Updates to:
The Beryllium-Associated Worker Registry Technical Standard and
The Beryllium Lymphocyte Proliferation Test Specification

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U.S. Department of Energy
Objectives

• To review the requirements related to monitoring and testing of beryllium exposure and sensitization among Department of Energy workers

• To review the Beryllium Registry Standard and its updates

• To review the Beryllium Lymphocyte Proliferation Test Specification and its updates
Background: Beryllium (Be)

- Beryllium is a strong, low-density metal used in alloys for a number of industrial applications.
  - Great strength-to-weight ratio, high melting point, thermal stability and conductivity, reflectivity
- Health effects of beryllium exposure include:
  - Sensitization and hypersensitivity
  - Pulmonary dysfunction, berylliosis or chronic beryllium disease (CBD)
  - Lung cancer
- **Be sensitization** occurs after Be exposure and activation of immune cells.
- **CBD** is a granulomatous lung disease that manifests as a result of Be sensitization.

https://enacademic.com/
Chronic Beryllium Disease Prevention Program (CBDPP)

• 10 CFR 850 establishes a CBDPP to:
  • Reduce the number of workers currently exposed to beryllium in the course of their work at DOE facilities managed by DOE or its contractors,
  • Minimize the levels of, and potential for, exposure to beryllium, and
  • Establish medical surveillance requirements to ensure early detection of the disease.
• Beryllium (Be)
  • Be, insoluble Be compound, or alloy containing ≥0.1% Be that may be released as an airborne particulate

• Beryllium-associated worker
  • Current worker who is or was exposed or potentially exposed to airborne concentrations of beryllium at a DOE facility. Includes:
    • Beryllium worker;
    • Current worker whose work history shows that the worker may have been exposed to airborne concentrations of Be at a DOE facility;
    • Current worker who exhibits signs or symptoms of beryllium exposure;
    • Current worker who is receiving medical removal protection benefits
Definitions from 10 CFR 850

- **Beryllium worker**
  - Current worker who is regularly employed in a DOE beryllium activity

- **Beryllium-induced lymphocyte proliferation test (BeLPT)**
  - An *in vitro* measure of the Be antigen-specific, cell-mediated immune response
Status of 10 CFR 850 Amendment

• Notice of Proposed Rulemaking
  • Federal Register - June 7, 2016

• Develop draft Final Rule - Completed
  • Based on comments from the public comment period

• Review and Concurrence Process
  • Beryllium-affected Program Offices: EM, NA, NE, and SC
    • Completed: August 2019

• Office of the General Counsel - September 2019
  • Comments received – January 15, 2020
  • Adjudication process is ongoing

• After adjudication, amendment will go to Secretary of Energy to review and concur
Status of 10 CFR 850 Amendment Continued

- Office of Management and Budget Review
  - Draft final rule and final economic assessment
  - Approves draft final rule and economic assessment
    - Publication in the Federal Register
- Secretary of Energy - Approves and signs the final rule
- Congressional Notification - 5 days
- Federal Register - Published in the Federal Register
- Final Rule
  - Effective Date: 30 days after publication date
  - Compliance Date: One year after the effective date
    - Engineering controls – Two years after the effective date
Status of 10 CFR 850 Amendment

Contacts

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Beryllium-Associated Worker Registry (BAWR)

• The DOE Beryllium Registry was established to collect and maintain information on workers who are exposed to beryllium. It is used to:
  • Conduct health studies to better understand the nature of the disease,
  • Measure the burden of health effects related to beryllium exposure, and
  • Evaluate the effectiveness of exposure control programs.

• Data submitted to the registry include:
  • Be-related exposures,
  • Results of Be sensitization testing, and
  • CBD status.

• To maintain confidentiality of worker data, a unique identifier is used to relay employee information to the registry.

https://oriseapps.orau.gov/BAWR/
# Sites and Organizations Currently Submitting to the BAWR

<table>
<thead>
<tr>
<th>Organization Name</th>
<th>Submitting Organization Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ames Laboratory (AMES)</td>
<td>LLNL Clean Harbors Environmental Services (LLNL CHES)</td>
</tr>
<tr>
<td>Argonne National Laboratory (ANL)</td>
<td>Los Alamos National Laboratory (LANL)</td>
</tr>
<tr>
<td>Brookhaven National Laboratory (BNL)</td>
<td>National Security Campus (NSC)</td>
</tr>
<tr>
<td>DOE Oak Ridge Office (DOE-ORO)</td>
<td>Nevada National Security Site (NNSS)</td>
</tr>
<tr>
<td>East Tennessee Technology Park (ETTP)</td>
<td>Oak Ridge National Laboratory (ORNL)</td>
</tr>
<tr>
<td>Fermi National Accelerator Laboratory (Fermi)</td>
<td>Pacific Northwest National Laboratory (PNNL)</td>
</tr>
<tr>
<td>Golden SVCS, LLC (GSVCS)</td>
<td>Paducah Site (PADUCAH)</td>
</tr>
<tr>
<td>Hanford Site (HAN)</td>
<td>Pantex Plant (PTX)</td>
</tr>
<tr>
<td>Idaho National Laboratory (INL)</td>
<td>Sandia National Laboratories (SNL)</td>
</tr>
<tr>
<td>Knolls Atomic Power Laboratory (KAPL)</td>
<td>Savannah River Site (SRS)</td>
</tr>
<tr>
<td>LANL N3B Project (LANL N3B)</td>
<td>SLAC National Accelerator Laboratory (SLAC)</td>
</tr>
<tr>
<td>Lawrence Berkeley National Laboratory (LBNL)</td>
<td>Y-12 Atkins Nuclear Secured (Y-12 ANS)</td>
</tr>
<tr>
<td>Lawrence Livermore National Laboratory (LLNL)</td>
<td>Y-12 National Security Complex (Y-12)</td>
</tr>
</tbody>
</table>

Office of Environment, Health, Safety and Security
Sites and Organizations Currently Submitting to the BAWR
DOE-STD-1187: Beryllium-Associated Worker Registry Data Collection and Management Guidance

• Provides acceptable methods for compliance with the requirements of 10 CFR 850.39
  • Recordkeeping and Use of Information

• Developed for employers subject to 10 CFR 850
  • To guide their submissions to the BAWR
  • To promote consistent reporting and efficient analysis and dissemination of information
Site Occupational Medical Directors should identify a Data Coordinator.

The roster should include:

- Current workers exposed or potentially exposed to Be at a DOE facility,
- Workers who self-identify and indicate a past history of possible exposure, and
- Workers who exhibit signs or symptoms of Be exposure or are receiving medical removal protection benefits.

Roster should include:

<table>
<thead>
<tr>
<th>*Site Code</th>
<th>*First Hire on Site Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Unique ID</td>
<td>Year Employment Ended</td>
</tr>
<tr>
<td>*Status Code</td>
<td>Death Date</td>
</tr>
<tr>
<td>*Year Born</td>
<td>Immediate Cause</td>
</tr>
<tr>
<td>*Gender</td>
<td>Previous Employer Unique ID</td>
</tr>
<tr>
<td>*Employer Type</td>
<td>Previous Site</td>
</tr>
</tbody>
</table>

*Asterisks denote required data fields.
DOE-STD-1187: Be-Related Medical Surveillance

- Data will contain the Be-related medical information obtained by SOMD.
- Medical information includes:
  - BeLPT, Bronchoalveolar lavage, Chest x-rays, Biopsies,
  - Medical referral/follow-up,
  - CT, Cardiopulmonary exercise testing, CBD evaluation, and
  - Be-induced dermatitis.
- Example data tables:

<table>
<thead>
<tr>
<th>*Site Code</th>
<th>*Site Code</th>
<th>*Site Code</th>
<th>*Site Code</th>
<th>*Site Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Unique ID</td>
<td>*Unique ID</td>
<td>*Unique ID</td>
<td>*Unique ID</td>
<td>*Unique ID</td>
</tr>
<tr>
<td>*Status Code</td>
<td>*Status Code</td>
<td>*Status Code</td>
<td>*Status Code</td>
<td>*Status Code</td>
</tr>
<tr>
<td>*LPT date</td>
<td>*Date CXR</td>
<td>*Referral Offered Date</td>
<td>*Date Lavage</td>
<td>*Date BX</td>
</tr>
<tr>
<td>*LPT result</td>
<td>*CXR Result</td>
<td>*Follow-Up Referral</td>
<td>*Lavage Result</td>
<td>*BX Result</td>
</tr>
</tbody>
</table>

- Note: All BeLPT results should be included, even if results are normal.
**DOE-STD-1187: Work History and Exposure Data**

- Data will contain information on all Be activities and exposures.

- Note: All employees who have been monitored for Be exposure should be included, even if results are non-detectable.

<table>
<thead>
<tr>
<th>Work History</th>
<th>Activity and Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Site Code</em></td>
<td><em>Site Code</em></td>
</tr>
<tr>
<td><em>Unique ID</em></td>
<td><em>Unique ID</em></td>
</tr>
<tr>
<td><em>Status Code</em></td>
<td><em>Status Code</em></td>
</tr>
<tr>
<td><em>Organization Code</em></td>
<td><em>Location Identification</em></td>
</tr>
<tr>
<td>*1st Be Job Start Date</td>
<td><em>Room/Area</em></td>
</tr>
<tr>
<td><em>Activity</em></td>
<td><em>Process</em></td>
</tr>
<tr>
<td><em>Job Title</em></td>
<td>Operation</td>
</tr>
<tr>
<td><em>Job Start Date</em></td>
<td>Task</td>
</tr>
<tr>
<td>Job Stop Date</td>
<td><em>Actual Exposure</em></td>
</tr>
<tr>
<td></td>
<td><em>Actual Exposure &lt; Reporting Limit</em></td>
</tr>
<tr>
<td></td>
<td><em>Exposure Sample Volume</em></td>
</tr>
<tr>
<td></td>
<td><em>8-hour TWA</em></td>
</tr>
<tr>
<td></td>
<td><em>Exposure Method</em></td>
</tr>
<tr>
<td></td>
<td><em>Sampling Method</em></td>
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<tr>
<td></td>
<td><em>Analytic Method</em></td>
</tr>
<tr>
<td></td>
<td><em>Exposure Sampling Time</em></td>
</tr>
<tr>
<td></td>
<td>Sample Number</td>
</tr>
<tr>
<td></td>
<td><em>Monitoring Date</em></td>
</tr>
<tr>
<td></td>
<td>Chemical</td>
</tr>
<tr>
<td></td>
<td>Engineering Controls</td>
</tr>
<tr>
<td></td>
<td>PPC&amp;E</td>
</tr>
<tr>
<td></td>
<td><em>Respirator Protection</em></td>
</tr>
<tr>
<td></td>
<td><em>Respirator APF</em></td>
</tr>
</tbody>
</table>
Changes to DOE-STD-1187

- Data fields removed:
  - Roster (table 3)
    - Race
    - Death date (not removed but not mandatory)
    - Immediate cause (not removed but not mandatory)
    - First cause
    - Second cause
    - Other cause
  - Smoking (table 4) – entire table removed
- More data fields are required (not retroactive).
  - Work History (table 5)
    - Organization code
    - Beryllium job start date

- Background appendix added
- Status:
  - RevCom review was completed, responses submitted, and sign-off obtained.
  - Finalized version should be posted on DOE Technical Standards website October 2019.

BAWR Annual Reports

• Annual Summary reports are based on the yearly submissions.

• Yearly and cumulative data analyses are performed.
• The report includes the evaluation of the number of workers, exposure and screening metrics, and disease incidence.

From 2016 to 2017, 34 additional Be-sensitized employees and no additional CBD cases were reported.
Challenges Encountered with the BAWR

- Frequent turnover of Data Coordinators
- Errors encountered with data submissions
- Limitations in data constrain the interpretability of results in the registry

A decline in exposure sampling has been observed in recent years.
Beryllium Lymphocyte Proliferation Test (BeLPT)

• The BeLPT is an assay used to screen for Be sensitization.
  • It examines the body’s immune response to beryllium.
  • Sensitization is characterized by abnormal proliferation of lymphocytes exposed to Be as compared to control.

• The BeLPT is used as a surveillance tool for working conditions and as part of the diagnostic criteria for CBD.
DOE-SPEC-1142: Specification for Beryllium Lymphocyte Proliferation Testing (BeLPT)

• Informal voluntary consensus standard which details criteria for:
  • BeLPT assay
    • Includes details for sample collection through processing
    • Analysis and reporting of assay results

• The specification is needed to establish acceptable criteria in the performance of the BeLPT.
  • It should be used in all contracts with DOE labs for BeLPT services.
  • Performing labs include:
    • Oak Ridge Associated Universities,
    • National Jewish Health, and
    • Cleveland Clinic.
Outline of BeLPT Specification

• Principle and Application
  • *In vitro* measurement of T cell response to a specific antigen, Be
  • A measurable response of T cell proliferation indicates sensitivity
Outline of BeLPT Specification

- Tritiated Thymidine Uptake Procedure
- Blood Specimens
- Bronchoalveolar Lavage Specimens
- Calculations
- Results

- Outlines acceptable reagents, procedures, equipment

Actor JK, Immunoassays. *in Integrated Review Immunology and Microbiology* (2nd Ed.), 2012
Updates to DOE-SPEC-1142

• Statistical analysis methods
  • Least squares method vs. least absolute values methods
  • Recognizes other outlier resistant methods

• Results: characterization of sensitization
  • If at least two of the three BeLPT tests are abnormal, the patient is deemed beryllium sensitized.

  • References American Thoracic Society recommendations which may be adopted in 10 CFR 850 in the future:
    • Two abnormal blood BeLPT results; or
    • One abnormal and one borderline blood BeLPT; or
    • One abnormal BeLPT test of alveolar lung lavage cells; or
    • Three borderline abnormal blood BeLPTs.
Status of DOE-SPEC-1142 Updates

- 8/13/19 Draft submitted to RevCom
- 10/16/19 Comments Due
- 11/16/19 Response to Review Due
- 11/20/19 Submit to AU-1 for final review
- 11/30/19 Additional comments
- 12/10/19 Comments addressed
- 12/16/19 Finalized document approved and posted:

Summary

• Beryllium is a carcinogen that may also cause sensitization leading to pulmonary dysfunction in some portion of the population.

• The Chronic Beryllium Disease Prevention Program (CBDPP) was established in 10 CFR 850 to minimize the risks to workers exposed to beryllium.

• The Beryllium Registry collects data from DOE sites to monitor worker exposures and the effectiveness of the CBDPP.

• The BeLPT is an important screening tool for protecting workers from chronic beryllium disease.
Discussion?

• Questions or Comments

• My contact information:
  Daniela Stricklin
  daniela.stricklin@hq.doe.gov
  301-903-0947
Question 1

• What workers should be monitored for beryllium exposure?
Answer

• Beryllium and beryllium-associated workers as defined in 10 CFR 850:
  • Current worker who is or was exposed or *potentially exposed* to airborne concentrations of beryllium at a DOE facility. Includes:
    • Beryllium worker;
    • Current worker whose work history shows that the worker may have been exposed to airborne concentrations of Be at a DOE facility;
    • Current worker who exhibits signs or symptoms of beryllium exposure;
    • Current worker who is receiving medical removal protection benefits.
Question 2

• What information should be submitted to the Beryllium-Associated Worker Registry for DOE workers?
Answer

• Roster of beryllium-associated workers

• Beryllium task, exposure, and health data on employees on the roster
  • Health data includes BeLPT results, referrals, chest x-rays, etc.
  • Work history
  • Exposure monitoring results
Question 3

• What results from the BeLPT constitute a sensitized worker?
Answer

• Today:
  • If at least two of three BeLPT results are abnormal, a worker is deemed sensitized.

• ATS recommends:
  • Two abnormal blood BeLPT, or
  • One abnormal and one borderline blood BeLPT, or
  • One abnormal lavage BeLPT, or
  • Three borderline abnormal blood BeLPT.
Thank you!
Beryllium-Associated Worker Registry

State of Exposure Monitoring Data

Eric Adams
Eric.Adams@orau.org
Background

• Exposure Monitoring Data
  • IH sampling for exposed/potentially exposed workers
  • TWA normalized
  • Core data for analysis

• STAND Package
  • Built in R
  • Addresses non-detectable, left censored data
Monitoring Exposure Baseline

Exposure Monitoring Records by Year

- 107,854 total records
- 106,356 span 1995-2018
Monitoring Exposure Data Integrity

- 14,379 > 25% Variance
- 13,335 > 50% Variance
Monitoring Exposure Data Integrity

• 318 missing TWA
• 493 “failed” samples
• 3,043 “soft” duplicates
• Total drop rate: 3.91%
Monitoring Exposure Censoring

- 11,683 censored records
- Represents 10.98%
Data Trending to “Small n”
Conclusion

• Quality continues to improve
• Monitoring exposure data is in good shape
• Velocity trending downward
  • Analytic impact of small “n”s
  • Reduced statistical confidence
Thank You

Questions/Open Discussion