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To: NIOSH Docket Office (CDC)
Subject: 099-C Asbestos Fibers and Other Elongate Mineral Particles: State of the Science and Roadmap for Research Version 4
Attachments: D Van Orden NIOSH Roadmap Comments.pdf; Footnote 6.pdf; Footnote 7.pdf; Footnote 8.pdf; Footnote 9.pdf; Footnote 10.pdf; Footnote 11.pdf; Footnote 12.pdf; Footnote 13.pdf; Footnote 14.pdf; Footnote 16.pdf; Footnote 17.pdf

Attached are comments related to the fourth version of the Roadmap. I have also attached several published references to expedite the review.

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Comments on the NIOSH Asbestos Roadmap, Version 4

NIOSH published version 4 of the Roadmap document[1] and has asked for public comments. The comments contained herein are to request clarification of certain sections of the Roadmap and also to offer a discussion of analytical procedures.

RJ Lee Group supports the efforts to fully elucidate the mineral characteristics that cause asbestos diseases. Improved knowledge will lead to better regulations and safer working environments for everyone. We caution that the proposed detailed research programs outlined in the Roadmap not be used to become some sort of "full employment act" for NIOSH[2] or that they are used as a bureaucratic delaying tactic when NIOSH finally acknowledges that non-asbestos elongate mineral particles do no cause asbestos diseases.

We request that NIOSH add Docket 99-c to the list of dockets on the webpage (http://www.cdc.gov/niosh/docket/default.html, accessed April 6, 2010) to facilitate public access to the Roadmap and any submitted comments.

The following are comments to version 4 of the Roadmap:

1. **Page vii, first paragraph.** Change the first sentence to read: "In the 1970s, federal enforcement agencies in the United States developed occupational regulatory definitions and standards for exposure to airborne asbestos fibers based on human evidence of respiratory disease observed in ~~exposed~~ workers *exposed to commercially-produced asbestos*."[3] Additionally, in a document that discusses elongate mineral particles, it is imperative that detailed information

[1] NIOSH Current Intelligence Bulletin. Asbestos Fibers and Other Elongate Mineral Particles: State of the Science and Roadmap for Research, Version 4. Draft. http://www.cdc.gov/niosh/review/public/099-C/pdfs/AsbestosRoadmapPublicDraftV4a.pdf (last accessed April 6, 2010).
[2] This echoes a comment made at the National Academy of Science public hearing on the Roadmap.
[3] Deleted words are shown with a ~~strikethrough~~ and added words are shown in *italics*.

be provided where it is known. Doing so will help to clarify the issues related to the health effects of asbestos fibers and non-asbestos particles.

2. Page viii, last paragraph. This paragraph suggests that a PCM has a limited ability "to differentiate various types of EMPs". In fact, the PCM has difficulty in differentiating EMPs from non-EMPs such as cotton fibers or fiberglass. This issue is not mentioned at all in the Roadmap and should be at least mentioned in this section. One possible way to address this is to amend the first sentence of the paragraph to read: "PCM, the primary method specified by NIOSH, OSHA, and MSHA for analysis of air samples for asbestos fibers, has several limitations, including limited the ability to resolve very thin fibers and to differentiate various types of EMPs *from each other or even from organic fibers*".

3. Page viii, last paragraph. In the second sentence, there is an opportunity to emphasize that the current risk factors are related to exposure to commercially produced asbestos fibers. Revise the second sentence to read: "Occupational exposure limits derived from human risk assessments have been based on airborne ~~asbestos~~ fiber concentrations *arising from work on commercially-produced asbestos and* determined directly using PCM ...".

4. Page ix, top of page. The statement: "Current lung cancer risk estimates for airborne asbestos fiber exposure are based on only a subset of airborne fibers ascertained using PCM" is incorrect. Current lung cancer risk estimates are based on epidemiology studies in which some or all of the airborne fiber concentrations were determined from midget impinger studies with that data converted to a fiber concentration. They are not based solely on PCM concentrations as is suggested by this sentence. A cursory examination of either OSHA's risk document[4] or EPA's risk document[5] will show that much of the exposure data are dust concentrations that have been converted to fiber concentrations. The sentence should be edited to read: "Current lung cancer risk estimates for airborne asbestos fiber exposure are based on *a combination* ~~only a subset~~ of airborne fibers ascertained using PCM *and fiber concentrations estimated from particle concentrations.*"

5. Page 5, line 9. The line should be amended to list the properties of asbestos fibers that made them commercially valuable. It should read: "properties *(such as high tensile strength, large aspect ratios, and resistance to chemical and thermal degradation)* that have made them commercially valuable"...

6. Page 7, line 12. The phrase "nonasbestiform asbestos minerals" is not correct. Revise it to read: "nonasbestiform ~~asbestos~~ *amphibole* minerals".

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[4] W. J. Nicholson (1983). "Quantitative Risk Assessment for Asbestos-Related Cancers". OSHA Contract J-9-F-2-0074.

[5] W. J. Nicholson ed., et al (1986). "Airborne Asbestos Health Assessment Update," U.S. Environmental Protection Agency, Environmental Criteria and Assessment Office, EPA Report No. EPA/600/8-84/003F, June 1986.

7. Page 10, line 12. The discussion of exposures that started in Section 2.4.2 was based on PCM measurements that, as acknowledged in the Roadmap, do not differentiate between asbestos fibers and nonasbestos particles. As such, this line should read: "The preceding summary of occupational exposures to *airborne fibers presumed to be* asbestos is based on the OSHA …".

8. Page 16, line 16. The lengthy quotation that is shown on this page is taken from reference NIOSH 1990b, not NIOSH 1990a. Revise this line to read: "In 1990, NIOSH [~~1990a~~ *1990b*] revised its REL …".

9. Page 16, lines 36-38. These lines (and those continuing on the next page) suggest that nonasbestos mineral particles are to be counted as asbestos in accordance with NIOSH 7402. NIOSH 7402 clearly indicates that the nonasbestos analogues of the asbestos minerals are interferences. As noted on page 7402-1 of the May 15, 1989 edition of the method: "Other amphibole particles that have aspect ratios greater than 3:1 and elemental compositions similar to asbestos minerals may interfere in the TEM analysis." On page 7402-5, an additional note is provided: "There are some crystalline substances which exhibit diffraction patterns similar to those of asbestos fibers. Many of these, (brucite, halloysite, etc.) can be eliminated from consideration by chemistry. There are, however, several minerals (e.g., pyroxenes, massive amphiboles, and talc fibers) which are chemically similar to asbestos and can be considered interferences."

10. Page 18, last paragraph. The paragraph is confusing to the reader. It is discussing the issue of amphibole contamination of chrysotile, but mentions testing of samples from the South Carolina textile mill where only 2 out of 18,840 fibers were classified as unidentified amphibole minerals. As noted by McDonald et al[6], the mill processed both Canadian and Rhodesian chrysotile as well as approximately 2,000 pounds per year of crocidolite yarn. Is this paragraph suggesting that no crocidolite fibers became airborne during processing or is it suggesting that both Canadian and Rhodesian chrysotile are free of amphibole contamination? Neither of these issues is discussed in the Stayner et al 2007 reference. These uncertainties suggest that the discussion on the South Carolina mill should be removed from this paragraph.

11. Page 20, line 36. NIOSH has articulated dichotomous positions on the issue of the effects of the nonasbestos minerals. NIOSH quoted (NIOSH 1990a) from the OSHA findings: "There is insufficient evidence to conclude that nonasbestiform tremolite, anthophyllite, and actinolite cleavage fragments present a health risk similar in magnitude or type to fibers of their asbestiform counterparts." NIOSH then states: "NIOSH concurs with OSHA's review and assessment of the epidemiologic and animal data submitted to the docket …". Despite the "insufficient evidence" and the "NIOSH concurs" statements, NIOSH goes on to conclude: "…that nonasbestiform tremolite, anthophyllite, and actinolite cleavage fragments present a

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[6] A. D. McDonald, J. S. Fry, A. J. Woolley, and J. C. McDonald (1983), "Dust Exposure and Mortality in an American Chrysotile Textile Plant," *British Journal of Medicine*, 40, 361-367.

health risk similar in magnitude to fibers of their asbestiform analogs". How does NIOSH reconcile these differences?

12. Page 34, line 33. The Roadmap, in this sentence, suggests that the TEM methods cannot differentiate between asbestos fibers and nonasbestos particles. NIOSH, itself, indicates in the 7402 procedure that the differentiation between asbestos and nonasbestos minerals can be performed. NIOSH 7402 clearly states that the nonasbestos amphibole minerals are interferences and that morphology of the particles can be used to differentiate between asbestos and nonasbestos minerals. "There are some crystalline substances which exhibit diffraction patterns similar to those of asbestos fibers. Many of these (brucite, halloysite, etc.) can be eliminated from consideration by chemistry. There are, however, several minerals (e.g., pyroxenes, massive amphiboles, and talc fibers) which are chemically similar to asbestos and can be considered interferences. The presence of these substances may warrant the use of more powerful diffraction pattern analysis before positive identification can be made. **If interferences are suspected, morphology can play an important role in making positive identification.**" [emphasis added] As discussed below, the characteristics that can be used to differentiate between asbestos and nonasbestos are known and have long been used for just such a purpose.

13. Page 60, lines 27-30. It should be noted that the PCM method counts all visible particles that appear to be fibers. The methods are not limited to EMPs, but will also count organic fibers such as hair or cotton. The lines should be amended to read: "Under the current NIOSH REL for airborne asbestos fibers, *all* particles are counted if they ~~are EMPs (i.e., mineral particles with an aspect ratio [length:width] of 3:1 or greater) of the covered minerals and they~~ are longer than 5 μm *and have a minimum aspect ratio [length:width] of 3:1* when viewed microscopically using NIOSH Method 7400 or its equivalent."

14. Page 63, line 39. At the magnifications typically used for asbestos analyses (roughly 20,000X), the resolution of FESEMs and TEMs are the same.

15. Page 64, line 36. There are published analytical procedures that can be used to reliably differentiate asbestos fibers from their nonasbestos analogues. One procedure[7] is based on long known characteristics of asbestos fibers and nonasbestos particles. This procedure, approved by the EPA for use in the evaluation of the Southdown, NJ quarry[8], incorporates previously published methods.[9,10,11] The recent trend is to incorporate both TEM and FESEM analyses of

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[7] D. R. Van Orden, K. A. Allison, and R. J. Lee (2008). "Differentiating Amphibole Asbestos from Non-Asbestos in a Complex Mineral Environment", *Indoor and Built Environment*, 17, p. 58-68.

[8] Paul Lioy, Junfeng Zhang, Natalie Freeman, Lih-Ming Yiin, and Robert Hague (2002). "Sparta Township Environmental Asbestos Study - Final Report of the Results of Air and House Dust Sampling," NJ Department of Environmental Protection, October 4, 2002.

[9] A. G. Wylie, R. L. Virta, and E. Russek (1985). "Characterizing and Discriminating Airborne Amphibole Cleavage Fragments and Amosite Fibers: Implications for the NIOSH Method", *American Industrial Hygiene Journal*, 46, p. 197-201.

the same particle to determine whether the particle is asbestos or nonasbestos.[12,13,14] These procedures start by comparing the particle in question with the basic definition of a fiber – a hair-like structure that is long and thin and has nominally parallel sides. Once the particle has been shown to meet this requirement, then other characteristics such as curvature, diffraction patterns, chemistry, and/or internal structural defects can be used to classify a particle as asbestos or nonasbestos.

16. Page 65, line 40. The original version of the ASTM D7200 was presented to OSHA during the 1990 hearings on asbestos standards.[15] At that time, it was shown to be an effective tool for classifying populations of fibers as either asbestos or nonasbestos. One of the key criteria is the presence of bundles of fibers in the airborne particles. Unfortunately, during the recent ASTM interlaboratory round robin of D7200, the procedure used to prepare the asbestos samples was the same procedure as was used to prepare nonasbestos samples – a procedure that effectively destroyed all bundles in the sample.[16] These samples were subjected to high energy ultrasonic energy which causes bundles to be split into individual fibers and also comminutes the fibers into shorter, more numerous particles.[17] The testing was effectively biased from the start of sample preparation. The basic conclusion of Harper, as it pertains to the round robin, was that experienced laboratories could differentiate asbestos from nonasbestos, inexperienced laboratories could not. This suggests that existing methods are adequate – but the training of the microscopists or laboratories is not.

Finally, it is clear throughout this document that nomenclature and descriptions of minerals and mineralogy are poorly written and are in need of improvement. Since it is apparent that NIOSH does not have a person on staff qualified to write on these topics, it is recommended

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[10] A. M. Langer, R. P. Nolan, and J. Addison (1991). "Distinguishing between amphibole asbestos fibers and elongate cleavage fragments of their non-asbestos analogues", in *Mechanisms in Fibre Carcinogenesis*, ed. R. C. Brown et al, Plenum Press, p. 253 – 267.

[11] A. M. Langer and R. P. Nolan (1988). "Distinguishing Asbestiform Tremolite from Non-Asbestiform Tremolite", VIIth Int'l Pneumoconiosis Conf, Pittsburgh, PA, August 23-26, 1988.

[12] K.E. Harris, K.L. Bunker, B.R. Strohmeier, R. Hoch, and R.J. Lee (2007). "Discovering the True Morphology of Amphibole Minerals: Complimentary TEM and FESEM Characterization of Particles in Mixed Mineral Dust", in *Modern Research and Educational Topics in Microscopy*, A. Mendez-Vilas, J. Diaz, Eds., Formatex Research Center, Vol. 3, No. 2, p. 643-650.

[13] M.E. Gunter, K.E. Harris, K.L. Bunker, R.K. Wyss, and R.J. Lee (2008). "Amphiboles between the sheets: observations of interesting morphologies by TEM and FESEM", *European Journal of Mineralogy*, 20, p 1035-1041.

[14] R.J. Lee, D.R. Van Orden, K.A. Allison, and K.L. Bunker (2009). "Characterization of Airborne Amphibole Particles in Libby, MT", *Indoor Built Environment*, 18, p. 524–530.

[15] R.J. Lee (1990). Letter To Tom Hall, Us Dept Of Labor, Regarding The Occupational Safety And Health Administrations Notice Of Proposed Rulemaking Occupational Exposure To Asbestos, Tremolite, Anthophyllite And Actinolite 29 CFR Parts 1910 And 1926, Docket H033D, Exhibit 534. http://dockets.osha.gov/vg001/V037B/00/72/79.PDF, accessed April 7, 2010.

[16] RTI International (2007). "Preparation of Nonasbestiform Amphibole Minerals for Method Evaluation and Health Studies: Summary Report", submitted to M. Harper, NIOSH.

[17] D. R. Van Orden, R. J. Lee, and S. Badger (2006). "Characterizing asbestos fiber comminution resulting from preparation of environmental samples", *Powder Technology*, 162, p. 183 – 189.

that NIOSH engage persons from the regulated and academic communities to rewrite and clarify these sections.

Sincerely,

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