



Cleveland-Cliffs Inc

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Re: RIN: 1219-AB24

Cleveland-Cliffs Inc is pleased to offer comments to the Mine Safety and Health Administration (MSHA) regarding its proposed rule¹ intending to revise existing health standards for asbestos exposure at metal and nonmetal mines, surface coal mines, and surface areas of underground coal mines. Our comments address the following two areas of the proposed rulemaking:

- **Definitions** [30 CFR §§56/57.5001(b)(1) and §71.702(a)];²
- **Measurement of Airborne Fiber Concentration** [30 CFR §§56/57.5001(b)(3) and §71.702(c)].³

We support a revised 8-hour time weighted average (TWA) permissible exposure limit (PEL) of 0.1 fibers per cc (f/cc), to enhance the health and safety of miners. It is important, however, that:

- (1) The PEL should be applied to fibers that are by definition *true asbestos*.
- (2) Because phase contrast microscopy (PCM) cannot be used to distinguish asbestos from other fibers, follow-up transmission electron microscopy (TEM) analysis should be conducted for any sample exhibiting fiber concentrations in excess of the standard as measured by PCM. The standard should apply only if TEM

¹ Mine Safety and Health Administration (MSHA). 2005. Asbestos exposure limit; Proposed rule. *Federal Register* 70(145):43950-43989. July 29.

² Mine Safety and Health Administration (MSHA). 2005. Asbestos exposure limit; Proposed rule. *Federal Register* 70(145):43972. July 29.

³ Mine Safety and Health Administration (MSHA). 2005. Asbestos exposure limit; Proposed rule. *Federal Register* 70(145):43974. July 29.

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analysis reveals, with appropriate modification in its use (see (3) below), the fibers to be true asbestos as defined in the MSHA rules.

- (3) MSHA recognizes that cleavage fragments “are not asbestiform and do not fall within our definition of asbestos,” but the analytical method proposed for use by the agency (i.e., PCM) does not permit cleavage fragments to be distinguished from true asbestos. In addition, TEM analysis (NIOSH 7402) as used by MSHA does not permit the analyst to distinguish cleavage fragments from asbestos. But it is clear that qualified experts are available to make such distinctions. Thus, provision should be made for independent review of the results of TEM analysis, modified to allow for independent evaluation by qualified experts, to determine whether fibers counted by this method are actually cleavage fragments. Further TEM analysis would be required only for positive PCM samples at sites with demonstrated non-asbestiform amphibole mineralogy, where “false positive” findings are highly probable.
- (4) Additional tools should be brought to bear on the question of whether a mining site is or is not a source of asbestos. These include bulk analysis of materials and understanding of deposit geology. Indeed, in the absence of evidence of asbestos by means of bulk analysis and geological characterization, MSHA should consider not pursuing further monitoring for asbestos.
- (5) If MSHA should not agree to follow-up with modified TEM analysis (using independent experts to confirm the presence or absence of true asbestos), then regulated companies should be allowed the opportunity to engage independent experts to conduct such analyses. Results from such analyses would be presented to MSHA for review.
- (6) Mining operations that can demonstrate, through the engagement of qualified experts and using other available tools (as in (4) above), the absence of true asbestos fibers should not be regulated under this rule.

These issues are addressed in detail and with support from the scientific literature, below. Included is a review of epidemiological findings related to possible asbestos exposures in certain mining industries; this review reveals the lack of an asbestos-related concern in these industries, and so supports our view that careful TEM analysis and evaluation of fibers found in these facilities will reveal the presence of cleavage fragments, and not true asbestos.

1. Definitions: §§56/57.5001(b)(1) and 71.702(a)

There are significant differences between mineralogical and regulatory definitions for asbestos and asbestos-related terms. For example, according to the *Glossary of Geology*, asbestos is defined as “a commercial term applied to a group of highly fibrous silicate minerals that readily separate into long, thin, strong fibers of sufficient flexibility to be woven, are heat resistant and chemically inert, and possess a high electrical insulation and therefore are suitable for uses where incombustible, non-conducting, or chemically resistant material is required.”⁴ From a regulatory perspective, the cited definitions are as follows.

From the Environmental Protection Agency (EPA):

*Asbestos means the **asbestiform** varieties of serpentinite (chrysotile), riebeckite (crocidolite), cummingtonite-grunerite, anthophyllite, and actinolite-tremolite.*⁵
[Emphasis added]

From the Occupational Safety and Health Administration (OSHA):

Asbestos includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered.^{6,7} [Emphasis added]

From the Mine Safety and Health Administration (MSHA):

*The 8-hour average airborne concentration of asbestos dust to which miners are exposed shall not exceed two fibers per cubic centimeter of air. Exposure to a concentration greater than two fibers per cubic centimeter of air, but not to exceed 10 fibers per cubic centimeter of air, may be permitted for a total of 1 hour each 8-hour day. As used in this subpart, the term asbestos means chrysotile, amosite, crocidolite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos **but does not include nonfibrous or nonasbestiform minerals.***⁸
[Emphasis added]

⁴ Gary, M., R. McAfee, Jr., and C.L. Wolf, eds. 1974. *Glossary of geology*. Falls Church, Virginia: American Geological Institute.

⁵ Environmental Protection Agency (EPA). 2005. National emissions standard for hazardous air pollutants. *40 CFR §61, Subpart M*. July 1. <http://www.access.gpo.gov/>

⁶ Occupational Safety and Health Administration (OSHA). 2005. Occupational Safety and Health Standards. *29 CFR §1910.1001*. July 1. <http://www.access.gpo.gov/>

⁷ Occupational Safety and Health Administration (OSHA). 2004. Safety and Health Regulations for Construction. *29 CFR §1926.1101*. July 1. <http://www.access.gpo.gov/>

⁸ Mine Safety and Health Administration (MSHA). 2004. Mandatory health standards, surface coal mines and surface work areas of underground coal mines. *30 CFR §71.702(a)*. July 1. <http://www.access.gpo.gov/>

*The determination of fiber concentration shall be made by counting all fibers longer than 5 micrometers in length and with a length-to-width ratio of at least 3 to 1 in at least 20 randomly selected fields using phase contrast microscopy at 400-450 magnification.*⁹

*The 8-hour time weighted average airborne concentration of asbestos dust to which employees are exposed shall not exceed 2 fibers per milliliter greater than 5 microns in length, as determined by the membrane filter method at 400-450 magnification (4 millimeter objective) phase contrast illumination. No employees shall be exposed at any time to airborne concentrations of asbestos fibers in excess of 10 fibers longer than 5 micrometers, per milliliter of air, as determined by the membrane filter method over a minimum sampling time of 15 minutes. "Asbestos" is a generic term for a number of hydrated silicates that, when crushed or processed, **separate into flexible fibers made up of fibrils**. Although there are many asbestos minerals, the term "asbestos" as used herein is limited to the following minerals: chrysotile, amosite, crocidolite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos.*¹⁰ [Emphasis added]

In addition, within the proposed rule, MSHA states "cleavage fragments are not asbestiform and do not fall within **our definition** of asbestos."¹¹ [Emphasis added] This conclusion from MSHA is in accord with our understanding of the definition of cleavage fragments.^{12,13} Given the widely accepted definitions of "asbestos" and "cleavage fragments", it is of great concern that the analytical technique proposed by MSHA to determine exposure within these proposed regulations (i.e., PCM), does not discriminate between asbestos and the non-asbestiform minerals (i.e., cleavage fragments) that occur in the mining industry. Wylie et al. (1985) correctly characterize the implications of these various definitions as they pertain to airborne amphibole cleavage fragments and amosite fibers when they state, "As long as the asbestos fiber definition is applied to an industrial environment in which only asbestos is being used, [PCM analysis] provides a useful basis for exposure monitoring. However, in the mining environment, where many non-fibrous particles may fit the definition of a fiber, it is not

⁹ Mine Safety and Health Administration (MSHA). 2004. Mandatory health standards, surface coal mines and surface work areas of underground coal mines. *30 CFR §71.702(b)*. July 1. <http://www.access.gpo.gov/>

¹⁰ Mine Safety and Health Administration (MSHA). 2004. Safety and health standards, surface metal and nonmetal mines/underground metal and nonmetal mines. *30 CFR §§56/57.5001(b)*. July 1. <http://www.access.gpo.gov/>

¹¹ Mine Safety and Health Administration (MSHA). 2005. Asbestos exposure limit; Proposed rule. *Federal Register* 70(145):43953. July 29.

¹² Campbell, W.J., R.L. Blake, L.L. Brown, E.E. Cather, and J.J. Sjober. 1977. Selected silicate minerals and their asbestiform varieties. U.S. Bureau of Mines, Information Circular. 8751. (Reported in Lowers and Meeker 2002. Available at: <http://pubs.usgs.gov/of/2002/ofr-02-458/OFR-02-458-508.pdf>).

¹³ Bates, R.L. and J.A. Jackson, eds. 1980. *Glossary of geology*. 2nd ed. Falls Church, Virginia: American Geological Institute. (Reported in Lowers and Meeker 2002. Available at: <http://pubs.usgs.gov/of/2002/ofr-02-458/OFR-02-458-508.pdf>).

appropriate. The problem is especially acute when non-asbestiform amphibole minerals are abundant.”¹⁴

2. Measurement of Airborne Fiber Concentrations: §§56/57.5001(b)(3) and §71.702(c)

According to the proposed rule, MSHA “cannot justify using a TEM analytical method for the initial determination of compliance”¹⁵ with the proposed asbestos PEL. In addition, “TEM allows us to better identify asbestos minerals in air samples collected in a mine.”¹⁶

MSHA also states that the agency “currently uses TEM on a limited basis, when necessary, to verify the presence of asbestos.”¹⁷ In MSHA’s proposed rule, however, the agency does not identify situations in which TEM analysis can be used to further evaluate samples that exhibit high fiber concentrations as determined by their preferred method (i.e., PCM). Instead, MSHA discounts the use of TEM and offers three reasons (as provided by NIOSH) for not using TEM for the determination of compliance:

- i. The lack of health risk data associated with TEM measurements of exposure (including a lack of correlational analysis relating TEM to PCM measurements);
- ii. The level of expertise required;
- iii. The high cost.¹⁸

With respect to the health risk data, MSHA is concerned about the apparent lack of peer-reviewed epidemiology or toxicology studies relating TEM measurements of asbestos to health outcomes. It has been proposed that the standard fiber methods (e.g., NIOSH 7400) may not measure the fibers that have the most biologically active dimensions and specific size ranges that relate to diseases in humans.^{19,20,21} We offer, in Section 5 below,

¹⁴ Wylie, A.G., R.L. Virta, and E. Russek. 1985. Characterizing and discriminating airborne amphibole cleavage fragments and amosite fibers: Implications for NIOSH method. *Am. Ind. Hyg. Assoc. J.* 46(4):197-201.

¹⁵ Mine Safety and Health Administration (MSHA). 2005. Asbestos exposure limit; Proposed rule. *Federal Register* 70(145):43974. July 29.

¹⁶ Mine Safety and Health Administration (MSHA). 2005. Asbestos exposure limit; Proposed rule. *Federal Register* 70(145):43975. July 29.

¹⁷ Mine Safety and Health Administration (MSHA). 2005. Asbestos exposure limit; Proposed rule. *Federal Register*. 70(145):43975. July 29.

¹⁸ Mine Safety and Health Administration (MSHA). 2005. Asbestos exposure limit; Proposed rule. *Federal Register*. 70(145):43975. July 29.

¹⁹ Quinn, M.M., T.J. Smith, E.A. Eisen, D.H. Wegman, and M.J. Ellenbecker. 2000.

a review of the available epidemiology studies pertaining to this question. We believe the results of these studies document the lack of asbestos exposures in the taconite, gold, copper, and talc mining industries, and further offer that TEM measurements in these mining industries support the epidemiology findings by revealing the lack of true asbestos fibers.

With respect to a predictive relationship correlating TEM and PCM, Verma and Clark (1995) stated that although the “fiber counts obtained by PCM differ greatly from TEM, this difference essentially relates to the issue of fiber dimensions.”²² Chesson et al. (1990)²³ presented a mathematical model for investigating asbestos risks based on measurements from both analytical methods. More recently, Breysse et al. (2005) obtained PCM and TEM air samples during clean-up operations for the World Trade Center disaster and concluded that even though air-sampling results were similar, “PCM-based estimates were generally higher than TEM results. This is probably due to the counting of non-asbestos fibers.”²⁴

With respect to alleged concerns about the level of expertise required for TEM analysis and its high cost, the EPA also considered similar issues in updating 40 CFR §763, Subpart E, Asbestos-containing materials in schools. In this 1987 rulemaking, “EPA chose to require analysis by TEM for four reasons:

- i. TEM is capable of measuring the smallest diameter fibers;
- ii. Based on existing, validated methods, a formal protocol has been developed;
- iii. TEM has been validated by intra- and inter-laboratory comparisons conducted by NBS [the National Bureau of Standards, currently called the National Institute of Standards and Technology (NIST)]; and

Implications of different fiber measures for epidemiologic studies of man-made vitreous fibers. *Am. J. Ind. Med.* 38: 132-139.

²⁰ Stanton, M.F., M. Layard, A. Tegeris, E. Miller, M. May, E. Morgan, and A. Smith. 1981. Relation of particle dimension to carcinogenicity in amphibole asbestoses and other fibrous minerals. *J. Natl. Cancer Inst.* 67:965-975.

²¹ Lippman, M. 1990. Effects of fiber characteristics on lung deposition, retention and disease. *Envir. Health Perspect.* 88:311-317.

²² Verma, D. and N. Clark. 1995. Relationship between phase contrast microscopy and transmission electron microscopy results of samples from occupational exposure to airborne chrysotile asbestos. *Am. Ind. Hyg. Assoc. J.* 56:866-873.

²³ Chesson, J., J.D. Rench, B.D. Schultz, and K.L. Milne. 1990. Interpretation of airborne asbestos measurements. *Risk Analysis* 10(6):437-446.

²⁴ Breysse, P.N., D.L. Williams, J.B. Herbstman, J.M. Symons, S.N. Chillrud, J. Ross, S. Henshaw, K. Rees, M. Watson, and A.S. Geyh. 2005. Asbestos exposures to truck drivers during world trade center cleanup operations. *J. Occ. Envir. Hyg.* 2(8):400-405.

- iv. A formal laboratory accreditation program for TEM laboratories is currently under development by the NBS.²⁵ [Note that the TEM accreditation program has now been in effect since 1988.]

3. Cleavage Fragments

MSHA appears to ignore the main analytical issue: cleavage fragments. According to 29 CFR §1910.1001, Appendix B (which MSHA does not mention in the proposed rule), cleavage fragments are defined as “mineral particles formed by comminution of minerals, specifically those characterized by parallel sides and a moderate aspect ratio (usually less than 20:1).”

Kelse and Thompson (1989) state, “While non-asbestiform particles clearly differ from asbestiform particles, many would be counted as asbestos under the current regulatory 3:1 dimension criterion for a fiber when ore is crushed, milled, or otherwise reduced. It is also important to note that asbestiform fibers cannot be created from non-asbestiform materials by crushing, milling, or grinding.”²⁶ Hence, under the proposed rule, non-asbestiform dust populations will continue to be mistaken as asbestiform, with the analytical results falsely concluding that miners are exposed to elevated asbestos fiber concentrations when, in reality, they are not.

Additionally, in the proposed rule, MSHA states, “In this rulemaking, we propose to continue to use PCM to determine asbestos concentration.”²⁷ MSHA is incorrect in stating that the continued use of PCM analysis can “determine asbestos concentration.” Chesson et al. (1990) state, “Since PCM does not distinguish asbestos from other fibers within the optical size range, the PCM measurement may also include non-asbestos fibers. Therefore, a complete characterization of the occupational exposures requires knowing the contribution from non-asbestos fibers.”²⁸ As noted in the Preamble to the Proposed Rule, the PCM method error is plus or minus 25%. To exacerbate the issue, PCM counting rules (e.g., NIOSH 7400 or OSHA ID-160) state, “if there is a question whether a fiber is asbestos or not, follow the rule: ‘WHEN IN DOUBT, COUNT,’”²⁹

²⁵ Environmental Protection Agency (EPA). 1987. Asbestos-containing materials in schools; Final rule. *Federal Register* 52(210):41839. October 30.

²⁶ Kelse, J. and C.S. Thompson. 1989. The regulatory and mineralogical definitions of asbestos and their impact on amphibole dust analysis. *Am. Ind. Hyg. Assoc. J.* 50(11):613-622.

²⁷ Mine Safety and Health Administration (MSHA). 2005. Asbestos exposure limit; Proposed rule. *Federal Register* 70(145):43977. July 29.

²⁸ Chesson, J., J.D. Rench, B.D. Schultz, and K.L. Milne. 1990. Interpretation of airborne asbestos measurements. *Risk Analysis* 10(6):437-446.

²⁹ See, for example, 29 CFR §1926.1101, Appendix B. <http://www.access.gpo.gov/>

producing potentially incorrect results due to the fact that non-asbestiform materials (i.e., cleavage fragments) would be counted. In sum, the accuracy of what is being measured and thus regulated simply cannot be put aside in favor of the perceived ease or relative cost of analysis.

4. Cleveland-Cliffs Inc Proposal

For the reasons reviewed above, we urge MSHA to incorporate modified TEM analysis (which allows for independent expert analysis of fibers) in situations in which PCM analysis reveals the presence of fibers at levels in excess of the proposed standard. Only in situations in which modified TEM analysis (allowing for independent expert analysis of fibers) confirms the presence of asbestos should the new standard apply. There is no reason to believe that cleavage fragments or non-asbestiform fibers captured by PCM analysis pose an asbestos-related health risk, and thus no reason to regulate them under the new asbestos standard. (See Section 5 below for our review of available epidemiology studies.) In addition, supplemental tools (e.g., bulk analysis of materials and understanding of deposit geology) should be used to determine whether a mining site is or is not a source of asbestos. In the absence of evidence of asbestos by means of bulk analysis and geological characterization, MSHA should consider not pursuing further monitoring for asbestos.

If MSHA chooses not to accept this proposal, the agency should allow regulated mining industries to sponsor modified TEM analysis (allowing for independent expert analysis of fibers) and to have results reviewed by MSHA. At the discretion of the operating mine, differential counting/analysis by a method other than PCM should be provided. TEM method (NIOSH 7402), with the addition of an opportunity for independent expert evaluation of the presence of true asbestos, is our proposed method. This is analogous to an owner/operator's ability to conduct additional analysis on samples to further quantify asbestos content under 40 CFR §61.141 or for rebutting the presumed asbestos-containing material designation as outlined in 29 CFR §1910.1001(j)(8).

If, through independent expert evaluation and the use of supplemental tools, such as bulk analysis of materials and understanding of deposit geology, a mine is found not to be a source of true asbestos, then it should be subject to no further regulation under the proposed MSHA rule.

5. Epidemiology Literature

Introduction

The available epidemiological literature supports the conclusion that in many mining industries covered by the proposed regulation, the presence of mineral fibers does not create an asbestos-related health risk for miners. These findings are explained by the observation that true asbestos fibers are not generally present in these mines.

We offer a review of the available epidemiology literature in the following.

Review of Relevant Epidemiological Studies

Taconite mining

Studies of taconite mining populations provide an indication of the risks associated with the overall taconite dust exposure. Reviewed studies of taconite populations have been limited to mines located in the Mesabi Range in Northeastern Minnesota. A literature search yielded 5 relevant publications. For the purpose of our review, we will focus on outcomes typically associated with asbestos, including respiratory cancers and non-malignant respiratory diseases.

Respiratory effects associated with taconite dust exposure were assessed in a cross-sectional study published by Clark et al. (1980).³⁰ The cohort consisted of 302 white males employed at a taconite mine located at the eastern end of the Mesabi Range in Minnesota. Of these men, 249 were employed in positions with regular exposure to taconite dust, and 51 were employed in positions with no exposure to taconite dust. All miners in the study population were currently employed and had been in the industry for 20 to 23 years. Additionally, 33 employees of a nearby school district were included in the analysis in order to increase the number of unexposed controls. Incidence and severity of cough, phlegm, wheezing, and dyspnea were assessed via a self-reported questionnaire. No significant differences were noted for the self-reported outcomes between the exposed and unexposed participants. Additionally, all participants were administered a chest radiograph. Small rounded opacities were observed in three of the exposed miners; none of these 3 individuals exhibited any symptoms. The authors concluded that the formation of these opacities was likely due to high silica dust exposure. No cases of extensive interstitial fibrosis or mesothelioma were observed in

³⁰ Clark, T.C., V.A. Harrington, J. Asta, W. K. Morgan, and E.N. Sargent. 1980. Respiratory effects of exposure to dust in taconite mining and processing. *Am. Rev. Respir. Dis.* 121(6):959-966.

this population. After 20 to 23 years of latency, there was no increased risk of asbestos-related disease associated with taconite dust exposure.

Higgins et al. (1983) reported results from a mortality study of Reserve Mining Company employees in 1983.³¹ The study population consisted of 5,751 men who had been employed at the mine for a year or more as of July 1, 1976. Cause of death for study participants was determined through review of death certificates. Expected numbers of deaths were calculated with the use of Minnesota and U.S. rate statistics. Fewer deaths than expected resulted from respiratory cancers and non-malignant respiratory diseases. Only four deaths due to non-malignant respiratory diseases were observed while seven were expected. Fifteen deaths due to respiratory cancers were observed while 18 were expected. Results were stratified with respect to latency period into two groups, 1 to 15 years since first exposure and greater than 15 years since first exposure. No increases in respiratory diseases or cancers were observed in participants with a latency of greater than 15 years. No cases of mesothelioma were observed in this cohort. The observation that there were fewer respiratory disease related deaths than expected indicates that the dusts would not carry the same risks as asbestiform fibers.

Three studies of taconite miners employed at the Erie and Minntac operations in Minnesota have investigated the effects of taconite dust exposure in 3,431 men. The initial report followed the miners from 1959 to 1977 and found no excess of lung cancers as compared to the U.S. population and the Minnesota population.³² A subsequent publication added 6 more years of follow-up by updating mortality data through 1983.³³ Still, no excess in lung cancers was observed. The most recent publication continues follow-up through 1988 with at least 30 years of follow-up after the first exposure to taconite dust for all participants.³⁴ Standardized mortality ratios were calculated using both the U.S. and Minnesota reference rates. Using the U.S. reference rates, there were significantly fewer cases of malignant neoplasms of the respiratory system (SMR=67, 95%CI=52-85) and non-malignant respiratory diseases (SMR=71, 95%CI=54-93) than expected. When Minnesota reference rates were used, the SMRs for both malignant and non-malignant respiratory diseases were 97 with a 95% confidence interval of 75 to 123.

³¹ Higgins, I.T., J.H. Glassman, M.S. Oh, and R.G. Cornell. 1983. Mortality of Reserve Mining Company employees in relation to taconite dust exposure. *Am. J. Epidemiol.* 118(5):710-719.

³² Cooper, W.C. 1984. An epidemiologic study of workers in the taconite mining and milling industry. Report prepared for American Iron Core Association. March 26.

³³ Cooper, W.C., O. Wong, and R. Graebner, 1988. Mortality of workers in two Minnesota taconite mining and milling operations. *J. Occup. Med.* 30(6):506-511.

³⁴ Cooper, W.C., O. Wong, L.S. Trent, and F. Harris. 1992. An updated study of taconite miners and millers exposed to silica and non-asbestiform amphiboles. *J. Occup. Med.* 34(12):1173-1180.

After more than 30 years of follow-up, there was no evidence of an increased risk of asbestos-related diseases within this population.

In 2003, the Minnesota Department of Health presented a retrospective study investigating the potential for exposure to commercial asbestos among taconite miners diagnosed with mesothelioma.³⁵ Researchers identified 17 former employees of the iron mining industry who had been diagnosed with mesothelioma between 1988 and 1996. Although only mines located on the eastern end of the Mesabi Range are thought to contain asbestos-like minerals, cases of mesothelioma were not associated with any particular mine or region. Job history records were used to determine potential exposure to commercial asbestos. Of 17 miners diagnosed with mesothelioma, 11 had jobs with probable exposure to commercial asbestos, 3 had jobs with possible exposure to commercial asbestos, 1 had no apparent exposure to commercial asbestos, and exposure information was missing for 2 participants. Only 1 of the 17 participants had held a mining job associated with high dust exposure. The lack of a control group does not allow us to draw a conclusion as to whether these cases resulted from commercial or natural asbestos exposure. However, the fact that no mesothelioma clusters were detected indicates that no one mine or mining region is associated with a significant excess risk of asbestos-related diseases.

Of the epidemiologic studies pertaining to taconite exposure in mines on the eastern end of the Mesabi Range, none have shown an increased risk of asbestos-related diseases. To further investigate whether minerals present in taconite dust have asbestiform properties, epidemiologic studies of other mining populations were reviewed. Several other mining populations with known exposure to non-fibrous amphibole have been the subjects of epidemiologic investigations. The following is a review of epidemiologic studies of mining populations with dust exposures similar to those found in taconite mining.

Gold mining

NIOSH investigators updated mortality through 1990 among the Homestake gold miners cohort,³⁶ previously studied by Brown et al. (1986).³⁷ Gillam et al. (1976)³⁸ and

³⁵ Brunner, W., A.N. Williams, and A.P. Bender. 2003. Exposures to commercial asbestos in northeastern Minnesota iron miners who developed mesothelioma. Minnesota Department of Health. Available at: <http://www.health.state.mn.us/divs/hpcd/cdee/occhealth/documents/MinersReport112503.pdf>

³⁶ Steenland, K. and D. Brown. 1995. Mortality study of gold miners exposed to silica and non-asbestiform amphibole minerals: An update with 14 more years of follow-up. *Am. J. Ind. Med.* 27(2):217-229.

³⁷ Brown, D.K.K. and R. Zumwalda. 1986. Retrospective mortality study of underground gold mine workers. In *Silica, silicosis, and lung cancer*, eds. D. Goldsmith, D. Winn, and C. Shy, 311-336. New York: Praeger.

McDonald et al. (1978)³⁹ have previously studied smaller subcohorts of these gold miners. The NIOSH cohort included 3,328 gold miners who worked underground for at least one year between 1940 and 1965. Study investigators created a job exposure matrix to estimate exposure to total dust for five major job categories using existing measurements of dust for each year from 1937 to 1975. The study investigators reported no trend between lung cancer mortality and quantitative measures of dust exposure among 3,328 gold miners exposed to silica and the non-asbestiform amphibole cummingtonite-grunerite. Study participants were followed for a minimum of 25 years, providing a sufficiently long latency period for most asbestos-related diseases.

Kusiak et al. (1991) studied mortality through 1986 among a cohort of 13,603 miners who worked in any of 43 gold mines in Ontario.⁴⁰ Since 1928, Ontario has mandated annual physical exams, including chest x-rays, for miners to certify fitness for continued employment in jobs with dust exposure in the mining industry. The cohort included miners who were employed for at least two weeks in dusty jobs in Ontario mines after 1954, and a minimum of 60 months in jobs with dust exposure in mining anywhere. The 60-month minimum employment criterion was imposed because 5 years was assumed to be the minimum exposure time required to develop silicosis. All miners who worked in asbestos mines in or out of Ontario were excluded. These miners were exposed to dusts, including silica and arsenic, as well as radon decay products. Common host rocks adjacent to the gold ores included the following compositions: basaltic, komatiitic, felsic, and banded iron formation. The authors noted that Ontario komatiites alter readily to serpentine and amphiboles, or to flaky minerals such as talc or chlorite. Geological surveys reported the presence of tremolite, actinolite, and fibrous amphiboles. Occasional dust concentration measurements taken in gold mines before 1950 reported levels between 500 and 1,000 particles/mL (p/mL) in the 1930s and 1940s. The average dust concentration in gold mines had decreased by 1959 to approximately 400 p/mL and by 1967 to less than 200 p/mL. The investigators reported an excess of lung cancer among miners who worked before 1946. In contrast, no excess of lung cancer among miners who began work after 1945 was observed, even among those with 30 years or more since first employment in the mines. Two deaths from mesothelioma were reported among gold miners; neither miner appeared to be exposed to fibrous amphiboles based on

³⁸ Gillam, J.D., J.M Dement, R.A. Lemen, J.K. Wagoner, V.E. Archer, and H.P. Blejer. 1976. Mortality patterns among hard rock gold miners exposed to an asbestiform mineral. *Ann. NY Acad. Sci.* 271:336-344.

³⁹ McDonald, J.C., G.W. Gibbs, F.D. Liddell, and A.D. McDonald. 1978. Mortality after long exposure to cummingtonite-grunerite. *Am. Rev. Respir. Dis.* 118(2):271-277.

⁴⁰ Kusiak, R.A., J. Springer, A.C. Ritchie, and J. Muller. 1991. Carcinoma of the lung in Ontario gold miners: possible etiological factors. *Br. J. Ind. Med.* 48(12):808-817.

geological composition of host rocks from Ontario mines in which they worked. The authors attribute the excess observed in miners who worked before 1946 to arsenic and radon decay products, in part because a higher incidence of mesothelioma would have been expected had miners been exposed to asbestiform fibers.

Talc mining

Honda et al. (2002) studied mortality among workers at a talc mining and milling facility in upstate New York who were exposed to dusts containing a high concentration of non-asbestiform amphibole minerals (i.e., tremolite cleavage fragments).⁴¹ The cohort included miners who worked between 1948 and 1989 and who were known to be alive in or after 1950. Mortality was followed through 1989. Semi-quantitative estimates of cumulative respirable dust exposure were derived using a job-exposure matrix. That is, a panel of long-term employees identified discrete work areas and calendar periods with similar dust exposure potential and assigned a relative exposure score on a scale from 0 to 10. These scores were combined with the results of a baseline exposure survey that measured current respirable talc dust concentrations to estimate historical average respirable talc dust concentrations for each work area and year combination. Lung cancer mortality was significantly elevated based on 18 observed and 4.6 expected deaths when mortality rates for miners were compared to regional population mortality rates. Internal analyses, however, demonstrated an inverse association between estimated cumulative exposure to respirable dust and lung cancer, and the miners in the highest cumulative exposure group experienced one-half of the lung cancer risk as miners in the lowest cumulative exposure group. Two deaths from mesothelioma were observed in the cohort. After review of employment records for the two decedents, the investigators concluded that the deaths were unlikely related to exposure to talc ore dust, based on an insufficient latency period for one decedent, and brief employment in a job with minimal exposure for the second decedent.

Other mining

Ilgren (2004)⁴² reports, based on personal communication, that no apparent increase in asbestos-related disease has been observed among copper miners exposed to cummingtonite-tremolite-actinolite cleavage fragments over a period of many years.

⁴¹ Honda, Y., C. Beall, E. Delzell, K. Oestestad, I. Brill, and R. Matthews. 2002. Mortality among workers at a talc mining and milling facility. *Ann. Occup. Hyg.* 46(7):575-585.

⁴² Ilgren, E.B. 2004. The biology of cleavage fragments: a brief synthesis and analysis of current knowledge. *Indoor and Built Environment* 13:343-356.

Ilgren (2004)⁴³ also reports, based on anecdotal evidence, an absence of asbestos-related diseases among nephrite jade (a form of massive tremolite-actinolite amphibole) miners. *Conclusions regarding epidemiological evidence*

In conclusion, no increased risk of asbestos-related diseases among individuals exposed to non-asbestiform amphibole particles, and specifically cleavage fragments, is evident based on epidemiological studies. The absence of an increased risk of asbestos-related diseases supports our view that efforts should be made to determine whether specific mines are sources of true asbestos, or only of cleavage fragments. Only if they are sources of true asbestos should they be regulated under this proposed rule.

6. Overall Conclusions

This epidemiological review (Section 5) highlights the points Cleveland-Cliffs Inc has already made, and it demonstrates the strong probability that asbestos exposure is absent from these mining environments. At the least, this should provide a strong basis for allowing the use of TEM measurements and expert evaluation of fibers to confirm or not confirm any findings of excess fibers determined by PCM measurements. If TEM analysis confirms the presence of asbestos, the proposed PEL should apply. If such analysis does not confirm the presence of asbestos, there is no need to apply the proposed PEL. There is a high expectation that fiber counts in many mining industries covered by this regulation will not accurately depict asbestos exposure, and it is important to allow for this possibility. It is the position of Cleveland-Cliffs Inc that the analysis of samples by Method 7400 does not define true asbestos.

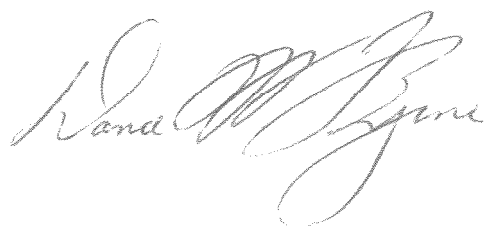
We support a revised 8-hour time weighted average (TWA) permissible exposure limit (PEL) of 0.1 fibers per cc (f/cc), to enhance the health and safety of miners. It is important, however, that:

- (1) The PEL should be applied to fibers that are by definition *true asbestos*.
- (2) Because phase contrast microscopy (PCM) cannot be used to distinguish asbestos from other fibers, follow-up transmission electron microscopy (TEM) analysis should be conducted for any sample exhibiting fiber concentrations in excess of the standard as measured by PCM. The standard should apply only if TEM analysis reveals, with appropriate modification in its use (see (3) below), the fibers to be true asbestos as defined in the MSHA rules.

⁴³ Ilgren, E.B. 2004. The biology of cleavage fragments: a brief synthesis and analysis of current knowledge. *Indoor and Built Environment* 13:343-356.

- (3) MSHA recognizes that cleavage fragments “are not asbestiform and do not fall within our definition of asbestos,” but the analytical method proposed for use by the agency (i.e., PCM) does not permit cleavage fragments to be distinguished from true asbestos. In addition, TEM analysis (NIOSH 7402) as used by MSHA does not permit the analyst to distinguish cleavage fragments from asbestos. But it is clear that qualified experts are available to make such distinctions. Thus, provision should be made for independent review of the results of TEM analysis, modified to allow for independent evaluation by qualified experts, to determine whether fibers counted by this method are actually cleavage fragments. Further TEM analysis would be required only for positive PCM samples at sites with demonstrated non-asbestiform amphibole mineralogy, where “false positive” findings are highly probable.
- (4) Additional tools should be brought to bear on the question of whether a mining site is or is not a source of asbestos. These include bulk analysis of materials and understanding of deposit geology. Indeed, in the absence of evidence of asbestos by means of bulk analysis and geological characterization, MSHA should consider not pursuing further monitoring for asbestos.
- (5) If MSHA should not agree to follow-up with modified TEM analysis (using independent experts to confirm the presence or absence of true asbestos), then regulated companies should be allowed the opportunity to engage independent experts to conduct such analyses. Results from such analyses would be presented to MSHA for review.
- (6) Mining operations that can demonstrate, through the engagement of qualified experts and using other available tools (as in (4) above), the absence of true asbestos fibers should not be regulated under this rule.

Respectfully submitted,

A handwritten signature in cursive script, appearing to read "Dana W. Byrne".

Dana W. Byrne
Vice President-Public Affairs