

PHYSICS DIVISION BERYLLIUM PROTECTION PLAN

Purpose: This Beryllium Protection Plan (BPP) is required by the ORNL Procedure, Working With Beryllium. Physics Division operations utilizing beryllium and beryllium compounds shall be evaluated and controlled to:

- (1) reduce the number of workers potentially exposed to beryllium,
- (2) minimize the levels of beryllium exposure and reduce the potential for exposure to beryllium to levels as low as practical, and
- (3) establish medical surveillance protocols to ensure early detection of beryllium disease.

Scope: This BPP applies to the processing and storage of beryllium and beryllium compounds in all Physics Division facilities. This BPP applies to all activities conducted in Physics Division facilities where there is exposure or potential for exposure to beryllium. Beryllium articles are excluded from this plan.

Regulatory Drivers: This plan is based on the requirements of the DOE Chronic Beryllium Disease Prevention Program, Final Rule, 10 CFR 850, published in the December 8, 1999, Federal Register (FR 68854, Vol. 64, No. 235).

Definitions:

Administrative Action Level: Levels established at which controls are implemented or actions taken to reduce or minimize exposure. Administrative action levels have been established for both airborne concentrations and surface contamination levels.

- The administrative action level for airborne beryllium is $0.2 \mu\text{g}/\text{m}^3$ calculated as an 8-hour time weighted average (TWA) as measured in the worker's breathing zone.
- The administrative action level for surface contamination is $3 \mu\text{g}/100 \text{ cm}^2$ for operational areas during non-operational periods.

Beryllium: Elemental beryllium and any insoluble beryllium compound, alloy, solution, or waste containing 0.1% beryllium or greater by weight or volume that may be released as an airborne particulate.

Beryllium Activity: 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 which may involve one DOE facility or operation or a combination of facilities and operations.

NOTE

A beryllium activity is an activity that can expose workers at DOE facilities to airborne beryllium *at any concentration*. The exposure does not have to meet or exceed the action limit to qualify as a beryllium activity.

Beryllium Article: A manufactured item formed to a specific shape or design during manufacture that has end-use functions dependent in whole or in part on its shape or design during end-use, and that does not release or otherwise result in exposure to airborne concentrations of beryllium under normal conditions of use.

Beryllium-Associated Worker: A current worker who is or was exposed or potentially exposed to airborne concentrations of beryllium at a DOE facility, including:

- A beryllium worker;
- A current worker whose work history shows that the worker may have been exposed to airborne concentrations of beryllium at a DOE facility;
- A current worker who exhibits signs or symptoms of beryllium exposure; and
- A current worker who is receiving medical removal protection benefits.

NOTE

A beryllium-associated worker can be a DOE Federal or contractor worker, an employee of a subcontractor to a DOE contractor, or a visitor who performs work at a DOE facility. This definition clarifies DOE intent that the rule only applies to current workers. It also clarifies that current workers who have been removed from beryllium activities as part of the medical removal plan are beryllium-associated workers and not beryllium workers. (FR 68865)

Beryllium Worker: A current worker who is regularly employed in a DOE beryllium activity. Only authorized Beryllium Workers can access Beryllium Areas and Regulated Beryllium Areas. DOE does not specify “exposures at or above the action level” in this definition.

NOTE

Since a beryllium activity is defined as an activity with any potential for beryllium exposure, even below the action limit, it follows that one must be a Beryllium Worker to do any work with a potential for beryllium exposure. (FR 68865)

Beryllium Area: An area where beryllium or beryllium compounds are processed or handled (exposure is possible) but removable surface contamination levels are maintained below $3.0 \mu\text{g}/100 \text{ cm}^2$ and personal air sample results are less than $0.2 \mu\text{g}/\text{m}^3$. Only authorized Beryllium Workers can access Beryllium Areas.

NOTE

The Physics Division has implemented use of “Beryllium Areas” (not defined in 10 CFR 850) to establish controls for beryllium activities that do not result in airborne exposures or surface contamination levels above the administrative action limits. Since a Beryllium Worker is a worker who is regularly employed in a DOE beryllium activity, and since a beryllium activity is defined as any activity with potential for beryllium exposure, it follows that one must be a Beryllium Worker to conduct a beryllium activity with any potential for exposure, even below the action level.

Beryllium-Regulated Area: An area where beryllium or beryllium compounds are processed or handled and airborne beryllium concentrations exceed, or can reasonably be expected to exceed, the action level of $0.2 \mu\text{g}/\text{m}^3$ calculated as an 8-hour time weighted average (TWA). The area must be posted with appropriate warning signs. Access must be restricted to authorized Beryllium Workers who have been trained to the hazards of beryllium and the controls required for the specific area. Records must be maintained of every Beryllium Worker who enters a Beryllium-Regulated Area. Records shall include name, date, time in, time out, and the type of work performed.

Operational Area: An area where workers are routinely in the presence of beryllium as part of their work activity.

Permissible Exposure Limit (PEL): The limit established at 29 CFR 1910.1000 ($2.0 \mu\text{g}/\text{m}^3$ over 8 hours) or a more stringent limit that may be promulgated by OSHA. No worker shall be exposed to an airborne concentration of beryllium greater than the PEL.

Release/Acceptance Criteria: ORNL administrative release/acceptance criteria for ORNL beryllium-contaminated equipment and other items, as follows:

- Removable contamination on equipment or item surfaces for release to the general public or to a DOE facility for non-beryllium use shall not exceed $0.2 \mu\text{g}/100 \text{ cm}^2$ or the concentration level of beryllium in soil at the point of release, whichever is greater.
- Removable contamination on equipment or item surfaces for release to another facility performing beryllium work shall not exceed $3.0 \mu\text{g}/100 \text{ cm}^2$.
- Waste acceptance criteria – greater than or equal to 1000 ppm must be labeled as beryllium. For acceptance at the TSCA incinerator, must be less than 20 ppm.

Removable Contamination: Beryllium contamination that can be removed from surfaces by nondestructive means, such as casual contact, wiping, brushing or washing.

Requirements:

- 1.) No worker shall be exposed to airborne beryllium at levels greater than the OSHA PEL, which is currently $2.0 \mu\text{g}/\text{m}^3$ time-weighted over 8 hours.
- 2.) The administrative action level for personal air sampling results is $0.2 \mu\text{g}/\text{m}^3$. When airborne concentration levels are found at or above this level, the following preventative measures shall be required:
 - periodic exposure monitoring (at least quarterly),
 - formal exposure reduction and minimization activities,
 - establishment of Beryllium Regulated Areas,
 - establishment of hygiene facilities and practices,
 - use of respiratory protection,
 - use of protective clothing and equipment, and
 - use of warning signs.
- 3.) A baseline inventory must be conducted to (1) identify the locations of beryllium operations and other locations of potential beryllium contamination (including storage areas), and (2) identify workers exposed or potentially exposed at these locations.
- 4.) If the baseline inventory establishes the presence of beryllium, then a hazard assessment must be conducted to determine exposure potential. Job Hazard Evaluation shall be conducted for any use of beryllium that has the potential to generate airborne concentrations of beryllium. The Job Hazard Evaluation forms the basis for subsequent exposure monitoring and industrial hygiene controls (engineering, administrative, and PPE).
- 5.) All work that has the potential to generate airborne concentrations of beryllium shall be conducted in either a Beryllium Area or a Beryllium Regulated Area.
- 6.) A Safety Work Permit shall be used to control beryllium work that has the potential to generate airborne concentrations of beryllium. The Safety Work Permit shall specify requirements for PPE, as determined by a Certified Industrial Hygienist.
- 7.) An exposure monitoring strategy shall be developed for all beryllium activities with the potential for airborne exposure. The frequency and number of samples for each type of monitoring will be determined with assistance from a Certified Industrial Hygienist. Whenever there is a change in the beryllium activity, additional monitoring shall be conducted to ensure appropriate controls.

- Breathing zone sampling shall be provided for workers exposed or potentially exposed to beryllium, or a documented rationale for monitoring a limited subset of workers shall be provided.
 - Area sampling shall be conducted, where appropriate, to determine the effectiveness of operational controls. Where beryllium is present in operational areas, removable surface contamination levels must not exceed $3.0 \mu\text{g}/100 \text{ cm}^2$ during non-operational periods.
- 8.) Initial exposure monitoring shall be conducted in any area that has the potential for airborne concentrations of beryllium, as shown by the baseline inventory and hazard assessment. Statistically based monitoring strategies shall be employed to obtain a sufficient number of sample results to adequately characterize exposure potential. When sufficient data has been collected to characterize the exposure potential, the sampling frequency may be reduced or terminated. Additional exposure monitoring is required whenever beryllium operations, maintenance, or procedures change.
- 9.) Periodic exposure monitoring is required at least every three months (quarterly) for workers exposed to airborne concentrations of beryllium greater than or equal to $0.2 \mu\text{g}/\text{m}^3$.

NOTE

- Monitoring and analytical methods must have accuracy, at a confidence level of 95 percent, of not less than plus or minus 25 percent for airborne concentrations of beryllium at the action level ($0.2 \mu\text{g}/\text{m}^3$). All laboratory analyses of air sampling data must be performed in a laboratory accredited for metals by the American Industrial Hygiene Association (AIHA), or a laboratory that demonstrates quality assurance for metals that is equivalent to AIHA accreditation.
- 10.) Workers must be notified of their monitoring results in writing within 10 days after receipt of results. If monitoring results indicate that a worker's exposure is at or above the action level, this must be included in the notice, as well as a description of any corrective actions that will be taken to reduce the exposure below the action level, if practicable.
- 11.) Where exposure levels are at or above the action level, a formal exposure reduction and minimization program must be established which addresses: (1) exposure reduction and minimization goals, (2) rationale to support and strategy for achieving goals, (3) specific actions required to achieve goals, and (4) tracking progress towards goals.
- 12.) Where exposure levels are below the action level, actions for reducing and minimizing exposures should be implemented, if practical. The conventional hierarchy of industrial hygiene controls should be used (*i.e.*, engineering controls, administrative controls, and PPE in that order).

- 13.) Any area where airborne concentrations of beryllium are measured at or above the action level of $0.2 \mu\text{g}/\text{m}^3$ shall be posted as a Beryllium Regulated Area.
- 14.) Beryllium Areas and Beryllium Regulated Areas shall be conspicuously posted with signs, including entrance requirements. Boundaries of Beryllium Areas and Beryllium Regulated Areas must be clearly delineated with flags, rope, chains, or by structural barriers such as walls or fences.
- 15.) Only authorized Beryllium Workers shall enter Beryllium Areas and Beryllium Regulated Areas. Records shall be kept of all personnel who enter Beryllium Regulated Areas. Records shall include name, date, time in, time out, and the type of work performed.

NOTE

Sign-in sheets attached to Safety Work Permits may be used to meet this requirement. The Safety Work Permit alone does not satisfy the requirement to document the type of work performed. The type of work performed shall be documented on the sign-in sheet.

- 16.) Beryllium Workers shall be identified to the ORNL Occupational Safety Services Division (OSSD) and to the Medical Department. Beryllium Workers shall be offered a baseline medical examination prior to initiating beryllium work.
- 17.) Beryllium Workers shall receive beryllium training prior to initiating beryllium work and every two years thereafter. Additional training is required whenever new beryllium-related hazards result from changes to operations, procedures, or controls or whenever a worker's performance indicates that the worker has not retained the requisite proficiency. Training shall be in accordance with the ORNL Hazard Communication Program.
- 18.) There shall be no eating, drinking, smoking, or chewing of gum or tobacco, application of cosmetics, taking of medicine, or storage of food in Beryllium Areas or Beryllium Regulated Areas.
- 19.) Beryllium Workers shall not exit Beryllium Areas or Beryllium Regulated Areas with contamination on their bodies or clothing. Approved receptacles for disposal of used PPE and clothing shall be provided at the exit of the Beryllium Area or Beryllium Regulated Area. Beryllium protective clothing and equipment must be placed in appropriately labeled containers when removed for laundering, maintenance, or disposal.
- 20.) Change areas (as opposed to a change room) shall be provided to don and doff protective clothing and equipment that is required for access to Beryllium Regulated Areas. Change areas required for Beryllium Regulated Areas should have a decontamination area for removing contaminated clothing and equipment and a

separate clean area, which is free from beryllium contamination, where workers can change into and store street clothes and clean PPE. Change areas for removing beryllium contaminated clothing and equipment must be maintained under negative pressure or located so as to minimize dispersion of beryllium into clean areas. Use of a HEPA filtered vacuum for vacuuming contaminated clothing and equipment prior to doffing is recommended.

NOTE

A portion of the Beryllium Regulated Area may be used for the change area provided that cross-contamination is not a concern.

- 21.) Handwashing and shower facilities must be provided for Beryllium Workers who work in Beryllium Regulated Areas. Either a hand-washing facility or wet cleaning wipes shall be available in Beryllium Areas. When gloves are not worn, hands must be washed before exiting Beryllium Areas or Beryllium Regulated Areas. Sinks in Beryllium Areas and Beryllium Regulated Areas must discharge to the sanitary sewer system and must be posted "this sink is designated for hand washing only."
- 22.) Beryllium Workers who work in Beryllium Regulated Areas must shower at the end of their work shift.
- 23.) Respirators shall be worn when measured or expected airborne concentrations of beryllium are at or above the action level of $0.2 \mu\text{g}/\text{m}^3$ TWA.
- 24.) Protective clothing and equipment (for skin and eyes) shall be required whenever (1) airborne concentrations of beryllium are at or above $0.2 \mu\text{g}/\text{m}^3$, (2) removable surface contamination levels are at or above $3.0 \mu\text{g}/100\text{cm}^2$, or (3) a worker requests protective clothing and equipment, regardless of the exposure level. Company provided full-body protective clothing (disposable tyvek or paper suits) shall be worn over company provided work clothes (khakis or scrubs) in Beryllium Regulated Areas. Shoe covers are also required in Beryllium Regulated Areas.
- 25.) The administrative action level for removable surface contamination in an operational area is $3.0 \mu\text{g}/100\text{cm}^2$ during non-operational periods. Surfaces contaminated with beryllium dusts and waste must not exceed a removable contamination level of $3.0 \mu\text{g}/100\text{cm}^2$. Any area where removable surface contamination is found at or above this level shall be posted as a Beryllium Regulated Area and cleaned until below $3.0 \mu\text{g}/100\text{cm}^2$.

NOTE

Surface monitoring is used to monitor the effectiveness of housekeeping efforts and is not a measure of personal exposure.

NOTE

Surface sampling is not required for the interior of installed closed systems such as enclosures, glove boxes, chambers, or ventilation systems where workers will not be exposed to beryllium.

26.) General housekeeping methods that suppress the formation of airborne dust, such as the use of a wet mop or a vacuum cleaner equipped with a HEPA filter, shall be used in areas where beryllium is present. Use of compressed air or dry sweeping /mopping is prohibited. Cleaning equipment used to clean beryllium contaminated surfaces must be properly labeled, controlled, and not used for non-hazardous materials.

27.) The free release limit for the public or non-beryllium areas is $0.2 \mu\text{g}/100 \text{ cm}^2$ or the concentration of beryllium in soil at the point of release, whichever is greater. All beryllium contaminated materials and equipment to be free released must meet the following requirements:

- the material must not exceed the free release limit,
- the material must be labeled with the beryllium label specified in the ORNL Procedure, Working With Beryllium, and
- a commitment must be obtained from the recipient of the material to implement controls to prevent foreseeable beryllium exposures, considering the nature of the equipment or item and its future use.

28.) The release limit for other beryllium facilities is $3 \mu\text{g}/100 \text{ cm}^2$. All beryllium contaminated materials and equipment to be released to other beryllium facilities must meet the following requirements:

- the material must not exceed the release limit,
- the material must be labeled with the beryllium label specified in the ORNL Procedure, Working With Beryllium, and
- the material or equipment to be released must be enclosed or placed in impermeable bags or containers to prevent release of beryllium dust during handling and transportation.

29.) Warning signs must be posted at each access point to Beryllium Regulated Areas. Warning signs must contain the following information:

DANGER
BERYLLIUM CAN CAUSE LUNG DAMAGE
CANCER HAZARD
AUTHORIZED PERSONNEL ONLY

30.) Beryllium and beryllium containing materials (including wastes) shall be clearly labeled and properly contained to prevent inadvertent exposures. Labels shall be in accordance with the ORNL Procedure, Working With Beryllium. Labels shall contain the following information:

DANGER
CONTAMINATED WITH BERYLLIUM
DO NOT REMOVE DUST BY BLOWING OR SHAKING
CANCER AND LUNG DISEASE HAZARD

31.) Beryllium records (inventories, hazard assessments, exposure measurements, exposure controls, and medical surveillance) are designated as agency records and must be retained for a minimum of 75 years.