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the State Implementation Plan
for
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Rogers Corporation, a Connecticut based manufacturer, wishes to express its serious concern over the proposed asbestos emission and ambient standard portion of the State Implementation Plan for Air Quality. We, as users of various asbestos minerals, do not pretend to be experts on asbestos related occupational and environmental hazards; however, we do have an inherent interest, in terms of concern for employee safety and market impact, in keeping current on medical, scientific, and technical developments in this area. It is upon this knowledge that we base some of our objections to this proposed legislation.

Rogers Corporation does not minimize the known health hazards associated with the use of asbestos; quite the contrary, we have installed sophisticated, state-of-the-art engineering and administrative controls to insure worker safety and compliance to all applicable regulatory requirements in our manufacturing facilities. It is from this experience in installing and operating state-of-the-art emission control devices that we draw our conclusion that industrial compliance to the proposed emission standard is not economically or technically possible.

We have been engaged, for some time, in the research and development of acceptable asbestos substitutes for use in our products. A number of product changes, especially in less critical applications, involving asbestos substitution, have already taken place. However, to date, acceptable asbestos

substitutes for many of our high temperature, high strength plastics applications do not exist. This fact, coupled with a growing body of data possibly implicating other, non-asbestos fiber materials as potential health hazards,¹ lends support to our contention that the "tunnel vision" approach embodied in these proposals will not result in the stated goal of minimizing the health risk to both workers and the general public. Indeed, if this proposal is implemented, we face the possible realization of the old adage, "Jumping out of the frying pan into the fire."

We would hope that responsible individuals, within the DEP, would realize our concerns over this proposal from the ensuing discussion. Effective minimization of risk to development of respiratory cancer, and other disabling diseases, from the inhalation of hazardous particulates, can only be achieved if industry, regulatory agencies, and the general public are aware of what is fact, what is supposition, and what is conjecture. Regulatory action, if it is to achieve its stated goals, must be based on factual data concerning the nature and scope of the problem, a realization of the capabilities and limitations of technology to provide the control mechanisms, and finally, an accurate assessment of the economic and social impact of proposed control strategy.

The corner-stones, so to speak, of these proposed asbestos regulations are the relationship of a sharp rise in mesothelioma within Connecticut during a ten-year period between 1960-1969 as compared to a similar interval between

¹We refer here to recently published articles, in the Hartford Courant, Norwich Bulletin, and Providence Journal (copy attached), which deal with recent Japanese research implicating fine, fibrous fiberglass as respiratory carcinogens. We also further elaborate on this later in our discussion.

1940-1949, and the estimated increase of asbestos use within Connecticut plotted (DEP's Figure 8, page 10-15) between 1900-1969. Very serious deficiencies exist in this conjecture.

In the introduction to these proposals (page 10-1), a statement is made alluding to a DEP conducted ". . . study of asbestos-induced mesothelioma incidence.^{5,6}" Review of indicated references fail to show a clear distinction has been made between asbestos and non-asbestos induced mesotheliomas. Further, in the mesothelioma discussion on page 10-14 of these proposals, no distinction is mentioned between asbestos and non-asbestos related mesothelioma. In fact, page 10-14 discussion does its best to implicate asbestos as the cause by innuendo and pure conjecture, such as ". . . only four people were reported with known exposure to asbestos. Eight others were felt to have experienced some exposure. . . . of the remaining individuals in (it) is interesting to note that one person was listed as a toll collector. . . ." It is very apparent the formulators of this proposal have made the pre-determination that asbestos is the cause of mesothelioma incidence within Connecticut.

At best, this is a very unscientific assessment. To be sure, asbestos, and especially the variety crocidolite, has been factually associated with the development of human mesothelioma. However, a significant body of data has been published^{2,3} which document non-asbestos induced human mesothelioma.

²Reference is made to papers presented at the Dec. 5, 1977, meeting of the Society for Occupational and Environmental Health, in Washington, DC, by Dr. J.C. Wagner of Llandough Hospital, Wales, U.K.; and Dr. J.M.G. Davis, of the Institute of Occupational Medicine, Edinburgh, Scotland. These papers, especially Dr. Wagner's, discuss both asbestos and non-asbestos induced mesotheliomas. Dr. Wagner's paper, "Animal Model for Inhalation Exposure to Talc," discusses the development of a proposed animal study; however, in the preliminary section, he discusses the known causes of human lung cancers, especially mesothelioma. Also, refer to discussion section of proceedings.

Dr. Wagner, in his presentation at the December, 1977, meeting of the Society for Occupational and Environmental Health, discussed two relevant studies. The first study deals with an almost epidemic level of mesothelioma among villagers of two Turkish communities (ten cases in 1977 out of a population of 600). The Health Ministry of Turkey, the U. S. EPA, and the World Health Organization have conducted investigations which strongly implicates zeolite, not asbestos, as the causative agent. Zeolite, like asbestos, is a naturally occurring mineral; its occurrence in Connecticut is common, especially in glacial moraine. The second study dealt with development of human mesothelioma from exposure, in India, to burning of sugar cane bagasse. You may rightly ask how this latter case has any bearing on mesothelioma in Connecticut; but in so doing, a serious discrepancy in the population statistics used by the DEP is pointed up. Although attempts were made to make age-related adjustments, population mobility was totally ignored. Since World War II, Connecticut has had a large influx of immigrants from the Caribbean and south-of-the-border areas; areas where growing and processing of sugar cane is basic to local economies. Statistics on mesothelioma incidence make no distinction on whether individuals developed this cancer due to exposure to the causative agent (whatever) here or elsewhere; they show only that diagnosis and termination occurred in Connecticut.

³Reference is made to the published proceedings, NBS Special Publication 506, Workshop on Asbestos: Definitions and Measurement Methods, page 197, General Discussion Section, to comments made pertaining to a study of mesothelioma in Switzerland where only 2 of 19 cases were related to asbestos exposure.

It is an undisputed fact that extremely long lag-times exist between exposure to cancer-causing agents and clinical diagnosis of human mesothelioma. In the case of asbestos-induced mesothelioma, the U.S. Department of Health, Education and Welfare, the Public Health Service, and the National Institutes of Health in their joint publication Asbestos - An Information Resource, DHEW Publication #(NIH) 78-1681, May 1978, page 29, state: "In 85% of one series of mesothelioma cases, death occurred more than 25 years after first exposure to asbestos, with a range of 3.5 to 53 years. Another investigator reported a mean latency period of 37 years, and among a large cohort of asbestos workers, most deaths from pleural and peritoneal mesotheliomas occurred 30-35 years after first exposure."

Accepting this latter statement that about 33 years is the significant latency period for asbestos exposure, we will now expose another serious discrepancy in the proposal's corner-stones. Working back from the 1960-1969 time period, when the "statistically significant" rise in mesothelioma occurred, we note that, if it was asbestos-related, exposure first occurred between 1927-1936 in these individuals. It is well known that the first recommendation for limiting occupational exposure to asbestos was made in 1938 by the U.S. Public Health Service. This recommendation wasn't generally accepted until 1964 and wasn't mandated until the passage of the Occupational Safety and Health Act of 1970.⁴ Exposure levels to industrial usage of asbestos during 1927-1936 were uncontrolled--due to lack of knowledge relating to associated health

⁴Asbestos: An Information Resource, U.S. Dept. of Health, Education and Welfare; et. al.; DHEW Publication #(NIH) 78-1681, dated May, 1978, p. 5.

hazards. To promulgate a regulation, as proposed, on the basis of alleged mesothelioma incidence diagnosed, in 1960-1969, without considering the very significant variable of asbestos exposure levels between 1927-1936 and current legal limits is unjustifiable.

Before pursuing a discussion of current levels of allowable occupational and emission exposure limits, we need to back up a minute and complete an earlier line of discussion. To pick up where we left off on discussing non-asbestos inducement of mesothelioma: the current technique used in trying to determine whether a material is carcinogenic in man is to utilize animal testing. Reference #4, page D-7, lists a number of materials, other than asbestos, that have demonstrated capability to produce intrapleural and intraperitoneal mesothelioma.⁵ These are brucite (a mineral), ceramic fiber, barium sulfate, glass powder, and aluminum oxide.

We don't generally agree that these animal studies are directly correlateable to human development of disease; however, they do raise questions which need to be further investigated. If indeed, other materials can lead to the development of mesothelioma in humans, then enactment of regulations to control only one causative agent, on the premise that passage will reduce human incident level to the same risk as death due to train accidents seems irresponsible. The General Public will be misled and industry will be forced to use non-asbestos materials, which may very well prove to be equally hazardous.

⁵A recent literature search, by computer, of a filing called Excerpta Medica (file 72), turned up 11 documented studies of non-asbestos induced mesothelioma in humans (attached). This listing also shows the bagasse-related study.

Getting back to current exposure levels to asbestos: passage of the Occupational Safety and Health Act of 1970 and the Clean Air Act of 1977 have imposed upon industry and society stringent exposure limits--limits which in no way existed during any of the "statistically significant" time periods referenced by the DEP in their risk assessment. No accurate data exists on possible asbestos exposure levels to workers and the general public back between 1926-1949. Most estimates of past exposure levels, relative to the current 2.0 f/cc--8 hours TWA, are 10 to 50 times above this level. This would give 8 hour exposure levels of 20 to 100 fibers/cc. Granted, no threshold level has been found, below which asbestos does not create lung cancer; however, considerable documentation does exist showing a direct relationship between dose/response.^{6,7}

Use of statistical manipulation based on mesothelioma deaths between 1960-1969 (without considering exposure levels between 1926-1937) and extrapolating this cancer's risk factor against today's legally mandated exposure levels is clearly conjecture.

Another deficiency is the DEP's comparison of this mesothelioma incidence against projected Connecticut asbestos consumption. Conceding

⁶A paper titled: Epidemiological Evidence on Asbestos, by William J. Nicholson, Arthur M. Langer, Irving J. Selikoff, presented at the Workshop on Asbestos, July 18-20, 1977, at the National Bureau of Standards. (See proceedings in NBS Special Publication 506, page 85.) Also see proceedings: discussion, page 141.

⁷A paper titled: Epidermiologic Evidence of the Effect of Type of Asbestos and Fiber Dimensions on the Production of Disease in Man, by W. Clark Cooper, presented at the above workshop. (NBS Special Publication 506, page 123.) Also see proceedings: discussion, page 141.

asbestos is a cause of mesothelioma, we submit this approach is either coincidental or irrelevant. No distinction between types of asbestos is made, yet medical authorities state there exists indisputable evidence that crocidolite (a variety of asbestos) is the major cause of asbestos-induced mesothelioma.^{7, 8} If true, then a comparison against consumption of this mineral would be more appropriate.

However, there are two other points that require emphasis here. First, there is significant evidence⁹ to suggest that radiation exposure is harmful where mesothelioma is concerned. We submit that early medical usage of x-ray diagnosis involved quite high radiation levels, relative to today's standards, and that these may have contributed to a higher level of incidence. It would be interesting to plot mesothelioma incidence against x-ray utilization (as a function of dosage); at least on the basis of conjecture, it may be much more relevant than the plot against asbestos. The second point that we wish to bring up is the DEP's apparent lack of consideration given to natural contributors of asbestos and "asbestos-like" fibers. Asbestos (and other fibers) occur naturally. Thus, it is reasonable to assume that man's disturbance of the environment would contribute to airborne presence of these types of fibers. Geologically, Connecticut is amply endowed with rock formations that contain these type of fibers. From the Asbestos: An Information Resource⁴, page 51, we quote:

⁸See Reference #2. Dr. Wagner's paper presented at the SOEH, December, 1977, meeting.

⁹Asbestos: An Information Resource, U.S. Public Health Service, et.al., DHEW (NIH) Publication #78-1681, May, 1978, page 96.

" Asbestos Emissions from Natural Sources

Rock that contains asbestos can be disturbed by natural means, such as weathering or landslides, or inadvertently by such human interventions as road building, construction and tilling of the soil. . . . If the primary areas of source rock are looked at in conjunction with high population density, the most critical areas for emissions from natural sources appear to be eastern Pennsylvania, southeastern New York, southwestern Connecticut and greater Los Angeles and San Francisco."

Nowhere within the proposal for asbestos emission standards (or in the supporting data) do we see any consideration given to contributions from these sources.

Turning now from addressing these proposals on the basis of our understanding of published documents, we will proceed to discuss them more based on our practical experiences.

Asbestos is now regulated by a number of federal agencies: the EPA regulates emissions to the environment; OSHA regulates manufacturing exposure limits; MESA regulates mining and quarrying exposures to workers; and CPSC regulates exposure to consumers. Presently, the EPA's emission standard states: "No visible emission and application of best available control technology." The DEP has called this rather general in scope and, thus, is proposing a numerical standard instead. On the surface this seems to be a reasonable premise; however, is it really? We think not!

The EPA first promulgated their ambient standard in 1973. In August of 1974, the EPA announced initiation of a major study to determine asbestos levels nationwide and to review existing regulations for a need to adjust them.¹⁰

¹⁰Volume 5, Number 16, BNA Environmental Reporter, page 477.

To date, no modifications to this standard have been promulgated. The EPA has discussed a possible numerical standard being assigned; however, they expressed considerable concern over its validity. As no changes have occurred in their standard, we can only surmise it is because either no justification exists or that its practicality is doubtful.

Now, let us look at the present EPA standard and what it means. First, no visible emission means just that--nothing visible. Normal human eyesight can detect particles down to about 25-30 microns in size (that's 10^{-6} meters). Also, that applies to the emission point, not to the property line. Second, application of best available control technology is not at all ambiguous. In the first place, it is flexible and allows for improvements in technology to be applied; in the second place, and probably most important, it recognizes technology's capabilities and limitations. According to the Asbestos: An Information Resource, page 83, the best available control technology for particulate removal is fabric filtration having efficiencies of up to 99.9 percent, on a weight basis.

This latter statement is very significant. 99.9 percent efficient, on a weight basis; however, a significant piece of data is missing--that is: above what minimum size? Most experts, and suppliers of fabric filters, will agree that 99.9 percent of all particulates above 0.5 microns in size is about the current state-of-the-art. It is important to note that particles less than 0.5 microns, in dimension, will pass through the collectors. Particles with lengths greater than 0.5 microns will, in all probability, be trapped.

Two vital points follow. First, any standard based on total weight of a

given particulate ignores particle shape or size. This totally disregards the medically significant fiber. Innumerable studies, and papers, have been given^{11, 12} emphatically stating fiber size is crucial in the development of lung cancers. Most medical researchers agree that medically significant fibers are those that are about 0.25 microns in diameter with a length greater than 8 microns; this is an aspect ratio of 1:32 (diameter to length). No medical studies have shown that particles of 0.5 microns or less in length are carcinogenic. Second, inclusion of very small particles into the total standard introduces almost impossible analytical and identification problems.

Quoting from page 10-1 of the DEP's proposal, "Connecticut proposed a numerical ambient air quality standard of 30 ng/m³ or 30,000 total asbestos fibers (determined by electron microscopy) per cubic meter of air, 30 day average, and a compatible mass emission standard of 24 gm/day. . . . The DEP conducted an ambient air asbestos survey. . ."; this survey was discussed in a paper presented to the NBS Asbestos Workshop by L. Bruckman. In the discussion following the paper, recorded in the proceedings of NBS Special Bulletin 506, page 197, L. Bruckman states that total weight of collected sample was not run on the Connecticut survey samples. All asbestos determinations were based on chrysotile mass measurements.

We would stress this is a highly variable and imprecise technique. On

¹¹The SOEH meeting held in December, 1977, in Washington, D. C. had a half dozen papers that stressed this. See proceedings.

¹²The NBS Special Bulletin 506, the proceedings of a 3-day asbestos workshop held at the National Bureau of Standards in July, 1977, had over a dozen papers where this is pointed out.

page 10-5 of the proposal data, reference is made to the "fact" that approximately 1000 asbestos fibers/nanogram of asbestos is an applicable ratio between weight and fiber count. This then becomes a basis for the 30 ng/m³ emission standard. Referring to page C-11 of Asbestos: An Information Resource, we quote:

"The ratios of electron-microscope-visible to optical-microscope-visible fibers vary among plant emissions, the workplace, and the general environment, as well as within each of the categories.

No universal ratios or factors for conversion of optical microscope results to electron microscope results exist. . . .

No single factor for conversion of mass emissions to fiber emissions exists.

Fiber/mass ratios differ markedly from the occupational to the general environments, and they also differ markedly with each environment. The number of electron-microscope-visible fibers per nanogram might well range from 100 - 10,000. . . . "

From these data, we see that the supposition of 1000 asbestos fibers/nanogram could be off by a factor of 10, either high or low. Add to this the variability of sampling, bearing in mind that this survey used a "modification" of the EPA approved sampling method, and the very high variability of analysis by electron-microscope and you see why we express our concern.

To be sure, electron-microscope analysis, specifically transmission electron microscopy with x-ray diffraction, is the most accurate mode of analysis available. However, this does not mean it is absolute. The EPA, in their recently released publication: Electron Microscope Measurement of Airborne Asbestos Concentrations, Publication #EPA-600/2-77-178, dated 8/1977, states in the foreward, page iii: "Electron microscopy is currently the principal technique used to identify and characterize asbestos fibers in

ambient air and water samples. . . . The several laboratories that perform such analyses generally have reasonable internal self-consistency. However, interlaboratory comparisons have shown that the results obtained by the separate laboratories are often widely different."

Continuing, in Asbestos: An Information Resource, pp C-8, C-9, and C-10 describe analytical disparities in duplicate analysis between perhaps two of the most respected authorities: Mount Sinai Department of Environmental Medicine and the California Department of Health. The average disparity factor in ten separate analyses between these laboratories, using TEM (Transmission Electron Microscopy) was 89:1, with a range of 210:1 through 2:1.

Finally, a number of papers on TEM analysis were presented at the NBS Asbestos Workshop which confirmed this high variability of results. Additionally, the BNA Environment Reporter, Volume 8, number 22, page 834, in their abstraction of the EPA's recently published publication EPA-600/2-77-178 states the reason for publication was to standardize interlaboratory procedure because: "Previous interlaboratory comparison tests of these '(prior used techniques)' had shown them to yield data that differed by as much as 1,000 to 10,000 fold. . . ." All of this assumes relatively pure asbestos samples and a high percentage of asbestos to non-asbestos materials in the sample.

Coupled with this would be industry's need to do its own compliance monitoring; now we quickly realize applicability and correlation of data as major problems. Because of the obvious large body of data indicating problems with TEM analysis, in general, and conversion of fiber identification to

mass relationships, specifically, we raise questions pertaining to the significance of the data obtained by the DEP on their survey conducted in 1975 and early 1977. (Especially, since the EPA didn't publish a "provisional optimum electron microscope procedure" until the latter half of 1977.)

We also have certain doubts pertaining to the data accumulated on the DEP survey itself. Page 10-17 of the proposal documentation shows four sampling sites. The molding materials facility referred to is Rogers Corporation's Manchester, Connecticut, facility. Here, seven monitoring stations around the facility are shown with varying "measured" levels of asbestos. Neither in this proposal, nor the actual survey report, is any mention made of certain variables which undoubtedly impacted on the one station exhibiting a "high" level value. Namely, that a large Chrysler auto dealership, that does brake relining, is located across the street from the plant; nor that a very high stop and go traffic population passes by the plant; nor that significant rail traffic (local) passes close by; and finally, no mention that large scale construction was underway in an industrial park less than 1/4 mile away. We will return to comment further upon this survey.

We have shown our concerns pertaining to the establishment of the ambient standard of 30 ng/m^3 , let us now address the problems of the 24 gram/day/premise emission standard. First, on page 10-9 of the proposal, it is stated that 24 grams/day is the allowable emission rate measured 300 to 350 feet from the source. However, on page A-186, the proposal itself explicitly states, "There shall be no emissions of asbestos to the ambient air from any premise which engages in the processing or manufacturing of any asbestos -

containing product in excess of 24 grams/day." What happened to the 300-350 foot sampling distance from the source?

It appears to us that this number value has been rather arbitrarily chosen; certainly, no consideration as to the probability of its technical achievement has been given. Going back to our previous discussion on best available technology for particulate removal, you will remember the reference to the quoted government figures that particulate removal of up to 99.9 percent is best available technology. Rogers Corporation has installed a large number of pulsed-air, fabric collectors which meet this criteria; in fact, the manufacturer of the collectors guarantees 99.99 percent removal of particles greater than 0.5 microns in dimension.

Although we have no transmission electron microscopy analyses of our emissions available at this time, we can easily perform some mass balance calculations. Taking three (3) collectors, and weighing the amount of collected asbestos particulates over a period of time, we can project what the emission rate will be.

<u>Collector Designation</u>	<u>Weight Collected over 13 days</u>	<u>Daily Average</u>	<u>m³/day Air Flow</u>
725 - #15	2,090 lbs	160.8 lbs	448,589
735 - #8	18,698 lbs	1,438.3 lbs	285,486
745 - #14	15,605 lbs	<u>1,200.4 lbs</u>	285,486
		approx. 2,799.5 lbs	

$$\frac{2799.5 \text{ lbs}}{99.99\%} = \frac{x}{100.00\%}$$

$$x = 2,799.8 \text{ lbs.}$$

$$\begin{array}{r} 2,799.8 \text{ lbs} \\ - 2,799.5 \text{ lbs} \\ \hline 0.3 \text{ lbs} \end{array}$$

Converting to grams: $0.3 \text{ lbs} \times 454 \text{ grams/lb} =$
 $136.2 \text{ grams/day}.$

Thus, we can project that just three of our numerous collectors, all of which reflect best available technology, emit 5.7 times the proposed emission standard per premise. Hence, our position that we believe compliance is not technologically possible. (All of this on the basis of particles greater than 0.5 microns dimensionally. If we added the weight of all particles, including those less than 0.5 microns in size, this number would rise significantly.) Additionally, a small amount of particulates are lost during cleaning and removal of dust from these collectors; which would increase emission level. Another very real contributor to increased emission would be enactment of OSHA's proposed 0.5 f/cc standard in lieu of the current 2.0 f/cc standard. This would force an increase in air movement out of plant and an attendant increase in fibers emitted.

Going back now to our earlier comments on the DEP survey study, the data showing one sampling station, out of seven set up around our Manchester, Connecticut, facility, with a high reading, exhibited an interesting anomaly. Bearing in mind that the highest recorded value was 33 ng/m^3 (10 percent over proposed ambient standard), and disregarding for the moment our comments pertaining to other contributing factors, we note that the average value was 8.1 ng/m^3 . If we were emitting 5.7 times the proposed emission standard of 24 grams/premise/day, then we didn't significantly show up on the site sampling survey. This would suggest that 24 gram/day/premise, "although compatible to the proposed 30 ng/m^3 ambient standard," is much lower than

it should be. This is a very significant inconsistency. It also suggests some very real problems with the survey technique used.

Now, we would like to briefly discuss the impact, upon Rogers Corporation, should this proposal be implemented as written. Based on our premise that comppliance is not possible, then one of two possibilities exist:

- 1) We relocate the manufacturing operations using asbestos fibers outside Connecticut.
- 2) We close down those asbestos operations for which asbestos substitutes are not available.

Both would mean loss of jobs in Connecticut. Case 2 would, conservatively, involve the immediate reduction of one third of our Manchester Division work force--approximately 60 people would be affected.

The loss in business sales to the Corporation, under case 2, would be of the order of \$8,300,000/year. That represents over 11 percent of the Corporation's 1978 sales.

The ripple effect of case 2 imposition is not easily calculated, but it would be significant both in and out of Connecticut.

We have not, because of the extremely short time available to us from when we became aware of these proposals and the end of public comment on January 30, 1979, (less than 20 days), commented upon all of the weaknesses and errors in the proposals. However, we believe those discussed reasonably reflect the overall problem.

It is quite easy to sit on the sidelines and criticize; it is another matter to offer specific recommendations for addressing obvious shortcomings. This

is a very complex problem and one which does pose a potential health risk.

We would offer the following suggestions:

- 1) Because we know of no federal or judicial mandate to include this asbestos proposal in the overall SIP for air quality, we recommend its separation from this plan.
- 2) We suggest the establishment of a committee of "experts" from DEP, industry, academia, EPA, medical consultants, testing laboratories, and emission control equipment manufacturers to define the scope of the problem, to separate fact from supposition, to set realistic and achievable standards, and to develop meaningful analytical protocols.

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