Testimony of

Kathleen M. Rest, Ph.D., M.P.A.

Acting Director, National Institute for Occupational Safety and Health

Centers for Disease Control and Prevention

on

Workplace Exposure to Asbestos

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Mr. Chairman and members of the Committee, on behalf of the National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control and Prevention, I am pleased to provide this testimony addressing the current scientific knowledge about health risks to workers from exposure to airborne asbestos.

Background

Asbestos is a term that is generally used in referring to a group of fibrous minerals with exceptional resistance to degradation by heat, acids, bases, or solvents. The minerals are not combustible and have a high melting point and low thermal and electrical conductivity. These and other useful properties had resulted in the development of thousands of commercial uses for asbestos-containing materials by the early 1970s. However, as the use of asbestos dramatically increased, the lethal effects of airborne asbestos became clear. Regulatory action and liability concerns related to the now well-established connection between inhalation of asbestos fibers and a variety of serious and often fatal diseases have reduced or eliminated the use of asbestos in many commercial products. However, asbestos and asbestos-containing materials are still found in many residential and commercial settings and pose a risk of exposure to workers and others.

Asbestos is defined in Federal regulations as the minerals chrysotile, crocidolite, amosite, tremolite asbestos, actinolite asbestos, and anthophyllite asbestos. These six minerals are regulated by the Occupational Safety and Health Administration (OSHA), the Mine Safety and Health Administration (MSHA) and the Environmental Protection Agency (EPA). Five of the six asbestos minerals were used commercially (actinolite asbestos was not) and, as a consequence, it has been possible to observe and characterize their adverse health effects on

humans.

Asbestos-Related Diseases

Exposure to asbestos significantly increases the risk of contracting several diseases. These include: 1) **asbestosis**—a disease characterized by scarring of the alveolar regions of the lungs; 2) **lung cancer**—for which asbestos is one of the leading causes among nonsmokers, and which occurs at dramatically high rates among asbestos-exposed smokers; 3) **malignant mesothelioma**—a cancer of the tissue lining the chest or abdomen for which asbestos and similar fibers are the only known cause; and 4) **nonmalignant pleural disease**—which can appear as a painful accumulation of bloody fluid surrounding the lungs, but which more commonly is seen as thick and sometimes constricting scarring of the tissue surrounding the lungs. In addition, asbestos exposure is associated with excess mortality due to cancer of the larynx and cancer of the gastrointestinal tract. The malignant diseases—the cancers including mesothelioma—are often fatal within a year or a few years of initial diagnosis. In contrast, asbestosis deaths typically occur only after many years of suffering from impaired breathing.

It is not known exactly how asbestos fibers cause disease. What is known is that the fibers, too fine to be seen by the human eye, can become airborne during various industrial processes or from handling asbestos-containing materials. These microscopic fibers can be inhaled and/or swallowed. As much as 50 percent or more of inhaled asbestos fibers remain lodged in the lungs, where it is almost impossible for the body to dispose of them. Asbestos fibers are extremely resistant to destruction in body fluids, and many of these fibers are too long to be

engulfed and removed by the cells that normally scavenge and remove particles that happen to deposit in the lungs. Generally, as the burden of retained fibers increases in the body, so does the likelihood of the diseases mentioned previously. Most asbestos-related diseases, particularly the malignant ones, have long latency periods often extending 10-40 years from initial exposure to onset of illness. While asbestos-related lung cancer and mesothelioma are frequently not curable, they and other asbestos-related diseases are clearly preventable by eliminating or limiting exposures to asbestos. The amount and duration of exposure are factors which can determine the risk of adverse health effects.

Exposure to Asbestos in the Workplace

Workplace exposure to asbestos remains a serious occupational health problem in the United States, with both vast numbers of workers at risk due to past occupational exposures and many other workers experiencing ongoing occupational exposures. Since the beginning of World War II, as many as eight million workers have been exposed to asbestos. Although the number of newly exposed workers has declined sharply since the development of regulatory standards in the 1970s, there are still substantial numbers of workers with continuing exposure. In 1991, NIOSH estimated that nearly 700,000 workers in general industry remained potentially exposed to asbestos, but that estimate did not include mining, railroad work, agriculture, and several other industry sectors.

The U.S. Geological Survey reports that asbestos continues to be imported for use in friction products (e.g., brakes and clutches), roofing products, gaskets, and thermal

insulation. Construction workers involved in the renovation or demolition of buildings that contain asbestos are at particular risk of asbestos exposure. Many workers in the relatively new asbestos removal industry are potentially exposed, relying on personal protective equipment and other methods for limiting inhalation of asbestos fibers. Industrial maintenance personnel are also at risk when they repair equipment, sometimes in enclosed spaces, that is insulated with asbestos-containing material, as are automotive service personnel involved in brake and clutch repair work.

In addition, "take-home" exposures—involving family members of workers who bring asbestos home on their hair, clothing, or shoes—is also a well-recognized hazard and was addressed in a 1995 NIOSH report to Congress.

Because of the hazardous nature of asbestos, approaches to consider for control of exposure include the substitution of less hazardous materials and the labeling of all asbestos-containing materials so that required exposure controls can be implemented.

Ongoing Research Into Asbestos Exposure

NIOSH currently is assessing workers' asbestos fiber exposure at selected horticultural operations that are using vermiculite, and at operations that expand vermiculite ore. Most of the vermiculite now being produced for domestic use is obtained from one of four mines, three of them domestic and one located in South Africa. NIOSH will complete asbestos exposure assessments at two expansion plants for each ore supplier, along with a number of horticultural

sites. We expect the field study to conclude by the end of calendar year 2001. At present, field sampling has been completed at four expansion plants and three horticultural operations.

Options under consideration for future research activities include identifying and characterizing other downstream uses of fiber-contaminated vermiculite that have not been previously recognized.

Tracking of Work-Related Asbestosis Deaths

NIOSH, using data from death certificates, has been tracking asbestosis mortality in the United States. Deaths associated with asbestosis increased from fewer than 100 annually in 1968 to more than 1200 per year in 1998, the most recent year for which final national data are available. In approximately one-third of these deaths, asbestosis was reported as the underlying, or main, cause of death, a proportion that has not changed appreciably over time. In the other two thirds of deaths, asbestosis was reported to have contributed but not caused the death. Death certificate data indicate that workers in the "ship and boat building and repairing" industry and "insulation workers" appear to have experienced the greatest risk of asbestosis. It also shows, however, that elevated asbestosis mortality is associated with a wide-ranging variety of other occupations and industry sectors.

Among the occupations with significantly elevated asbestosis mortality are: insulation workers; plumbers; sheet metal workers; plasterers; heating/air-conditioning/refrigeration mechanics; electricians; welders; chemical technicians; mechanics and repairers; stevedores; masons;

furnace and kiln operators; painters; construction workers; and janitors and cleaners. Please note that the fact that an occupation (or industry sector) has "significantly elevated asbestosis mortality" does not mean that all workers in the occupation or industry sector are exposed to asbestos.

The other industry sectors with significantly elevated asbestosis mortality include, but are not limited to: nonmetallic mineral products; construction materials and industrial chemicals; petroleum refining; tires and other rubber products; aluminum production, hardware, plumbing, and heating supplies; construction; electric power generation; railroads; glass products; building material retailing; paper manufacturing; and steelmaking.

Asbestosis mortality is a delayed phenomenon which reflects exposures that typically occurred decades earlier. To better describe more recent exposures, NIOSH recently prepared and published a summary of data describing the results of asbestos samples collected and reported by OSHA and MSHA inspectors in their agencies' centralized data systems. Over the decade-long period from 1987 to 1996, Federal occupational safety and health inspectors reported an average of about 600 air samples for asbestos each year, although the annual number of reported samples declined by about 50% for each agency during that decade. (Not all collected samples are reported into the centralized data systems.) In the construction industry, nearly 7% of the samples indicated asbestos fiber concentrations exceeding the applicable OSHA or MSHA permissible exposure limit (PEL), and the average asbestos fiber concentration of all samples was about one-half the PEL. In the industry classified as "miscellaneous nonmetallic mineral

and stone products," (which includes sites regulated by OSHA and MSHA) over 30% of asbestos samples exceeded the exposure limit (either OSHA's or MSHA's, as applicable) and the asbestos fiber concentrations averaged nearly twice the relevant PEL. In the "motor vehicles and motor vehicle equipment" industry, 10% of asbestos fiber samples exceeded the PEL and the asbestos fiber concentrations averaged more than twice the PEL. While asbestos exposure concentrations generally decreased in the more recent years of that ten-year period, and although fewer samples were being collected, samples continued to exceed the PEL in all three of those industry sectors. Federal inspectors detected asbestos in other settings, as well, ranging from textile operations to schools.

The Definition of Asbestos

In 1990 testimony before OSHA, NIOSH broadened its science-based definition of "asbestos" as a result of concerns about the microscopic identification of the six regulated asbestos minerals. The six minerals can also occur in a non-fibrous (so-called "massive") form. The non-fibrous mineral forms of the six asbestos minerals can be found geologically in the same ore deposits in which the fibrous asbestos minerals occur or in deposits where other commercially exploited minerals are mined (e.g., industrial grade talc). "Cleavage fragments" can be generated from the non-fibrous forms of the asbestos minerals during their handling, crushing, or processing, and these "cleavage fragments" are often microscopically indistinguishable from typical asbestos fibers of the (fibrous) minerals.

The elemental composition of the six asbestos minerals can vary slightly as a result of geological

conditions such as pressure, temperature, or proximity of other minerals. Recognizing these variations in elemental composition, NIOSH believes that the six asbestos minerals can be defined by their "solid-solution" mineral series. For example, the mineral series tremolite-ferroactinolite contains the asbestos mineral actinolite. These mineral series are considered solid-solutions in which cations (i.e., sodium, calcium, magnesium, iron, etc.) are replaced by other cations which can affect the elemental composition of the mineral without significantly altering the structure.

NIOSH bases this expanded "asbestos" definition—encompassing the entire solid-solution mineral series for each of the six currently regulated asbestos minerals and including cleavage fragments from the non-fibrous forms of these minerals—on scientific evidence from cellular and animal studies suggesting that dimension, specifically length and diameter, as well as durability, may be more critical factors in causing disease than chemical or elemental composition.

Challenges to Preventing Asbestos Exposure: Areas of Possible Additional Research

There are other fibrous minerals that technically do not fall within either the current regulatory or the NIOSH definition of asbestos, even though fiber shape, size, and durability indicate their potential to induce health effects similar to those of the six regulated asbestos minerals. The inclusion of only six specified fibers within the asbestos regulations may create a false sense of security that those mineral fibers that are not included are without risk. Clearly, other fibers may act in the same way as the regulated fibers and pose significant health risk, and mixtures of fibers may be lethal as well.

Based on epidemiological studies, it is clear that occupational exposure to mineral fibers that contaminate vermiculite from Libby, Montana, caused high rates of asbestos-related diseases among exposed workers. The fibers that contaminate vermiculite from Libby include tremolite, one of the minerals within the definition of asbestos as currently regulated. Some evidence indicates that only 10 to 20% of the fibrous mineral content of the Libby vermiculite was tremolite. A much higher proportion—80 to 90%—of the fiber contaminant in this vermiculite has been characterized as several other similar fibers that are not currently regulated as asbestos, such as richterite and winchite.

Another example of a mineral that can produce asbestos-related diseases but is neither regulated as asbestos nor classified as asbestos under NIOSH's current scientific definition, is erionite. Erionite is a known human carcinogen, and environmental exposures outside the U.S. have been associated with an increased risk of malignant mesothelioma and lung cancer. (We

are unaware of any occupational exposure to erionite in the U.S.)

Additional research possibilities which may be considered include efforts to better determine physical and/or chemical characteristics affecting toxicity of these naturally occurring mineral fibers as well as durable manufactured fibers. Direct evidence by which to attribute particular health effects to each possible fiber type is not currently available; obtaining such evidence is another area under consideration for future research. Epidemiological studies of people exposed to naturally occurring or manufactured fibers would provide important new information and are also under consideration for future research, along with animal toxicologic studies to help supply needed information if epidemiologic studies are not feasible.

In addition, further research is under consideration in the areas of exposure measurement and analysis of fibers. Although asbestos is comprised of fibers of many diameters and lengths, risk assessments and exposure assessments are based on air concentrations of fibers detectable by a technique called phase contrast microscopy. This method leaves an undetermined number of asbestos fibers in each sample uncounted because they are too thin for detection. Because of this measurement bias, asbestos exposure risks are currently based only on fibers large enough to be detected. More sensitive methods are currently available, but these methods could benefit from better standardization. Additional work to improve and standardize the methods for asbestos fiber measurement is being considered because it would help advance prevention and control efforts to protect exposed workers.

Conclusion

In summary, we know much about the adverse health effects caused by the inhalation of asbestos fibers. Many exposures or potential exposures have been identified, and appropriate precautions are used when workers are handling or working around these materials. Increased understanding of the health effects of fibrous minerals that fall just outside the existing definitions of asbestos will help us find ways to provide appropriate protection for workers exposed to those materials. Further identification and tracking of potential exposures to fiber-contaminated vermiculite and other contaminated materials that may be identified will help us assure that no one is unknowingly exposed to these materials. While information is being gathered, public health prudence guides us to reduce known exposures to these potentially hazardous fibrous minerals.