renaming to subgrantees into a new § 440.15 entitled "Subgrantees", and renaming § 440.16 "State Plans". This reorganization eliminates the indefinite heading "Administrative Requirements" and places in its place two headings which give a more precise indication of

weatherized by the program. Through the comments submitted in response to the NOI and through other communications, DOE is aware that service to low-income renters needs to be increased. Some 55 percent of the low-income population is composed of renters, yet only 10 percent of the homes

the need for extensive justification. However, weatherization projects will be monitored to determine the reasonableness of the costs requested and approved. Additional justification will be required if monitoring results indicate that grantees do not exercise sufficient financial accountability or

S-A04112 0021(01)03-NOV-83-15:13:23)

PLAINTIFF'S EXHIBIT

197

federal register

Friday
November 4, 1983

Part VII

Department of Labor

Occupational Safety and Health Administration

Occupational Exposure to Asbestos; Emergency Temporary Standard

S-A04110 0063(03)03-NOV-83-14:19:32)

51085

51088 Fede

DEPARTMENT OF

Occupational Safet
Administration

29 CFR Part 1910

[Docket No. H-033O]

Occupational Expos

AGENCY: Occupation
Administration (OSH

ACTION: Emergency te

SUMMARY: OSHA is i
emergency temporary
reduce the permissible
(PEL) for asbestos fro
than 5 micrometers) p
centimeter (2 f/cc) as
weighted average, to 0
period of the emergenc
employers may use all
control methods, such
controls, work practice
protective equipment t
limit of 0.5 fibers per c
(0.5 f/cc). Training pro
required to be instituted

The basis for this ET
determination that cont
exposure to asbestos u
conditions that exceed
a grave danger of devel
induced cancer and asb
exposed employees, and
emergency standard is
protect them. The ETS a
proposal to revise the c
standard pursuant to sec
6(c) of the Act.

This notice also reque
on the appropriateness o
provisions of the ETS as
revisions to the asbestos
addition, OSHA will soo
separate notice of propos
that further explains the
consideration for the per
standard and which raise
additional issues regardi
application of certain pro
asbestos standard to the c
industry. That notice will
comments and will sched
rulemaking hearing pursu
6(b) of the Act concerning
permanent revision to the
standard.

DATES: The effective date
November 4, 1983. Comme
evidence concerning the p
revisions to the permanent
made by the ETS must be
before January 3, 1984. As
will publish a notice of pro
rulemaking shortly that wil
dates for submissions to th
docket for the issues raised

S-A04110 0064(03)03-NOV

Table 2

Estimates of All Cancer Deaths Avoided at Three PELS

Assuming 20 Years of Exposure

Industry Segment	PEL (f/cc)		
	0.5	0.2	0.1

Table 3

ESTIMATES OF CANCER DEATHS AVOIDED

Based upon lifetime risk estimates for exposures [a]

Industry Sector	PEL of 0.5 f/cc

341-990

51088 Federal Register

permit DOE to take such action upon

Project Retro-Tech do not need to get approval from DOE before using it but

S-A04112 (0022(01)(03-NOV-83-15:13:26)

DEPARTMENT OF LABOR

Occupational Safety and Health Administration

29 CFR Part 1910

[Docket No. H-033D]

Occupational Exposure to Asbestos

AGENCY: Occupation Safety and Health Administration (OSHA), Labor.

ACTION: Emergency temporary standard.

SUMMARY: OSHA is issuing an emergency temporary standard (ETS) to reduce the permissible exposure limit (PEL) for asbestos from 2 fibers (longer than 5 micrometers) per cubic centimeter (2 f/cc) as an eight-hour time-weighted average, to 0.5 f/cc. During the period of the emergency standard, employers may use all practicable control methods, such as engineering controls, work practices and personal protective equipment to meet the new limit of 0.5 fibers per cubic centimeter (0.5 f/cc). Training programs are also required to be instituted within 30 days.

The basis for this ETS is OSHA's determination that continued employee exposure to asbestos under current conditions that exceed 0.5 f/cc presents a grave danger of developing asbestos-induced cancer and asbestosis to exposed employees, and that an emergency standard is necessary to protect them. The ETS serves also as a proposal to revise the current asbestos standard pursuant to section 6(b) and 6(c) of the Act.

This notice also requests comments on the appropriateness of including the provisions of the ETS as permanent revisions to the asbestos standard. In addition, OSHA will soon publish a separate notice of proposed rulemaking that further explains the issues under consideration for the permanent standard and which raises some additional issues regarding the application of certain provisions of the asbestos standard to the construction industry. That notice will invite public comments and will schedule a rulemaking hearing pursuant to Section 6(b) of the Act concerning the proposed permanent revision to the asbestos standard.

DATES: The effective date for this ETS is November 4, 1983. Comments and evidence concerning the proposed revisions to the permanent standard made by the ETS must be received on or before January 3, 1984. As noted, OSHA will publish a notice of proposed rulemaking shortly that will set due dates for submissions to the asbestos docket for the issues raised therein.

ADDRESSES: Written comments should be submitted to the Docket Officer, Docket No. H-033C, Room S-6212, U.S. Department of Labor, Third Street and Constitution Avenue, N.W., Washington, D.C. 20210.

FOR FURTHER INFORMATION CONTACT: James F. Foster, Director, Office of Information and Consumer Affairs, OSHA, U.S. Department of Labor, Room N-3637, 200 Constitution Avenue, NW, Washington, DC 20210. Telephone (202) 523-8151.

SUPPLEMENTARY INFORMATION:

Table of Contents

I. Introduction

This is an emergency temporary standard (ETS) issued pursuant to section 6(c) of the Occupational Safety and Health Act of 1970 (the Act) (84 Stat. 1596; 29 U.S.C. 655), the Construction Safety Act (Pub. L. 91-54; 40 U.S.C. 333), the Longshoremen's and Harbor Workers Compensation Act (33 U.S.C. 941), the Secretary of Labor's Order No. 9-83 (48 FR 35736), and 29 CFR Part 1911. This emergency standard consists of revisions to the existing standard covering occupational exposure to asbestos, 29 CFR 1910.1001, in order to protect employees from a grave danger from continued exposure to asbestos at current exposure levels.

OSHA has determined that workers exposed to asbestos under exposure conditions existing under the current standard face a grave danger of developing incurable cancer and asbestosis. Further, OSHA has found that an immediate reduction in exposure levels to 0.5 f/cc or below is necessary to protect such employees from this grave danger. Therefore OSHA is issuing this ETS to compel reduced exposures to respond to this emergency situation.

OSHA's determination that a grave danger currently exists is predicated upon quantitative risk estimates in this record which point to a large number of excess deaths from cancer (and asbestosis) among currently exposed workers which are attributable to continued exposures under present working conditions. OSHA estimated the number of cancer deaths avoided through lowering of the exposure to 0.5 f/cc, based on 6 months, 1-year, 20-year and 45-year periods of exposures at current levels.* The predicted cancer deaths avoided that result from these periods of exposure are respectively 210, 428, 5725 and 7815. A more detailed discussion of these estimates is found in the sections, Quantitative Risk Analysis (Section V), Grave Danger (Section III A), and Need for an ETS (Section III B). Risks of this magnitude at permitted and actual exposure levels defined a situation which demanded immediate regulatory action. Evaluation of the relevant scientific data, policy considerations and exposure patterns of workers has convinced OSHA that continued exposure at the current PEL and under actual workplace conditions constitutes a "grave danger" to employees, and that an ETS is needed to protect them.

The ETS requires that employees may not be exposed to concentrations of asbestos exceeding 0.5 f/cc on an 8-hour time-weighed average basis, and permits the employer to choose among engineering controls, work practices and respirators to reduce exposures to the new PEL. However, the requirement in § 1910.1001(c) to utilize feasible engineering controls and work practices to reduce exposure levels to 2 f/cc remains in effect under this temporary standard. The ETS also requires employers to institute a training program within thirty days of the effective date of this emergency standard. The training progam will include instruction on respirator fitting and use, handling of asbestos, medical information, the relationship between smoking and lung cancer, and a review of the asbestos standard. The ETS applies to all industries covered by the Act, including "general industry", construction and maritime industries.

* OSHA is aware, of course, that Section 6(c) of the Act limits the effective time of an ETS to 6 months and OSHA concludes that a grave danger exists and an ETS is necessary even if OSHA focuses exclusively on this six month period. However, the Agency believes it is appropriate to calculate benefits deriving from an ETS using lifetime risks from 20 and 45 years of exposure to the PEL of 0.5 f/cc established by the ETS. Although the ETS expires within 6 months, Section 6(c) requires that rulemaking on a permanent standard also be completed within 6 months, so that there will be no gap in protection for exposed employees. In OSHA's experience and judgment, complying with this statutory directive and completing rulemaking for a permanent standard within 6 months of an ETS has and can be done.

S-A04110 (0044(03)(03-NOV-83-14:19:56)

Table 3

CANCER DEATHS AVOIDED

...ime risk estimates for ...posures [a]

...L of 0.5 f/cc ...ths	1 Year	20 years	45 years
	8	117	174
	31	471	684
	8	134	194
	1	29	41

As provided in 29 CFR 1953.22, the 24 States with their own OSHA-approved occupational safety and health plans are expected to adopt a comparable standard within 30 days of this publication date. These States are: Alaska, Arizona, California, Connecticut (for State and local government employees only), Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Virgin Islands, Washington, and Wyoming.

Also, in response to the emergency conditions faced by exposed workers, OSHA is stepping up its enforcement activities in targeting workplaces where asbestos is handled.

The temporary provisions that are being added to the existing asbestos standard prescribes the major components of an occupational safety and health standard. In general, most of the current requirements remain unaffected by the emergency temporary standard. However, compliance with some requirements will be triggered by the new exposure limit of 0.5 f/cc instead of the former PEL of 2 f/cc. For example, requirements such as change rooms remain unaffected by the ETS and the trigger level for change rooms remains the former PEL of 2 f/cc (§ 1910.1001[d][4]). However, the ETS requires that where concentrations may exceed the new PEL, the employer must post signs indicating such locations (§ 1910.1001[k][6]).

OSHA based its decisions concerning appropriate provisions for the ETS on its determinations of the kind and degree of protective action needed to protect against a grave danger and the feasibility of instituting these provisions during the period of the ETS.

Under section 6(b) of the Act, OSHA will shortly schedule an informal rulemaking hearing on the proposed permanent changes to the standard. OSHA will also propose other revisions to the asbestos standard that will be explained in the separate notice of proposed rulemaking. Application of certain provisions of the asbestos standard to the construction industry will be raised at that time. OSHA anticipates that this notice will be published shortly. OSHA is now accepting written comments on those issues raised in the ETS which are relevant to revising the permanent rule. The Secretary must promulgate a section 6(b) standard no later than six months after publication of the emergency standard.

II. Legal Authority and Background

A. Legal Authority

Section 6(c) of the Act provides for immediately effective emergency temporary standards in certain circumstances. The Secretary has the authority to issue such a standard, without rulemaking, "if he determines (A) that employees are exposed to grave danger from exposure to substances or agents determined to be toxic or physically harmful or from new hazards, and (B) that such emergency standard is necessary to protect employees from such danger." 29 U.S.C. 655(c)(1). Thus, the danger must be "from" worker exposure and it must be "grave," not merely significant and the regulation must be "necessary" to address "such danger," not merely reasonably necessary or appropriate to provide safe employment. In addition, as in section 6(b) permanent standards, OSHA may impose requirements in the emergency standard only to the extent that they are "feasible" within the meaning of section 6(b)(5) of the Act.

The Fifth Circuit has emphasized the importance of the severity of health effects in OSHA's consideration of whether an ETS is appropriate:

> * * * the danger of incurable, permanent, or fatal consequences to workers, as opposed to easily curable and fleeting effects on their health, becomes important in the consideration of the necessity for emergency measures to meet a grave danger." *Florida Peach Growers Association, Inc.* v. *United States Department of Labor*, 489 F.2d. 132 (CA5).

OSHA also has interpreted relevant judicial decisions to require that its evaluation of the gravity of the danger and the necessity for emergency action must be made in the context of actual workplace conditions.

B. Background

1. *Events Leading to the ETS.* In June, 1983, OSHA received a petition for an ETS from the International Association of Machinists and Aerospace Workers (Exs. 84-244). Subsequently letters supporting this petition were received from 18 other unions (Ex. 84-284 to 84-294, 84-387 to 84-391). The petition requested an ETS to reduce the PEL to 0.1 f/cc, to modify some existing work practice requirements, and to require other protective provisions regardless of exposure level. The main reasons set forth in the petition and supporting letters are that continued exposure under current workplace conditions constitutes a grave danger and that delaying remedial action until a permanent standard is promulgated would cost large numbers of currently-exposed workers their lives. OSHA shares the genuine concern expressed by the petition and letters from unions representing thousands of employees who are directly faced with the threat of asbestos-related disease from continued exposure. And OSHA concludes that failure to issue this ETS may cost a number of exposed workers their lives.

In August 1983, OSHA completed a comprehensive risk assessment based on numerous human studies which estimated the number of excess deaths from the three major asbestos-related cancers, i.e., lung cancer, mesothelioma and gastrointestinal cancer, at the current permissible exposure level of 2 f/cc and at various reduced exposure levels. OSHA placed this document, "Quantitative Risk Assessment for Asbestos-Related Cancers", in the Asbestos docket in August 1983 (Ex. 84-349). OSHA subsequently revised this document (See Ex. 84-392).

2. *History of the Asbestos Standard.* OSHA has regulated asbestos since 1971. A 12 f/cc limit for asbestos was included in the initial promulgation of OSHA standards pursuant to section 6(a) of the Act, on May 29, 1971 (36 FR 10466). In response to a petition by the Industrial Union Department of the AFL-CIO, OSHA issued an ETS on asbestos on December 7, 1971, which established a PEL of 5 f/cc on a time-weighted average basis and peak exposures of 10 f/cc.

The current standard, promulgated in June 1972, first established an 8-hour time-weighted average PEL of 5 f/cc and a ceiling limit of 10 f/cc. The limits were intended primarily to protect employees against asbestosis, and it was hoped that they would provide some incidental degree of protection against cancer. Effective July 1976, the TWA limit was reduced by the standard to 2 f/cc. This limit has remained in effect since that time. The standard also includes provisions covering methods of compliance, monitoring, medical surveillance and housekeeping.

Court review of this standard upheld all major provisions, but remanded two issues for OSHA's reconsideration. *IUD* v. *Hodgson*, 499 F. 2d 467 (CADC 1974). These issues were whether the July 1976 date for the 2 f/cc standard should be accelerated for some industries and the adequacy of the 3 year retention period for exposure monitoring records. Subsequently, OSHA increased this retention period to 20 years (41 FR 11504) and the acceleration issue became moot.

After reviewing the then available scientific data, in October 1975 OSHA published a notice of proposed

Although the results in Table 4 show fewer benefits OSHA believes the number of deaths avoided under this scenario, 80 for six months, 162 for 1 year, 2418 for 20 years, and 3513 for 45 years indicate a grave danger and necessitate this ETS action.

Table 4

Cancer Deaths Avoided with a 0.5 f/cc ETS

Assuming Compliance with the 2 f/cc Standard

Industry Sector	6 months	1 year	20 years	45 years
Primary manufacturing	2	8	117	174
Secondary manufacturing	17	31	471	684
Automotive Aftermarket	4	8	134	194
Shipbuilding/Repair*	0	0	0	0

workers would remain unacceptably high. As stated above, OSHA has estimated that at a 2 f/cc level employees exposed over a working lifetime of 45 years are predicted to have an excess risk of dying from cancer of 84 in 1000 and of contracting disabling asbestosis of 50 in 1000; employees exposed over 20 years are predicted to have excess cancer risk of 44 in 1000 and a disabling asbestosis risk of approximately 22 in 1000. Even at exposures lasting one year, an estimated 3 employees out of 1000 are predicted to die of asbestos related cancer, and there is also additional risk of developing asbestosis. Risks at the 2 f/cc level have been acknowledged as unacceptable by other governments which have reduced their permissible levels below 2 f/cc.

rulemaking to revise the asbestos standard because OSHA believed that "sufficient medical and scientific evidence had been accumulated to warrant the designation of asbestos as a human carcinogen" and that advances in monitoring and protective technology made reexamination of the standard "desirable." This proposal would have reduced the time-weighted average to 0.5 f/cc and imposed a ceiling limit of 5 f/cc for 15 minutes (40 FR 47652).

The basis for the 1975 proposal's reduced permissible level of 0.5 f/cc was OSHA's then current policy for carcinogens that no safe threshold level was demonstrable and, therefore, the Act required OSHA to set the PEL as low as technologically and economically feasible. This policy was rejected by the Supreme Court in the benzene decision (*IUD* vs. *API*, 448 U.S. 601 (1980)). OSHA limited the proposed revisions in the 1975 notice to all industries except construction. No hearing was scheduled on the 1975 proposal. Also, although OSHA announced its intention to develop a separate proposed revision applicable to the construction industry, no such proposal has been published to date.

OSHA is basing its present decision to issue an ETS, and to propose revisions to the permanent standard covering all employees, on information and analyses which postdate the 1975 proposal. Therefore, this ETS marks a new regulatory initiative, related to, but not part of the 1975 proceeding. On May 24, 1983, OSHA consulted the Construction Advisory Committee for Occupational Safety and Health (CACOSH) concerning applicability of a new asbestos standard for the construction industry. CACOSH endorsed OSHA's position that changes in the PEL made for general industry should also apply to the construction industry. OSHA is also including the comments and data received in response to the 1975 notice in the record of this proceeding, with the understanding that some commenters may have changed their positions based on intervening scientific developments and policy shifts.

In the decision to issue an ETS, the Agency has reviewed this regulatory history of asbestos. However, the Agency bases the decision to issue an ETS on the actual emergency conditions which now confront exposed workers, on epidemiologic studies that provide data to make numerical estimates of risks and on interpretations of these studies using quantitative risk analysis.

3. *The Rulemaking to Revise the Permanent Standard.* The 6(b) rulemaking initiated by this proposal is intended to be limited to the revisions made by the ETS and the additional proposed amendments raised in the notice of proposed rulemaking to be published soon. The major subjects of the 6(b) rulemaking will be: reducing the permissible exposure limit, revising the definitions of asbestos and asbestos fibers, reassessing the methods of compliance to achieve such limits, revising the provisions regarding respirator selection, revising the sampling and analytical method to improve reliability, and adding a training requirement. OSHA will also raise issues regarding the application of the permanent standard to the construction industry. As previously stated, OSHA will soon publish a separate notice of proposed rulemaking to further explain these issues.

III. OSHA's Rationale for the ETS

OSHA has determined that prevailing conditions involving worker exposure to airborne asbestos dust justify the promulgation of an emergency temporary standard. OSHA estimates that approximately 375,000 workers are exposed to asbestos at various levels (Table 1), ranging from a high value of 20 f/cc to below 0.5 f/cc. OSHA has estimated that under current exposure conditions asbestos-exposed workers face an extraordinarily high risk of contracting asbestos-related cancer whether the risk is computed over a working lifetime of exposure or for exposure periods as short as 6 months. The average excess cancer risks for all workers exposed above 0.5 f/cc using available exposure data and relying on the risk assessment are estimated as approximately 196 excess cancer deaths per 1000 workers for 45 years of exposure, 139 deaths per 1000 workers for 20 years, 10 per 1000 workers for 1 year, and 6 per 1000 workers for 6 months of exposure.

OSHA believes that risks of these magnitudes, taking into account all relevant considerations such as total numbers of workers at risk and quality of supporting data, constitute an emergency situation which requires immediate response by the agency.

The Act states that when certain statutory criteria are met, OSHA is authorized to respond to an emergency situation by issuing an ETS. The two-pronged statutory test for an ETS is that (1) employees must be exposed to a grave danger from exposure to substances or agents determined to be toxic or physicially harmful, and that (2) an emergency standard is necessary to protect employees from such dangers.

After evaluating all the evidence available to the agency concerning the severity and magnitude of the risk of asbestos-related disease to the current asbestos-exposed working population, comparing these risks to other occupational risks, applying relevant policy considerations, and reviewing all relevant judicial decisions for guidance, the agency has determined that both prongs of the statutory test are met and that an ETS should be promulgated.

For purposes of clarity, the discussion is divided into two parts, "Grave Danger" and "The Need for an ETS." OSHA believes, however, that the factors which indicate that a substance constitutes a grave danger are related to and overlap those which determine that an ETS is necessary.

A. Grave Danger

OSHA has determined that the risk to workers from exposures to asbestos at conditions that exist in the workplace pose a grave danger of death from cancer and of severe disability from the lung disease, asbestosis. In making a "grave danger" determination, the severity of the disease produced by exposure to the regulated substance and the magnitude of the predicted risks of disease must be considered. In addition, the Supreme Court has suggested that a determination of "grave danger" indicates a situation where the risk is more than "significant" (*IUD* v. *API*, *supra* n. 45).

OSHA has applied that analytic approach endorsed by the Supreme Court for "significant risk" determinations in evaluating the gravity of the danger faced by asbestos-exposed workers. The Supreme Court gave some general guidance as to the process to be followed. It recognized that while the Agency must support its finding that a certain level of risk exists with substantial evidence it also recognized that its determination that a particular level of risk is "significant" will be based largely on policy considerations (*IUD* v. *API*, 448 U.S. 655, 656, n. 62).

OSHA believes, therefore, that its determinations regarding the magnitude of the risk faced by employees should, to the extent possible, rely on quantitative expressions of that risk, utilizing the best available data.

The Court stated that the significant risk determination required by the OSH Act is "not a mathematical straitjacket," and "OSHA is not required to support its finding that a significant risk exists with anything approaching scientific certainty. *** A reviewing court [is] to give OSHA some leeway where its findings must be made on the frontiers of scientific knowledge [and that] *** the Agency is free to use conservative assumptions in interpreting the data

exposures may be reduced to below 0.5 f/cc and the benefits of the ETS will be correspondingly increased. Further, an ETS by nature of the action itself, and the accompanying enforcement program, will undoubtedly boost the incentives to comply with all protective provisions of the asbestos standard.

(b) OSHA rejected relying on merely beginning Section 6(b) rulemaking proceedings to revise the standard to reduce the PEL as an inadequate response to the grave danger faced by asbestos-exposed workers. Beginning rulemaking proceedings results in no immediate workplace changes. Employees would still continue to be exposed to those conditions which define a grave danger for at least the pendency of the rulemaking. In OSHA's experience, completing 6(b) rulemakings not initated by an ETS concerning a gap in protection between the expiration of the ETS and the imposition of the permanent standard for a substance already determined to present a grave danger.

OSHA also believes that it is helpful to evaluate the extent of risk resulting from lifetime exposure periods of 20 and 45 years in the absence of this ETS. As shown in Tables 10 and 11, these risks are extraordinarily high.

4. *Other Factors Indicating a Need for an ETS.* Although worker exposure to asbestos has been declining over the years, OSHA believes that exposure conditions will continue to present grave danger in the near future unless an emergency standard is promulgated. OSHA bases this finding on its evaluation of exposure information, asbestos use statistics, considerations of parts will be needed for many years. For example, automobile manufacturers may switch to non-asbestos brakes and clutch facing in new vehicles in the next several years. Old vehicles, containing asbestos parts, will remain in use for many years thereafter. Paik et al. found over half of all multistory buildings surveyed (68 out of 127) contained sprayed on asbestos material (Ex. 84-262). The potential for asbestos exposure exists as long as asbestos remains in these buildings. Renovation work in the building such as relocating walls and electrical wiring, will result in continued exposure for carpenters, painters, electricians, laborers, sheet metal workers and others.

Therefore, OSHA does not believe that major exposure level reductions are

with respect to carcinogens, risking error on the side of overprotection rather than underprotection" [488 US at 655, 656].

In the case of asbestos, the data available are of unusual breadth and high quality. However, because risk assessment itself involves many uncertainties, OSHA made certain assumptions in its analysis and evaluation of these data. In assessing the risk for asbestos-exposed workers, OSHA has attempted to use realistic assumptions, although the court stated that the Agency was free to use "conservative assumptions" in interpreting data. OSHA, in many cases, has indicated where different assumptions may produce different results. In addition OSHA cautions that because the risk figures finally derived are the products of a process which, as the Supreme Court acknowledged, is "on the frontiers of science," they should be viewed as approximations of the degree of risk faced by asbestos-exposed workers and not as precise fixed predictions of the number of workers who will actually develop disease.

OSHA has evaluated the kinds of dangers presented by asbestos exposure, the quantification of those dangers under present asbestos exposure conditions, the quality of the data on which risk estimates are based, a comparison of asbestos risks to other occupational risks, and relevant policy and legal considerations in concluding that workers are exposed to a grave danger from asbestos.

1. *Nature of the Diseases.* As stated above, the nature of the disease associated with exposure to a toxic substance is one of the most important elements OSHA evaluates in determining whether a grave danger exists. This factor was discussed in *Florida Peach Growers Association, Inc. v United States Department of Labor, supra.* The court, in overruling OSHA's organophosphate pesticide ETS, observed:

> We reject any suggestion that deaths must occur before health and safety standards may be adopted. Nevertheless, *the danger of incurable, permanent, or fatal consequences to workers, as opposed to easily curable and fleeting effects on their health, becomes important in the consideration of the necessity for emergency measures to meet a grave danger.* 489 F 2nd at 132 (emphasis added)

OSHA is aware of no instances in which exposure to a toxic substance has more clearly demonstrated detrimental health effects on humans than has asbestos exposure. The diseases caused by asbestos exposures are in large part life-threatening or disabling. Among these diseases are lung cancer, cancer of the mesothelial lining of the pleura and peritoneum, and asbestosis. In addition, workers exposed to asbestos are at increased risk of gastrointestinal cancer, as shown by epidemiologic studies. Although colo-rectal cancer may be curable if detected in an early stage, other gastrointestinal cancers are usually fatal. OSHA also believes that asbestos might induce cancers at other sites, which are also often fatal.

Of these, lung cancer constitutes the greatest health risk for American asbestos workers and has accounted for more than half of excess mortality in some occupational cohorts. About 90% of lung cancer patients die within 5 years of diagnosis. Mesothelioma is an incurable cancer which is usually fatal within a year after diagnosis. It is epidemiologically linked to asbestos exposure, and occurs very rarely, if at all, in persons never exposed to asbestos. Asbestosis, a type of pulmonary fibrosis, is usually non-reversible, its advanced stages are disabling, and can be fatal. OSHA concludes that all these diseases are very serious, and that the excess mortality from such severe diseases must be considered an important factor for making a grave danger determination.

2. *Degree of Risk of Developing Dangerous Disease.* OSHA based its calculations of extent of risk faced by workers under current exposure conditions primarily on the results of a quantitative analysis which derived numerical estimates of cancer risk at various cumulative exposures corresponding to levels at which workers are exposed [Ex. 84-392].

Although 2 f/cc is the current PEL for asbestos exposure, actual exposure conditions vary widely, mostly by industry segment. As explained later in this document and as set forth in Table 1, average ambient exposure levels in various industries include high exposure levels such as 20 f/cc in drywall removal, renovation and demolition; 5 f/cc in shipbuilding and repair; mid-range exposure levels such as 2 f/cc in secondary fabricating of cement sheet, packing and gaskets and paper products and rebuilding and refacing brakes; 1.5 f/cc for dry processing of textiles; and lower exposure levels such as 0.5 f/cc and 0.2 f/cc in the manufacture of floor tile.

Because OSHA is required to consider the actual danger faced by workers in assessing whether exposure to a substance presents a "grave danger", OSHA looked at the risk of developing disease not only at the 2 f/cc permissible level but at all exposure levels which workers currently face. Most of the results of these calculations for cancer are presented in Table 11 in the risk assessment section of this document.

The table sets forth predicted excess lifetime cancer risks for exposures of one year, 20 years and 45 years. Risks for exposures of 6 months are closely approximated by one-half the risks for exposures of one year. Although average exposures in demolition and renovation are estimated at 20 f/cc, the table presents risks only for selected exposure levels up to 10 f/cc.

These calculations show that the risks of asbestos-related disease are alarmingly high at current occupational exposure levels. For example, an estimated total cancer risk of 285 excess deaths per 1000 workers exists for workers exposed for a 45-year lifetime at 10 f/cc, a level which currently exists on some construction sites. At 5 f/cc, the exposure levels which are considered average in shipbuilding and repair, the risk of developing asbestos-related cancer for a 45-year exposure period is 149 excess deaths per 1000 workers. At the current permissible level of 2 f/cc which also represents actual exposure levels in such industries as secondary fabricating of cement sheet, packing gaskets and paper products and rebuilding and refacing brakes, risk is estimated as 64 excess cancer deaths per 1000 workers for a 45-year exposure period.

These risks remain very high when the period of exposure for which calculations are done is shortened to 20 years, which OSHA believes is another appropriate point for examination. The period of 20 years is the approximate midpoint between 1 year and 45 years of exposure; also many workers receive 20 years of exposure. Counterpart risk calculations using a 20-year exposure period are: for workers exposed to 10 f/cc, 140 excess cancer deaths per 1000 workers; for exposures to 5 f/cc, 105 excess cancer deaths per 1000 workers and for exposures to 2 f/cc, 44 excess cancer deaths per 1000 workers.

OSHA also estimated risks of developing cancer for a one year period of exposure at various levels to which employees are exposed. The counterpart risks for exposures to 10 f/cc for one year are: 15 excess cancer deaths per 1000 workers; to 5 f/cc, 7 excess cancer deaths per 1000 workers and to 2 f/cc, 3 excess cancer deaths per 1000 workers.

Even at current workplace exposure levels which are less than the current PEL, extraordinarily high risks of disease exist. At 0.5 f/cc, 17 excess cancer deaths per 1000 workers are

respirators (with a protection factor exceeding 10) must be worn drops from 20 f/cc [10 times the former PEL of 2 f/cc) to 5 f/cc [10 times the new PEL of 0.5 f/cc). Therefore OSHA believes that more workers will wear more protective respirators under the ETS than under the current permanent standard, that their actual exposure levels will be reduced to below 0.5 f/cc and consequently that their risks will be reduced even more than the calculations indicate.

OSHA finds also that requiring a training program to be instituted as quickly as possible is one of the most effective methods of maximizing the beneficial impact of the exposure reduction and of all the protective provisions of the current standard. Thus, the content of this ETS has been chosen as the most effective short-term strategy

IV. Occupational Health Data

A. Introduction

1. *Asbestos-related Diseases.* Asbestos exposure can cause a number of disabling and fatal diseases. Among these diseases are lung cancer, cancer of the mesothelial lining of the pleura and peritoneum, and asbestosis. It is also likely that asbestos increases the risk of gastrointestinal cancers. Of all the diseases caused by asbestos, death from lung cancer constitutes the greatest health risk for American asbestos workers. Lung cancer has been responsible for over half of the excess mortality from asbestos exposure in some occupational cohorts.

The relationship between lung cancer and asbestos exposure has been established by numerous epidemiologic studies of diverse groups. Asbestos-induced lung

fibrosis is absent and do not seem to reflect the severity of pulmonary parenchymal disease. Pleural calcification is also commonly found in persons who have been exposed to asbestos (Craighead et al., 1982: Ex. 84-033).

Asbestosis is pulmonary fibrosis caused by the accumulation of asbestos fibers in the lungs. Adverse effects of asbestosis range from shortness of breath upon exertion to cyanosis, effusions of serous fluid, respiratory failure, cardiac decompensation, and death. Often, asbestosis is a progressive disease, even in the absence of continued exposure. Symptoms of disease are shortness of breath, cough, fatigue, and vague feelings of sickness. When the fibrosis worsens, shortness of breath occurs even at rest. One clinical

budget, except that the Secretary may

"Subgrantee" means an entity managing a weatherization project

"Weatherization Project" means a project conducted in a single geographical area which undertakes to

S-A04112 . 0026(01)(03-NOV-83-15:13:40)

predicted for a 45-year lifetime exposure, and 11 excess cancer deaths per 1000 workers for a 20-year exposure period.

OSHA notes that the above calculations are for cancer risk only. In addition, asbestos-exposed workers face a high risk of developing asbestosis, a disabling and often fatal disease. Predictions concerning the estimated magnitude of the asbestosis risk have been performed by OSHA and are discussed in the risk assessment section of this document. Accordingly, OSHA estimates that at 2 f/cc, 50 workers per 1000 exposed to asbestos for 45 years will develop disabling asbestosis. At 0.5 f/cc for 45 years, it is estimated that 12 workers per 1000 will develop disabling asbestosis. Asbestosis risks can also be estimated for exposures for durations shorter than 45 years. For example, the risk of disabling asbestosis from exposure to 1.0 f/cc for 22.5 years is 12 cases per 1000 workers. OSHA's estimates of the magnitude of the asbestosis risk are based on sound data from good epidemiological studies. OSHA believes, however, that the confidence which can be placed in predictions of asbestosis risk is not as great as for the predictions of cancer risk. This is because the cancer risk estimates are based on a larger and more varied data base and are derived from dose-extrapolation models that are better established. Because OSHA has determined that the risks for cancer alone indicate a grave danger, the additional risks of developing asbestosis are not necessary to justify this ETS. However, OSHA has considered that the additional and independent risk of developing asbestosis increases the danger faced by exposed workers and underscores the gravity of the health threats to employees posed by asbestos.

3. *Quality of Data on Which Risk Estimates are Based.* The underlying data upon which the quantitative risk assessments for asbestos are based are high quality epidemiologic studies, conducted in occupational environments. OSHA emphasizes that the data bases for asbestos are of unusual quality and size. Unlike most potential occupational carcinogens, asbestos has been studied often and thoroughly for evaluation of its effects on occupational populations.

In deriving these quantitative estimates for cancer risk, OSHA utilized eleven studies for the calculation of the lung cancer risk, four of which were also used to calculate the mesothelioma risk. Investigations involved "cohort" studies where the frequencies of various types of cancers in workers exposed to asbestos were compared to those in "control" groups not exposed to asbestos or to those of general populations such as U.S. males. Studies of such design are able to provide direct estimates of excess risk.

The studies used by OSHA in deriving dose-response relationships for its risk assessment covered a variety of work situations and industrial processes. This variety improves the predictive value of the risk assessment because it lessens or eliminates the possibility that the results were unique to any one occupational situation or were in fact aberrational. The occupational settings studied were: workers exposed at a chrysotile textile plant from 1930-1975 (Dement *et al.* Exs. 84-036 and 84-037); Canadian workers at an asbestos cement facility (Finkelstein Ex. 84-240); Italian chrysotile miners and millers who worked during 1930-1965 (Rubino *et al.* Ex. 84-68); workers in an asbestos cement pipe plant (Weill *et al.* Ex. 84-206); workers in an asbestos production plant and asbestos cement pipe factory (Henderson and Enterline Ex. 84-48); British workers manufacturing asbestos textile products (Peto Ex. 84-189); asbestos miners and millers in Quebec, Canada (Liddell *et al.* Ex. 84-59); and in the Thetford Mines, Canada (Nicholson *et al.* Ex. 84-72); and workers manufacturing asbestos friction materials (Berry and Newhouse Ex. 84-21).

"Well-conducted epidemiologic studies that show a positive association between an agent and a disease are accepted as the most convincing evidence about human risk" (Risk Assessment in the Federal Government: Managing the Process, National Research Council, 1983, p. 21, Ex. 84-222).

No extrapolation from animal data to human data is necessary in order to show carcinogenicity of asbestos. For most substances, OSHA must infer human health effects, such as carcinogenicity, from animal data.

The results of this risk assessment performed by OSHA agree well with other recent risk assessments performed by other governmental and outside scientists (see Acheson and Gardner) (Ex. 84-218 and 84-243); EPA (Ex. 84-180); Kang and Chu (Ex. 84-001); Selikoff *et al.* (84-002); and CHAP (Ex. 84-256).

4. *Comparative Analysis.* Insight into the magnitude of the risk associated with asbestos exposure can be gained by reviewing other occupational risks. OSHA believes it is instructive to compare asbestos risks with other workplace hazards agreed on as presenting an unusually high degree of hazard, where the data are considered both available and reliable.

The risk of excess mortality estimated as a result of exposure to asbestos at the conditions in the workplace today appears to be substantially higher than other risks experienced by workers from occupational injury hazards. The National Safety Council (NSC) has reported the annual death rates in 1981 from work accidents in a variety of industries (Ex. 84-339). Using the NSC data OSHA has reviewed the annual mortality from work accidents per 1000 workers in several industries in light of the excess cancer mortality from a single year of exposure to asbestos per 1000 workers. For example, in the high risk occupations of agriculture and mining-quarrying, the annual mortality rates from work accidents were 0.64 and 0.55 per 1000 workers respectively in 1981 (Ex. 84-339). In contrast, the death rate from work accidents for all industries combined was 0.12 per 1000 workers in 1981.

OSHA has estimated that the lifetime risk for one year of exposure to 2 f/cc of asbestos is about 3 excess cancer deaths per 1000 exposed workers during the remainder of the workers' lifetimes (Ex. 4-349). Thus, asbestos workers' risk of excess cancer mortality from a single year of exposure to 2 f/cc is roughly 5 times higher than the risk of accidental occupational fatalities from one year of employment in agriculture and mining-quarrying.

As shown in Table 1, OSHA estimates that many workers are exposed to asbestos in the vicinity of 2 f/cc. In addition, OSHA calculated the average excess cancer risk to workers exposed at conditions that exist in the workplace today (for those above 0.5 f/cc and using the scenario described in Table 3). OSHA estimates that 10 excess cancer deaths will occur per 1000 workers for 1 year exposure; thus the average risk to workers (exposed above 0.5 f/cc) in the workplace today is approximately 20 times the annual fatal accident rates in agriculture and mining-quarrying.

These comparisons are striking. They show that the estimated risk of dying of cancer from asbestos exposure at levels existing at the workplace today far exceeds the accidental death rate in the riskiest of industries. Although the estimated mortality rates for cancer due to asbestos exposure are not completely comparable to the total actual accidental fatalities, the review is clearly useful in showing that the magnitude of the asbestos risk is grave.

One example of predicted cancer risk as a result of occupational exposure is the following cancer risk estimated from

S-A04110 . 0068(04)(03-NOV-83-14:22:37)

Dement et al., 1983) (Exhibits 84-040, 84-189, 84-020, 84-037), insulation work (Selikoff et al., 1979) (Exhibit 84-090), shipbuilding (Selikoff et al., 1979; Blot et al., 1980; Tagnon et al., 1980) (Exhibits 84-091, 84-109, 84-182), and in a variety of asbestos products manufacturing industries (Jones et al., 1980; Henderson and Enterline, 1979; McDonald and McDonald, 1978; Seidman et al., 1979; Robinson et al., 1979; Acheson et al., 1981) (Exhibits 84-128, 84-048, 84-154, 84-087, 84-082, 84-103).

It should be noted that 2 fibers per cubic centimeter, which is the current OSHA standard, is equivalent to 2 million fibers per cubic meter of air. Because humans breathe in about a cubic meter of air every hour, depending on physical exertion, the current OSHA PEL for asbestos allows workers to inhale 2 million asbestos fibers per hour during an 8-hour work day...

joint NIOSH/OSHA Asbestos Work Group stated that there was no level of exposure to asbestos below which clinical effects did not occur and recommended a PEL of 0.1 fibers per cubic centimeter (0.1 f/cc), based on the limitations of current technologies of measuring air concentrations of asbestos. The 1979 report of the Advisory Committee of the Health and Safety Commission of the United Kingdom, hereafter referred to in this section as the U.K. Committee, led to the reduction of the British standard for asbestos to 1 f/cc for chrysotile, 0.5 f/cc for amosite, and 0.2 f/cc for crocidolite. Currently, it appears that the United Kingdom may lower the PEL for chrysotile to 0.5.

2. *Evaluation of Risk.* OSHA's first step in analysis of risk of disease from exposure to a potentially hazardous...

extrapolation models are valid indicators of the existence of significant health risks.

Exposure data frequently are not available for workers exposed before 1970. Where historical exposure data are available, the data often have such limitations as having been collected and analyzed using industrial hygiene techniques no longer in use or having been collected in only some areas of the worksite or having been collected on only a few occasions. Therefore, of necessity, estimates of dose-response based on epidemiologic studies will have a fairly broad range of uncertainty. OSHA must examine the best available data on exposure-response to arrive at a determination of significance of risk, despite inherent and inevitable

occupational exposure to ionizing radiation. The estimated excess cancer fatality rate from 47 years of exposure to the maximum permissible occupational exposure to ionizing radiation (5 rems) is 17 to 29 per 1000 workers (Committee on the Biological Effects of Ionizing Radiation (BEIR) III predictions, see 45 FR 1902). However, most radiation standards (unlike OSHA standards) require that exposure limits be reduced to the lowest level reasonably achievable below the exposure limit (the ALARA principle). Approximately 95 percent of radiation workers have exposures less than one-tenth the maximum permitted limit. The excess cancer deaths at one-tenth the permitted level are 1.7 to 2.9 per 1000 workers exposed 47 years. Asbestos exposures of 45 years to 2 f/cc are predicted by OSHA to result in 64 excess cancer deaths per 1000 workers beginning work at age 25 (Ex. 84-392). OSHA's calculation for the average excess cancer risk to worker exposed at conditions that exist in the workplace today (for those above 0.5 f/cc) for a 45-year exposure, is 196 excess cancer deaths per 1000 workers. This figure was calculated by taking the number of cancer deaths estimated from exposure to existing conditions for 45 years for those workers exposed to greater than 0.5 f/cc of asbestos and dividing by the number of workers exposed to asbestos greater than 0.5 f/cc (multiplied by 1000).

Therefore, the excess cancer risk at 2 f/cc for asbestos workers is estimated as more than twice as high as the maximum permitted radiation cancer risk and about 25 times higher than the estimated cancer risk of 95 percent of the workers exposed to radiation. At existing conditions, asbestos workers' excess cancer risks are estimated to be 85 times higher than the cancer risk faced by 95 percent of the workers exposed to radiation. The risk of asbestosis further increases the significance of the risk from asbestos exposure.

At 0.5 f/cc, OSHA estimates that 17 excess cancer deaths will occur in 1000 workers exposed 45 years. This risk is approximately 7 times higher than the cancer risk faced by 95 percent of the workers exposed to radiation. OSHA finds that these comparative risks strongly support OSHA's finding that workers exposed to air concentrations above 0.5 f/cc are far above the point of significant risk and are at grave danger of dying from cancer.

5. *Conclusion.* OSHA's finding of "grave danger" is based on evidentiary and policy considerations. OSHA's determination that the magnitude of the estimated risk to exposed workers is alarmingly high constitutes the major component of the "grave danger" finding. The overall extraordinary degree of risk, the extent that very high risk is found in many asbestos using industries, and the unusually high quality of the data utilized to make these assessments present a very strong evidentiary basis for a "grave danger" finding. Just as importantly, the unique gravity of asbestos-caused diseases, in particular cancer, such as mesothelioma which is linked almost exclusively to asbestos exposure, strongly supports OSHA's finding of grave danger. Also OSHA's comparison of the risk of asbestos-related diseases to other industrial risks underscores the extraordinarily high risk estimated for asbestos exposure. OSHA has also noted the concerns of workers about current workplace conditions and the numerous petitions for an ETS from unions representing many exposed workers. Finally OSHA has relied on its experience in evaluating and regulating workplace hazards in recognizing the extraordinary degree of risk currently faced by asbestos workers and in determining that such risk constitutes a grave danger to those workers.

B. Need for an ETS

OSHA has determined that this ETS is necessary to protect employees from grave danger, the second prong of the Act's test of OSHA's exercise of its ETS authority (Section 6(c) of the Act). As explained in detail, the effect of this ETS is to save many lives which would otherwise be lost to asbestos-related disease if current working conditions were not changed. OSHA believes that employees can be adequately protected against this grave danger only by issuing an ETS. This is because no other Agency action and no other foreseeable event would result in sufficiently reduced asbestos exposures that would alleviate the grave danger. Further, the provisions of the ETS are tailored to effect the necessary exposure reductions expeditiously.

1. *Lives Saved by Issuing an ETS.* OSHA has estimated the number of deaths avoided as a result of an ETS which would reduce the PEL to 0.5 f/cc (see Tables 2 and 3). For cancer only, based on continuing exposures under currently existing conditions for 6 months, the potential number of lives saved is estimated as approximately 210. Based on continuing exposures at currently existing conditions for 1 year, the potential number of lives saved is estimated at approximately 420. Also, OSHA has estimated that the promulgation of an ETS setting a 0.5 f/cc PEL may avoid 5725 cancer deaths assuming 20 years exposure to asbestos of the current workforce at current conditions and 7815 cancer deaths assuming 45 years exposure.

OSHA is aware, of course, that Section 6(c) of the Act limits the effective time of an ETS to 6 months, and OSHA concludes that a grave danger exists and an ETS is necessary even if OSHA focuses exclusively on this six month period. However, the Agency believes it is appropriate to calculate benefits deriving from an ETS using lifetime risks from 20 and 45 years of exposure to the PEL of 0.5 f/cc established by the ETS. Although the ETS expires within 6 months, Section 6(c) requires that rulemaking on a permanent standard also be completed within 6 months, so that there will be no gap in protection for exposed employees. In OSHA's experience and judgment, complying with this statutory directive and completing rulemaking for a permanent standard within 6 months of an ETS has and can be done.

OSHA also believes, based on its experience, that it is very likely that the PEL established after 6(b) rulemaking will be no higher than 0.5 f/cc, the ETS limit. Therefore, OSHA believes that the ETS will result in a reduced lifetime worker exposures of 0.5 f/cc or lower for 20 or 45 years, and that the benefits derived from these exposure reductions for these time periods are appropriately attributed to OSHA's promulgation of this emergency standard.

a. *Employee Exposures.* To derive these estimates of numbers of lives saved, OSHA depended on its knowledge of the following factors: (1) The employee exposure levels from the ambient asbestos air concentrations in the workplace; (2) the number of workers exposed at the various asbestos levels; (3) the duration of the exposure; and (4) the probability of the disease (or the risk) associated with the cumulative exposure.

Employee exposure levels are conventionally measured in terms of the number of asbestos fibers that are 5 microns or more in length in one cubic centimeter of air, f/cc. In these terms, an ambient concentration may seem to be a small amount of asbestos. However, in physical terms, 2.0 f/cc equals 2,000,000 fibers per cubic meter (f/m³). Humans inhale about one cubic meter of air per hour, depending on degree of physical activity. Thus, at this concentration, a worker would inhale roughly 16,000,000 fibers, 5 microns or more in length, over an eight hour workday.

carcinogenesis assume that the risk of transformation of target cells to cancer cells increases with increases in the total dose. Exposures received after such a transformation has taken place may aid the development of cancer, but have not caused the cancer. Thus, in some instances, using total cumulative exposure may overstate the exposures sufficient to produce increased cancer risk. For this reason, some epidemiologists omit the later years of exposure to a carcinogen in analyses of mortality in relation to cumulative exposure.

In addition to cumulative exposure, *Intensity* of exposure can be examined in relation to disease. Intensity of exposure is often approximated by 8-hour time-weighted averages (TWA's). The OSHA PEL of 2 fibers per cubic centimeter (2 f/cc) as an 8-hour TWA

converting mpcf to f/cc has been suggested as ranging from 1:1 to 1:5 depending on the industry studied by the scientists (Kang and Chu, Ex. 84-1; Hammad et al., Ex. 84-277; McDonald, Liddell, Gibbs, Eyssen, and McDonald, Ex. 84-065). For example, using conversion factors of 1:1 to 1:5 a cumulative exposure of 20 mpcf-years could range from 20 f/cc-years to 100 f/cc-years.

The British Occupational Hygiene Society Committee on Asbestos conducted a study of dust concentrations measured by current methods and historical methods (Ex. 84-026). Conversion factors for historical methods to current methods were 1: 0.07, 1: 2.2, and 1:2, depending on the historical method.

For asbestos mining and

contacts of the amosite workers. Presumably, family contacts received their exposure to asbestos from dust carried home on the worker's clothing, especially during the laundering of dusty clothes. About a 10-fold increase in prevalence of pleural thickening compared to controls was observed in family contacts of workers with only one year of exposure within the amosite factory.

Estimated asbestos exposure levels of family contacts and community members observed to be at risk of asbestos related disease have not been reported. OSHA considers it very likely that the cumulative exposures of the family contacts and community members were less than 100 f/cc-years.

Seidman, Selikoff,

State which shall indicate projected

funds, Federal and non-Federal, expected to be applied to the program;

comply substantially with the provisions of the Act or this part and should be replaced, such finding shall be treated

S-A04112 002(01)(03-NOV-83-15:13:49)

Form rev. 10-12-83

tion of an ETS setting a 0.5 f/cc
avoid 5725 cancer deaths
20 years exposure to asbestos
ent workforce at current
and 7815 cancer deaths
45 years exposure.
s aware, of course, that
c) of the Act limits the
me of an ETS to 6 months.
concludes that a grave
sts and an ETS is necessary
HA focuses exclusively on
nth period. However, the
lieves it is appropriate to
enefits deriving from an ETS
ne risks from 20 and 45 years
to the PEL of 0.5 f/cc
by the ETS. Although the
within 6 months, Section
s that rulemaking on a
standard also be completed
nths, so that there will be no
ction for exposed
n OSHA's experience and
mplying with this statutory
completing rulemaking for
standard within 6 months
s and can be done.
believes, based on its
hat it is very likely that the
ed after 6(b) rulemaking
her than 0.5 f/cc, the ETS
re, OSHA believes that the
lt in a reduced lifetime
ures of 0.5 f/cc or lower for
, and that the benefits
hese exposure reductions
periods are appropriately
OSHA's promulgation of
y standard.
Exposures. To derive
s of numbers of lives
depended on its
wing factors: (1)
e levels from the
concentrations in
(2) the number of
ed at the various asbestos
uration of the exposure;
bability of the disease (or
ated with the cumulative

posure levels are
measured in terms of the
stos fibers that are 5
in length in one cubic
. f/cc. In these terms, an
ration may seem to be a
asbestos. However, in
2.0 f/cc equals 2,000,000
meter (f/m³). Humans
cubic meter of air per
on degree of physical
this concentration, a
nale roughly 16,000,000
or more in length, over
kday.

Note.—Depending on the industrial process, up to 784,000,000 additional asbestos fibers less than 5 microns in length may also be inhaled, assuming that 99% of airborne asbestos fibers are less than 5 microns.

OSHA continues to use the term, f/cc, for convenience but cautions that the numerical estimates of air concentrations given in these terms are only one way of viewing asbestos concentrations and should not be evaluated without interpreting the meaning of the units.

OSHA used existing information to estimate worker asbestos exposure in each affected industry. Data sources included government contractor reports (Ex. 84-002 and Ex. 84-009), various studies reported in the literature, NIOSH Health Hazard Evaluations, and OSHA compliance data (Ex. 84-355). OSHA reviewed the information, and decided to use the 1980 Research Triangle Institute (RTI) report (Ex. 84-009) as the primary basis for exposure estimates because the RTI estimates appear to OSHA to be the most comprehensive. In addition, RTI used a large number of different data sources to make their exposure estimates, including interviews, existing documentation, and industrial hygiene surveys of worksites.

Using the RTI report as the primary reference, OSHA compared RTI data with other exposure information available for each industry. For example, specific reports were found for asbestos cement manufacturing (Ex. 84-248), textile manufacturing (Ex. 84-267), removal of sprayed asbestos material from buildings (Ex. 84-282), and brake repair (Exs. 84-283, 84-298). The Asbestos Information Association provided data concerning exposures during field fabrication and installation of asbestos cement pipe and sheet in controlled conditions (Ex. 84-295). The Environmental Sciences Laboratory (Ex. 84-002) also made best estimates of worker exposure in various industries for 1975.

In addition, OSHA used its own field inspection experience to estimate exposures. OSHA reviewed selected case files and obtained information that listed OSHA asbestos measurements during compliance inspections from 6/1/79 to 5/31/83 (Exs. 84-354, 84-355).

OSHA adjusted the RTI estimate as appropriate, based upon a qualitative judgment as to which data best represent existing exposure conditions. OSHA's exposure estimates are based, therefore, upon a substantial data base and upon considerable experience in enforcing the existing asbestos standard.

OSHA used the employee exposure levels in each industry to calculate the number of deaths avoided by reducing the exposure from current levels to the emergency PEL. Alternative exposure distributions used for sensitivity analysis will be provided in the Preliminary Regulatory Impact Analysis.

OSHA believes that the exposure estimates are relatively good, given the state of the art of worker exposure estimation techniques and data available today. OSHA is not aware of any other available current exposure estimates.

Industrial hygiene reports of operations in the same industry, but at different work sites, invariably report different asbestos exposures among the workers. OSHA reviewed these reports and made decisions regarding typical industry practices. For some operations, such as brake relining, several reports were available with complete descriptions of the working environment and OSHA was able to use these to make direct exposure estimates. Other reports, such as "Removal of Pre-formed Asbestos Insulation" (Ex. 84-296), described careful processes for asbestos handling that did not appear representative of the methods used throughout industry, since the reported air concentrations were not consistent with other reports showing higher exposures (Exs. 84-306, 84-282).

Table 1 shows OSHA's estimates of employee exposure to asbestos by industry segment.

BILLING CODE 4510-26-M

S-A04110 007(04)(03-NOV-83-14:22:43)

Form rev. 10-12-83

ite workers.
contacts received
bestos from dust
worker's clothing.
laundering of dusty
old increase in
thickening
was observed in
rkers with only
he amosite

xposure levels of
ommunity
be at risk of
se have not been
ders it very likely
posures of the
mmunity
n 100 f/cc-years.
nd Hammond (Ex.
rtality of 820
rkers employed
45. Seidman et al.

and efforts should be continued to reduce asbestos dust to as low a level as possible. At this stage it is impossible to state definitely that the standard is inadequate, because its introduction is so recent, and it is essential to follow up groups exposed to low levels in order to improve the data necessary for the formulation of better standards" (Ex. 84-020, p. 199).

Finkelstein (Ex. 84-044) studied the development of compensable (certified) asbestosis among 157 Ontario asbestos cement production workers in relation to cumulative exposures (f/cc-years). All workers in the study cohort had at least 15 years of exposure. Ontario criteria for certifying asbestosis, which results in the award of disability pensions, are not inflexible and involve consideration of such factors as history of occupational [illegible] based upon substantial medical evidence of severe disability from the disease.

Dement and colleagues conducted a detailed study of plant processes and dust control methods at a chrysotile textile plant during 1930-1975 (Ex. 84-036, 84-037). Exposure histories were constructed for each worker and estimates of individual cumulative exposures in terms of f/cc-days were made. After 1940, exposure levels usually were in the range of 5-10 f/cc. Workers were categorized as receiving exposures of less than 1000; 1000-10,000; 10,000-40,000; 40,000-100,000; and greater than 100,000 f/cc-days. Because Dement et al. included holidays and weekends in their estimates of f/cc-days, their estimates of cumulative exposure are likely to be [illegible]

1941-1967. Mortality was observed during the period 1941-1973. Cumulative exposures, expressed in millions of particles per cubic foot of air times years exposed (mpcf-years), were estimated for each man included in the study cohort. Mean exposures for 6 cumulative exposure categories were 62, 182, 352, 606, and 976 mpcf-years.

Hammad et al. (Ex. 84-277) suggested a mpcf to f/cc conversion factor of 1:1.4 for a cement plant. Because cement and other mineral particles have been extensively used in asbestos products manufacturing, using a conversion factor of 1:1.4 does not appear to be unreasonable for Henderson and Enterline's study cohort. Using a factor of 1:1.4, 62 mpcf-years is roughly equal to 87 f/cc-years.

...this risk at this time. The high quality and well-supported estimates of excess risk of mortality from lung cancer, mesothelioma and asbestosis alone provide sufficient bases upon which to justify this action.

E. Estimates of Cancer Mortality

A best estimate of K_L was calculated for each of the eleven epidemiologic studies and an estimate of K_M was calculated from four of these studies (see Table 5) (Ex. 84–392). For each study, the best estimate for K_L and K_M is indicated along with a range of uncertainty. The ranges listed are those are the result of estimates of exposure uncertainties (usually a factor of 2), methodological uncertainties that led to alternate evaluations of risk or exposure ... the uncertainties around this estimate of K_L are such that, an appropriate estimate of K_L could lie between 0.003 and 0.03.

The estimates of K_M given in Table 15 are derived from studies with four of the five highest K_L values. That is, there is some bias in examining the value of K_M independent of the K_L in the same studies because it is likely that these K_M would tend to be slightly higher than those derived from other studies, due to the demonstrated high power of these studies to detect risk. The arithmetic mean of the K_M's is 4.96×10^{-8}, and the geometric mean of the K_M's is 2.91×10^{-8}.

To account for some of this bias when estimating K_M, it is useful to examine the ratio of K_M to K_L. For the four studies for which K_M was calculated, the range of the ratios of K_M to K_L is only two-fold (from 0.75×10^{-6} to 1.79×10^{-6}). Both the ... workers. Therefore, the choice of a midpoint unit risk for all industrial processes ($K_L = 0.01$) is a reasonable and justified choice.

The best estimates of K_L and K_M were utilized to estimate the mortality from exposures to varying concentrations of asbestos for different time periods beginning at different ages. The calculations are age, intensity and duration specific. Tables 10 and 11 show the excess asbestos-related mortality rates from lung cancer, mesothelioma, and gastrointestinal cancer (gastrointestinal cancer excess is assumed to be 10 percent of the lung cancer excess). In these calculations, Equation 1 and Equation 3 were used with values of K_L equal to 0.01 and K_M equal to 1×10^{-8} and the 1977 U.S. male background lung cancer mortality rates. Because of age-specific increases in lung cancer rates in older men since 1977,

S-A04110 . 0108(06)(03-NOV-83-14:29:18)

FR91 ... 10-12-83

respirators, and to assure that all such employees participate in the program and are informed of specified categories of information. OSHA considers this provision to be "necessary" within the meaning of section 6(c) of the Act, to reduce the grave danger faced by asbestos exposed employees. The absence of a training program requirement in the asbestos standard has been pointed out as one of the serious deficiencies of the current standard. OSHA believes that participation in an adequate training program is essential for the protection of employees because most protective provisions enlist the employee as an active participant. For example, many employees handling asbestos depend on effective work practices. Without training in applying these work practices, employee protection would be inadequate. Where the employee plays a more passive role in his protection such as where engineering controls are relied on, training is also essential, because the employee must know the sources of workplace asbestos contamination, and the health hazards of asbestos exposure, in order to assess his own exposure situation and to help recognize when engineering controls are not operating properly. Certainly where housekeeping plays an important role in control, instruction about housekeeping methods, for example, frequent vacuuming, is essential. Perhaps most importantly, where employee protection depends upon respirator use, OSHA's experience shows that training employees in the use, fitting and limitations of respirators is critical to the effectiveness of respirator protection. Accordingly this requirement applies where airborne concentrations are reasonably expected to exceed 0.5 f/cc, even if employees use respirators to reduce breathing zone concentrations and thereby comply with the ETS.

As set forth in paragraph (k)(4) the employer must inform the employee of the health effects of asbestos exposure; the relationship between asbestos and smoking in producing lung cancer; the operations exposing employees to asbestos fibers and necessary protective steps to minimize exposure; the purpose, proper use, fitting instructions and limitations of respirators, and the contents of all the provisions of the Asbestos Standard at 1910.1001.

5. *Paragraph (k)(5) Respiratory protection during the ETS.* The ETS adds a new paragraph (k)(5) which includes a table which ties respirator selection to the 0.5 f/cc PEL. Under the ETS, the concentration cut-offs for various kinds of respirators are multiples of the reduced PEL of 0.5 f/cc, rather than multiples of the previous 2 f/cc permissible limit. For example, approved air purifying respirators may be used only where asbestos concentrations are not expected to exceed 5 f/cc (10 x the PEL). Before the ETS, because the PEL was 2 f/cc, such respirators could be used where asbestos concentrations would not have exceeded 20 f/cc (10 x the PEL of 2 f/cc).

Similarly, powered air purifying respirators may be used where asbestos concentrations do not exceed 100 times the PEL, which at the new level of 0.5 f/cc is 50 f/cc. Previously, employers could have used such respirators at concentrations up to 200 f/cc.

It is likely that the main impact of the reduced PEL on respirator choice will be in operations and industries where exposure levels are between 5 f/cc and 20 f/cc. Formerly, employees exposed in this range could use half-mask air purifying respirators; now they must be protected by a powered air purifying respirator or a full facepiece respirator, or they may use a supplied air respirator.

6. *Paragraph (k)(6). Warning signs during the ETS.* The ETS requires that legible signs warning of the health hazards of asbestos be displayed at locations where airborne concentrations of asbestos fibers exceed the reduced exposure limit of 0.5 f/cc. No specific legend is required signs for newly posted during the ETS. OSHA wishes to make as practicable as possible the rapid posting of signs, especially in workplaces where there has been previous non-compliance and in areas where asbestos concentrations were formerly below the 2.0 f/cc PEL.

XI. Public Participation

Interested persons are invited to submit written data, views and arguments with respect to the revisions to the asbestos standard made by the ETS. These comments must be postmarked on or before January 3, 1984 and sent to the Docket Officer, Docket No. H-033C, Occupational Safety & Health Administration, U.S. Department of Labor, 200 Constitution Avenue, NW., Room S-6212, Washington, D.C. 20210.

The data, views and arguments that are submitted will be available for public inspection and copying at the above address. All timely written submissions will be made a part of the record of the proceeding.

List of Subjects in 29 CFR Part 1910

Occupational safety and health, Asbestos, Health, Emergency temporary standard, Cancer.

Authority and Signature

This document was prepared under the direction of Thorne G. Auchter, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, 200 Constitution Avenue, NW, Washington, DC 20210. Pursuant to Sections 6(b), 6(c), 8(c) and 8(g) of the Act, 29 CFR 1910.1001 is amended by adding a new paragraph (k) as set forth below.

(Secs. 6(b), 6(c), 8(c) and 8(g), Pub. L. 91–596, 84 Stat. 1593, 1596, 1599, 1600; 29 U.S.C. 655, 657; Sec. 107, Pub. L. 91–54, 83 Stat. 96 (40 U.S.C. 333); 29 CFR Part 1911; Secretary of Labor's Order No. 9-83 (48 FR 35736))

Signed at Washington, D.C., this 2nd day of November 1983.

Thorne G. Auchter,

Assistant Secretary of Labor.

PART 1910—[AMENDED]

Section 1910.1001 of Part 1910 of Title 29 of the Code of Federal Regulations is hereby amended by adding a new paragraph (k) reading as follows:

§ 1910.1001 Asbestos.

* * * * *

(k) *Emergency temporary standard effective November 4, 1983.*—(1) *Scope.* This emergency temporary standard is issued pursuant to section 6(c) of the Act and applies to all workplaces where employees may be exposed to asbestos in all industries covered by the Act, including, general industry, construction and maritime. Except to the extent modified by this emergency temporary standard all provisions of § 1910.1001 remain in effect.

(2) *Permissible levels of exposure.* The 8-hour time-weighted average airborne concentration of asbestos fibers to which any employee may be exposed shall not exceed one-half (0.5) fiber, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(3) *Methods of compliance with the emergency temporary standard.* Notwithstanding any other requirements of this section, compliance with the reduced exposure limit of 0.5 f/cc shall be achieved by any feasible combination of engineering controls, work practices, and personal protective equipment and devices.

(4) *Employee information and training.*—(i) As soon as possible, but not later than thirty (30) days from the effective date of this emergency temporary standard, the employer shall institute a training program for all employees exposed to airborne concentrations of asbestos in excess of

S-A04110 . 0108(06)(03-NOV-83-14:29:53)

FR96 ... 10-12-83

0.5 f/cc, without regard to the use o... respirators and shall assure their participation in the program during... effective period of this emergency temporary standard.

(ii) The employer shall assure tha... each such employee is informed of ... following:

(A) The health effects associated ... asbestos exposure;

(B) The relationship between asb... and smoking in producing lung canc...

(C) The nature of operations whic... could result in exposure to asbestos... necessary protective steps to minim... exposure including, as applicable, engineering controls, work practice... respirators, housekeeping and prote... clothing;

(D) The purpose, proper use, fittin... instructions and limitations of respirators permitted by the standar... and

(E) A review of all the provisions ... contained in 1910.1001.

(5) *Respiratory protection during t... ETS.* Notwithstanding any other requirement of this section, where respirators are used to achieve the permissible exposure limit of 0.5 f/c... they shall be selected according to Table 1.

(6) *Warning signs during the ETS.* ... addition to the requirements of

S-A04110 . 0108(06)(03-NOV-83-14:29:5...

FR96 ... 10-12-83