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16. Abstract (Limit: 200 words): This testimony discussed the work conducted by NIOSH concerning protection for workers exposed to asbestos (1332214), which was still widely used in a variety of products such as brake linings, asbestos cement pipe, roofing tile and wallboard. All commercial forms of asbestos were considered to be carcinogenic. Exposure to asbestos significantly increased the risk of contracting three diseases: asbestosis, lung cancer, and mesothelioma. Asbestos was one of the primary causes of lung cancer in nonsmokers. It was estimated that since the beginning of World War-II as many as eight million workers have been exposed to asbestos. Over one million currently worked where exposure may be a problem. Construction workers involved in the demolition of buildings containing asbestos insulation were at increased risk of developing asbestos related disease. Maintenance personnel often repaired machines in asbestos contaminated work spaces or worked directly with products containing asbestos. NIOSH programs have involved measuring and characterizing asbestos fibers found in the work environment, quantification of the extent of disease among workers through epidemiological studies, and supporting these study results with toxicological experiments. NIOSH has also sponsored educational programs for the public and the training of workers to alert individuals to the dangers of asbestos.

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Chairman and Members of the Subcommittee:

I am Richard A. Lemen, Director, Division of Standards Development and Technology Transfer (DSDTT), National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control, U.S. Public Health Service. I am pleased to have been invited to discuss NIOSH activities relating to asbestos, a subject with which I have been involved since 1970. I have conducted industrial hygiene and epidemiologic studies in approximately a dozen asbestos manufacturing and processing facilities in the United States. I was the primary author of the NIOSH Revised Recommended Standard for Asbestos published in 1976 as well as the monograph on asbestos published by the World Health Organization's International Agency for Research on Cancer (IARC). In addition, I chaired the NIOSH/OSHA Asbestos Working Group which reported its findings and recommendations for the protection of workers in April 1979.

NIOSH MISSION

NIOSH was established by the Occupational Safety and Health Act of 1970 to conduct research, provide technical assistance and to assist in training professionals in the field of occupational safety and health. Under the Federal Mine Safety and Health Act, NIOSH is also responsible for conducting health research related to mining, recommending health standards and conducting health hazard evaluations in mines. Under these authorities NIOSH is also required by statute to make recommendations to the Department of Labor for new or revised occupational standards. The Department of Labor is responsible for the promulgation and enforcement of standards for occupational exposure.

ASBESTOS

Asbestos is still widely used in a variety of products such as brake linings, asbestos cement pipe, roofing tile and wallboard. Asbestos is also found as a contaminant in metal and non-metal mining environments. There are several commercial forms of asbestos used in the manufacture of various products. Based on widespread scientific evidence, all commercial forms of asbestos are considered to be carcinogenic.

ASBESTOS-RELATED DISEASES

Exposure to asbestos significantly increases the risk of contracting three diseases: asbestosis, lung cancer, and mesothelioma (a cancer of the lining of the chest or abdomen). Asbestos is one of the leading causes of lung cancer in non-smokers. Asbestos exposure for smokers increases the risk of lung cancer approximately 55 times over that of those who are not exposed to asbestos and who do not smoke. Excess deaths that have been associated with asbestos exposure include gastro-intestinal cancer and laryngeal cancer.

It is not known how asbestos causes disease. There has been speculation that surface properties, fiber size, and metallic content of the fibers may influence the carcinogenic properties of the substance. What is known is that fibers too fine to be seen by the human eye can become airborne during various industrial processes or from contact with asbestos containing products and can be inhaled and/or swallowed. As much as 50 percent of inhaled asbestos fibers remain lodged in the lungs where it is almost impossible for the body to dispose of them.

It is not known how much asbestos is necessary to cause disease. Studies to date show that asbestos-related disease can be demonstrated at all levels of exposure. A linear relationship appears to best describe the shape of the dose-response curve. In other words, higher concentrations of asbestos will produce a greater incidence of disease. There is evidence that the lowest measureable levels of exposure cause asbestos-related disease. Studies of family members of asbestos workers have found as high as 35% of family members with x-ray changes consistent with asbestos-induced pulmonary disease. These family members had no known history of asbestos exposures except that brought home on the clothes of the worker. Mesothelioma has occurred in adults whose only known exposure was from a parent who worked with asbestos. It has also occurred in persons living near asbestos waste sites or mining areas.

EXPOSURES

Workplace exposure to asbestos is a major occupational health problem in the United States, both because of the vast number of workers that have been exposed over many years and the potential for disease manifestation. It is estimated that since the beginning of World War II, as many as eight million workers have been exposed to asbestos. Over one million currently work where exposure to asbestos may be a problem. Of the remaining workers, 4.5 million are estimated to have worked in shipyards during World War II.

Persons peripherally exposed to asbestos must also be considered susceptible to disease. Construction workers involved in the demolition of buildings containing asbestos insulation are at increase risk of developing asbestos-related disease. Maintenance personnel must often repair machines in

asbestos-contaminated work spaces or work directly with products containing asbestos. Secretaries, executives, teachers and school children working or going to school in buildings insulated by asbestos may also be at risk. Families of workers can be exposed to asbestos brought home on the hair, clothing, or lunch boxes of workers.

NIOSH RESEARCH

NIOSH and its predecessor organizations in the Public Health Service have been involved in asbestos research and disease prevention programs since the 1930's. The research programs have included efforts to measure and characterize asbestos fibers found in the work environment, to quantify the extent of disease among asbestos workers through epidemiological studies and to support these epidemiological studies with toxicological experiments using a variety of asbestos forms. We have also conducted research on control technology for asbestos, such as using vacuum cleaning methods for collecting asbestos wastes.

Asbestos was the subject of the first NIOSH recommended standard which was forward to the Department of Labor in 1972. It served as the basis for the first new standard promulgated by the Occupational Safety and Health Administration (OSHA) after the Occupational Safety and Health Act was passed.

The standard, promulgated in 1972, provided for an exposure limit of 5,000,000 fibers greater than 5 microns in length per cubic meter of air until July 1976, when the limit was to be reduced to 2,000,000 fibers per cubic meter. This is the current standard for occupational exposure to asbestos.

In 1976, based on new scientific evidence about health hazards of asbestos exposure, NIOSH recommended that OSHA further lower the standard to 100,000 fibers per cubic meter, the lowest concentration at which fibers could be reliably monitored. In transmitting the revised recommendations to OSHA, NIOSH made the following comment:

> Because it is not possible to specify a safe exposure level for a carcinogen, only a ban on the use of asbestos can ensure complete protection against this mineral's carcinogenic effect. Therefore, emphasis should be placed on prohibiting the occupational use of asbestos in other than completely closed operations and on substituting other products whenever possible. Asbestos should be replaced, where technically feasible, by substitutes with the lowest possible chronic toxicities.

In 1979 a joint NIOSH/OSHA working group re-affirmed this recommendation.

To date no Federal standard regulating the amount of asbestos permitted in the ambient air in the non-industrial environment has been established.

The NIOSH program on asbestos has included a variety of public education and training programs. Since 1976, NIOSH has conducted 27 courses and trained 480 health and safety specialists in the area of hazard evaluations including asbestos sampling and counting. In addition, through the NIOSH-sponsored Educational Resource Centers located at 15 universities, 26 courses have been given and 451 more health and safety specialists have been trained in these techniques.

The Institute has supported worker education programs to alert asbestos workers and those peripherally exposed to the hazards of asbestos and how they can protect themselves by avoiding contact with friable asbestos and by substituting less hazardous materials for asbestos whenever possible. We also recommend other methods of control such as wetting and vacuum cleaning for

dust suppression and in some situations, the use of approved respirators in applications in which exposure cannot be kept within recommended limits by ventilation and other engineering controls.

In collaboration with the National Cancer Institute, NIOSH supported a contract with the American College of Pathologists to develop a syllabus on the recognition and diagnosis of asbestos-induced disease for use by physicians. Together with Johns Hopkins University and the American College of Radiology, NIOSH has also developed a proficiency examination for certifying physicians in chest x-ray identification of dust-induced diseases.

NIOSH also aids management, labor, and various Federal, State, and local agencies in solving asbestos related problems by providing technical guidance. Since 1970, NIOSH has also conducted health hazard evaluations at approximately 150 schools and public buildings to determine if asbestos used as insulation poses a health risk to the occupants.

The state-of-the-art techniques used by NIOSH in these investigations are designed to evaluate as accurately as possible the potential for asbestos exposure to building occupants. Air samples are collected at a height approximating the breathing zone of occupants. These samples are obtained using millipore AA 37 mm 0.8 μm pore size mixed cellulose ester filters (open face) and battery-powered sampling pumps calibrated at 2.5 and 3.5 liters per minute (lpm) respectively. Samples are normally collected over a 4 to 5 hour period.

Air samples are then quantitatively analyzed for asbestos according to a method developed by NIOSH for asbestos analysis. A small wedge from each filter sample is first cleared on a microscope slide with 1:1 solution of dimethyl phthalate and diethyl oxylate. Fibers greater than 5 μm in length are then counted from each prepared slide using a phase contrast optical microscope at a magnification of 400X. Due to the low fiber concentrations generally found in buildings and schools, 100 fields are counted for each sample. A limit of detection (LOD) is calculated based on pooled results from filter blanks. Samples resulting in fiber counts below this value are reported as below the limit of detection ($<$LOD).

If bulk samples are taken, they are submitted for qualitative asbestos analysis by transmission electron microscopy (TEM). In preparation for analysis, each sample is ground fine in a cryogenic freezer mill. An aliquot of each sample is then suspended in ethanol and deposited on a 200 mesh copper grid. Asbestos is confirmed using energy dispersive X-ray analysis and electron diffraction techniques.

Wipe samples are also sometimes collected from surfaces near air sample locations in the buildings. These samples are collected using millipore AA 37 mm 0.8 μm pore size mixed cellulose ester filters from a surface area approximating 0.1 ft^2. These samples are submitted for qualitative asbestos analysis by TEM.

Depending upon the sampling results at the evaluated sites, a variety of recommendations have been made. If the material releases fibers easily when rubbed, scraped or damaged, it is considered friable and corrective steps must

be taken to encapsulate or remove it. If the material does not release fibers or cannot be damaged easily, it is generally recommended that no immediate corrective action be taken. However, recommendations are made to observe the material for future signs of deterioration at which time encapsulation or removal may be warranted. NIOSH also recommends that asbestos containing products not be used for new construction or repair in buildings, schools or homes.

This concludes my summary of NIOSH asbestos health-related activities. I would be glad to answer any questions you might have.