



Physics Division

ESH Bulletin 98-3

BERYLLIUM OXIDE EXPOSURE AT LLNL

On February 12, 1998, at the Lawrence Livermore National Laboratory, a facility supervisor reported that a researcher was potentially exposed to airborne beryllium oxide when he brushed a laboratory table with his hand to demonstrate that the material would not become airborne. The researcher incorrectly believed the material was aluminum oxide. When he realized that the material was beryllium, he called Health Services personnel for assistance, and they directed him to shower as a precautionary measure. An industrial hygienist sealed the room to contain any airborne beryllium. Health Services personnel took nasal swipes from the researcher and surveyed the room and adjacent areas. They determined that no beryllium was present on the nasal swipes. However, they found beryllium contamination on the laboratory room floor and low-but-detectable levels in an adjoining hallway. Because investigators determined that the beryllium oxide ceramic had been on the laboratory table for several weeks, Hazards Control personnel checked the researcher's car and home as a precaution. No beryllium contamination was found. Exposure to low levels of beryllium can cause chronic beryllium disease, which can be fatal to individuals who are particularly susceptible to this disease. (ORPS Report SAN--LLNL-LLNL-1998-0012)

Investigators reported that the supervisor entered the laboratory and observed a torn bag and pieces of material spread on a laboratory work table. The supervisor believed the material was beryllium oxide ceramic, so he contacted facility personnel to assess the situation and met with the researcher to discuss the material. The researcher then went to another laboratory, retrieved a bagged sample of beryllium oxide, compared it to the material on the laboratory table, and determined that it was beryllium oxide.

Investigators determined that the worker had taken beryllium training and had worked with beryllium previously. Health Services and Hazards Control personnel are evaluating other facility personnel who accessed the laboratory room over the last several months to determine if any of them were exposed to beryllium oxide. The facility manager formed an incident analysis team to investigate this event. The incident analysis team will continue to investigate this event to determine (1) why the researcher believed the material was aluminum oxide, (2) why the beryllium oxide ceramic was in the room, (3) why the researcher did not initially recognize it was beryllium oxide ceramic, and (4) what administrative and supervisory controls were in place to control beryllium.

NFS has reported beryllium exposures in the following Weekly Summaries.

- Weekly Summary 95-19 reported that four experimenters at the Brookhaven National Laboratory Alternating Gradient Synchrotron Facility were exposed to Osmium-185 and Beryllium-7 when a beam target broke during a high intensity experiment. (ORPS Report CH-BH-BNL-AGS-0002)
- Weekly Summary 93-37 reported that health physics personnel at the Los Alamos Meson Physics Facility determined that 11 workers received beryllium-7 uptakes while performing replacement of an accelerator target. (ORPS Report not available)

The Environmental Protection Agency classifies beryllium oxide as a special health hazard substance because it is a carcinogen. Beryllium oxide is a white, odorless powder that is used in ceramics, glass, electron tubes, electronic components, nuclear fuels, and nuclear moderators. Beryllium oxide inhalation can lead to chronic beryllium disease. According to the Environmental Protection Agency, chronic beryllium disease is irreversible and can produce the following effects.

- High exposures of beryllium oxide usually result in severe bronchitis or pneumonia, within 1 to 2 days after exposure, accompanied by fever, cough, and shortness of breath.
- High exposures of beryllium oxide can result in death.
- High or repeated low exposures of beryllium oxide can scar the lungs and other organs. Fatigue, weight loss, shortness of breath, lung damage, and heart failure can occur years after the exposure.
- Exposure to beryllium oxide can cause an allergic skin rash.
- High or repeated beryllium oxide exposures can cause kidney stones.

Additional information about the clinical characterization of chronic beryllium disease can be found in the Defense Programs Beryllium Good Practice Guide and in DOE G 441.1-7, Implementation Guide for use with DOE N 440.1, Interim Chronic Beryllium Disease Prevention Program. These documents state that chronic beryllium disease is characterized by pulmonary symptoms that include dyspnea, nonproductive cough, and deterioration in lung functions. Symptoms also can include progressive weakness and fatigue, pain, and anorexia. Some public health practitioners believe there may be no safe level of exposure to beryllium oxide, so all exposure should be reduced to the lowest possible levels. Individual susceptibility may play a role in who does or does not develop chronic beryllium disease. This may account for the development of the disease in individuals with low or seemingly inconsequential exposures. The following are workplace exposure limits for beryllium oxide from several sources. However, DOE adheres to the limits of the Occupational Safety and Health Administration or the American Conference of Governmental Industrial Hygienists, whichever is lower.

- Occupational Safety and Health Administration, 29 CFR 1910.1000, "General"

– The legal airborne permissible exposure limits are $2 \mu\text{g}/\text{m}^3$ averaged over a 8-hour work shift of a 40-hour work week; $5 \mu\text{g}/\text{m}^3$ as an acceptable ceiling during an 8-hour work shift; and $25 \mu\text{g}/\text{m}^3$ as a maximum peak above the acceptable ceiling concentration, which is not to be exceeded during any 30-minute work period for beryllium and beryllium compounds.

- National Institute for Occupational Safety and Health – The recommended beryllium airborne exposure limit is $0.5 \mu\text{g}/\text{m}^3$; it should not be exceeded at any time.
- American Conference of Governmental Industrial Hygienists – The recommended airborne exposure limit is $2 \mu\text{g}/\text{m}^3$ averaged over an 8-hour work shift for beryllium and beryllium compounds.

These events illustrate the importance of controlling hazardous materials and point out that managers and supervisors must strictly enforce laboratory policies and procedures to prevent contamination and exposure. Facility personnel were not aware that the researcher had beryllium in the room, which emphasizes the need to establish and enforce strict controls when hazardous materials are introduced into a facility. Beryllium and other hazardous materials may also be encountered more frequently as DOE facilities transition to deactivation and decommissioning activities.

Managers and supervisors in charge of laboratories or facilities that handle beryllium should review the following documents to ensure that appropriate controls are in place and that employees adhere to them.

- DOE N 440.1, Interim Chronic Beryllium Disease Prevention Program, establishes a chronic beryllium disease prevention program to reduce the number of workers exposed, minimize exposure levels, and establish medical surveillance protocols. This notice also requires a training program for exposed and potentially exposed beryllium workers on (1) proper handling and control, (2) exposure hazards, and (3) controls and work practices (such as engineering controls, administrative controls, personal protective equipment, exposure minimization, medical monitoring, and waste management and decontamination procedures.)
- Draft DOE G 441.1-7, Implementation Guide for use with DOE N 440.1, Interim Chronic Beryllium Disease Prevention Program, addresses beryllium, including (1) general information, (2) program elements for reducing and minimizing exposures, (3) programmatic considerations, (4) baseline inventories and

sampling, (5) hazard assessments, (6) exposure monitoring, (7) specific exposure reduction and minimization guidance, (8) medical surveillance, (9) training, (10) record-keeping, and (11) performance feedback measures.

- National Institute for Occupational Safety and Health, Criteria for a Recommended Standard Occupational Exposure to Beryllium, provides criteria for the development of standards to prevent beryllium-related diseases. This recommended standard also includes information on beryllium properties, sources, and the biological effects of exposure.
- Defense Programs Beryllium Good Practice Guide, July 3, 1997, provides a program for controlling beryllium exposure. The guide includes information about (1) minimizing worker exposure, including during decontamination and decommissioning work; (2) controls for the handling of beryllium and its compounds; (3) medical monitoring and surveillance of exposed workers; and (4) site-specific safety procedures for beryllium processes.

Additional information on DOE beryllium worker protection activities can be obtained by calling the Office of Worker Protection and Hazards Management at (301) 903-6061. Information on the DOE Chronic Beryllium Disease Prevention Program and the documents referenced herein can be obtained at URL <http://tis-nt.eh.doe.gov/be/>. National Institute for Occupational Safety and Health information regarding beryllium can be obtained at URL <http://www.cdc.gov/NIOSH/>. The Rocky Flats Environmental Technology site has a beryllium information site at URL <http://www.dimensional.com/~mhj/bsg/rfets.html>. Lawrence Livermore National Laboratory also maintains a beryllium information site at URL http://www_training.llnl.gov/training/hc/Be/Be.html.

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