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LIVERMORE
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LABORATORY

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LLNL Chronic Beryllium Disease Prevention Program (CBDPP)

Implementation of 10 CFR 850, Revision 7

March, 2012

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LLNL Chronic Beryllium Disease

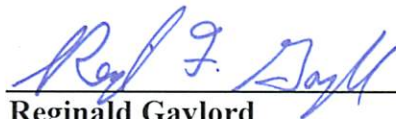
Prevention Program (CBDPP)

Implementation of 10 CFR 850, Revision 7

March 2012

On March 8, 2012, the IORB recommended the CBDPP Revision 7.0 for approval:

Approved by:



Reginald Gaylord

Acting Director for Environment, Safety, and Health

3/16/12
Date

LLNL Chronic Beryllium Disease Prevention Program Implementation of 10 CFR 850

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I. Introduction

This document describes how Lawrence Livermore National Laboratory (LLNL) meets the requirements and management practices of federal regulation 10 CFR 850, “Chronic Beryllium Disease Prevention Program (CBDPP).” This revision of the LLNL CBDPP incorporates clarification and editorial changes based on lessons learned from employee discussions, observations and reviews of Department of Energy (DOE) Complex and commercial industry beryllium (Be) safety programs. The information is used to strengthen beryllium safety practices at LLNL, particularly in the areas of:

- Management of small parts and components.
- Communication of program status to employees.

Future changes to LLNL beryllium activities and on-going operating experience will be incorporated into the program as described in Section S, “Performance Feedback.”

Revision History

This document supersedes *LLNL Chronic Beryllium Disease Prevention Program (CBDPP): Implementation of 10 CFR 850*, UCRL-AR-144636, Revision 6, July 7, 2009.

General (10 CFR 850.1 and .2)

Beryllium work at DOE and DOE contractor sites is subject to 10 CFR 850, “Chronic Beryllium Disease Prevention Program,” referred to in this document as “The Regulation.” This Regulation is applicable to LLNL subject to the following exceptions:

1. Beryllium articles. (10 CFR 850.2(b)(1))
2. DOE laboratory operations that meet the definition of laboratory use of hazardous chemicals in 29 CFR 1910.1450, “Occupational Exposure to Hazardous Chemicals in Laboratories.” (10 CFR 850.2(b)(2))

LLNL interprets the exemption concerning beryllium articles to be applicable only to items which meet the definition of commercially-available off-the-shelf products, and recognizes the need to actively manage noncommercial items, such as small research and development samples and large stock material, which meet the definition of article in the Regulation.

Program Goals

The overall goals of the LLNL CBDPP are to:

- Minimize the number of unprotected workers exposed and potentially exposed to beryllium.
- Decrease opportunities for unprotected workers to be exposed to beryllium.
- Minimize exposure levels for unprotected workers.
- Reduce the number of beryllium-related incidents and occurrences.

Covered Locations and Workers (10 CFR 850.2)

This CBDPP covers (1) beryllium work at the Livermore Main Site and Site 300; and (2) any Lawrence Livermore National Security, LLC (LLNS) employees (including former employees of

DOE or other DOE contractors now employed by LLNS) and employees of supplemental labor contractors, other contractors, and other non-LLNL entities, who are directed or supervised by LLNS employees and who may be or have been exposed or potentially exposed to beryllium in the course of their work at LLNL, another DOE facility¹, or an off-site facility not subject to DOE regulations.

Beryllium operations within the scope of this document include cutting, welding, heat treating, radiography, inspections, assembly, destructive and non-destructive testing, hydrodynamic testing, metallography, joining and coating, vapor deposition, plasma spray, laser or x-ray ablation, powder operations, chemical analysis, materials research and development, bioscience research, and other beryllium operations in support of Laboratory missions.

Related support operations include housekeeping, construction, maintenance, repair, decontamination, decommissioning, waste operations, sampling, inspections, industrial hygiene activities, and excavation work. No beryllium operations outside the scope of this CBDPP may be initiated until an update has been reviewed and approved by the National Nuclear Security Administration (NNSA) Livermore Site Office (LSO).

Implementation (10 CFR 850.12)

Integration of the CBDPP into the LLNL Environment, Safety, and Health Program

The LLNL CBDPP is integrated into the LLNL Integrated Safety Management System (ISMS) as required by parts 10 CFR 850.1 and 850.11 of the Regulation. The Regulation is an integral part of LLNL's Worker Safety and Health (WSH) Program, which is enforceable under 10 CFR 851.

10 CFR 850 is implemented by the LLNL CBDPP, which integrates the safety and health standards required by the Regulation, along with components of the LLNL ISMS, and other elements of the LLNL Environment, Safety, and Health (ES&H) Program. As described in the Regulation, and to fully comply with the Regulation, specific portions of existing programs and additional requirements are identified in the CBDPP. The CBDPP is implemented by documents that interface with the workers, principally through *ES&H Manual*, Document 14.4, "Working Safely with Beryllium." This document contains information on how the management practices prescribed by the LLNL ISMS are implemented, how beryllium hazards that are associated with LLNL work activities are controlled, and who is responsible for implementing the controls. Adherence to the requirements and processes described in the *ES&H Manual* ensures that ES&H practices across LLNL are developed in a consistent manner. A graphical depiction of the documents that implement the LLNL CBDPP is included in Appendix B, "Implementation of the LLNL Beryllium Safety Program."

Internal and External Review and Approval

Per LLNL Contractor Assurance Office procedure DES-0032, "Management of Institutional Documents," the Director of the ES&H Directorate internally approves this document, after review by the Institutional Operations Review Board, which ensures that contractual requirements are implemented in a manner that balances risk across the institution. The CBDPP

¹ A "DOE facility" is any facility operated by or for DOE (10 CFR 850.3, "Definitions").

is then submitted to the NNSA LSO Manager for review and approval as required by the Regulation, Subpart B.

New Work

For beryllium work that is subject to the Regulation but outside the scope of this CBDPP, LLNS will submit an addendum to the CBDPP for approval by DOE prior to performing the work activity. Under the Regulation, NNSA LSO has 90 days to approve any submittal. Unexpected activities may proceed without an update to the CBDPP, but only with the approval of the NNSA LSO Manager. LLNS will consider updates approved 90 days after submission if DOE has not acted upon the request within the 90-day timeframe.

Roles and Responsibilities

Table 1 details the beryllium-associated roles and responsibilities at LLNL.

Table 1. Roles and Responsibilities

Organization	Responsible Person	Responsibilities
Director's Office	Director ES&H	<ul style="list-style-type: none">• Approve the LLNL CBDPP.• Submit amendments to the CBDPP to NNSA LSO.
ES&H	Safety Education Training Section (SETS)	<ul style="list-style-type: none">• Develop, maintain, and deliver beryllium related training courses in cooperation with the Beryllium Subject Matter Expert (Be SME).
ES&H	Functional Area Manager (FAM) for WSH	<ul style="list-style-type: none">• Ensure a regulatory-compliant Beryllium Safety Program is established and maintained in the context of the LLNL ISMS.• Appoint a Be SME to provide technical guidance to the program. Includes periodic program review and assessment.• Submit the LLNL CBDPP for internal review and approval.
WSH Functional Area	Be SME	<ul style="list-style-type: none">• Maintain awareness of regulatory changes and, when appropriate, ensure that such changes are incorporated into the CBDPP and/or implementing documents.• Represent technical aspects and requirements to internal and external inquiries (e.g., notifications on exposures, industrial hygiene records, etc.). Includes communication and dissemination of information to appropriate stakeholders.• Maintain the LLNL beryllium inventory.• Periodically assess and review program.• Periodically review and update beryllium-related training material and assist SETS in conducting training courses.

Organization	Responsible Person	Responsibilities
WSH Functional Area	ES&H Team Industrial Hygienist (IH)	<ul style="list-style-type: none"> • Perform hazard assessments for beryllium operations and identify beryllium areas to determine applicable controls (e.g., engineering, administrative, and personal protective equipment); training, exposure and workplace monitoring, and medical surveillance requirements; and appropriate posting requirements for the area. • Participate in evaluating beryllium restrictions concerning beryllium-affected workers. • Evaluate the results of exposure and workplace monitoring and communicate findings to Responsible Line and ES&H management. • Assist in gathering information on beryllium operations to support the LLNL beryllium inventory.
ES&H	Site Occupational Medical Director (SOMD)	<ul style="list-style-type: none"> • Ensure a regulatory-compliant beryllium medical surveillance program is established and maintained. • Periodically review the results of medical surveillance, in consultation with the Be SME, to identify trends in beryllium sensitization or disease.
ES&H	Health Services Department (HSD)	<ul style="list-style-type: none"> • Provide beryllium medical surveillance to LLNL beryllium-associated workers. • Provide counseling services to beryllium-affected workers. • Recommend work restrictions, including removal from beryllium work, when medically appropriate. • Ensure the proper management of beryllium medical surveillance program and records. • Submit semiannual reports to the DOE beryllium registry.
Responsible Facility Management	Facility Manager	<ul style="list-style-type: none"> • Maintain sufficient knowledge of facility beryllium characterization and concurrent activities to release work, per the LLNL Institution-Wide Work Planning & Control Process (LLNL I-WWP&C). • Assure that all facility maintenance work involving beryllium areas has been appropriately evaluated to establish proper controls before work begins.
Payroll Management Organizations	Payroll Supervisor	<ul style="list-style-type: none"> • Work with the Return to Work liaison to ensure temporary or permanent assignments are compatible with the beryllium-affected worker medical restrictions.

Organization	Responsible Person	Responsibilities
Work Activity Line Management	Authorizing Individual (AI)	<ul style="list-style-type: none"> • Ensure that all tasks, hazards, and environmental aspects have been identified, and the appropriate controls and mitigations have been selected.
Work Activity Line Management	Responsible Individual (RI)	<ul style="list-style-type: none"> • Ensure that beryllium operations are evaluated, authorized, approved, and released through the LLNL I-WWP&C. • Engage the ES&H Team IH to help develop controls when planning beryllium work. • Ensure that work in beryllium areas is performed in accordance with LLNL procedures and work control documentation. • Approve and control worker and visitor access to beryllium areas. Minimize the number of workers exposed to beryllium and the opportunities for exposure. • Evaluate the potential for exposure to visitors and other ancillary personnel and inform such personnel of the hazards and controls of the area.
Work Activity Line Management	Workers	<ul style="list-style-type: none"> • Attend training, briefings and or facility specific training, as required. • Perform beryllium-related work in compliance with specified controls and required training.
Work Activity Line Management	Visitors	<ul style="list-style-type: none"> • Comply with all requirements and procedures for visitors at the work site.

II. Program Elements

A. Baseline Beryllium Inventory (10 CFR 850.20)

LLNL maintains an inventory of locations with current beryllium-related activities and areas with identified surface contamination. On a periodic basis, the information contained in the inventory is updated to reflect significant changes in existing operations, introduction of new operations/activities, or termination of operations/activities.

The inventory was developed as part of an institutional facility characterization process which included:

- Reviewing current and historical records.
- Interviewing workers.
- Documenting the characteristics and locations of beryllium at the facility.
- Conducting work place monitoring, as required.

The inventory and facility characterization processes are managed under the direction of the Be SME. The inventory of locations with current beryllium-related activities and areas with identified surface contamination is maintained on the Beryllium Safety Program website.

B. Hazard Assessment (10 CFR 850.21)

LLNL has implemented a risk-based, graded approach to assessing beryllium exposure hazards. For operations/activities identified in the LLNL inventory, an area IH performs hazard assessments, as required, to determine the potential for employee exposure to airborne and/or surface beryllium associated with planned activities and to ensure the necessary controls are identified to minimize the exposure risk, minimize the number of workers involved, and minimize the number of exposure events.

The hazard assessment describes the operation performed by task; identifies the beryllium exposure hazards; specifies the required controls [engineering, administrative, and personal protective equipment (PPE)] commensurate with the hazard; identifies training, sampling, and medical surveillance requirements; and determines the appropriate posting requirements for the area.

If sufficient information is not available to determine beryllium exposure levels for a work activity, conservative controls are established until operations are characterized.

C. Exposure Standards (10 CFR 850.22 and .23)

It is LLNL policy that beryllium hazards are controlled to assure that no worker is exposed to airborne beryllium in excess of the permissible exposure limit (PEL): 2.0 $\mu\text{g}/\text{m}^3$, as an 8-hour time-weighted average (TWA). Routine and periodic exposure monitoring allows LLNL to identify beryllium in the workplace, evaluate operations with respect to regulatory limits, determine the effectiveness of controls and housekeeping efforts, and continue evaluating initial hazard assessments.

Through the Regulation, DOE has established standards and allowable limits for beryllium airborne exposure and surface contamination in DOE facilities. LLNL policy uses these limits (Table 2).

Table 2. LLNL Airborne Beryllium Limits

	Criteria (8-hr TWA)	Source
PEL	2.0 $\mu\text{g}/\text{m}^3$	10 CFR 850.22
Action Level	0.2 $\mu\text{g}/\text{m}^3$	10 CFR 850.23

D. Exposure Monitoring (10 CFR 850.24)

Exposure monitoring is used to help evaluate the potential for airborne beryllium, and aids in verifying the effectiveness of controls implemented and in generating performance feedback for operations involving beryllium. Initial monitoring for current operations with the potential for airborne beryllium has been performed. Additional exposure monitoring may be warranted if:

- Periodic monitoring (quarterly) when potential or actual exposures exceed the action level.

- Monitoring when operations, maintenance, or procedures change, or when changes are suspected to have occurred.

Exposure monitoring is performed in accordance with 10 CFR 850.24, which includes the applicable National Institute for Occupational Safety and Health sampling method² and internal industrial hygiene exposure monitoring procedures. Samples collected for assessing worker exposure to airborne beryllium are analyzed in a laboratory accredited for metals by the American Industrial Hygiene Association or a laboratory that demonstrates quality assurance for metals analysis that is equivalent to accreditation from the American Industrial Hygiene Association. Table 3 details air sampling required actions and reporting requirements.

If personal air sampling results meet or exceed the action level, then the affected workers, WSH Functional Area–Be SME, SOMD, and NNSA LSO are notified in writing within 10 days of receiving the results along with a description of the corrective action being taken to reduce employee exposure to below the action level.

Table 3. Personal Air Samples

Sample Results µg/m ³	Required Actions	Reporting Requirements
< 0.2	No formal corrective action required.	Notify all affected workers of personal monitoring results – worker, Be SME.
≥ 0.2	Pause operations that could result in worker exposure or spread of surface contamination to non-beryllium areas. Restrict access to minimize exposure to personnel, as applicable. Notify line management, facility management, and Be SME of sampling results and planned actions. Further evaluate the situation to determine the source of the exposure. Evaluate and implement requirements of a RBWA. Evaluate corrective actions.	Notify all affected workers of personal monitoring results within 10 days of receipt – worker, Be SME, SOMD, and NNSA LSO.

Note: If a sample exceeds the action level and no respiratory protection was used during the activity, the operation is suspended immediately.

Note: Notification of exposure results at or above the action level to the SOMD and NNSA LSO is performed by the Be SME.

E. Housekeeping (10 CFR 850.30)

Surface sampling is used to monitor the effectiveness of controls, evaluate housekeeping efforts, identify beryllium-contaminated surfaces, and verify the effectiveness of cleaning and decontamination efforts. The responsible IH will determine the location to be sampled and the frequency of sampling based upon:

² The National Institute for Occupational Safety and Health method for monitoring and analysis that has an accuracy of not less than plus or minus 25 percent, with a confidence level of 95 percent, for airborne concentrations of beryllium at the action level will be used pursuant to 10 CFR 850.24(e).

- Review of the operation.
- Potential for dermal contact.
- Potential for beryllium on surfaces to become airborne.
- Review of the condition of surfaces where beryllium may collect.
- Occupancy and use of areas adjacent to Beryllium Work Areas (BWAs).
- Potential for contamination due to historical beryllium operations.

LLNL policy uses beryllium surface contamination limits established in 10 CFR 850 (Table 4).

Table 4. Surface Contamination Limits

	Criteria (surface contamination)	Source
Housekeeping	3 µg/100 cm ²	10 CFR 850.30
Release Criteria	0.2 µg/100 cm ²	10 CFR 850.31

Surfaces within a BWA or Regulated Beryllium Work Area (RBWA) are maintained below the housekeeping limit for removable beryllium during non-operational periods. Surfaces to be maintained below these criteria do not include the interior of closed or contaminated systems (e.g., target chambers, glove boxes, fume hoods, duct work, etc.) used to control beryllium exposure.

Surfaces above the LLNL housekeeping criteria may be cleaned using certified high-particulate air filter (HEPA)-equipped vacuums specifically designated for beryllium use or wet-cleaning methods to clean floors or other surfaces.

Dry-sweeping and dry-cleaning methods and use of compressed air are prohibited. All equipment used for cleaning and decontamination of posted areas is labeled, controlled, and stored in a beryllium area, as defined in Section H, “Beryllium Area (10 CFR 850.26),” and prohibited from use in non-beryllium operations or areas unless it has been evaluated and approved by the responsible IH.

F. Release Criteria (10 CFR 850.31)

LLNL’s policy on surface contamination is intended to prevent beryllium exposure and uncontrolled contamination resulting from the release of equipment/items with potential surface contamination. Items from Beryllium Storage Areas, BWAs, RBWAs, and Beryllium Contamination Areas are evaluated by the responsible IH prior to being released. Release requirements are specified in Table 5.

Table 5. Release Requirements for Beryllium-Contaminated Items

Recipient	Criteria (surface beryllium concentration)	Documentation
General Public	Items contaminated with or potentially contaminated with beryllium are prohibited from being released to the general public.	Not Applicable
Non-BWA at a DOE Facility	Equipment/items must be cleaned, as practicable, so that the removable beryllium surface levels on external and internal surfaces do not exceed 0.2 $\mu\text{g}/100\text{ cm}^2$. Note: Release is contingent upon recipient's commitment to implement controls to minimize beryllium exposure.	Equipment/Property Release Form (Appendix C, <i>ES&H Manual</i> , Document 21.5)
Another Facility Performing Beryllium Work	Beryllium-contaminated equipment/items must be cleaned, as practicable, so that the removable contamination levels on external surfaces do not exceed 3 $\mu\text{g}/100\text{ cm}^2$. Note: Release is contingent upon recipient's commitment to implement controls to minimize beryllium exposure.	Equipment/Property Release Form (Appendix C, <i>ES&H Manual</i> , Document 21.5)

To minimize the potential release of beryllium dust during handling and transport, the equipment/item is enclosed or placed in sealed bags or containers, impermeable to particulate contamination. All items, including containers, contaminated with beryllium are labeled according to requirements specified in Section Q, "Warning Signs and Labels (10 CFR 850.38)."

Release of items to non-BWAs or non-DOE/NNSA facilities is contingent upon the recipient's commitment to implement controls that will prevent foreseeable beryllium exposure.

G. Exposure Reduction and Minimization (10 CFR 850.25)

LLNL has identified various beryllium-related activities (e.g., waste treatment, D&D, and hydrodynamic testing) that have resulted in airborne levels of beryllium in excess of the LLNL action level. A standard hierarchy of industrial hygiene controls (engineering controls, administrative controls, and PPE in that order) is implemented through the LLNL Institution-Wide Work Planning & Control Process (LLNL I-WWP&C) (i.e., "Develop Controls" core function of the ISMS, as described in Section 2.3 of Document 2.2, "LLNL Institution-Wide Work Planning and Control Process") and developed and integrated in a manner to minimize both the number of employees exposed and the potential opportunities for exposure, as described in Section B, "Hazard Assessment (10 CFR 850.21)."

Airborne exposure at LLNL is typically low, with a majority of the sample results below reporting limits of the accredited laboratory's analysis protocols. For those activities with detectable airborne beryllium, airborne beryllium exposures are to be abated, controlled, or otherwise mitigated in a manner that provides assurance that workers are adequately protected.

Workplace monitoring and exposure reduction efforts are reviewed as part of ongoing performance feedback, as described in Section S, "Performance Feedback (10 CFR 850.40)."

H. Beryllium Areas (10 CFR 850.26)

LLNL recognizes and provides operational requirements for 5 types of beryllium-related areas:

- Beryllium Buffer Area
- Beryllium Storage Area
- Beryllium Contamination Area
- Beryllium Work Area (BWA)
- Regulated Beryllium Work Area (RBWA)

Beryllium Buffer Areas are administratively controlled, posted areas that may encompass contamination areas, BWAs and RBWAs, and serves as an intermediate area established to prevent the spread of beryllium contamination and to limit the potential exposure to workers who have not been trained as beryllium workers.

Beryllium Storage Areas are established for the storage of beryllium material, beryllium-contaminated items, and waste.

Beryllium Contamination Areas are areas where baseline facility characterization, hazard assessment, and/or sampling have indicated the presence of beryllium contamination above the action level (greater than $0.2 \mu\text{g} / 100 \text{ cm}^2$) on accessible surfaces, but where there are no ongoing beryllium work activities.

Beryllium Work Areas are established for work activities that have the potential to generate airborne beryllium below the action level or the potential for surface contamination in excess of release criteria during normal operations.

Regulated Beryllium Work Areas are established for work activities that have the potential to generate airborne beryllium at or above the action level.

I. Hygiene Facilities and Practices (10 CFR 850.27)

BWAs and RBWAs are managed so that beryllium on accessible surfaces in the normal work environment exceeding the release criteria is minimized.

At a minimum, the following hygiene practices apply to BWAs and RBWA:

- Food, beverage, or tobacco products shall not be allowed in these beryllium areas.
- Cosmetics shall not be applied in these beryllium areas.
- Contaminated PPE will be doffed or cleaned in a manner that prevents beryllium particulates from becoming airborne or contaminating surfaces.
- Designated locations for donning and doffing of any required protective clothing and PPE.
- Designated locations for the collection or storage of contaminated protective clothing, PPE, and waste.

In addition to these requirements, the following additional facility requirements will apply to RBWAs:

- Separate areas, free of beryllium contamination, shall be provided for workers to don/doff PPE and to store personal clothing and property.
- Change rooms shall be maintained at negative pressure or located so as to minimize spreading contamination.
- Showers and hand-washing facilities shall be available to workers at the end of the shift.
- Lunchrooms and break rooms shall be available to beryllium workers.

J. Protective Clothing and Equipment (10 CFR 850.28 and .29)

The types of PPE to be used are determined by a hazard assessment and are suitable to protect against inhalation, skin contact (including penetration of openings in the skin) and eye contact. The area IH determines specific PPE requirements based on the hazard assessment for each beryllium operation, and the required PPE, such as anti-Cs or coveralls, is documented in an Integration Work Sheet (IWS) or other work control documents. Operations with the potential for airborne beryllium at or exceeding the action level utilize clean, disposable PPE. LLNL policy regarding use of PPE and respiratory protection can be found in *ES&H Manual*, Document 11.1, “Personal Protective Equipment.”

Respirator use is mandatory when:

- Potential or actual exposures are at or above the action level.
- There is potential for acute worker exposure (short-term exposure at high levels).
- There is reasonable potential for failure of a critical control system.
- It is expected that new or modified activities may exceed the action level (until sampling results demonstrate that the operation is being adequately controlled).

Gloves shall be worn when handling beryllium, beryllium material, beryllium compounds, or beryllium-contaminated equipment, materials, or waste.³

Beryllium workers and/or co-located workers may request the use of PPE, regardless of measured exposure levels and task hazard assessment PPE requirements and if PPE use does not introduce additional safety hazards. When exposures are below the action level, individual workers may request a respirator for their voluntary use.

K. Waste Disposal (10 CFR 850.32)

Waste materials containing beryllium or having beryllium contamination, including waste generated by cleaning beryllium-contaminated surfaces, are managed in accordance with federal, state, and local regulations. Characterizing, managing, and disposing of wastes is implemented through *ES&H Manual*, Volume III, “Environmental Hazards and Controls.”

³ LLNL recognizes that there are conditions in which the handling of beryllium items with gloves may present issues with the design of the experiment (e.g., metallurgy samples, cleanliness, etc.). In those situations, the responsible IH will determine through the hazard assessment process the conditions for use and handling.

All beryllium-contaminated waste and equipment disposed of as waste are sealed in containers impermeable to particulate contamination (e.g., plastic bags, wrap, other containers) to prevent the release of beryllium dust during handling and transportation. Containers are clearly labeled per Section Q, “Warning Signs and Labels (10 CFR 850.38).”

L. Emergencies (10 CFR 850.33)

For the purposes of this section, an emergency is an unplanned event (e.g., accidental exposures, spills, loss of containment, and fire) involving beryllium. LLNL has both emergency management and emergency response programs that are enacted to respond to both environmental and medical emergencies. The consequences resulting from the release of airborne beryllium in an unplanned event are part of the Comprehensive Emergency Management System per *ES&H Manual*, Document 22.1, “Emergency Preparedness and Response.” Emergency action levels and response protocols have been incorporated into facility emergency response plans.

If the IH hazard assessments for individual beryllium activities identify situations where there exists a reasonable potential for significant release of beryllium or beryllium exposure to emergency responders, the corresponding IWS or other work control documents must include emergency shutdown procedures.

M. Medical Surveillance (10 CFR 850.34)

Medical services (including medical surveillance, medical approvals for respirator use, emergency medical care and treatment, laboratory tests, and clinical procedures) are provided to LLNL workers through the LLNL Health Services Department (HSD), an organization within the ES&H Directorate. LLNL policy regarding occupational medical services can be found in *ES&H Manual*, Document 10.1, “Occupational Medical Program.”

A Medical Surveillance Program has been established and implemented for beryllium-associated workers. This includes employees who are currently working with beryllium, and those who have had previous exposure to beryllium who may want to participate in medical surveillance. The medical surveillance process is initiated by:

- Identification of medical surveillance requirements through an authorized electronic IWS or other work control document.
- Enrollment of the worker in the program by line management through the responsible IH.
- The worker completing the LLNL Beryllium Employee Occupational History Questionnaire.
- A review of exposure monitoring data and/or job activity descriptions.

Participation in medical surveillance is voluntary. Specific elements of the beryllium surveillance program include the following:

- Medical evaluations at no cost and at a time convenient to employees.
- Medical baseline and periodic evaluations for beryllium workers who have given written consent.

- Pertinent information to beryllium workers, prior to providing any medical test(s)/evaluation.
- Emergency evaluations, as soon as possible, to any worker who may have been exposed to beryllium because of a beryllium emergency.
- An option to obtain a multiple physician review and/or an alternate physician determination with respect to the review of initial medical findings, determinations, or recommendations from any medical evaluation, written medical opinion, and associated information.
- Consultation before temporary or permanent medical restriction.
- A written opinion of medical removal from beryllium work (e.g., temporary, permanent reassignments), if deemed medically appropriate.
- Return-to-work assistance after medical removal.
- Counseling to assist beryllium-affected workers.

HSD maintains medical records in accordance with 10 CFR 850 and 10 CFR 851. HSD provides de-identified information on a semiannual basis to the Beryllium Registry according to DOE Technical Standard 1187-2007, “Beryllium-Associated Worker Registry Data Collection and Management Guidance.” (See Section R, “Recordkeeping (10 CFR 850.39).”)

Beryllium worker exposure and group sensitization data (medical, job, and exposure) are regularly reviewed and analyzed to establish a prevalence rate and thereby identify work groups who are at risk for Chronic Beryllium Disease (CBD) and working conditions that are contributing to that risk. The results of this analysis and trending are incorporated into periodic program reviews as described in Section S, “Performance Feedback (10 CFR 850.40).”

N. Medical Removal (10 CFR 850.35)

LLNL has established Medical Protection Requirements for current and prospective employees. The details are provided in Section M of the LLNL *Personnel Policies and Procedures Manual* and in internal procedures for HSD. These policies are consistent with the intent of the Regulation.

The requirement for LLNL to provide medical removal protection benefits is not intended to expand upon, restrict, or change any rights to a specific job classification or position under the terms of an applicable collective bargaining agreement. LLNL may condition the provision of medical removal protection benefits based upon the beryllium-associated worker’s participation in medical surveillance.

The medical removal process including employee notification and job relocation efforts are coordinated between the payroll organization, HSD, and Strategic Human Resources Management.

O. Medical Consent (10 CFR 850.36)

The following information is available to employees identified as beryllium-associated workers:

- A summary of the Medical Surveillance Program, including:
 - The type of data that will be collected in the Medical Surveillance Program.

- How the data will be collected and maintained.
- The purpose for which the data will be used.
- A description of how confidential data will be protected.
- Information on the benefits and risks of medical tests.
 - The worker is given an opportunity to have any questions answered.

Before performing any medical evaluations or tests, the SOMD obtains the worker's consent on the consent form provided in Appendix A of 10 CFR 850.

P. Training and Counseling (10 CFR 850.37)

Training

Workers at LLNL, including LLNS employees and subcontractors assigned to LLNL, must attend and successfully complete training in the hazards of, and controls for, working with beryllium. The required level of training is dependent on a worker's potential exposure to beryllium.

At a minimum, awareness-level training on beryllium hazards and controls is required for persons working at LLNL. Refresher courses on beryllium safety are required every 2 years thereafter. Retraining or additional training is required when:

- New or significantly changed beryllium operations introduce hazards or required controls on which a worker was not previously trained.
- There have been changes to a facility that could impact beryllium operations.
- There is reason to believe that a beryllium worker lacks the proficiency, knowledge, or understanding needed to work safely with beryllium.

Counseling

HSD administers a beryllium-counseling program in accordance with the Regulation to assist workers who are affected by an occupational exposure to beryllium. This counseling program includes providing beryllium-associated workers with information about:

- Medical Surveillance Program provisions and procedures.
- Medical treatment options and the risk of continued beryllium exposure after sensitization.
- Medical and psychological counseling (i.e., Employee Assistance Program and/or Beryllium Support Group).

HSD also provides referrals to other LLNL units that can counsel workers on medical benefits, administrative procedures and workers' rights under applicable Workers' Compensation laws and regulations, career counseling, and work practice procedures limiting beryllium-associated worker exposure to beryllium.

Q. Warning Signs and Labels (10 CFR 850.38)

For beryllium activities, as defined in Section H, "Beryllium Areas (10 CFR 850.26)," warning signs and labels are used and posted at each access point to a beryllium area or affixed, as

determined by the responsible IH, to containers of beryllium, beryllium compounds, or beryllium-contaminated clothing, equipment, waste, scrap or debris.

Warning signs and labels are specified in *ES&H Manual*, Document 14.4, which meets the provisions specified in 10 CFR 850.38.

R. Recordkeeping (10 CFR 850.39)

Records Retention

The following beryllium records are maintained pursuant to the Regulation:

1. Baseline beryllium inventory.
2. Hazard assessments.
3. Exposure measurements (air sample and surface sample results).
4. Personal exposure reports.
5. Medical surveillance records.

The ES&H Directorate is responsible for maintaining the beryllium-associated records as part of the LLNS WSH Program. These records are maintained in accordance with LLNS procedures to ensure appropriate record access, confidentiality and protection of personal information, and quality requirements. In the event LLNS is no longer involved with the CBDPP, LLNS will convey all records required by the CBDPP to DOE/NNSA or designee.

Use of Information

Records generated by the CBDPP (e.g., exposure measurements, contamination assessments, hazard assessments, workplace conditions, medical surveillance results, and health outcomes) are used as required to aid in understanding the beryllium exposure health risk, and when appropriate, measuring progress toward exposure reduction and minimization goals.

Beryllium Registry

Information is transmitted to DOE's Office of Illness and Injury Prevention Programs. Information submitted includes, but is not limited to, a unique identifier, date of birth, gender, site, job history, medical screening test results, exposure measurements, and results of referrals for specialized medical evaluations in an effort to trend and analyze the prevalence of sensitization and CBD cases throughout the DOE complex.

All work-related records generated under the Regulation are kept confidential as required by ensuring that all records transmitted to other parties do not contain names, social security numbers, or any other variables or combination of variables that could be used to identify particular individuals.

S. Performance Feedback (10 CFR 850.40)

The WSH-FAM, through the Be SME, periodically assesses the implementation and effectiveness of the CBDPP in accordance with LLNL institutional assessment processes and procedures. The assessment objectives are to:

- Identify work groups at risk of exposure and/or working conditions that contribute to that risk.

- Identify work groups that may need to be included in the beryllium program.
- Identify opportunities to reduce exposure below airborne exposure criteria.

The assessment periodicity for the Beryllium Safety Program is outlined in Table 6.

Table 6. Periodicity of Program Assessments

Assessment Type	Periodicity	Topical Areas	Owning Organization
Informal	Annual*	At a minimum, assessments shall include: <ul style="list-style-type: none"> • Workplace monitoring activities and results • Hazard assessment • Medical surveillance trends • Exposure reduction efforts • Occurrence reporting data 	WSH-FA
Formal	Every 3 years	In addition to the topical areas identified for the annual assessment and analysis, the IIA Team Leader shall review 10 CFR 850 regulation and LLNL requirements documents to develop the assessment plan.	Quality Assurance Office (QAO)

***Note:** informal assessments may be combined with formal assessments.

The goal of these assessments is to generate feedback on the performance of the program and to identify program elements that may need modification or additional analysis and are used as a part of the continuing effort to minimize beryllium exposure at LLNL. Recommendations and actions generated may not require modification or update to this document and reflect changes or clarifications to internal implementing documents. Significant changes, additions, or expansion to this document will require NNSA/LSO review and approval.

A formal internal independent assessment of the LLNL CBDPP program is performed on a triennial basis by the Quality Assurance Office (QAO).

Appendix A. Definitions

Term/Acronym	Definition
Action level	The level of airborne concentration of beryllium that is established pursuant to 10 CFR 850.23 and that, if equaled or exceeded, requires the implementation of worker protection provisions specified in that section. The beryllium action level is 0.2 $\mu\text{g}/\text{m}^3$ averaged over 8 hours.
Article	See Commercially available Off-The-Shelf (COTS)
Beryllium (Be)	Elemental beryllium and any insoluble beryllium compound or alloy that contains at least 0.1% beryllium by weight or volume and that may be released as an airborne particulate.
Beryllium-affected worker	A worker affected medically by beryllium exposure (e.g., beryllium sensitization, CBD, or a medical condition otherwise associated with beryllium exposure).
Beryllium Area	A defined area where work is performed with beryllium that has the potential for either beryllium surface contamination above the release criteria, or airborne beryllium. LLNL uses 5 types of beryllium-related work areas: <ul style="list-style-type: none"> • Beryllium Buffer Area • Beryllium Storage Area • Beryllium Contamination Area • Beryllium Work Area • Regulated Beryllium Area
Beryllium-associated worker	A Laboratory worker who was formerly exposed to beryllium or is currently exposed or potentially exposed to beryllium. Exposure may be due to work with or around beryllium or through incidental exposure. The term includes current beryllium workers, past beryllium workers, incidentally exposed workers, workers whose work history shows that they may have been exposed to beryllium, workers who exhibit signs and symptoms of beryllium exposure, and workers who are receiving medical removal protection benefits.
Beryllium Buffer Area	An administratively controlled, posted area that may encompass BWAs and RBWAs, and serves as an intermediate area established to prevent the spread of beryllium contamination and to limit the potential exposure to workers who have not been trained as beryllium workers.
Beryllium Contamination Area	Location in which there is beryllium contamination on accessible or inaccessible surfaces that is greater than the release criteria ($>0.2 \mu\text{g}/100 \text{ cm}^2$) and no ongoing beryllium work activities. Measurable levels of airborne beryllium (i.e., $>0.02 \mu\text{g}/\text{m}^3$) would not be expected under normal conditions.
Beryllium emergency	Any occurrence (including, but not limited to, equipment failure, container rupture, or failure of control equipment or operations) that results in an unexpected and significant release of beryllium at a DOE facility.
Beryllium Storage Area	Location where beryllium material, beryllium-contaminated items, or waste is stored.

Term/Acronym	Definition
Beryllium work	An activity, taken for, or by DOE at a DOE facility, that can expose workers to airborne beryllium, including, but not limited to, design, construction, operation, maintenance, or decommissioning, and that may involve one DOE facility or operation or a combination of facilities and operations. This term is synonymous with “beryllium activity,” used in the Regulation.
Beryllium Work Area (BWA)	An area with current beryllium activities that have actual or potential generation of measurable surface contamination above the LLNL release criteria. Operations may have the potential for generation of airborne beryllium at concentrations less than the action level ($<0.2 \mu\text{g}/\text{m}^3$) during routine work.
Beryllium worker	A worker who currently works with or around beryllium on a routine or occasional basis or who is assigned job duties (e.g., skilled craft, maintenance technician) that are expected to include work with or around beryllium when their services are needed. Beryllium workers must be current in their required training and authorized to perform beryllium operations under an IWS or I-WWP&C Work Permit.
Be SME	Beryllium Subject Matter Expert
CBDPP	Chronic Beryllium Disease Prevention Program
CFR	Code of Federal Regulations
Chronic Beryllium Disease (CBD)	A disease of the lungs caused by the body’s immune system and characterized by progressive scarring of the lungs.
Commercially available Off-The-Shelf (COTS)	<p>Commercially available Off-The-Shelf (COTS) is a Federal Acquisition Regulation (FAR) term defining a non-developmental item of supply that is both commercial and sold in substantial quantities in the commercial marketplace, and that can be procured or utilized under government contract in the same precise form as available to the general public.</p> <p>COTS are typically manufactured to a specific shape or design that have end-use functions that depend in whole or in part on their shape or design during end use and are not expected to result in exposure to airborne concentrations of beryllium under normal conditions of use as intended by the manufacturer.</p> <p>Includes RF Coaxial BNC Plugs with beryllium copper contacts and research equipment with solid beryllium material (e.g., ICP-MS or –OES, radiation detectors, etc.).</p>
Contaminated	Presence of beryllium surface contamination in excess of $0.2 \mu\text{g}/100 \text{ cm}^2$ or when the visible accumulation of dust is present in excess of the concentration (in $\mu\text{g}/\text{g}$ of soil) of beryllium in soil at the point of release.
Contaminated area	Area with existing surface contamination above the LLNL release criteria. Facility or areas may be identified as contaminated based upon knowledge of the operation, historical activities, and/or facility characterization surveys.

Term/Acronym	Definition
Contaminated equipment	<p>Equipment, materials, items, etc. that have beryllium surface contamination levels greater than 0.2 µg/100 cm² or have the potential to have surface contamination levels greater than 0.2 µg/100 cm² based on their use during beryllium work.</p> <p>Note: Definition includes internal contamination. For the purposes of release or transfer, “equipment” is a general term that means equipment, tools, parts, materials, or other objects that are not beryllium or beryllium-containing materials, but have been used for beryllium operations, have been used in beryllium areas, or otherwise have potential for beryllium contamination.</p>
D&D	Decommissioning and Demolition
DOE	Department of Energy
DOE facility	Any facility operated by or for the Department of Energy. Includes LLNL.
ERMP	Exposure Reduction and Minimization Program
ES&H	Environment, Safety, and Health
FAM	Facility Area Manager
HEPA Filter	High-efficiency particulate air filter
HSD	Health Services Department
IH	Industrial Hygienist
ISMS	Integrated Safety Management System
Item	For the purposes of release or transfer, “item” is a general term that means equipment, tools, parts, or materials that is not beryllium or beryllium-containing materials but has been used for beryllium operations, have been in beryllium areas, or otherwise have a potential for beryllium contamination.
IWS	Integration work sheet
I-WWP&C	Institution-Wide Work Planning & Control Process
LLNL	Lawrence Livermore National Laboratory
LLNS, LLC	Lawrence Livermore National Security, Limited Liability Corp.
LSO	Livermore Site Office
µg/m ³	Micrograms per cubic meter
NNSA	National Nuclear Security Administration
Permissible exposure limit (PEL)	The level of air contaminants that represents an acceptable exposure level as specified in standards set by a national government agency; for beryllium the PEL is 2 µg /m ³ expressed as 8-hour time-weighted average concentrations (TWA).
PPE	Personal protective equipment

Term/Acronym	Definition
Regulated Beryllium Work Area (RBWA)	Beryllium work areas where the airborne concentration of beryllium exceeds or can reasonably be expected to exceed the action level ($>0.2 \mu\text{g}/\text{m}^3$).
Release criteria	Removable beryllium surface contamination criteria utilized for release of equipment/property to non-beryllium work areas, DOE sites, non-DOE sites, or the general public. LLNL utilizes these release criteria as a minimum level to institute beryllium controls, decontamination procedures, or facility/area release requirements.
Removable contamination	Beryllium contamination that can be removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or washing.
Responsible employer	<ul style="list-style-type: none"> • For DOE contractor employees, the DOE contractor office that is directly responsible for the safety and health of DOE contractor employees while performing a beryllium activity or other activity at a DOE facility. • For DOE employees, the DOE office that is directly responsible for the safety and health of DOE federal employees while performing a beryllium activity or other activity at a DOE facility. • Any person acting directly or indirectly for either of the above offices with respect to the terms and conditions of employment of beryllium-associated workers.
RI	Responsible Individual
SETS	Safety Education and Training Section
Site Occupational Medical Director (SOMD)	The physician responsible for the overall direction and operation of occupational medicine at LLNL.
SME	Subject Matter Expert
TWA	Time-weighted average
Unique identifier	The part of a paired set of labels used in records that contain confidential information that does not identify individuals except for when labels are matched. The key is held by the SOMD.
Visitor	A person not assigned to a beryllium work area but has an irregular or intermittent need to be in the area.
Worker	A person who performs work for, or on behalf of DOE, including a DOE employee, an independent contractor, a DOE contractor or subcontractor employee, or any other person who performs work at a DOE facility.
Worker exposure	The exposure of a worker to airborne beryllium that would occur if the worker were not using respiratory protective equipment. This is synonymous with “exposure.”
WSH	Worker Safety and Health

Appendix B. Implementation of the LLNL Beryllium Safety Program

Requirements Flowdown		LLNL Confidential										Page 1
RULE		10 CFR 830										
LLNL Beryllium Safety Program Elements	PROGRAM PLAN	LLNL CBDPP										
	IMPLEMENTATION	Work Line		Worker Safety and Health FA - Industrial Hygiene			Occupational Medical Program		Emergencies	Waste Management	Performance Feedback	Training
	Institutional Procedures	General Work Control	Be-Specific Work Control	Industrial Hygiene Practices	Control Specification	Analytical Support to IH	Medical Surveillance Program	Medical Restrictions/Removal	Doc. 22.1: Emergency Preparedness and Response	Doc. 36.1: Hazardous, Radioactive, and Biological Waste Management Requirements	DES 0048: LLNL Assessment Program PBO 0049: Institutional Assessment Plan	Doc. 40.1: LLNL Training Program Manual
		IGMS Program Description [DES-0541] Doc. 2.1: General LLNL Worker ESH/H Responsibilities Doc. 2.2: LLNL Institution-Wide Work Planning and Control Process Doc. 2.5: Managing Subcontracted Work at LLNL Doc. 21.5: Requirements for Transfer of Equipment and Property for Repair, Reuse, Maintenance, Storage, Excess, or Scrap	Doc. 14.A: Working Safely with Beryllium	Worker Safety and Health Program	Specific IH Elements: Doc. 11.1: Personal Protective Equipment Doc. 14.A: Working Safely with Beryllium		Doc. 10.1: Occupational Medical Program Human Resource: Personnel Policies and Procedures Manual Doc. 10.3: Occupational Medical Program					
	Organizational Procedures	F&I Work Control Manual Superblock Work Control Manual NIF&PS Principal Directorate Integrated Safety Management System - NIF&PS Directorate Safety Manual - NIF&PS Directorate Subcontractor Safety Manual	Beryllium Addendum: Subcontractor Language Controlled Items Service Ltd, defines procurement of beryllium related: - Service (i.e., laundry) - Materials (e.g., beryllium alloys or compounds) NIF&PS Radiological and Beryllium Control Manual	LLNL Industrial Hygiene Surveillance Program, UCR-AM-228154-Rev 1 Industrial Hygiene Policies and Information Manuals. Specific documents include: PIM 14: Equipment Transfer and Release PIM 91: Industrial Hygiene Surface Sampling ("Swipe Sampling")	Beryllium Program Elements: Baseline Be Inventory and Facility/Area Characterization Plan Industrial Hygiene documents specific to Beryllium program include: - PIM 85: Beryllium Safety Program Requirements - Discipline Action Plan 22: Beryllium Program Surveillance Requirements	Industrial Hygiene Lab: AHLA Laboratory Accreditation Onsite Laboratory: Hazardous Control Analytical Lab QA/QC Manual Offsite Laboratory: See ALAB procurement specifications.	Health Services Department: - Beryllium Medical Surveillance Program - Beryllium Medical Test/Exam Processing Procedure - Beryllium Clinical Reference Guide					
		RWS and RWS/SP OSP Institution-Wide Work Control Permit - WCI Work Permit - NIF Work Permit	RWS and RWS/SP OSP Release Packages Be Checklist Signage/Labels HACs	Exposure Monitoring Memo General correspondence Analytical results (STAR/Spharoid data)	Beryllium Disease Prevention Program website (LLNL Be Areas/Activities Inventory) Hazard Assessments: Facility or Task-specific (Activity) Individual facility characterization summaries/reports. Includes references to: - OAP Results - Field survey form - STAR/Spharoid data	ALIMS STAR/Spharoid	OMAGS Case File (eCAR) MAQS (Be Medical Surveillance Roster) Be Registry Report Medical outcomes analysis reports	Work Accommodations Memo HSS (Medical Restrictions)				
	Records/Deliverables									WDR (Waste Disposal Req) Container labels Data supporting waste characterization: - ALIMS - STAR/Spharoid	Internal Independent Assessment reports External Program Reviews Information sources for performance feedback: - Lessons Learned - OAPS - Regulatory Alerts - Medical Outcomes/Workplace Monitoring Analysis Employee comments	Regulatory Driven Curriculum: H5425BW and 4W-Be Awareness H5425S and 4W-Be Worker Training Additional courses: H50001: New Staff Safety Orientation H50016-W: Site Access Safety and Security Orientation H50100-W: ESH Annual Briefing H54252: Providing Support and Work Accommodations for Employees with Beryllium Work Restrictions H54956: Industrial Hygiene Surface Swipe Sampling

Appendix C. Summary of CBDPP Revisions

LLNL has had a beryllium safety program since the 1950's. The program was consolidated and enhanced in 1997–1998 in response to guidance communicated in DOE N440.1, “Interim Chronic Beryllium Disease Prevention Program,” issued July 15, 1997. This “Beryllium Control Program” was approved internally and forward to DOE for approval on January 14, 1998.

The initial version of the LLNL CBDPP was developed as required by the Regulation, and approved by the DOE Oakland Operations Office September 6, 2000. Significant revisions are described below:

- **Revision 1:** Perspective changed from action plan to program status, in compliance with the Regulation. In parallel, the ERMP was developed and approved for B-801. (August 15, 2003; approved September 23, 2003)
- **Revision 2:** The expiration date for the DOE/NNSA approval was clearly articulated in the CBDPP. (June 30, 2005; approved July 19, 2005)
- **Revision 3:** Changes in the definitions for beryllium workers, and incorporation of specific requirements of the 10 CFR 851 rulemaking. “Wet” swiping was adopted. The CBDPP was given conditional approval pending revision of the hazard assessments and Appendix C. (July 19, 2006; conditional approval July 19, 2006)
- **Revision 4:** Not issued and superseded by Revision 5.
- **Revision 5:** Minor changes from revision 3/4 (including being more specific in regard to some of the 10 CFR 851 requirements). The definition of a “dormant” activity is introduced, with the splitting of Appendix C into current and dormant activities. (September 5, 2007; approved November 15, 2007)
- **Revision 6:** Major revision including: alignment of definitions in accordance with the Regulation; revision of requirements in baseline inventory and hazard assessment sections; and expansion of area definitions for beryllium operations (e.g., Beryllium Buffer Area, Beryllium Storage Area, BWA, RBWA, and Beryllium Contamination Area). (June 23, 2009; approved June 30, 2009)
- **Revision 7:** Minor revision including: recognition of articles as only items meeting the definition of commercially available-off-the items; revisions to medical surveillance and performance feedback sections to address items identified in the 2011 Effectiveness Review; and, updates to clarify roles and responsibilities associated with the CBDPP.