NIOSH Comments to DOL

Comments of the
National Institute for Occupational Safety and Health
on the
Mine Safety and Health Administration
Advanced Notice of Proposed Rulemaking on
Measuring and Controlling Asbestos Exposure

30 CFR Parts 58 and 72

U.S. Department of Health and Human Services
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National Institute for Occupational Safety and Health

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The National Institute for Occupational Safety and Health (NIOSH) has reviewed the Mine Safety and Health Administration (MSHA) Advance Notice of Proposed Rulemaking (ANPR) on measuring and controlling asbestos exposure at mining operations. NIOSH supports MSHA's efforts to propose rulemaking to lower the asbestos permissible exposure limit (PEL) and reduce miners' exposure to asbestos. In addition to the topics presented in the ANPR for comment, we are providing commentary on two areas important to the development of a revised standard: the definition of asbestos and medical surveillance. Our responses to specific questions in the ANPR will follow.

Definition of Asbestos

An integral part of an occupational standard for asbestos should include an appropriate definition that will ensure, to the extent possible, the greatest level of health protection to workers. In comments on OSHA's Notice of Proposed Rulemaking [NIOSH 1990a], NIOSH stressed the importance of having a definition for asbestos that was sufficiently comprehensive in scope so as to include those "fibers" that should be regulated for compliance purposes. A copy of these comments is enclosed. In summary, NIOSH presented the following justification in support of a comprehensive asbestos "fiber" definition:

> 1) the asbestos minerals, chrysotile, anthophyllite, crocidolite, amosite, tremolite, and actinolite, and the nonfibrous (nonasbestiform) analogs of these asbestos minerals, can occur separately or in the same geologic area where crushed stone, aggregate rock, talc, and vermiculite mines are found. The location and identification of the asbestiform minerals within deposits of the same nonasbestiform minerals are often difficult to determine since the asbestiform minerals can occur sporadically at the mine or quarry site. The occurrence of these minerals within the mine or quarry can often inadvertently contaminate the mined commodity;
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> 2) the nonasbestiform analogs of the asbestiform minerals can cleave during their handling and generate microscopic-sized fibers (i.e., fragments >3:1 aspect ratio and > 5 μm in length) that are indistinguishable from the six (asbestiform) asbestos minerals when using phase contrast optical microscopy (PCM) and are difficult to differentiate even when using electron microscopy;
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> 3) experimental animal carcinogenicity studies with various minerals have provided strong evidence that the carcinogenic potential depends on the "particle" length and diameter. The consistency in tumorigenic responses observed for various mineral particles of the same size provides reasonable evidence that neither composition nor origin of the particle is a critical factor in carcinogenic potential;

> 4) epidemiologic studies of workers exposed to nonasbestiform cleavage fragments provide inconsistent evidence of an excess in lung cancer risk. The results of other epidemiologic studies of workers exposed to mixed exposures of asbestos fibers and nonasbestiform cleavage fragments have demonstrated an excess in lung cancer risk.

NIOSH further stated in the 1990 comments to OSHA that there was no scientifically valid health evidence to exclude from an asbestos standard cleavage fragments from the nonfibrous analogs of the asbestos minerals if they meet the microscopic definition of a fiber. Exclusion of these nonasbestiform cleavage fragments from the standard would pose a potentially serious health risk to exposed workers and would compromise the protection afforded to workers with mixed airborne exposures to the asbestiform and nonasbestiform minerals. Based on these concerns, NIOSH adopted the following mineralogic nomenclature for defining asbestos and recommended to OSHA that they incorporate this definition as part of the standard for asbestos:

> Using these NIOSH microscopic methods, or equivalent, airborne asbestos fibers are defined, by reference, as those particles having (1) an aspect ratio of 3:1 or greater and having a length greater 5 µm; and (2) the mineralogic characteristics (that is, the crystal structure and elemental composition) of the asbestos minerals and their nonasbestiform analogs. The asbestos minerals are defined as chrysotile, crocidolite, amosite (cummingtonite-grunerite), anthophyllite, tremolite, and actinolite. In addition, airborne cleavage fragments from the nonasbestiform habits of the serpentine minerals antigorite and lizardite, and the amphibole minerals contained in the series cummingtonite-grunerite, tremolite-ferroactinolite, and glaucophane-riebeckite shall also be counted as fibers provided they meet the criteria for a fiber when viewed microscopically.

Recent scientific work [Lockey et al. 1996; NIEHS 1998; Ye et al. 1999; Morimoto 1999; Ye et al. 2001; Bernstein et al. 2001] suggests that biopersistent durable fibers similar to asbestos, but which are not currently within the regulatory definition of asbestos, may cause health problems comparable to those from exposure to asbestos. In light of these findings, the inclusion of only six specified fibers within the asbestos regulations may create a false sense of security among workers and others who may come into contact with the other minerals that fall outside of the current regulatory definition of asbestos. Thus, NIOSH believes that durable inhalable fibers with characteristics similar to asbestos should be considered potentially harmful. Exposure to these fibers should be avoided if possible or otherwise minimized through standard industrial hygiene practices.

Medical Monitoring

NIOSH recommends periodic medical monitoring of workers exposed to asbestos for the identification of potential health effects and symptoms which may be related to contact with airborne fibers. Primary goals of a workplace medical monitoring program are the early identification of adverse health effects that may be related to exposures at work and possible health trends within groups of exposed workers. These goals are based on the premise that early detection, subsequent treatment, and workplace interventions will maximize the opportunity for maintenance of good health of the exposed workforce [International Labour Office (ILO) 1998].

Medical monitoring and resulting interventions represent secondary prevention and should not replace primary prevention efforts to minimize worker exposures to asbestos. In the case of asbestos, medical monitoring is especially important because achieving compliance with the NIOSH recommended exposure limit (REL) of 0.1 fibers per cubic centimeter (f/cc) does not assure that all workers will be free from risk of chronic respiratory diseases caused by occupational exposure. Early identification of respiratory system changes and symptoms associated with asbestos exposures, such as losses in pulmonary function, irritation, dyspnea, chronic cough, wheezing, and pleural plaques may signal the need for more intensive medical monitoring and the assessment of existing controls to minimize the risk of long-term adverse health effects. An ongoing medical monitoring program also serves to inform workers of potential health risks and promotes support of, and an understanding of the need for, exposure control activities.

A medical monitoring program serves as an effective secondary prevention method on two levels, screening and surveillance. Medical occupational screening focuses on the early detection of health outcomes for individual workers, and may involve an occupational history, medical examination, and application of specific medical tests to detect the presence of toxicants or early pathologic changes before the worker would normally seek clinical care for symptomatic disease. By contrast, medical surveillance involves the ongoing evaluation of the health status of a group of workers through the collection and aggregate analysis of health data for the purpose of disease prevention and for evaluating the effectiveness of intervention programs.

Medical monitoring programs should also be implemented where workers are exposed to durable biopersistent fibers similar to asbestos, such as richterite, winchite, or erionite, even when those fibers may fall outside the regulatory definition of asbestos.

Criteria for Medical Screening

To determine whether specific tests or procedures for medical screening are appropriate and relevant to a specific hazard (in this case, exposure to airborne fibers of asbestos), the following factors should be considered:

- Prevalence of an associated disease or symptoms in the population
- Risk of toxicity associated with the exposure
- Consequences of false positive test results
- Sensitivity, specificity, and predictive value of the screening test(s) to be used
- Reliability and validity of the screening test(s)
- Ability of the screening test(s) to identify disease early so that effective treatment or intervention may be used to impede disease progression
- Whether follow up, further diagnostic tests, and effective management of the disease are available, accessible, and acceptable
- The benefits of the screening program compared to the costs [Wagner 1996]

Based on these criteria, NIOSH recommends a medical screening program for workers exposed to asbestos that requires initial and periodic medical examinations. The elements of the program should include: physical examinations, an occupational history, respiratory symptom questionnaire, spirometric testing, and chest radiographs when warranted. Should a particular medical screening test indicate the presence of exposure-related disease or the increased probability that disease will develop, further evaluation and diagnostic testing may be needed. Recommended guidelines and schedules for specific medical tests are described below.

Worker Participation

All workers potentially exposed to asbestos may benefit by being included in an occupational medical monitoring program. Workers should be provided with information about the purposes of medical monitoring, the health benefits of the program, and the procedures involved. The following hierarchy describes those workers who should be included in a medical monitoring program and could receive the greatest benefit from medical screening:

- Persons exposed to elevated fiber concentrations (e.g., all workers exposed to airborne asbestos at concentrations above an action level, established by MSHA, the employer, or the medical monitoring program director)
- Persons in work areas or in specific jobs and activities, regardless of airborne fiber concentration, where one or more workers have recently developed symptoms or respiratory changes apparently related to asbestos exposure
- Persons who may have been previously exposed to asbestos or other respiratory hazards that place them at an increased risk of respiratory disease

- Persons in work areas or in specific jobs and activities, regardless of airborne fiber concentration, where respiratory protection is used to control asbestos exposures

Medical Monitoring Program Director

Oversight of the medical monitoring program should be assigned by the employer to a qualified physician or other qualified health care provider (as determined by appropriate State laws and regulations) who is informed and knowledgeable about the following:

- The administration and management of a medical monitoring program for occupational hazards

- The establishment of a respiratory protection program, based on an understanding of the requirements of the OSHA respiratory protection standard and types of respiratory protection devices available at the workplace

- The identification and management of work-related respiratory effects or illnesses

Recommended Program Elements

Recommended elements of a medical monitoring program for workers exposed to asbestos include provisions for an initial medical examination and periodic medical examinations at regularly scheduled intervals. Based on the findings from these examinations, more frequent and detailed medical examinations may also be necessary. Worker education should also be included as a component of the medical monitoring program. Specific elements of the examinations and scheduling are described below.

A. Initial medical examination

An initial (baseline) examination should be performed as near as possible to the date of beginning employment (within 3 months). The initial medical examination should include:

- A physical examination of all systems with an emphasis on the respiratory system

- A spirometric test administered by an individual who has completed a NIOSH-approved training course in spirometry or other equivalent training

- A chest x-ray interpretation by a certified B-reader using the most recent ILO standard International Classification of Radiographs of Pneumoconioses

- Other medical tests as deemed appropriate by the attending health care professional

- A standardized respiratory symptom questionnaire, such as the American Thoracic Society respiratory questionnaire [Ferris 1978, or the most recent equivalent] with additional questions to address symptoms of pleuritic chest pain and pleurisy

- A standardized occupational history questionnaire that gathers information on all past jobs with special emphasis on those with potential exposure to dust, a description of all duties and potential exposures for each job, and a description of all protective equipment the worker has used

B. Periodic medical examination

Periodic examinations, including a physical examination of the respiratory system, spirometric testing, a respiratory symptom update questionnaire, and an occupational history update questionnaire, should be administered at regular intervals determined by the medical monitoring program director. The frequency of the periodic medical examinations should be determined according to the following guidelines:

- For workers with fewer than 10 years since first exposure to asbestos, periodic examinations should be conducted at least once every 5 years

- For workers with 10 or more years since first exposure to asbestos, periodic examinations should be conducted at least once every 2 years

A chest x-ray and spirometric testing are important upon initial examination, and may also be appropriate medical screening tests during periodic examinations for detecting respiratory system changes, especially in workers with more than 10 years since first exposure to asbestos. The value of periodic chest x-rays in a medical monitoring program should be evaluated by a qualified health care provider in consultation with the worker to assess whether benefits of testing warrant the additional exposure to radiation. As with the frequency of the periodic examinations, the utility of the chest x-ray as a medical test becomes greater for employees with more than 10 years since first exposure to asbestos, based on the latency period between first exposure and appearance of noticeable respiratory system changes. Because persons with advanced fiber-related pleural changes experience difficulty in breathing as the parietal and visceral surfaces become adherent and lose flexibility, it may prove beneficial to detect

fibrotic changes in the early stages so steps may be taken to prevent further lung damage [Balmes 1990].

C. More frequent medical examinations

Any worker should undergo more frequent and detailed medical evaluation if he or she has any of the following indications:

- New or worsening respiratory symptoms or findings (e.g., chronic cough, difficulty breathing, wheezing, reduced lung function, or radiographic evidence of pleural plaques or fibrosis)
- History of prior exposure to other respiratory hazards
- Other medically significant reason(s) for more detailed assessment

D. Worker education

Workers should be provided with sufficient training to recognize symptoms and diseases associated with asbestos exposures (e.g., chronic cough, difficulty breathing, wheezing, lung function loss, lung fibrosis, cancer, mesothelioma). Workers should also be instructed to report symptoms to designated safety and health personnel and a physician or other qualified health care provider for appropriate diagnosis and treatment.

Written Reports to the Worker

Following initial and periodic medical examinations, the physician or other qualified health care provider should provide each worker with a written report containing the results of any medical tests performed on the worker, and a medical opinion in plain language about any medical condition that would increase the worker's risk of impairment from, or as a result of, exposure to airborne asbestos, recommendations for limiting the worker's exposure to asbestos, which may include the use of appropriate personal protective equipment, as warranted, and recommendations for further evaluation and treatment of medical conditions detected.

Written Reports to the Employer

Following initial and periodic medical examinations, the physician or other qualified health care provider should provide a written report to the employer containing occupationally pertinent results of the medical evaluation, a medical opinion about any

medical condition that would increase the worker's risk of impairment from or as a result of exposure to airborne asbestos, recommendations for limiting the worker's exposure to asbestos (or other agents in the workplace), which may include the use of appropriate Personal Protective Equipment (PPE) or reassignment to another job, as warranted, and a statement to indicate that the worker has been informed about results of the medical examination and about the medical condition(s) that should have further evaluation or treatment. Specific findings, test results, or diagnoses that have no bearing on the worker's ability to work with asbestos should not be included in the report to the employer. Safeguards to protect confidentiality of the worker's medical records should be enforced in accordance with all applicable regulations and guidelines.

Employer Actions

The employer should assure that the qualified health care provider's recommended restrictions of a worker's exposure to asbestos or to other workplace hazards are followed, and that the REL for asbestos is not exceeded without requiring the use of personal protective equipment. Efforts to encourage worker participation in the medical monitoring program and to report any symptoms promptly to the program director are essential. Medical evaluations performed as part of the medical monitoring program should be provided by the employer at no cost to the participating workers. If the recommended restrictions determined by the medical program director include job reassignment, such reassignment should be implemented with the assurance of economic protection for the worker. Specifically, where medical removal or job reassignment is indicated, the affected worker should not suffer loss of wages, benefits, or seniority.

The employer should ensure that the medical monitoring program director communicates regularly with the employer's safety and health personnel (e.g., industrial hygienists) to identify work areas that may require evaluation and implementation of control measures to minimize the risk from exposure to any potential hazards.

Surveillance of Health Outcomes

Standardized medical screening data should be periodically aggregated and evaluated by an epidemiologist or other knowledgeable personnel to identify patterns of worker health that may be linked to work activities and practices that require additional primary preventive efforts. Routine aggregate assessments of medical screening data should be used in combination with evaluation of exposure monitoring data to identify changes associated with specific work areas or exposure conditions [Rocskay et al. 1996]. NIOSH recognizes a synergistic effect between exposure to asbestos and cigarette smoking that increases the risk of adverse respiratory health effects. The combined effects of smoking and dust exposures have been recognized as contributing to increased risk of respiratory diseases including chronic bronchitis, airflow limitation, and

lung cancer. Employers are urged to establish smoking cessation programs that inform workers about the increased hazards of cigarette smoking and exposure to asbestos and provide assistance and encouragement for workers who want to quit smoking. NIOSH recommends that all workers with potential exposure to airborne fibers of asbestos who also smoke should participate in a smoking cessation program. With regard to smoking in the workplace, NIOSH recommends the following:

- Cigarette smoking should not be permitted at worksites because of the known synergistic effects of cigarette smoking and asbestos on lung cancer

- Information about health promotion and the harmful effects of smoking should be disseminated

- Smoking cessation programs should be offered to workers at no cost to the participant

- Detailed smoking history information should be collected as part of the medical monitoring program

Activities promoting physical fitness and other healthy lifestyle practices that affect respiratory and cardiovascular health should also be encouraged through training, employee assistance programs, or health education campaigns.

NIOSH Responses to MSHA Questions

The following comments address specific questions from the five areas presented by MSHA in the ANPR:

1. Asbestos PEL

***We are considering rulemaking to lower both the eight (8) hour time-weighted average and the short-term exposure limits, and request comments on the most appropriate fiber concentrations to designate in light of their health risk and their technological and economic feasibility. We seek information, data, and comments on the following*:**

a. What exposure limit would provide the appropriate level of protection to exposed miners? Would adopting the OSHA limits afford sufficient protection **to miners?**

On June 21, 1984, NIOSH testified at the Occupational Safety and Health Administration (OSHA) public hearing on occupational exposure to asbestos and presented supporting evidence that there is no safe airborne concentration of fibers for any asbestos mineral [NIOSH 1984]. As noted in the1976 criteria document on

asbestos [NIOSH 1976], not even the lowest fiber exposure limit can assure workers of absolute protection from asbestos-related cancer. NIOSH recommends that MSHA establish a goal of eliminating exposures to asbestos fibers or, where they cannot be eliminated, limiting them as much as possible below 0.1 f/cc, which is the lower limit of quantification for the sampling and analytical method. NIOSH also recommends that the 0.1 f/cc exposure limit be determined by a sample collected over any 100-minute period at a flow rate of at least 4 L/min using NIOSH Method 7400, or equivalent. The shortening of the time period for determining compliance to 0.1 f/cc limit will help to identify and control sporadic exposures to asbestos and contribute to the overall reduction of exposure throughout the work shift.

b. MSHA's recent field sampling data show that none of the samples collected exceed OSHA's 8 hour time weighted average of 0.1 f/cc when analyzed using the TEM method. Considering the low fiber levels observed, what would be an appropriate agency action?

NIOSH recommends that MSHA proceed with rulemaking to lower the PEL for asbestos to 0.1 f/cc. Where asbestos fiber exposures cannot be eliminated, exposures must be controlled to concentrations below 0.1 f/cc. Lowering the PEL from the current standard of 2 f/cc to 0.1 f/cc will allow MSHA to begin enforcement leading to risk reduction in the event that any operator permits exposures to exceed the 0.1 f/cc limit. The data MSHA has collected, documenting existing exposure levels already below that limit, demonstrates clearly that the 0.1 f/cc PEL is technically feasible.

2. Analytical Method

We are considering the use of TEM rather than PCM to analyze fiber samples that may contain asbestos. We seek information, data, and comment on the following:

c. What is the advantage for MSHA to use TEM to initially analyze airborne fibers collected on all filters?

d. What is the availability and cost of commercial TEM analysis services?

e. Should we measure PEL compliance using TEM?

f. Are there studies which correlate asbestos exposure determined by TEM with incidence of asbestos disease?

Response to Questions c-f:

NIOSH considers the use of transmission electron microscopy (TEM) a valuable analytical tool for the identification of specific minerals; it may have utility in the initial assessment of airborne exposures and bulk dust samples for determining the presence of asbestos in the mine or other work environments. However, the routine use of TEM as the primary analytical method for compliance with an asbestos PEL is not recommended for the following reasons:

- The health basis for current occupational exposure limits (e.g., NIOSH REL, OSHA PEL) is based primarily on the increased risk of mortality due to asbestosis and lung cancer in workers occupationally exposed to asbestos. Risk estimates for lung cancer have been derived from epidemiologic studies of asbestos exposed workers in which exposure-response relationships have been constructed using asbestos fiber measurement data determined by the use of PCM. These data have served as the basis of quantitative risk assessments by OSHA, NIOSH, and EPA. We are not aware of any reports that have examined the incidence of lung cancer or other asbestos diseases in miners or general industry workers using asbestos exposure measurement data determined by electron microscopy analysis. NIOSH has recently initiated a 3-year research study to determine the relationship between exposure to chrysotile asbestos and the increased risk of lung cancer mortality using samples collected in an asbestos textile plant and analyzed by TEM. An integral part of this study will be to ascertain the relationship between fiber dimension (i.e., length, diameter) and lung cancer risk.

- In testimony to OSHA in 1984 and 1990 [NIOSH 1984, 1990b], NIOSH acknowledged that there are limitations in using PCM for determining asbestos fiber concentrations. These limitations include: a) lack of specificity when asbestos and other fibers occur in the same environment, and b) inability to detect fibers with diameters less than approximately 0.25 micrometers. However, NIOSH concluded that for regulatory purposes, PCM is the most practical technique for routinely assessing asbestos fiber exposures (NIOSH Analytical Method 7400 or an equivalent method). NIOSH further stated that the analysis of air samples by electron microscopy, where both electron diffraction and micro-chemical analysis could be performed, would be appropriate when fiber identification was necessary.

- The expertise required to count and measure fibers using PCM is widely available, as are established laboratory procedures for ensuring quality assurance in sample preparation and analysis. Qualified laboratories and microscopists are available for the measurement and identification of fibers using electron microscopy; however, the routine use of these laboratories for evaluating samples for asbestos compliance purposes would be resource intensive because of the longer time required for sample preparation and analysis. The cost incurred to perform sample analysis by electron microscopy could be as much as 10 times the

cost of performing PCM analysis by NIOSH Method 7400 or an equivalent method.

g. Are there data comparing PCM to TEM fiber counts from the same filter for the mine environment?

We have performed a literature search of NIOSHTIC-2 and found the following citations (enclosed) relevant to this question. NIOSHTIC-2 is a bibliographical database of occupational safety and health publications generated by NIOSH researchers or developed with NIOSH funding. It contains more than 16,000 citations identifying occupational safety and health documents and publications that were published between 1971 and 1998. We are searching for additional information and will forward it to MSHA when available. If MSHA proposes the use of TEM to analyze fiber samples in an asbestos Notice of Proposed Rulemaking, NIOSH will provide a thorough written analysis of all relevant data comparing PCM to TEM fiber counts.

- Dement [1978]
- Dement and Zumwalde [1976]
- Dement and Zumwalde [1977]
- Dement and Zumwalde [1979]
- Dement, Zumwalde, and Wallingford [1976]
- Snyder, Virta, and Segreti [1987]
- Zumwalde and Ludwig [1978]
- Zumwalde, Ludwig, and Dement [1981]

h. What method is most appropriate for MSHA to use (e.g., EPA, ASTM, OSHA, or NIOSH) to analyze bulk samples for asbestos in the mining industry?

There are several methods that are available to analyze bulk samples for asbestos content. NIOSH does not recommend one bulk sample method as superior to all others. The methods prescribed by NIOSH (Method 9002), the Environmental Protection Agency (EPA) [(EPA/600/R-93 and 600/M4-82-020)], and OSHA (ID-191) all require the use of polarized light microscopy with dispersion staining to determine the asbestos content. The method is useful for the qualitative identification of asbestos and the semi-quantitative determination of asbestos in bulk samples. The method is typically used to determine the percent of asbestos within a mixture of other mineral particles that are present on the sample. The method requires a great degree of sophistication on the part of the microscopist; mineralogical training of the analyst as well as experience in using the technique are important and serve as the basis for the subjective decisions that are made on fiber identification. The detection limit has not been precisely determined, but the method is capable of determining the asbestos content from < 1% to 100%. The accuracy of determining the percentage of asbestos is dependent on the number of particles present in the sample and whether other fibrous interferences exist.

3. Take-Home Contamination

We are also considering methods of reducing take-home contamination from asbestos. We specifically request information, data, and comments on the following:

i. How and/or should MSHA require operators to address take-home contamination from asbestos?

As noted in the NIOSH *Report to Congress on Workers' Home Contamination Study Conducted Under the Workers' Family Protection Act* [NIOSH 1995], families of asbestos-exposed workers are at increased risk of asbestos-related disease, including cancer and asbestosis, based on cohort and case-control studies and case series. Included in the occupations associated with asbestosis-related disease in family members is mining. NIOSH suggests MSHA consider requiring operators to address take-home contamination from asbestos as OSHA has done in the general industry [29 CFR 1910.1001], construction [29 CFR 1926.1101] and shipyard asbestos standards [29 CFR 1915 1001]. When an employee is exposed to airborne concentrations of asbestos that exceed the TWA and/or excursion limit, these standards have provisions for protective clothing and laundering, hygiene facilities, decontamination areas, showers, and clean change rooms, among others, to prevent take-home contamination with asbestos.

NIOSH recommends in the *Report to Congress on Workers' Home Contamination Study Conducted Under the Workers' Family Protection Act* that the following measures be taken to prevent contamination of workers' homes and to protect workers' families:

- Reduce exposures in the workplace
- Change clothes before going home and leave the soiled clothing at work to be laundered by the employer
- Store street clothes in separate areas of the workplace to prevent their contamination
- Shower before leaving work
- Prohibit taking toxic substances or contaminated items home
- Separate work areas from living areas of cottage industries
- Store and dispose of toxic substances in cottage industries properly

- Prevent family members from visiting the workplace

- Launder separately from family laundry when it is necessary to launder contaminated clothing at home

- Inform workers of the risk to family members from home contamination and ways to prevent it

These measures can be effective in reducing home contamination; however, home contamination has occurred when one or more of these measures has been omitted.

j. How should MSHA asbestos regulations provide for any special needs of small mine operators?

Fatal lung diseases have occurred among family members of workers employed in manufacturing processes that use asbestos. Exposures of family members has also occurred from asbestos brought home by miners. Because of the danger of fatal health effects from take-home asbestos contamination, we recommend that all mining operations follow the measures to prevent contamination of workers' homes and to protect workers' families outlined in the NIOSH *Report to Congress on Workers' Home Contamination Study Conducted Under the Workers' Family Protection Act*.

k. What technical assistance (e.g., step-by-step instructions, model programs, certification of private programs) should we provide to mine operators when they develop a program to reduce take-home contamination from asbestos?

MSHA should develop a program of outreach and assistance to help all mine operators develop a program to reduce take-home contamination from asbestos. This outreach could include assistance to operators to help them address asbestos contamination issues at the mine; development of training materials and direct training of operators and miners to promote understanding of the health risks of exposure to asbestos; development by MSHA of a set of compliance assistance tools, including Internet-based training and distance learning; and including information for non-English speaking miners when developing these materials.

4. Sampling and Awareness of Asbestos Hazards

We are reviewing the adequacy of our field sampling methods for asbestos and how sampling results are being used, by both MSHA and operators, to protect miners. We specifically request information, data, and comments on the following:

n. How can mineral dust interference be most accurately removed from the samples?

There are two approaches to reducing the interference level on asbestos samples. The first is to sample in such a way as to collect only those particles that might have reached the lungs, i.e., the thoracic fraction of the aerosol. The second approach is to modify the collected sample to remove particles that are not asbestos.

The International Organization for Standardization (ISO), the European Commission on Standards (CEN), and the American Conference of Governmental Industrial Hygienists (ACGIH) have all recommended thoracic sampling for those materials that are hazardous when deposited anywhere within the lung airways and the gas-exchange region. This approach requires the use of a selection device, or thoracic classifier, prior to the filter sampling cassette. The thoracic classifier can be a cyclone, porous foam, or other aerodynamic selection device. The advantage of this approach is that it removes larger particles from the sample, resulting in a cleaner, easier to count sample. A disadvantage of this approach is that each thoracic classifier operates at only one flow rate, thus removing the flexibility normally associated with choosing a flow rate to optimize the loading on the filter. However, several classifiers of the same type can be designed so that each operates at one of several flow rates that cover the desired range. These classifiers would have to be designed, built and tested prior to use.

Several studies have been carried out on the use of thoracic samplers for asbestos. Baron [1996] performed a theoretical comparison between thoracic sampling and the practice of counting only fibers smaller than 3 µm in diameter. He concluded that the two approaches agreed within approximately 10% for most size distributions. Maynard [1999] investigated the question of whether or not thoracic classifiers would modify the length distribution of the sampled fibers and concluded that they do not. A report to the Health and Safety Executive [Jones 2001a], and a followup report to CEN [Jones 2001b], investigated several aspects of thoracic sampling for fibers. The overall conclusion was that thoracic samplers should be used and that use of thoracic samplers did not make a large difference in the overall counting accuracy or speed. However, mines were not included in the field studies and further tests are needed.

Several approaches have been tried to remove non-asbestos particles from samples, including low temperature ashing and chemical dissolution. Low temperature ashing only removes organic material and would therefore not be useful in mining environments. Chemical dissolution requires suspension of the sample in an acid or

other solvent to remove non-asbestos material. The suspension step disturbs the integrity of the sample so that fibers or clumps of fibers originally present in the air may be broken apart, resulting in an overestimate of fiber concentration. Therefore, these techniques are not recommended for mining samples.

p. How should mine operators ensure that miners are aware of potential asbestos hazards at the mine site and provide adequate protection?

Workers should be provided with training to detect hazardous situations and should be informed of practices or operations that may generate airborne fiber concentrations. An appropriate training curriculum for asbestos includes the following:

- Identification of possible hazards at the work site, including asbestos-containing materials
- Proper handling methods for asbestos-containing materials, including appropriate engineering and work practice controls that may be specified in the standard
- Reporting, recordkeeping, and record transfer requirements that may be specified in the standard
- Requirements for personal air monitoring and actions to be based on monitoring results
- The selection of appropriate protective equipment (including respirators) and the feasibility of using them at various asbestos-related operations
- Recognition of adverse respiratory health effects associated with asbestos exposure and the importance of reporting them to appropriate safety and health personnel
- The importance of following all requirements to prevent take-home asbestos contamination
- The value of smoking cessation and the interaction between tobacco smoke and asbestos

Health examinations, performed as part of a medical monitoring program, can function as an additional venue for informing miners of the potential hazards of asbestos, and the adverse consequences of personal actions, such as tobacco smoking, in increasing the risk of respiratory tract cancers and other asbestos-related disease. The specific questions and tests utilized during the medical examinations will periodically highlight the health risks and also emphasize the seriousness of the potential outcomes and the importance of strict adherence to optimal work practices.

q. What educational and technical assistance (e.g., step-by-step instructions, model programs) should we provide to mine operators when we develop a program to sample and analyze for asbestos?

There are a number of commercial concerns, as well as NIOSH Education and Research Centers (ERCs), that provide training for asbestos sampling technicians, and for professionals and managers who must supervise sampling programs. MSHA could direct mine operators to these resources or could develop analogous training materials for MSHA-produced courses.

The analysis of asbestos samples should be performed by accredited laboratories that participate in one or more quality assurance round-robin programs. Specific step-by-step written procedures for asbestos sampling and analysis are provided in the NIOSH Manual of Analytical Methods (NMAM) under NIOSH Methods: 7400, 7402, and 9002.

If a TEM method is used for routine analysis of asbestos in mine environment samples, NIOSH TEM Method 7402 is a useful starting point, but will require modification and testing to establish its accuracy. In addition, courses must be provided to train analysts to use the method, and a quality assurance program, with audit samples several times a year, should also be implemented.

Two programs provide quality assurance samples several times a year for feedback on the counting accuracy of laboratories [(American Industrial Hygiene Association (AIHA) Proficiency Analytical Testing (PAT) program] and individual counters (AIHA Asbestos Analyst Registry). These samples may be appropriate for TEM analysis as well.

Approximately 80 laboratories around the country provide TEM analysis for asbestos. Several methods are used, but the mechanism to ensure consistency is provided by the National Institute for Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), and also by the New York state program. The NVLAP accreditation may be adequate for laboratories performing mine sample analysis. These programs also provide quality assurance samples for feedback on the counting accuracy of laboratories, as the PAT program does. An analysis of NVLAP data by Crankshaw [2000] indicates that the coefficient of variation (CV) for reference samples ranged from 0.25 for high loadings to 0.54 for low loadings, somewhat higher, but similar to CVs found for PCM in the PAT program.

r. What other factors, circumstances, or measures should MSHA consider when engineering controls cannot reduce asbestos exposure below the PEL?

NIOSH recommends that whenever possible workers and employers eliminate asbestos exposures completely through engineering controls and good work practices rather than protect themselves with PPE, including respiratory protection. In comments and testimony to the OSHA docket on the proposed rule for methods of compliance, we stated our support for the OSHA policy for controlling exposures to hazardous agents [NIOSH 1989; NIOSH 1990c]. This policy states that, whenever feasible, engineering controls and work practices should be used to prevent exposures, and that PPE, including respiratory protection, should be used only when engineering controls are not

feasible. Because of the many deficiencies of respiratory protection in reducing worker exposure to airborne asbestos, NIOSH continues to recommend that respiratory protection be used only when engineering controls are not feasible for reducing exposures below the PEL. In comments to the OSHA docket on methods of compliance, we discussed several deficiencies regarding respiratory protection, including uncertainty in the level of protection provided by respirators, the physiological and psychological burden to the respirator wearer, the difficulty of implementing and enforcing a respirator user program, safety concerns for the respirator wearer, and numerous other deficiencies.

Medical monitoring programs are useful in workplaces where personal protection must be used for asbestos exposure control. In such situations, recognition of medical conditions which might reduce the miner's tolerance of respirators is particularly important. The emergence of symptoms, abnormal radiographs, and/or declines in lung function in an individual or a group of workers may indicate a failure of protection, and signal a need for further evaluation of the protection program, as well as the individual miners.

If respiratory protection is needed, the employer should establish a comprehensive respiratory protection program that incorporates all the elements of the OSHA respiratory protection standard [29 CFR 1910.134].

5. Impact

We anticipate that the benefits of a rulemaking addressing measurement and control of asbestos would be the reduction or elimination of asbestos-related diseases (cancers and asbestosis) arising from exposure to asbestos. We anticipate there will be operator and agency costs associated with lowering our asbestos PEL, reducing take-home contamination, and using TEM to analyze fiber samples. We request information, data, and comments on the following:

s. How many miners are currently being exposed to asbestos?

The potential for asbestos exposure can exist at mining operations where deposits of igneous or metamorphic rocks occur [Juntilla et al. 1996]. This would include nearly all metal mines [Zumwalde and Ludwig 1978; NIOSH 1981; Zumwalde et al. 1981; Dement et al. 1976; Gillam et al. 1976] as well as some rock and industrial mineral mines and quarries. Published reports of environmental and industrial hygiene surveys conducted at crushed stone quarries [Kullman et al. 1995] and vermiculite [Amandus 1987; Amandus and Wheeler 1987; Amandus et al.1987a, 1987b] and talc mines/mills [Dement and Zumwalde 1976; Dement 1978; Dement and Zumwalde 1979; NIOSH 1980; Fitzgerald et al. 1991] have clearly demonstrated the risk of worker exposure to asbestos fibers and to cleavage fragments from the nonfibrous (nonasbestiform) analogs of the asbestos minerals. Based on MSHA [2002] mine employment data,

NIOSH estimates that approximately 44,000 miners and other mine workers may be exposed to asbestos fibers and/or cleavage fragments as a result of their contamination in the mine commodity. A listing of mine commodities where exposure to asbestos and/or cleavage fragments may occur is enclosed. In addition to the risk of exposure during mining operations, miners and other workers may inadvertently be exposed to asbestos during the handling of asbestos friction products (e.g., brake linings, clutch facings) or asbestos insulation materials at the mine site [Tarchi et al. 1994].

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MINE COMMODITY

Risk of Exposure to Asbestos Fibers and/or Cleavage Fragments from the Non Fibrous Analogs of the Asbestos Minerals

Commodity	Number of	
	Miners	Mines
Talc	598	51
Vermiculite	102	8
Asbestos	20	3
Metal	29884	588
Dimension Slate	906	119
Dimension Traprock	143	19
Crushed and Broken Granite	7505	776
Crushed and Broken Marble	1101	45
Crushed and Broken Slate	192	30
Crushed and Broken Traprock	3167	389
Aplite	32	3
Brucite	7	3
Kyanite	145	6
Mica	295	33
Total	44097	2073