AMES LABORATORY BERYLLIUM SURVEY REPORT

August 2001

Executive Summary

Beryllium is a hard, lightweight metal that is very strong and easy to shape. It has many industrial uses. Beryllium-copper alloys and beryllium-oxide ceramics are used in the electronic, nuclear and aerospace programs. Beryllium parts for nuclear weapons were manufactured and used at a number of Department of Energy (DOE) laboratories. This manufacturing process continues at some laboratories today. Additional information on beryllium is included in the Ames Laboratory Beryllium Fact sheet (Appendix I).

On December 8, 1999, the Department of Energy published 10 CFR Part 850—Chronic Beryllium Disease Prevention Program; Final Rule in the Federal Register. The rule required the establishment of a chronic beryllium disease prevention program (CBDPP) to reduce the number of workers currently exposed to beryllium in the course of their work at DOE facilities, and established medical surveillance requirements to ensure early detection of the disease. Because Ames Laboratory is a DOE facility with a past history of beryllium usage, a beryllium surveillance program was begun in the spring of 2001 to comply with the CBDPP requirements.

Although beryllium has not been used in significant quantities in research activities at Ames Laboratory for nearly 50 years, a high level of concern exists over the possible presence of beryllium contamination in Iowa State University (ISU) and Ames Laboratory facilities.

To address concerns over potential contamination, it was determined that specific areas in existing campus buildings that were used for Ames Laboratory research as part of the Manhattan Project would be considered potentially contaminated and that representative wipe sampling would be conducted. Wipe sampling locations were determined after reviewing historical information about beryllium work in Gilman Hall, Physics Hall, and Wilhelm Hall and by conducting interviews with current and former employees who were familiar with the project. Wipe samples were collected from ceiling and wall surfaces and from representative horizontal surfaces such as desktops, lab benches or window ledges. Samples were also collected from several "non-public" areas where beryllium may have been deposited, such as utility chases and mechanical rooms. Control samples were collected in three other campus buildings where beryllium was not used. Control buildings were chosen by construction date and proximity to Gilman and Wilhelm Halls.

One hundred fifteen surface wipe samples were analyzed for beryllium content. Results indicate that beryllium concentrations are below the analytical method's detection limit in all accessible public areas. Nine samples collected from restricted access mechanical spaces had beryllium concentrations greater than the analytical method's detection limit, with concentrations ranging from 0.5μg/100 cm^2 to 9.0μg/100 cm^2. Three of these samples had concentrations equal to or less than the "clearance" limit of 1.0 μg/100 cm^2. This clearance limit was identified to represent acceptable clean conditions by at least two other DOE facilities (see Beryllium Exposure Limit table). The other six samples collected from limited access mechanical areas had beryllium concentrations greater than the clearance limit.

Overall, the results indicate no beryllium contamination concerns in occupied areas of buildings tested and only low levels of beryllium contamination in non-routine, restricted work areas of the facilities tested.

Purpose and Scope

The purpose of the beryllium survey was to determine surface concentrations of beryllium in buildings with potential for historical beryllium contamination. Although beryllium has not been used in these buildings in any significant quantities in nearly 50 years, employees still occupy several of the facilities where beryllium was used as part of the Manhattan Project. Historical records are limited to lists of spaces that the Ames Laboratory occupied as part of their research in the 1940's-1950's. Laboratory room numbers 24, 26, 28, 30 and 32 located in Wilhelm Hall were identified as having processed beryllium during this time period.

For the scope of this survey, all areas in which the Ames Laboratory had administrative control were considered to have potentially processed beryllium. Once these areas were identified, a representative wipe sampling of rooms and spaces within those rooms was planned. A total of 35 separate spaces were wipe-sampled in six different buildings. Twelve of the samples were controls collected from four spaces in three different buildings with no history of beryllium usage.

Project Personnel

The beryllium sampling project was led by Certified Industrial Hygienists (CIH's) from Iowa State University and Ames Laboratory. All wipe samples were collected by the same individual to ensure consistent sampling techniques. Two other individuals assisted by logging each sample location and ensuring that cross-contamination between samples was prevented by use of clean sampling templates, gloves and containers for each sample.

Sampling Protocol

Development of a sampling plan began by reviewing historical records for each facility at Iowa State University involved with Ames Laboratory activities prior to the 1950's. The review effort included a search for any documentation of the use of beryllium-containing materials or processes associated with beryllium in any of the Ames Laboratory occupied facilities. This review was followed up with interviews with past facility representatives to identify areas that were used for Ames Laboratory research. Areas that could be identified as research areas were considered to be potentially contaminated. A sampling plan was then devised to evaluate a majority of these areas.

The sampling plan consisted of wipe samples collected from various areas within buildings formerly used by Ames Laboratory. Sample collection areas fell into two distinct categories: accessible occupied areas and limited access mechanical spaces. In the occupied areas, a wipe sample was collected from surfaces that could pose a contact hazard and surfaces where dust could settle. Surfaces sampled included walls, original ceilings and horizontal surfaces within each representative room. The horizontal surfaces sampled typically consisted of a window ledge, top of overhead cabinet or workbench surface. In mechanical spaces, samples were collected from various surfaces, ranging from walls, floors and ceilings to old airshafts and tops of air handling units. Samples were not collected from areas that would require demolition or dismantling of equipment, such as ventilation ductwork, block chases or attic spaces.

The sample collection area was noted on a floor plan of each building sampled. Pre-labeled sample containers, clean nitrile gloves and a fresh template were used to collect each wipe sample. Templates typically had a 10 x 10 centimeter (cm) cutout that was placed on the surface to be sampled. Separate templates were made for window ledges consisting of a 4 x 25 cm opening. When there was insufficient space to place the template on a surface, a tape measure was used to demarcate a 100 cm^2 area.

Wipe sample media was obtained from Test America, Inc., an American Industrial Hygiene Association (AIHA) accredited analytical laboratory. The wipe sample media consisted of individually packaged Ghost Wipes™ from Environmental Express. The wipes were pre-moistened with deionized water and met American Society for Testing and Materials (ASTM) specifications. A new Ghost Wipe™ was opened before each wipe sample, then the template opening was wiped both vertically and horizontally to ensure that the complete surface was sampled. After collection, wipe samples were placed in clean, pre-labeled polyethylene containers with tight fitting snap tops. Sample numbers were noted on a sample log as well as on a floor plan of the building.

Analytical Methods

Wipe samples were submitted to two different analytical laboratories. Chain of custody forms were completed for each batch of samples submitted. A majority of the samples were submitted to Test America, Inc., an AIHA accredited laboratory located in Cedar Falls, Iowa. Test America utilized a modified National Institute of Occupational Safety and Health (NIOSH) Method 7300 to analyze the samples for beryllium.

Samples that were possibly cross-contaminated with thorium were sent to Severn Trent Services in Arvada, Colorado, a DOE approved laboratory. Severn Trent Services utilized USEPA approved method "Beryllium by ICP SW-846 6010B." Severn Trent Services has performed laboratory analysis for other DOE facilities. Specific analytical details are included in the project narrative of the Analytical Report supplied by Severn Trent Services (see Appendix III).

Both laboratories used methods that included sample preparation consisting of acid digestion of the wipe sample followed by inductively coupled plasma (ICP) atomic emission spectroscopy. An appropriate quantity of blank samples (at least 1 blank per 10 samples) was provided for each batch of samples. The detection limit for the wipe sample analyses was 0.5 micrograms (μg) per wipe sample. Each wipe was used to sample a 100 cm^2 area. The analytical method detection limit therefore was 0.5 μg/100 cm^2.

Wipe Sample Results

A total of 115 wipe samples were analyzed for beryllium contamination (see Appendix II and Appendix III for sample locations and results). Of the 115 samples analyzed, 103 were actual samples and 12 were blanks. No duplicate samples were collected. The majority of the samples (91%) had beryllium concentrations less than the analytical detection limit of 0.5μg/100 cm^2. Of the samples collected from occupied areas, none had beryllium concentrations greater than the analytical detection limit.

A total of nine samples (9%) had beryllium concentrations equal to or greater than the analytical detection limit for the sample. The concentrations ranged from 0.5μg/100 cm^2 to 9.0μg/100 cm^2. As noted in the Beryllium Exposure Limits table, DOE's limit for surface beryllium contamination in areas where beryllium was used is 3.0μg/100 cm^2. Other DOE laboratories have set limits at less than or equal to 1.0 μg/100 cm^2. For equipment and other items to be released to the general public, DOE has adopted a clearance limit of 0.2μg/100 cm^2.

All nine samples that exceeded the analytical limit of detection were collected from restricted access areas in Gilman and Wilhelm Halls. The four samples from Gilman Hall were collected from a mechanical space and adjacent attic area accessible only to Iowa State University Facilities Planning and Management (FP&M) personnel. The five samples collected from Wilhelm Hall originated from restricted access areas as well. These Wilhelm Hall areas are currently restricted to trained, authorized Ames Laboratory personnel due to potential thorium contamination.

Eight samples had decreased analytical limits of beryllium detection because of interferences from high levels of calcium, iron and zinc. High calcium and iron concentrations can mask samples containing low concentrations of beryllium (i.e., < 1.0 μg per wipe). Given the number and consistency of other sample results, it was determined that further analysis of these samples was not necessary.

Beryllium Exposure Limit Table

Standard	8-hour TWA[b] (μg/m^3)	Surface Contamination (μg/100 cm^2)
OSHA PEL[a]	2	NA[c]
ACGIH TLV[d]	2	NA
NIOSH REL[e]	0.5	NA
DOE [f]	0.2	3.0; 0.2
Rocky Flats[g]	0.5	0.2
Hanford OEL[h]	0.2	1
Lawrence Livermore National Laboratory[i]	<0.2	<1

[a]Occupational Safety and Health Administration Permissible Exposure Limit
[b]Time Weighted Average
[c]Not Applicable
[d]American Conference of Governmental Industrial Hygienists Threshold Limit Value
[e]National Institute for Occupational Safety and Health Recommended Exposure Limit-Ceiling
[f]As set by 10 CFR Part 850, Department of Energy action level for airborne beryllium exposure is 0.2μg /m^3. Surface contamination is separated in building surface levels in areas where beryllium was used versus "release" levels for release of equipment, etc. to the general public. The building surface contamination limit during non-operational periods is 3μg /100 cm^2. Equipment below this limit may also be released to other facilities for beryllium work. <u>The general release level for items released to the public must not exceed 0.2 μg /100 cm^2.</u>
[g]Rocky Flats' airborne exposure limits and surface concentration used to determine items acceptable for public release.
[h]Hanford Site's Occupational Exposure Limit (and Surface Contamination Limit for wipe samples)
[i]Lawrence Livermore National Laboratory's acceptable levels for airborne and surface contamination of beryllium. Surfaces with > 3μg /100 cm^2 are considered "regulated areas."

Recommendations

The sampling program was designed to assess contamination that might be encountered by building occupants during routine activities. Samples were collected from Gilman Hall, Wilhelm Hall, Physics Hall, Science Hall, Forker Building and the Veterinary Medicine Building. It is possible that low concentrations of beryllium may be present in some of the limited access mechanical spaces of Wilhelm and Gilman Halls. Sampling data indicates that beryllium is not a concern in any of the other buildings sampled.

The samples from Wilhelm Hall with elevated beryllium concentrations were collected from areas that are already labeled as restricted access due to potential thorium contamination. Access to these areas is currently limited to maintenance personnel and technicians who have the necessary training and personal protective equipment to safely enter the restricted areas. It is recommended that the presence of beryllium be noted on the current signage and that any necessary adjustments to personal protective equipment for safe entry be made under the direction of the Ames Laboratory industrial hygienist.

Duct chases in the walls of Gilman Hall terminate into rooftop mechanical spaces. The elevated samples collected from Gilman Hall were restricted to mechanical space M4050. The chases in mechanical space M4050 (southwest part of the room) exist in their original configuration, though do not appear to be functional. The chases in mechanical space CC4000 have been enclosed with concrete blocks from a prior remodeling of the mechanical space. All wipe samples collected from this area were below the clearance limit of 1.0 $\mu g/100\ cm^2$.

In the short term, it is recommended that warning signs be posted (see Appendix IV for example) at the termination area of each of the chases in M4050 (southwest part of the room). Any entry into or work on these areas should be done by trained personnel who utilize appropriate personal protective equipment. Iowa State University industrial hygienists should be consulted before any extensive work in these chases takes place. Longer term, additional sampling in room M4050 and chases leading into this area may be necessary to better characterize the extent of beryllium contamination in restricted access areas of Gilman Hall. Additionally, exposed chase openings and chase terminations of non-functional chases in M4050 may need to be enclosed similarly to what was done in the southeast corner of room CC4000.

All samples collected from occupied areas indicated beryllium concentrations below the analytical limit of detection. Therefore, beryllium contamination should not be a concern in any occupied areas tested. Given the extensive remodeling in several of the areas formerly occupied by Ames Laboratory, the time since the last use of beryllium and the apparent limited scale of usage during research and initial production of beryllium, it is reasonable to assume the results of this survey are representative of any areas known to be formerly occupied by Ames Laboratory.