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Memo

date: *June 17, 1999 [Updated March 23, 2005]*

to: *Robert Selvey*

from: *Andrew Ackerman*

subject: *Beryllium (Be) Use at the NSLS*

This memorandum contains a summary of beryllium use at the NSLS. The information presented here was gathered through discussions with NSLS staff and inspection of work areas where Be materials are used. A description of Be containing materials in use, a definition of the scope of Be work in the department, and an evaluation of personnel health risks presented by that work follows.

Be Materials and Scope of Use

Articles

Most Be containing material in use at the NSLS is in article form. These articles are manufactured off site and require no machining at BNL. Typical articles include vacuum enclosures and Xray windows used to segment vacuum conditions within beam lines. Beryllium has good Xray transmission properties and is useful for vacuum isolation. These windows and enclosures typically are composed of Be metal with a total mass of less than 100 grams. We also have Beryllium Oxide ceramic electrical components. These are articles with individual component masses of less than a few hundred grams.

Any one of approximately 20 workers from the department's mechanical engineering and experimental systems groups may be asked to complete tasks requiring work with the Be articles described above. Those tasks include installation of Be windows within beam lines, attaching Be vacuum enclosures to flanges, and testing enclosures or windows for mechanical integrity. These operations require no Be machining. The equipment is typically handled with gloves for vacuum cleanliness reasons and no visible dust is generated. Installation of windows and enclosures involves placing the Be article into a metal holder or flange and securing the apparatus with screws and hand tools. Mechanical integrity testing involves securing a window or enclosure to a test apparatus equipped with a pump and a detection system for finding vacuum leaks. We estimate less than 30 man hours involved in these projects in a typical year.

Copper-Beryllium (CuBe) Alloy

Copper-Beryllium metal sheet and wire is in use as electrical contacts in much of our equipment. The Be content of these materials is less than 2 per cent. Occasionally our technicians are required to form and install some of this material. Small electrical contacts are made from sheet metal approximately one millimeter thick and with a total mass of less than 50 grams. Special contacts called spring fingers are used as sliding electrical contacts in some equipment. These are made from sheets of the alloy and come preformed. Strips of spring fingers are used that measure approximately 100 cm x 10 cm and are less than one millimeter thick. The mass of these strips is usually less than 200 grams. We also use 125 micron CuBe wire in lengths of several centimeters and masses less than one gram.

Any one of approximately 15 workers from the department's electrical engineering, accelerator R&D, mechanical engineering and experimental systems groups may be asked to complete tasks requiring work with CuBe metal. Fabrication and installation of these components involves trimming with hand scissors and manipulation and stretching with hand tools. There is no machining and no visible dust generation. There are no routine production operations involving CuBe metal. We estimate less than 50 man hours expended on these small projects in a year.

Beryllium Risk Assessment

Discussion

Work with Be in the department involves limited handling of small quantities of material, no machining, no dust generation, and short duration projects. Generation of airborne Be concentrations or significant surface contamination during work with Be containing materials is unlikely. Risk of beryllium exposure to personnel from work with materials at the NSLS is minimal.

Precautions and requirements associated with Be materials are directed at control, storage, and maintenance of the department inventory. The department has completed an inventory of Be containing materials and has added that information to the BNL Chemical Management System database. The materials are stored at several locations with many in use on the beam lines. The materials are in good condition and present little risk of surface contamination. [Subsequent to this memo, BNL decided not to include Be articles in CMS.]

Experience indicates that Be articles exposed to the synchrotron beam oxidize quickly [in air] (weeks) and that the oxide layer can disperse and generate an inhalation concern. Oxidized windows are also weakened and more likely to break. Most Be window failures result from small pin holes, but the windows may break into several pieces or even shatter into many. Precautions are taken to protect the windows from oxidation and breakage. These include use of inert gases, use of spray coatings, vacuum requirements, and routine monitoring. Beryllium window oxidation is uncommon, as is failure or breakage. Typical precautions needed for cleanup and disposal of broken articles include, use of gloves, thoughtful packaging of sharp pieces, alcohol wiping, attention to personal hygiene, and use of a vacuum equipped with high efficiency particulate air (hepa) filtered exhaust. Beryllium containing materials are discarded as RCRA hazardous waste.

Power levels for some of the equipment with CuBe electrical contacts are in the kilowatt range. The contacts in that equipment can fail and cause electrical arcing and melting of some of the CuBe alloy. These failures occur infrequently; perhaps once a year. Investigation of a recent event involving this type of failure found no detectable airborne Be concentrations during cleaning of Be contaminated surfaces. Precautions employed during the cleanup included, use of disposable clothing and gloves, use of full face air purifying respirators, alcohol wiping, attention to personal hygiene, and careful packaging of discarded material.

Exposure Monitoring

We have collected data for evaluation of two operations involving work with Be materials. The first survey was aimed at evaluating housekeeping conditions in the NSLS vacuum shop and finding any Be contamination on surfaces where Be articles are in use. The second was conducted to monitor surface and air conditions resulting from a CuBe electrical contact failure and clean up. Summaries of these two surveys follow.

During October, 1998, wipe samples were taken from surfaces on and around the Be window test station located in the NSLS vacuum shop. That equipment has been in use for several years in testing the mechanical integrity of Be windows. No Be surface contamination was found.

In March, 1999, wipe and air samples were collected when a radio frequency transmitter failed and approximately 100 grams of CuBe (<2% Be) alloy was melted. Several surfaces of the transmitter were found to have detectable levels of Be before cleaning began. All surfaces were cleaned with alcohol wiping while air sampling was conducted. Those samples did not detect airborne Be concentrations. Final wipe samples showed effective removal of Be surface contamination.

Conclusions

Industrial hygiene sampling and experience suggest that the risk of significant personnel exposure to Be at the NSLS is low. Existing practices for maintenance and control of the department inventory of Be containing material are adequate. Clean up of broken articles or melted contacts presents some concern for exposure and must be planned to minimize that risk. In general, careful housekeeping and use of wet methods for dust control are adequate to control exposures for most clean up operations expected. Individual risk assessments should be based on the scale of the expected work and potential for Be containing dust generation. Exposure monitoring suggests that alcohol wiping of Be contaminated surfaces may be adequate to control dust generation and avoid the need for respiratory protection.

Future Needs

The department must continue to meet its responsibility to manage its Be containing materials inventory. Much of what is needed is in place. Suggestions for improvement follow.

- Department requirements for Be containing materials should be gathered into a single policy document. That document should be incorporated into the NSLS Safety and Environmental Administrative and Procedures Manual (SEAPPM) and should address requirements for inventories, storage, maintenance, disposal, and housekeeping.

- More data pertaining to surface and airborne Be levels resulting from electrical contact failure and the subsequent clean up would be useful for future risk assessment and to guide decisions for use of personal protective equipment.

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