Controls
		10	30	75	Without Engineering Controls
		10	14	50	With Engineering Controls
		1	100	100	With Engineering Controls
PVC	Warm	50	75	1	With Engineering Controls
		25	100	3	With Engineering Controls
		10 ppm TWA +25 ppm ceiling	100	25	With Engineering Controls
		1	NA	NA	With Engineering Controls
	Cold	50	100	10	Without Engineering Controls
		25	100	25	Without Engineering Controls
		1	100	100	Without Engineering Controls

Source: Exhibit D-11 and Snell Assessment

5. MOST OF THE TYPES OF PROTECTIVE CLOTHING ARE AVAILABLE WITHIN FOUR WEEKS FROM ORDER PLACEMENT

- Disposable clothing, hoods, shoe covers, gloves and overalls are available within one week from the manufacturers including one piece pressurized suits, as shown in Exhibit D-9.
- Permanent (reusable) work clothing is also available within one month of order.
- Full impervious pressurized suits however, have a procurement lead time of at least two months.

6. COSTS FOR PROTECTIVE CLOTHING VARY WITH TYPE, WITH A LOW OF $3.50 FOR DISPOSABLE CLOTHING TO A HIGH OF $178 FOR A PERMANENT, IMPERVIOUS,FULL PRESSURIZED SUIT

- A full suit of disposable clothing including coveralls, hoods, shoe covering, and gloves costs approximately $3.50.

- Permanent work clothing costs in the neighborhood of $40.00 per worker for a full suit of clothing including coveralls, gloves and boots.

- A permanent impervious full pressurized work suit which can be worn with an air mask costs $178. Industry believes that routine use of these is not feasible on grounds of human factors, indicated in Exhibit D-5 and concluded from the Snell industry interviews.

- The cost of cleaning a suit of permanent work clothes is in the range of $1.00 to $1.50 per suit, per worker, per day.

* * * * *

The next section deals with monitoring equipment.

VC. MONITORING EQUIPMENT AVAILABILITY AND COSTS

This section summarizes the available types of VCM monitoring equipment, their costs, and procurement lead times needed to determine worker VCM exposure under the provisions of the proposed permanent standard.

1. THE THREE MAJOR CLASSES OF VCM MONITORING DEVICES: PERSONAL, AREA, AND LEAK, ARE ALL AVAILABLE TO THE VCM AND PVC PRODUCING INDUSTRIES

- Personal monitoring, which is the technique recommended to OSHA by NIOSH (see Exhibit E-3), is available to industry from the manufacturer within two months from time of order. The gas chromatograph needed for the analysis of their samples can be received from the manufacturer in two to three months time.

- Area monitoring systems of the automatic sequential or continuous type can be obtained for installation within six months from time of order. Installation could take upwards of two months.

- Manual area monitoring systems comprising a gas chromatograph with a flame ionization detector (FID) and Mylar or Tedlar bags for sample collection can be obtained from the manufacturer within three months. These devices require little or no set-up time.

- Leak detection devices such as portable gas chromatographs or infrared spectrophotometers can be received from suppliers within two months.

- If demand for these devices suddenly increase, it is Snell's judgment that procurement lead times could double, especially for the more sophisticated types of equipment such as the area monitoring systems.

2. THE COSTS OF MONITORING EQUIPMENT RANGE WIDELY DEPENDING ON TYPE, HOWEVER, MOST EQUIPMENT PURCHASED UNDER THE TEMPORARY 50 PPM STANDARD MAY BE USED AT LEVELS DOWN TO AND BELOW ONE PPM VCM

- Personnel monitoring equipment vary in cost from $300 for automated charcoal tube/pump system to $70 for colorimetric tube devices. For the automated system, a back-up gas chromatograph is required at a cost upwards of $7,000 including basic chromatograph, columns, recorder, and mechanical integrator as shown in Appendix Exhibit D-5.

- Area monitoring systems of the sequential gas chromatograph type cost in the neighborhood of $12,000 per 10 point instrument system without installation. Those operating under the FID total hydrocarbon principle can be purchased for $8,000, again without installation charges.

- Leak detection equipment, which are either of the portable gas chromatograph, total hydrocarbon FID, and infrared types cost from $3,000 to $5,000. No installation is required for these devices.

3. EXPENDITURES FOR MONITORING EQUIPMENT FOR A TYPICAL VCM OR PVC PLANT AVERAGE $100,000 IN CAPITAL WITH ANNUAL OPERATING EXPENSES OF $80,000

- Personal monitoring equipment of the colorimetric types do not require a chemist for back-up due to their instantaneous reading capability. The charcoal tube types, however, require a trained chemical technologist for analysis of samples due to the necessity of using a gas chromatograph. At least one chemist per plant is needed at an annual cost of $15,000 to $20,000. Overhead, general and administrative and chemical costs in support of the chemist could approximately double his annual cost.

- The cost of installation for automated sequential or continuous area monitoring systems is approximately $15,000 per 10 point unit with operating and maintenance costs of about $30,000 per year with an operator. A mini-computer can be interfaced with the system for alarming and recordkeeping for an additional $10,000 to $15,000 and O&M costs of $4,000 per year.

- Leak detection devices cost in the area of $2,000 to $3,000 for O&M including a part-time operator for each instrument.

4. THE INDUSTRY AS A WHOLE SHOWS NO PREFERENCE FOR PARTICULAR TYPES OF MONITORING EQUIPMENT, ALTHOUGH THE CONCEPT OF AREA MONITORING APPEARS WELL ACCEPTED

- The VCM and PVC producing industries employ a variety of different types of monitoring equipment in each classification.

- In personal monitoring, both the colorimetric and charcoal tube system are employed. However, the charcoal tube type are sensitive to lower VCM concentrations than colorimetric devices.

- For area monitoring, both gas chromatographs (GC) and total hydrocarbon analyzers and combustion conductivity detectors are used.

  - gas chromatographs provide concentration values which are specific for vinyl chloride monomer

  - total hydrocarbon analyzers, as their name suggests, are not specific for VCM but give the total hydrocarbon concentration in the sample air.

  - combustion conductivity detectors have also shown great utility in VCM detection at low concentration levels.

5. AUTOMATIC SEQUENTIAL MONITORING SYSTEMS (ASMS) CAN SERVE AS A LONG TERM DATA COLLECTION SYSTEM FOR AN ENTIRE PLANT

- The ASMS can analyze an air sample from a particular point in the plant in 1 to 3 minutes with potential for at least 10 point monitoring.

- A system installed in the polymerization building can provide warning to work personnel in that area if VCM levels have gone above ceiling levels.

- Personal monitoring data can provide the statisitical basis for locating sampling points for the ASMS.

  - TWAs can be determined by the personnel monitors for critical areas

  - these values can provide a calibration for the ASMS and determine the points within an area where the greatest VCM exposures are most likely to occur.

- The ASMS can be used to provide correlation with personnel monitoring data of actual worker exposure. In addition, it can be used to provide a permanent record of VCM levels, provide alarms in case of exceeding ceiling values, serve as a means to initially identify the general sources of VCM releases, and to monitor progress in complying with OSHA requirements.

6. THE AUTOMATIC SEQUENTIAL MONITORING SYSTEM CAN PROTECT WORKERS AND ALERT MAINTENANCE PERSONNEL WHEN EXCESSIVE VCM CONCENTRATIONS OCCUR

- VCM emissions can occur from two sources:

  - slowly developing minor continuous leakage, such as a worn pump seal

- serious leakage, such as resulting from an operating error (e.g. valve left fully or partially open) or a serious sudden leak (e.g. blown gasket, sight glass breakage, etc.)

In both cases, the system can prove useful in alarming the potentially affected people.

- In the case of a minor leak however, (with localized effects) the sample point nearest the leak will register the localized concentration and alarm on the next sampling indicating localized concentration above the limit.

- Response to either type of alarm can be standardized. These steps could include donning of personal protective equipment, investigation using leak detectors, isolating the point of VCM release and corrective maintenance.

* * * * *

The next section deals with medical surveillance costs.

VD. MEDICAL SURVEILLANCE COSTS

This section presents the annual costs to industry for medical surveillance essentially based on the NIOSH recommendations to OSHA.

1. THE AVERAGE TIME REQUIRED PER EMPLOYEE FOR THE REQUIRED MEDICAL EXAMINATION IS FOUR HOURS WHEN PERFORMED OUTSIDE THE PLANT

From the information presented in the Appendix Exhibit F-2, the time allowance per employee is itemized as follows:

- Travel to and from examination facility -- 2.5 hours
- Examination and laboratory tests - 1.5 hours
- Maximum time required - 4 hours or 1/2 working day

2. THE SNELL ESTIMATE FOR TOTAL EXAMINATION COST PER EMPLOYEE IS $160

- The cost estimate developed by Snell is based primarily on the tests and examination procedures recommended to OSHA by NIOSH as detailed in Exhibit F-3.
- The costs were estimated for examination and tests completed outside the plant for a manufacturing facility with 500 covered workers. The total cost for such a plant would be approximately $82,000/year.

3. INDUSTRY ESTIMATES OF THEIR PRESENT MEDICAL SURVEILLANCE COSTS AVERAGE $140 PER WORKER PER YEAR

It was assumed by Snell that the examinations performed by the reporting plants were based on the NIOSH recommendations to OSHA.

VE. VINYL CHLORIDE EXPOSURE DATA

This section presents the analyses of ambient air monitoring data taken under the Emergency Temporary Standard and supplied to Snell by industry and OSHA. In addition, the limitations of these data are discussed together with the summary of probable worker exposure for both monomer and PVC plants.

1. INDUSTRY AND OSHA SUPPLIED DATA ARE LIMITED, HOWEVER, THEIR ANALYSES BY SNELL PROVIDED AN INDICATION OF AVERAGE VCM LEVELS FOR THE MONOMER AND PVC PLANTS

The following points describe the data limitations:

- Sample locations for area monitoring or spot sampling within the plants are not clearly identified. However, the data allowed general association with job classifications.

- The measuring techniques employed for the OSHA data were 10 minute Sippin pump carbon tube samples with a total ambient air volume collection of 1 liter. Industry data were collected by organic vapor analysers (OVA), bag samples, charcoal tube pumps, or area monitoring. Some of the data levels represent averages of individual samples gathered at random time intervals.

- In general, Snell did not receive raw data from industry, but rather the averages of individual data points without data point statistics (i.e., No. of individual data points, mean, standard deviation, etc.). The OSHA data submitted to Snell are in terms of individual data points, but these are not related to job classifications or unit operations.

- In both the industry and OSHA cases, the data population is small.

- The data base is judged inadequate to quantitatively differentiate suspension polymerization from emulsion polymerization which are the main processes of the PVC industry.

- Snell arranged the available data in two major categories

  - VCM Plants
  - PVC Plants

- The available data were averaged and then correlated to the various job classifications. The data presented average levels of VCM for individual plants which were then used to develop an industry-wide profile of average VCM concentrations.

2. IN PVC PLANTS THE HIGHEST EXPOSURE OCCURS IN JOB CLASSIFICATIONS DIRECTLY INVOLVED IN THE MANUFACTURE OF PVC; WITH VCM LEVELS AVERAGING APPROXIMATELY 15 PPM ACCORDING TO DATA SUBMITTED TO SNELL BY INDUSTRY

The following table summarizes the average VCM levels by job classification as presented in Exhibit B-22 in Appendix B.

	Range PPM		
	Average	High	Low
I. Production			
VCM Unloading			
VCM Unloaders	16	40	6
PVC Processing			
Supervisors	10	22	5
Senior Reactor Operators	9	20	1
Reactor Operators	17	30	5
Chargers	19	70	7
Stripper Operators	35	90	5
Centrifuge Operators	NA	120	3
Dryer Operators	13	51	1
Utility Men (Cleaners, Laborers, etc.)	25	78	6
Baggers	7	20	1
Warehouse	9	20	1
Overall Production	16	-	-
II. Maintenance	24	92	2
III. Laboratory			
Professionals	NA	6	1
Technicians	63	184	1
Overall Laboratory	42	-	-
IV. Management & Support	< 1	2	< 1

Source: Exhibit B-22

3. ANALYSIS OF THE MONITORING DATA SUBMITTED TO SNELL BY THE PVC PRODUCING INDUSTRY INDICATES THAT 92% OF AVERAGE MEASUREMENTS HAD VALUES OF 50 PPM VCM OR LESS

As summarized in Exhibit B-23

3% of averages had values of 1 ppm or less
22% of averages had values of 5 ppm or less
58% of averages had values of 10 ppm or less
67% of averages had values of 15 ppm or less
75% of averages had values of 20 ppm or less
80% of averages had values of 25 ppm or less
83% of averages had values of 30 ppm or less
84% of averages had values of 40 ppm or less
92% of averages had values of 50 ppm or less

4. ANALYSIS OF THE MONITORING DATA TAKEN BY OSHA AT PVC PLANTS AND CONFIDENTIALLY SUBMITTED TO SNELL INDICATES THAT 93% OF ALL SPOT SAMPLES HAD VALUES OF 50 PPM; WITH VCM LEVELS AVERAGING APPROXIMATELY 14 PPM

As summarized in Exhibit B-24

3% of samples had values of 1 ppm or less
46% of samples had values of 5 ppm or less
56% of samples had values of 10 ppm or less
64% of samples had values of 15 ppm or less
72% of samples had values of 20 ppm or less
76% of samples had values of 25 ppm or less
79% of samples had values of 30 ppm or less
86% of samples had values of 35 ppm or less
90% of samples had values of 45 ppm or less
93% of samples had values of 50 ppm or less

Overall, agreement exists between the OSHA data and those submitted by industry to Snell. However, the OSHA data contains approximately twice as many more values, on a percentage basis, in the range of 5 ppm or less. The OSHA data do not specify the unit operations or job classifications associated with each reading.

5. · ANALYSIS OF THE MONITORING DATA TAKEN BY OSHA AT VCM PLANTS AND CONFIDENTIALLY SUBMITTED TO SNELL INDICATES THAT 96% OF ALL SPOT SAMPLES HAD VALUES OF 35 PPM OR LESS; WITH VCM LEVELS AVERAGING APPROXIMATELY 8 PPM

From Appendix B-108

15% of samples had values of 1 ppm or less
62% of samples had values of 5 ppm or less
77% of samples had values of 10 ppm or less
84% of samples had values of 15 ppm or less
89% of samples had values of 20 ppm or less
94% of samples had values of 25 ppm or less
96% of samples had values of 35 ppm or less

6. INDUSTRY AND OSHA DATA INDICATE THAT AVERAGE VCM CONCENTRATIONS IN PVC PLANTS ARE LESS THAN 50 PPM FOR THE FOUR BROAD JOB CLASSIFICATIONS

The following table summarizes PVC industry-wide VCM average exposure levels as a function of broad job classifications in relation to industry employment in each worker category.

Broad Job Classification	Approximate 1974 Number of Workers	Percent of Total	Average of Concentration
Production [1]	3,030	55%	16
Maintenance [1]	1,350	24	24
Laboratory	390	7	42
Management and Support [2]	805	14	1
Total [3]	5,575	100%	15 [4]

Notes: (1) Includes line supervisors, such as foremen
(2) Includes plant managers, engineering staff, clerical, etc.
(3) Personnel associated with compounding and fabrication in integrated facilities are not include
(4) Average VCM concentration for all job classifications

Sources: Exhibit III-10, B-22, and Snell assessment of data.

7. INDUSTRY AND OSHA DATA INDICATE THAT AVERAGE VCM CONCENTRATIONS IN VCM PLANTS ARE LESS THAN 10 PPM FOR THE FOUR BROAD JOB CLASSIFICATIONS

The following table summarizes VCM industry-wide average VCM exposure levels as a function of broad job classifications in relation to industry employment in each worker category.

Broad Job Classification	Approximate 1974 Number of Workers	Percent of Total	Average VCM Concentration
Production (1)	410	44%	4
Maintenance (2)	250	27	2
Laboratory	60	6	4
Management and Support (2)	220	23	1
Total	940	100%	3 (3)

Notes: (1) Includes line supervisors, such as foremen
(2) Includes plant managers, engineering staff, clerical, etc.
(3) Average VCM concentration for all job classifications

Sources: Exhibits III-3, B-107, and Snell assessment of data.

* * *

Based on the assessment of the limited data supplied to Snell be industry and OSHA, it appears that average VCM concentrations for the four broad job classifications in both the VCM and PVC producing industry are below 50 ppm. Furthermore, the average VCM concentration in vinyl chloride plants is in the range of 3 to 8 ppm while for PVC plants the average concentration is approximately 15 ppm.

The next chapter provides conclusions and recommendations.

APPENDICES

A - DETAILED PROCESS DESCRIPTIONS AND PROCEDURES

B - EXPOSURE DATA FOR POLYVINYL CHLORIDE (PVC) AND VINYL CHLORIDE MONOMER (VCM) PLANTS

C - ECONOMIC DETAILS

D - PERSONAL PROTECTIVE EQUIPMENT AND HYGIENE

E - MONITORING EQUIPMENT

F - MEDICAL SURVEILLANCE OF EMPLOYEES

G - SAFETY AWARENESS PROGRAMS

H - NIOSH RECOMMENDED OCCUPATIONAL HEALTH STANDARD FOR THE MANUFACTURE OF SYNTHETIC POLYMER FROM VINYL CHLORIDE

APPENDIX A

DETAILED PROCESS DESCRIPTIONS AND PROCEDURES

VI. CONCLUSIONS AND RECOMMENDATIONS

VI. CONCLUSIONS AND RECOMMENDATIONS

This chapter addresses the conclusions and recommendations of the report based on the findings and economic analysis of the previous section.

1. ACHIEVING "NO DETECTABLE" LEVELS OF VCM PRINCIPALLY THROUGH ENGINEERING MEANS IS JUDGED NOT FEASIBLE WITH PRESENT TECHNOLOGY BOTH IN THE VCM AND PVC SECTORS

- Based on the industry surveys and Snell's independent assessments of the state-of-the-art of the technology, it is concluded that achieving "no detectable" (0 - 1 ppm) VCM levels in the VCM industry is not feasible principally through engineering means. Reasons include the following:

  - technology, including state-of-the-art developments, is not available to eliminate VCM leaks and fugitive losses

  - existing plants have not been designed for total VCM containment

  - there is no design or operating experience in the industry aimed at maintaining very low VCM levels

  - no direct technology transfer opportunities are known to enable development of designs for "no detectable" levels in new plants.

- Based on the industry surveys and Snell's independent assessments of the state-of-the-art of the technology, it is concluded that achieving "no detectable" (0 - 1 ppm) VCM levels in the PVC industry is not feasible principally through engineering means. Reasons include the following:

  - PVC manufacture is a batch operation

  - Technology, including state-of-the-art developments is not available to eliminate VCM leaks and fugitive losses

- existing plants have not been designed for total VCM containment

- there is no design or operating experience in the industry aimed at maintaining very low VCM levels

- no direct technology transfer opportunities are known to enable development of designs for "no detectable" levels in new plants.

. Up to four years of development is estimated to reduce residual VCM levels below 100 ppm in PVC products on the basis of output volume.

. The technology including state-of-the-art developments is not available to reach very low or "no detectable" residual VCM levels on the basis of output volume.

2. THE COSTS OF COMPLIANCE INCREASE RAPIDLY WITH DECREASING VCM TARGET LEVELS AND REPRESENT SIGNIFICANT ENGINEERING UNCERTAINTY OR INFEASABILITY BEYOND 10 PPM CEILING AND 2 - 5 PPM TWA FOR THE VCM INDUSTRY AND 15 - 25 PPM CEILING AND 10 - 15 TWA FOR THE PVC INDUSTRY

. The analysis which follows indicates the cost sensitivity of attempting to reach very low VCM levels in the VCM industry.

VCM Target Level (ppm)	Standard Price (¢/lb.)	Price Index	ent of VCM Industry Capacity Endangered	Time To Reach Level Via Engineering Controls (years)
Historical Practice	7.41	1.00	Not Applicable	Not Applicable
50 ceiling	7.47	1.01	0%	0.5
25 ceiling	7.59	1.02	0%	2.5
10 ceiling and 2-5 TWA	7.69	1.04	0%	3.0
Extrapolated Attempt to Reach "No Detectable" Levels	12.71	1.72	100% @ "No Detectable" Levels	Not Estimated

Source: Exhibits V-15 and V-13

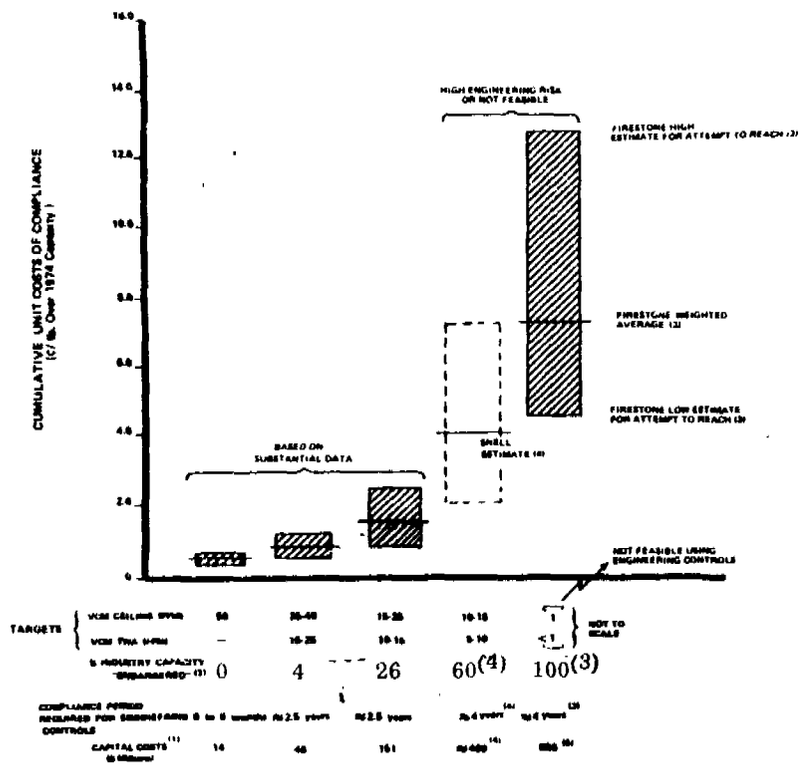
The table indicates the rapid rise in costs associated with attempting to reach the technologically infeasible "no detectable" levels beyond the 10 ppm ceiling and 2 - 5 ppm TWA target level.

Exhibit VI-1, on the following page, presents a similar discussion for the PVC industry.

EXHIBIT VI-1

USDOL / OSHA

PVC INDUSTRY CLAIMED ANNUAL COSTS TO ACHIEVE VCM TARGET LEVELS AND SUSTAIN 1974 CAPACITY (1)



ECONOMIC IMPACT CRITERIA

PLANTS LIKELY TO BE MOST "ENDANGERED"(2)

- Highest compliance costs
- Plant located in cold climate
- Old plant
- Small plant
- Small reactors
- Copolymer, emulsion or latex resin production (High free monomer)
- Small company
- Merchant sales
- Slackening demand

PLANTS LIKELY TO BE LEAST "ENDANGERED"(2)

- Lowest compliance costs
- Plant located in warm climate
- Modern plant with automation
- Large reactors
- Bulk or suspension resin production
- Large company
- Large plant
- Captive use of PVC
- Highly disciplined plant personnel

NOTES:

(1) ESTIMATES INCLUDE COSTS OF ENGINEERING CONTROLS PERSONAL PROTECTIVE AND MONITORING EQUIPMENT AS WELL AS COSTS DUE TO PRODUCTIVITY LOSSES

(2) ENDANGERED-MANAGEMENT WILL SERIOUSLY CONSIDER PLANT SHUTDOWN

(3) FIRESTONE PROVIDED COST ESTIMATES RELATED TO "NO DETECTABLE" VCM LEVEL FOR AN ATTEMPT PRIMARILY BASED ON ENGINEERING CONTROLS, CONCLUDING INFEASIBILITY AND INDICATING THAT FIRESTONE PLANTS WOULD BE ALSO ENDANGERED

(4) SHELL ESTIMATE BASED ON INTERPOLATION OF INDUSTRY DATA AND JUDGEMENTAL ASSESSMENT OF THE ECONOMIC IMPACT CRITERIA ABOVE

(5) SHELL ORDER OF MAGNITUDE PROJECTION FOR THE INDUSTRY BASED ON FIRESTONE DATA WITH ITS LIMITATIONS

SOURCE: INDUSTRY INTERVIEWS, HEARING RECORDS AND SHELL ESTIMATES IN CHAPTER FIVE

- For the VCM industry, the engineering control steps for OSHA compliance are significantly the same as those potentially used for air pollution control. Therefore, appreciable air pollution control costs are automatically accounted for by OSHA compliance.

- For the PVC industry, engineering control steps from the 50 ppm VCM ceiling level to the 15 - 25 ppm ceiling with 10 - 15 ppm TWA primarily address OSHA compliance, but significant air pollution control benefits are gained, especially at lower levels.

3. AREA MONITORING, PARTICULARLY IN PVC PLANTS IS RECOMMENDED TO OSHA AS A COMPLIANCE REQUIREMENT REGARDLESS OF THE TARGET LEVEL SELECTED BY OSHA

- Automatic Sequential Monitoring Systems (ASMS) can serve as a long term data collection system for an entire plant.

  - The ASMS can analyze an air sample from a particular point in the plant in 1 to 3 minutes with potential for at least 10 point monitoring.

  - The ASMS can be used to provide correlation with personnel monitoring data of actual worker exposure. In addition, it can be used to provide a permanent record of VCM levels, provide alarms in case of exceeding ceiling values, serve as a means to initially identify the general sources of VCM releases, and to monitor progress in complying with OSHA requirements.

  - A system installed in the polymerization building can provide warning to work personnel in that area if VCM levels have gone above ceiling levels.

  - Response to alarm can be standardized. These steps could include donning of personal protective equipment, investigation using leak detectors, isolating the point of VCM release and corrective maintenance.

4. IT IS RECOMMENDED THAT OSHA ESTABLISH PHASED REQUIREMENTS FOR REACHING VCM TARGET LEVELS TO ALLOW THE COLLECTION OF ADDITIONAL VCM MONITORING DATA TO FULLY ASSESS THE EFFICIENCY OF THE CORRECTIVE STEPS, SUBJECT TO REVIEW IN LIGHT OF CURRENT MEDICAL FINDINGS, AND AS THEY BECOME AVAILABLE

- The currently available data base particularly for VCM monitoring, is relatively small. In addition, the technology required for compliance with the lower VCM levels is not yet proven. Consequently, considerable risks exist as to the efficacy of engineering controls even for levels other than "no detectable", which is not technologically feasible.

- A phased compliance plan would allow for the assessment of the efficiency of corrective steps already taken by industry. In any event, significant lead times exist for hardware required for engineering controls.

- The phased compliance plan should be reviewed in light of current and emerging medical findings.

- A possible result of a phased compliance plan would be to spread the costs of compliance over periods of time. This may be desirable considering that the VCM and PVC price impacts may be of the same order of magnitude as the price results of the "energy crisis".

- Developmental efforts should be encouraged to improve techniques in personal protective devices, monitoring systems, and residual monomer reductions.

* * * * *

The Appendices supporting the report follow in a separate volume.

APPENDICES
TO
DRAFT FINAL REPORT

ECONOMIC IMPACT STUDIES OF THE EFFECTS OF PROPOSED OSHA STANDARDS FOR VINYL CHLORIDE

Contract No. L/A 74-167

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