



THE Ames Laboratory
Creating Materials & Energy Solutions

Alexander H. King, Director

December, 2011.

Characterization of Beryllium Contamination at the Ames Laboratory

Dear Ames Laboratory Stakeholders:

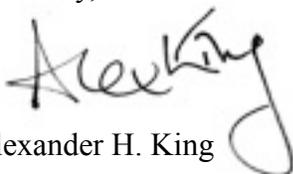
With this letter, we release the 2011 Ames Laboratory Beryllium Survey Report. The report documents the 2011 actions of a multi-year characterization effort undertaken to achieve a better understanding of the extent and level of historical contamination due to beryllium related research activities during the early years of the Ames Laboratory.

Our 2011 characterization efforts supplement the results from the 2010 survey and provide a more complete database regarding historical contamination. During 2011, we completed analysis of the door-tops in Metals Development. Results indicate background levels on most door-tops, with some elevated levels near materials processing areas, and all of the door-tops have been cleaned. Also, 2011 remediation efforts included cleaning and disposal of old laboratory fixtures in a storage shed and the completion of renovation activities in a Spedding Hall research machine shop. Sampling, cleaning and verification efforts were performed during space renovations, HVAC upgrades, and demolition and preparation for the Spedding Hall Auditorium remodeling project.

The Ames Laboratory continues to have confidence in the safety of its work spaces, although beryllium contamination remains a challenge. Cleaning practices ensure our workspaces are safe, but there remains an elevated likelihood of encountering beryllium contamination in spaces above suspended and plastered ceilings, especially near historical materials processing areas. Accordingly, whenever work is carried out in such spaces, special controls are used to ensure the safety of the staff performing the work, and all personnel in or near the work area.

Legacy issues like beryllium contamination will continue to affect current and future operations, but we are committed to taking appropriate precautions, sharing information, and responding to employee inquiries.

Sincerely,



Alexander H. King

2011 Ames Laboratory Beryllium Survey Report

Executive Summary

Ames Laboratory continued beryllium characterization and decontamination efforts in its research facilities during 2011. The primary goal of these efforts is the protection of current workers and the public, with a secondary goal of further documentation of the extent and levels of historical contamination. The activities documented herein supplement the activities performed during 2009 and 2010. Corresponding reports are available on the Ames Laboratory [beryllium information](#) website.

The scope of the characterization of historical beryllium contamination at the Ames Laboratory has been completed and the conclusion is that beryllium contamination remains in interstitial spaces and spaces generally not accessible to the public and the general Laboratory work force. In some cases, laboratory spaces in areas are clean today because beryllium work took place decades ago and since then the work surfaces, walls, floors, etc. have been cleaned repeatedly. Other spaces, such as the spaces above the ceilings, are accessed less frequently and cleaned rarely, if ever, so there is a higher probability of encountering beryllium contamination there. Accordingly, whenever work is carried out in such spaces in buildings where beryllium contamination is suspected or known to exist, special controls are used to ensure the safety of staff.

Minimal survey activities were performed in 2011, and the completion of door top sampling in the Metals Development Building was the primary sampling task. Results of door top sampling in Metals Development primarily indicate background levels, with elevated levels near materials processing areas. Sampling was also conducted in a storage shed where used laboratory fixtures are stored. Remediation efforts included cleaning of door tops, cleaning and disposal of old laboratory fixtures, and the completion of renovation activities in a Spedding Hall research machine shop space. Precautionary cleaning and verification efforts were also performed during space renovations, HVAC upgrades, and demolition and preparation for the Spedding Hall Auditorium remodeling project.

All beryllium characterization, remediation, and maintenance and renovation activities were conducted in accordance with established procedures that ensure the protection of workers, including contamination control. Air sampling has shown no airborne beryllium concentrations of significance; follow up surface sampling has been below established DOE thresholds.

A beryllium room clearance process has been developed in consultation with a statistician. The procedure describes the methodology used to evaluate spaces within Ames Laboratory for the presence of beryllium. It takes into account the historical usage of the room, availability of previous sampling data, routine activities that involve interaction with any horizontal surfaces and usage of personal protective equipment. The procedure will be finalized after further testing and validation is conducted.

The Laboratory has proceeded openly regarding the discovery and characterization of beryllium contamination. In January 2011, the Laboratory director issued a message to employees, stressing that beryllium can be a significant threat to human health and that beryllium contamination remains a challenge. He further stated that Ames Laboratory has confidence in the safety of its occupied spaces and expressed a commitment to share future information and respond to employee inquiries. The Laboratory also undertook efforts to communicate the findings of its beryllium contamination to interested groups other than its direct stakeholders. ESH&A shared information regarding beryllium survey results at multiple local and national forums.

The exposure potential to current workers, building visitors, and the public remains extremely low as the contaminated areas are not accessible to the general workforce and the public. The Laboratory assesses the need for sampling in support of remodeling and maintenance activities on a case by case basis.

Introduction

During 2011, the Ames Laboratory continued sampling and decontamination efforts in its facilities. The primary goal of the Laboratory's characterization efforts was the continued assurance of the protection of current workers and the public. An additional interest was further documentation of the extent and levels of historical contamination due to beryllium research activities in the early history of the Ames Laboratory.

Surface wipe sampling was performed according to standard practices employing GhostWipe™ and Berylliant™ techniques. A micro vacuum bulk sampling technique and multi-element analysis was employed to assist in the determination of the source of beryllium in building dust.

A release limit of 0.2 µg/100 cm² was applied to the results of wipe (surface loaded) samples. A derived site value has been established as 1.47 ppm (parts per million, mg/kg) based on site soils and this value was applied to bulk samples.

Background and Brief History of Beryllium at the Ames Laboratory

In the early 1940s, Iowa State College participated in a classified research and development effort, known as the Manhattan Project. These efforts produced over one thousand tons of uranium from 1942 to 1945 by a metallothermic reduction process. In 1947, the Ames Laboratory was established. The current research facilities of the Ames Laboratory were constructed between the late 1940s and the early 1960s. After the Ames Laboratory was established, uranium, thorium and other metals were produced in limited quantities. Beryllium, as beryllia, was used in crucibles, and produced by the reduction of beryllium fluoride.

Beryllium exposure assessments in the early 1950s, by the AEC (Atomic Energy Commission, now DOE) Chicago Operations Office, identified that several of the operations in Wilhelm Hall exposed technicians to concentrations exceeding the AEC maximum allowable concentration. Discussions with researchers revealed that sporadic research activities with beryllium took place since the 1960s. Documentation associated with episodic beryllium activities in the 1960s indicated that more formal safety practices, oversight, and monitoring were utilized. Additional information about the history of beryllium and beryllium survey activities is included in the [2010 Ames Laboratory Beryllium Survey Report](#).

In June 2009, a [news release](#) was issued announcing the discovery of beryllium contamination in Spedding Hall fume-hood ventilation stacks. Laboratory leadership initiated actions designed to ensure the protection of employees and the public and communicate the concern to its stakeholders and an Ames Laboratory website was established to provide additional [beryllium information](#).

Widespread survey sampling was performed in 2009 and 2010, and in January 2011, a description of characterization activities, results, and cleanup efforts was provided in the [2010 Ames Laboratory Beryllium Survey Report](#). Although background levels of beryllium were revealed on surfaces in the majority of occupied spaces, structural troughs in the tops of many of the doors in the Laboratory's buildings were identified as repositories of past airborne contamination. Analysis of the contents of these troughs helped identify previously unsuspected areas of the facilities where beryllium work was conducted.

Where higher-than-background levels were discovered on surfaces, evaluation of the exposure potential determined the risk to occupants to be very low, and thorough clean-ups were conducted. Some work spaces may be clean today because beryllium work took place decades ago and the work surfaces, walls, floors, etc. have been cleaned repeatedly since then. Other spaces in the buildings, such as the spaces above the ceilings, were accessed less frequently and cleaned rarely, if ever, and therefore present a greater potential for encountering beryllium contamination.

Release Limits and Derived Background Limit

Title 10 of the U.S. Code of Federal Regulations (CFR), Part 850, Section 850.31(b) (1) sets the removable contamination level for equipment and other items to be released to the general public or for use in DOE non-beryllium work areas at $0.2 \mu\text{g}/100 \text{ cm}^2$ or the concentration level of beryllium in soil at the point of release, whichever is greater. Data analysis of local soil samples was used to establish a derived background limit of 1.47 ppm (parts per million, mg/kg) beryllium. The release limit of $0.2 \mu\text{g}/100 \text{ cm}^2$ beryllium was applied to the results of wipe (surface loaded) samples and a derived background level of 1.47 ppm beryllium was applied to the results of micro vacuum bulk samples.

2011 Sampling and Remediation Activities

No new areas were identified as having potential or known beryllium activities, although occasionally monitoring of renovation activities discovered above background beryllium concentrations in dust upon elevated conduits, switches and electrical boxes in areas suspected of beryllium activities. Remediation activities were completed in a shop in Spedding Hall. Door top sampling was also completed in Metals Development.

Several renovation and facility upgrade projects were performed during 2011. Precautionary cleaning and verification efforts were performed during space renovations, heating, ventilation and air conditioning (HVAC) upgrades, and demolition and preparation for the Spedding Hall Auditorium remodeling project. HVAC upgrade projects were conducted on the first floor and basement floor of Spedding Hall. A Metals Development room used for consumable arc melting was renovated. Cleaning activities were performed in preparation for an access control project primarily on basement and first floor of Spedding Hall and for the Spedding Hall auditorium renovation project. Also, in consideration of a DOE Lessons Learned notification, potential beryllium contamination from grinding wheels was evaluated. An inventory of grinding wheels was compiled and bulk testing of select wheels was completed.

Beryllium characterization, remediation, and maintenance and renovation activities are conducted in accordance with established procedures that ensure the protection of workers. Facilities Services personnel utilize various SOPs that address work activities related to beryllium remediation. Typically, work activities in areas with suspected beryllium contamination require the use of personal protective equipment (PPE) including gloves, Tyvek suit and a respirator. In some cases, engineering controls (e.g. HEPA-filtered negative air machines, and/or containments) are also utilized. Air sampling conducted to date has shown no airborne beryllium concentrations of significance; follow up surface sampling has been below established DOE thresholds. These monitoring processes confirm that worker protection and contamination control procedures are effective.

ESH&A, in consultation with a statistician, drafted a beryllium room clearance procedure. The procedure describes the methodology used to evaluate spaces within Ames Laboratory for the presence of beryllium and the process by which the room can be deemed safe for occupancy. The proposed methodology takes into account the historical usage of the room, availability of previous sampling data, routine activities that involve interaction with any horizontal surfaces and usage of personal protective equipment. To date, limited field testing of the overall procedure has been conducted. For example, the existence of prior characterization sampling data has allowed Laboratory personnel to adequately identify areas of concern within the facility prior to any work by Facilities Services. The procedure will be finalized after further testing and validation.

Spedding Hall 237-238 Shop Facility

Remediation activities were concluded in a machine on the second floor of Spedding Hall. A square conduit near the ceiling raceway across the front of the 237-238 room was unable to be fully decontaminated and was labeled with a beryllium contamination warning.

Metals Development Door Tops

Ames Laboratory research facilities contain interior doors with trough-like recesses on the door tops. These potential deposition sites could have accumulated dust and building contaminants over 50+ years as there is no recorded evidence to indicate these door tops were subject to periodic cleaning. During 2010, the doors in Wilhelm Hall were surveyed for beryllium contamination removed as part of an access control upgrade of Ames Laboratory facilities. Doors in Spedding Hall, and less than half of the doors in Metals Development were also sampled in 2010 in order to establish a record of contamination of facilities due to historical research activities. During 2011, the remaining doors in Metals Development were sampled and cleaned.

The table below lists summary results for Wilhelm Hall, Spedding Hall, and Metals Development. Results of door top samplings are reported as ppm beryllium. Some sample results were reported with limit of quantitation (LOQ) or limit of detection (LOD) notation. For the summary of data presented here, LOQ or LOD marked values are included. Examination of the median values indicates that in Wilhelm Hall (~3.3 ppm) over half of the values are above the site limit, whereas for Spedding Hall (~0.6 ppm) and Metals Development (0.78 ppm) over half of the values are below the site limit.

Ames Laboratory Research Facilities Door Tops	sample size	LCL 95%	UCL 95%	Mean	Stdev.	Min	Q1	Median	Q3	Max
Wilhelm Hall	137	6.97	12.40	9.08	18.37	0.11	1.35	3.30	7.20	130.00
Spedding Hall	265	1.43	2.15	3.09	14.14	0.01	0.27	0.57	1.40	170.00
Metals Development	151	1.19	1.86	1.49	6.73	0.00	0.34	0.78	1.40	63.00

LCL = lower confidence limit, UCL = upper confidence limit, Q1 = 1st quartile, Q3 = 3rd quartile

The door-top sampling in Metals Development was completed during 2011. The resulting data consist of 151 samples, 7 from the basement, 90 from the first floor and 54 from the second floor.

Metals Development	sample size	LCL 95%	UCL 95%	Mean	Stdev.	Min	Q1	Median	Q3	Max
Metals	151	1.19	1.86	1.49	6.73	0.00	0.34	0.78	1.40	63.00
Basement	7	0.56	2.21	1.12	1.1	0.06	0.28	0.40	1.30	3.20
First floor	90	1.39	2.60	1.90	8.64	0.05	0.54	0.86	1.60	63.00
Second floor	54	0.69	1.26	0.93	0.89	0.00	0.27	0.45	1.28	3.80

CL = lower confidence limit, UCL = upper confidence limit, Q1 = 1st quartile, Q3 = 3rd quartile

Over half of the values for each floor are well below the site limit as indicated by the median values for basement (0.40 ppm), first floor (0.86 ppm) and second floor (0.45 ppm). Basement and second floors show similar characterization of beryllium distributions, with three fourths of the results and the mean values below the derived background concentration. The first floor has higher mean (1.90 ppm) values and a broader range of results.

Spedding Hall HVAC Upgrade Project (First Floor and Basement Floor)

In 2011, the Ames Laboratory conducted activities related to a comprehensive upgrade of the HVAC system in Spedding Hall. Renovation was completed on first floor and initiated in the basement. All work was conducted with controls and monitoring to assure protection of craft workers and building occupants. The safe work protocols included vacuuming and personal protective equipment for craftspeople and air and surface wipe sampling. Several samples from the return air duct near 160 Spedding Hall contained concentrations of beryllium above the derived site background concentration. The area near 160 Spedding Hall was identified by the door top survey as being suspect for beryllium activities. Air samples and wipe samples collected from the floor during dismantling and reconstruction were analyzed and all were below levels of concern.

Construction Storage Shed Survey

Sampling was also conducted in a storage facility (Construction Storage Shed) where used laboratory fixtures are stored. Remediation efforts included sampling and cleaning of door tops, and cleaning and disposal of old laboratory fixtures.

Room 130 Metals Development

Room 130 Metals Development was completely decommissioned with removal of its consumable electrode melting systems (a.k.a, Vacuum Arc Remelting) and support systems. Elevated beryllium concentrations, above the derived background level, were discovered above an overhead switch panel, light fixture, and a welder. All items were cleaned satisfactorily.

Spedding Hall Auditorium Renovation

In summer 2011, additional sampling, monitoring, and cleaning activities were performed during demolition efforts associated with the auditorium renovation project. In the 301 area, low levels of beryllium were detected, but the concentrations indicate the beryllium was most likely derived from local soil dust. The space and items removed were thoroughly vacuumed as a precaution. Also, the spaces on the floor below the auditorium space (201 Spedding area) were reviewed for beryllium exposure potential and no concerns were identified. A thorough cleaning was performed before contractors were granted access.

Access Control Project

During 2011, Ames Laboratory conducted cleaning and contamination review activities for an additional access control project involving replacement of doors primarily in the vicinity of first floor east and basement west (near B56) of Spedding Hall. The preparatory actions (primarily electrical) were completed by Ames Laboratory Facilities Services staff during spring and summer of 2011 and the door replacement and card swipe system installation activities performed by contractor personnel will be performed during fall of 2011.

Communication with Stakeholders

In January 2011, the Laboratory director issued a beryllium update message to employees, stressing that beryllium and some of its compounds can be significant threats to human health, and noting that the beryllium forms found in most soils do not pose a health hazard. The message noted that Ames Laboratory has confidence about the safety of its work spaces, although beryllium contamination remains a challenge and such legacy issues affect current and future operations. The director's message reiterated a commitment to share future information and respond to employee inquiries.

In 2011, the Laboratory also undertook efforts to communicate the findings of its beryllium contamination to interested groups other than its direct stakeholders. The ESH&A manager gave a presentation on Beryllium

Contamination and Characterization at the Ames Laboratory at the 2011 CSHEMA (Campus Safety, Health, and Environmental Management Association) conference. ESH&A's industrial hygienist shared information regarding beryllium survey results at the national industrial hygiene meeting, at the mid-Iowa chapter meeting of occupational medicine nurses, and as an invited speaker to a group of occupational health specialists at the University of Iowa's College of Public Health departmental seminar in Iowa City.

Conclusions

The Ames Laboratory continues to have confidence about the safety of its work spaces, but recognizes that beryllium contamination remains in interstitial spaces and spaces generally not accessible to the public and the general Laboratory work force. The Laboratory also recognizes that work spaces in areas where known beryllium work was performed may be clean today because beryllium work took place decades ago and since then the work surfaces, walls, floors, etc. have been cleaned repeatedly.

The Laboratory understands that there is a higher probability of encountering beryllium contamination in spaces above suspended and plastered ceilings as such spaces are accessed infrequently and cleaned rarely, if ever. Accordingly, whenever work is carried out in such spaces in buildings where beryllium contamination is suspected or known to exist, special controls are used to ensure the safety of staff involved. Beryllium characterization, remediation, and maintenance and renovation activities are conducted in accordance with established procedures, special controls, and monitoring that ensures the protection of workers.

Air sampling conducted to date has shown no airborne beryllium concentrations of significance; follow up surface sampling has been below established DOE thresholds. These monitoring processes confirm that worker protection and contamination control procedures are effective.

A protocol to evaluate specific spaces for the presence of beryllium has been developed. It takes into account the historical usage of the room, availability of previous sampling data, routine activities that involve interaction with any horizontal surfaces and usage of personal protective equipment.

Beryllium contamination remains a challenge and legacy issues of this type will continue to affect current and future operations. The Ames Laboratory commits to share future information and respond to employee inquiries.