U.S. Department of ENERGY | **Office of Environment, Health, Safety & Security**

Beryllium-Associated Worker Registry Dashboard, (2023)

Welcome to the Beryllium-Associated Worker Registry (BAWR) Dashboard, developed by the *Oak Ridge Institute for Science and Education (ORISE)* BAWR project team, under a contract with the U.S. Department of Energy (DOE). The BAWR program began in Calendar Year 2002 (CY2002), and since its inception has tracked, monitored, and analyzed data on workers exposed to beryllium and produced annual reports and summary data tables for more than 30 active and inactive DOE sites throughout the United States. The first Registry publication reported data for 12,267 workers through CY2005. In CY2023, the Registry has grown to more than 50,000 workers (including those at inactive reporting organizations such as Rocky Flats and some retrospective data provided prior to the CY2002 start date of the Registry).

This BAWR Dashboard for CY2023 is the continued presentation of the BAWR data on an annual basis. As a means of providing a better user experience with this tool, in 2018 the BAWR program has transitioned from presenting data in a paper-based annual report to an interactive digital format, or a Dashboard. This transition from paper to digital format is intended to allow for interaction with and visualization of data contained in the Registry.

Enhancements to facilitate the user experience include topical sections and tabs, navigation features such as mouse-overs with data details, and other helpful functions that allow users to quickly examine information. Users are able to explore the *standard metrics and results of data analyses* for the BAWR through an interrelated series of graphics and tables to provide a comprehensive overview of Registry demographics, health monitoring, and exposure activities.

Some helpful hints for the best experience as you explore the Dashboard:

- To interact with the data explorer, hover over any of the graphics on the screen and click on your selection for more information.
- Once the selected graphic is open, roll the cursor over data to enable a pop-up screen with more detailed information.
- When you have completed your review of the graphic, please click on the 'x' button located in the upper right-hand corner of the graphic.
- More information is provided in the *Help* section of the Dashboard.
- A PDF of the Dashboard is available for download, located at the bottom of the navigation bar on the left.

If you have any comments, questions, or suggestions concerning this tool, please contact Kali Crosby, DOE EHSS-13 Office of Domestic and International Health Studies, at *Kali.Crosby@hq.doe.gov* or ORISE Health Studies at *BAWR@orau.org*.

DOE Mission & BAWR Initiative

DOE Mission

Introduction

The *U.S. Department of Energy (DOE)* is responsible for protecting the health and safety of DOE workers, contractors, and subcontractors. The Office of Environment, Health, Safety and Security (EHSS) provides the federal-level leadership and strategic vision necessary to establish clear expectations for health, safety, environment, and security programs. In support of this mission, the *Office of Health and Safety (EHSS-10)* collects, analyzes, and disseminates data and performance indicators, such as beryllium health and exposure information for individuals potentially at risk for chronic beryllium disease due to their work at DOE facilities.

The DOE Beryllium-Associated Worker Registry (BAWR) is a complex-wide internal program established to help DOE conduct and improve its Chronic Beryllium Disease Prevention Program (CBDPP), the purpose of which is to protect workers from the adverse health effects of exposure to beryllium. The *U.S. Code of Federal Regulations (CFR) Title 10, part 850 Chronic Beryllium Disease Prevention Program (10 CFR 850)* requires DOE sites to inventory and assess beryllium exposure hazards and transmit all records generated as required by this rule to DOE. Established in Calendar Year 2002 (CY2002), the BAWR is the repository for these data and contains information from more than 30 DOE facility reporting organizations, both active and inactive. Data from the BAWR and the annual summary reports were included in the Federal Register on June 7, 2016, in support of proposed amendments to 10 CFR 850. These recent proposed changes to the rule, reflecting DOE's goals to achieve aggressive reduction and minimization of worker exposures to airborne beryllium, will further strengthen the current CBDPP, worker protection programs, and reporting of affected workers.

Background

The Department of Energy and Department of Defense (DOD) have historically been some of the largest users of beryllium. Since the early 1940s, many thousands of workers at DOE and DOD plants or facilities have worked with beryllium and had the potential for exposure. These U.S. Departments have also been among the most involved in the study of beryllium and its possible health effects, and DOE took steps to initiate a comprehensive beryllium worker health program. Following years of aggressive data collection and analysis of beryllium activities, exposure measurements, and disease occurrence, a public notice of intent to establish a chronic beryllium disease prevention program was published in 1998 (*63 FR 66940*). Within the notice of intent, DOE requested comments, data, and any other relevant information from the public and industry for consideration in developing the beryllium worker health program. Following receipt and consideration of numerous comments and other relevant information, DOE published the final rule of 10 CFR part 850 CBDPP in 1999. DOE issued a comprehensive implementation guide (DOE G 440.1-7) to assist line managers in meeting responsibilities required by the CBDPP in CY1997 and updated it in CY2001 (*DOE G 440.1-7A*). In CY2006, DOE published *10 CFR 851*, a final rule establishing and implementing a formal worker safety and health program (WSHP) which also included some updating of the CBDPP. The WSHP, including the amendments to the CBDPP Rule, went into effect in CY2007.

BAWR Initiative

The U.S. Department of Energy (DOE) *Beryllium-Associated Worker Registry (BAWR)* was established to meet the requirements of 10 CFR 850 enacted in December 1999 and has been in operation since Calendar Year 2002 (CY2002). It is a collection of health and exposure information of individuals potentially at risk for chronic beryllium disease (CBD) due to their work at DOE-owned or leased facilities.

The *DOE Office of Domestic and International Health Studies* supports the operation of a surveillance registry of current workers who are exposed to beryllium in their current job or may have been exposed to beryllium in the past from work conducted at a DOE site. Data reported electronically to the BAWR are analyzed and summarized to help DOE accomplish several goals. One goal of the Registry is to determine the incidence and prevalence of beryllium sensitization and CBD. The data are analyzed to help better understand CBD and to identify those at risk. Another goal is to monitor and evaluate the effectiveness of DOE's Chronic Beryllium Disease Prevention Program. A third goal is to provide data and analyses to help answer questions posed by DOE Headquarters (and other agencies) regarding, for example, the effects of lowering established personal exposure limits.

Regulations, Standards, and Specifications

Code of Federal Regulations 10 Part 850

Title 10, Code of Federal Regulations, part 850 (10 CFR 850), "Chronic Beryllium Disease Prevention Program," requires U.S. Department of Energy (DOE) sites to inventory and assess beryllium exposure hazards to determine whether workers are at risk for chronic beryllium disease (CBD). Sites that determine workers are at risk due to ongoing or past work must implement CBD prevention programs that include reporting health and exposure data to the DOE Beryllium-Associated Worker Registry (BAWR). Health data are collected through the operation of medical surveillance programs for current workers. Exposure data are collected through the operation of industrial hygiene programs at sites that have continuing beryllium operations.

Standards and Specifications

Beryllium-Associated Worker Registry Data Collection and Management Guidance, DOE-STD-1187-2019 is a technical standard that provides acceptable methods for compliance with the requirements of *Title 10 Code of Federal Regulations, Part 850.39 (10 CFR 850.39)* "Recordkeeping and Use of Information." It should be used by responsible employers subject to the requirements of 10 CFR 850 "Chronic Beryllium Disease Prevention Program" to guide their submission of information to the DOE BAWR. Use of this standard promotes consistent reporting and efficient analysis and dissemination of information to those who need to know. It supersedes DOE-STD-1187-2007, dated June 2007.

Beryllium Lymphocyte Proliferation Testing (BeLPT) Technical Specification, DOE-SPEC-1142-2019 is a specification for BeLPTs used for detecting whether an individual has developed a sensitization to beryllium and for clinical evaluation and diagnosis of patients for CBD (a lung biopsy is needed to fully establish the presence of CBD). This specification should be used in all contracts with laboratories for the purchase of BeLPT services. It supersedes DOE-SPEC-1142-2001, dated May 2001.

Executive Summary

Summary of Findings, 2023

The Beryllium-Associated Worker Registry (BAWR) 2023 Dashboard provides a summary of cumulative data collected by the U.S. Department of Energy (DOE)-affiliated reporting organizations through the end of the Calendar Year 2023 (CY2023). The Oak Ridge Institute for Science and Education (ORISE) Data Center in collaboration with DOE's Office of Health and Safety developed the analyses and statistics presented within this report. The report provides an overview of Registry demographics and health monitoring and exposure activities, highlighting changes over the last reporting period. In brief:

Registry Demographics

- The Registry includes 27 active reporting organizations during the CY2023 reporting period. There were no changes in reporting organizations for CY2023.
- There were 7 changes in data coordinators in CY2023. Two organizations had more than one data coordinator change during the calendar year.
- The Registry includes 50,155 workers among the active reporting sites.
- The majority of the workers in the Registry are males over 50 years of age (54% of workers). The number of workers increased by 2,781 (from 47,374 workers in CY2022 to 50,155 workers in CY2023).

Health Monitoring

- Participants' medical surveillance programs screened a total of 6,444 workers for beryllium sensitization (BeS) in CY2023. Of those workers, 1,828 workers were newly reported to the Registry.
- The Registry has a total of 546 BeS workers and 155 workers diagnosed with chronic beryllium disease (CBD). The Registry reported 1 new BeS case in CY2023.
- The majority of BeS workers and CBD cases are associated with Y-12 and Hanford.
- 27% of BeS workers are associated with employment at Y-12 and 23% of BeS workers are associated with Hanford. 40% of CBD cases are associated with Y-12 and 22% of CBD cases are associated with Hanford.
- The majority of BeS workers and CBD cases are associated with work histories involving crafts and line operators.
- Crafts work histories are associated with 106 (19%) BeS workers. Line operators account for an additional 90 (16%) BeS workers. Crafts work histories are associated with 37 (24%) CBD cases. Line operators account for 23 (15%) CBD cases.

Exposure Monitoring

- The Registry received data for 1,388 air monitoring samples for the locations where 439 workers were present in CY2023.
- Of the samples measured in CY2023, approximately 97.4% had non-detectable results. Only 0.4% of the samples exceeded the 8-hour time weighted average (TWA) action level of 0.2 µg/m^3. Across all years, Y-12 and LANL report the largest number of samples exceeding the action level with 70% of the reported exceedances.
- The highest 8-hour TWA level measured during CY2023 was 0.754 µg/m^3. This was lower than the highest reported measurement in CY2022 which was 2.90 µg/m^3 at Idaho among Deactivation & Decommissioning (D&D) workers.

Health and Exposure Monitoring Comparisons

- Site medical programs screen a greater proportion of workers for beryllium sensitization (BeS) than are monitored for exposure to airborne beryllium. This may be due to some extent from monitoring for the onset of BeS and chronic beryllium disease (CBD) in workers no longer performing beryllium-related work; workers moving between sites/contractors; the discovery of legacy beryllium in poorly documented areas; and the use of swipe sampling results, not required for the Registry.
- 33% of workers (178 of 546) identified as BeS and 52% of workers (80 of 155) identified as CBD do not have exposure monitoring results submitted to the Registry.
- Of those with exposure monitoring, 47% of workers only have exposure monitoring results after identification as BeS.
- 22% of CBD cases (34 of 155) have exposure records dated earlier than their reported date of CBD diagnosis.

Significant Findings

The U.S. Department of Energy (DOE) Chronic Beryllium Disease Prevention Program (CBDPP) and Beryllium-Associated Worker Registry (BAWR) have been essential in raising awareness of and increasing vigilance in ensuring accountability for workers' health and for a workplace that limits harmful exposure to airborne beryllium. The BAWR remains a valuable occupational health program.

The BAWR 2023 Dashboard provides a summary of data collected by DOE-affiliated reporting organizations through the end of the Calendar Year 2023 (CY2023).

During the CY2023, important findings from the BAWR are:

- Registry data show the number of reported sensitizations has decreased over time. The yearly average for workers developing sensitization, whose first abnormal Beryllium Lymphocyte Proliferation Test (BeLPT) results were reported between CY2001 and CY2010, was 35. The current ten-year average (2014–2023) has dropped to 6.7 sensitizations per year. For workers later diagnosed with CBD, the yearly averages dropped from 9 to less than 1 per year for the respective time frames.

- Over 4 times as many workers are screened for BeS compared to the number of workers monitored for beryllium exposure.

- While health monitoring for BeS appears vigorous, industrial hygiene programs have historically submitted fewer exposure sampling measurements to the BAWR each year. In CY2023, the number of exposure sample results was the lowest number reported in over 10 years, with the numbers reported decreasing by almost 75% since 2014 (see the "DOE-wide Trend in Reported Exposure Sampling for 2014–2023" graph in the *Exposure Monitoring Activities tab of the Data Metrics and Results* section).

- Due to BeS and CBD observed in workers without exposure monitoring data (i.e., over two-thirds of total cases), sites may need to review and update exposure sampling plans to be more proactive identifying cases. For example, recent cases include workers whose jobs had no expected risk for exposure. For BeS and CBD cases that do have exposure sampling reported, the amount of data prior to their diagnosis date (i.e., having data for monitoring conducted earlier than their date of sensitization or CBD diagnosis) is very limited.

- Significant delays in reporting impact the BAWR analyses and the conclusions drawn from them. Data submitted with missing required values (such as first hire on site date, 8-hour time weighted average, actual exposure level, first beryllium job start date, or job title) also limit BAWR analyses and make it difficult to identify potential problem areas or those warranting further investigation.

- Analyses of the data from the BAWR yielded no statistical correlation between the incidence of BeS/CBD and the percent of exceedances among exposure sampling results submitted to the Registry. The lack of correlation could be due to sensitization and CBD cases associated with past work locations or conditions rather than the environment currently monitored. However, it is also possible that the exposure monitoring programs are missing sources of exposure.

  Reporting organizations with low exposure monitoring results and high sensitization or CBD rates should further investigate cases to determine if there is a possibility of ongoing exposures.

Accomplishments

The U.S. Department of Energy (DOE) Beryllium-Associated Worker Registry (BAWR) is a centralized repository for the collection and analyses of beryllium exposure data since Calendar Year (CY2002). The program was mandated by *U.S. Code of Federal Regulations (CFR) Title 10, part 850 Chronic Beryllium Disease Prevention Program (10 CFR 850)* (published December 8, 1999) when DOE required sites, on an ongoing basis, to monitor and assess beryllium exposure hazards and transmit associated records containing health and exposure data to the BAWR. Since that time, the Registry has grown significantly, both in the numbers of included organizations and the longitudinal nature of the data, making it a valuable and unique resource for DOE, the sites overseen by the DOE Chronic Beryllium Disease Prevention Program (CBDPP), and even other agencies.

The BAWR accomplishments to date highlight the importance and contributions made by this program in partnership with the DOE CBDPP.

Chronic Beryllium Disease Prevention Program

- The results of the BAWR data analyses indicate that the percent of exposure samples that exceed the 0.2 µg/m^3 personnel exposure limit have remained low, averaging 0.4% in CY2023.
- Between CY2001 and CY2010, an average of 35 workers per year developed sensitization. Between CY2014 and CY2023, this rate dropped to an average of 7.4 workers per year. For workers later diagnosed with CBD, the average number of workers developing CBD during the respective 10-year time frame dropped from 9 workers a year to less than 1 worker per year. The CBDPP and the BAWR have been critical in reducing CBD among workers and remain valuable occupational health programs.
- The data in the BAWR have been used by both the DOE Office of Inspector General and by the reporting organizations to investigate the effectiveness of sites' beryllium protection and prevention programs or follow-up to assure that recommendations from audits have been implemented. The BAWR has also provided special analyses for individual reporting organizations to help with quality assurance of their data and to prepare for internal or external audits. This cumulative data resource has proven to be more comprehensive and accurate than individual sites' records, as well as designed to provide easy comparisons between the health and exposure information.

BAWR Data Used in Support of 10 CFR 850 Amendments

- Data from the BAWR were included in the Federal Register on 7 June 2016, in support of proposed amendments to 10 CFR 850. These proposed changes to the rule, reflecting DOE goals to achieve aggressive reduction and minimization of worker exposures to airborne beryllium, will further strengthen the current CBDPP, worker protection programs, and reporting of affected workers. As part of the justification for lowering DOE established personal exposure limits (PELs), BAWR data was analyzed to determine the effects of the current cutoff of 2.0 µg/m^3 and played a critical role in lowering it to several levels between 1.0 and 0.33 µg/m^3.
- Data from the BAWR were also used by DOE staff working on updates to the rule to monitor reporting organizations by geographic location and account for reporting organizations (and changes in numbers of workers), which had been combined when contracts were rebid and/or organization names had changed.

Improved Algorithms for Earlier Identification of Affected Workers

- Staff from Oak Ridge Institute for Science and Education (ORISE) and the BAWR have provided input to the revised algorithm, based on blood BeLPT results, for determining BeS. The new algorithm will lead to, in many cases, earlier identification of affected workers.
- To determine the differences between algorithms, the current and the proposed algorithm were modeled for comparison. ORISE Beryllium Laboratory staff later provided expert testimony at the public hearings for revisions to 10 CFR 850 regarding the importance of adding an additional 3 borderlines criteria to the methodology, and the BAWR and Beryllium Laboratory provided supporting data.

Cross-Agency Data Sharing

- Results from BAWR analyses to study the effects of lowering DOE established personal exposure limits (PELs) were shared by DOE with the Occupational Safety and Health Administration (OSHA). The BAWR is the only source for these cumulative data for DOE-affiliated sites.

- Raw exposure data from the BAWR were requested and used by OSHA in evaluating lowering their permissible exposure limit (PEL) to 0.2 µg/m^3. ORISE staff created and provided a de-identified file for OSHA with a limited number of fields to protect workers' identities.

Subject-Matter Expertise – Specifications, Standards, and Studies

- As subject matter experts with regard to beryllium, worker health, and interpretation of BeLPT results, ORISE staff played a major role in assisting DOE in revising the Beryllium Lymphocyte Proliferation Testing (BeLPT) Technical Specification, *DOE-SPEC-1142-2019*. This specification had not been updated since CY2001.

- ORISE staff with decades of experience with the BAWR, provided substantial input in guiding updates to the BAWR Technical Standard, which had not been updated since CY2007. The *DOE-STD-1187-2019 Technical Standard* was completed in late CY2019.

- Studies using BAWR data have provided a better understanding of impacts on worker health. Studies that combined data from the BAWR with data from the former DOE Illness and Injury Surveillance Program (IISP) include:

  - *Illness Absences Among Beryllium Sensitized Workers* (American Journal of Public Health, Janice Watkins, et. al., September 2014).

  - Y-12 American Recovery and Reinvestment Act (ARRA), workers hired after January 1, 2009, analyses of exposures and health data for the cohort (Paul Wambach, White Paper, July 2011).

- ORISE, in cooperation with DOE and National Jewish Health, continue to evaluate studies regarding beryllium test results, latency from first BeS to disease onset, and evidence of a dose-response relationship between beryllium exposure and disease outcomes. The data in the BAWR are of interest with regard to discovering more about how these are correlated. Some examples include:

  - *Clinical and laboratory factors contributing to uninterpretable beryllium lymphocyte proliferation tests (BeLPT)* (American Journal of Industrial Medicine, Derek Smith, et. al., March 2018).

  - *Exposure and genetics increase risk of beryllium sensitization and chronic beryllium disease in the nuclear weapons industry* (Occupational and Environmental Medicine, Michael Van Dyke, et. al., November 2011).

Improvements to Data Quality

- Because of the regular and required electronic reporting of data to the BAWR, the BAWR has been used as justification by the reporting organizations for streamlining their processes by developing new systems, infrastructure, and/or procuring new software. Over time, data have improved dramatically, as evidenced by decreasing error rates in the data condition reports. There is a continued effort made by BAWR and DOE staff to improve data quality, notably securing complete worker rosters and work history data.

- DOE and ORISE staff have worked together to help assure that once 10 CFR 850 is updated and published, the BAWR's Technical Standard is specifically cited as containing the guidance and elements required to satisfy mandatory reporting. DOE and ORISE staff worked together to help assure the BAWR's Technical Standard is specifically cited as the guidance and elements required to satisfy mandatory reporting in current updates to 10 CFR 850. This effort will ensure sites do a better job of complete and accurate reporting and correction of errors. As a result, the BAWR will be an even more robust resource to better understand the relationship between beryllium exposure and disease outcomes, in order to protect worker health.

Limitations to Data Interpretation

Due to limitations associated with data submitted to the Beryllium-Associated Worker Registry (BAWR), caution should be exercised in the conclusions drawn from data analyses results and data summarizations. Caveats to consider when interpreting the data presented in the BAWR Dashboard are discussed below:

Absence of Personally Identifiable Information

The Registry does not contain PII (personally identifiable information) on workers. Each reporting organization is free to choose its own encryption algorithm to assign a unique identifier for a given worker. While this approach ensures the protection of the individual's privacy, it restricts the Registry's ability to determine when a given worker moves from one reporting organization to another.

Need for Updated Exposure Sampling Plans

In general, reporting of air monitoring samples have declined each year. Due to beryllium sensitization (BeS) and chronic beryllium disease (CBD) observed in workers without exposure monitoring data, reporting organizations may need to review and update exposure sampling plans. In contrast, health monitoring for BeS appears to be robust, although additional medical follow-up of CBD cases would be useful.

Absence of Worker Morbidity and Mortality Data

Morbidity and mortality data are not reported by sites to the BAWR. However, the Registry does capture health outcome information on workers' development of beryllium sensitization (BeS) or chronic beryllium disease (CBD). The clinical criteria and incidence rules for the case definition of BeS is one of the following:

- Individual must have 2 abnormal blood tests, or
- 1 abnormal and 2 borderline blood tests, or
- An abnormal bronchoalveolar lavage BeLPT (Beryllium Lymphocyte Proliferation Test), or
- Clinical evaluation with a diagnosis of BeS.

The current diagnostic algorithm used in the identification of cases is limited because of the time lapse between meeting any one of the above criteria to a time when the worker may already be experiencing health effects. When *10 CFR 850* is updated and published, revisions to the current algorithm for determining BeS will result in earlier dates of BeS for many workers, providing more timely identification and subsequent medical follow-up or appropriate work restrictions.

- Cause of death is not available to the Registry, which prevents further analyses focused on estimation of mortality risk from particular causes.

Incomplete Worker Rosters

Reporting organizations are not required to submit data on the total number of workers for each reporting year. Additionally, it is difficult to ensure that each reporting organization has submitted a complete roster of workers with potential beryllium exposure due to current or past work locations or activities. The number of workers tested using the beryllium lymphocyte proliferation test, therefore, is the denominator in many of the analyses and calculated rates of beryllium sensitization or chronic beryllium disease.

Inability to Confirm First Date of Hire

The Registry cannot always confirm the date of first hire because some organizations define the date of first hire as the date of first hire by the current (sub)contractor, and this date overwrites the previous date of first hire by a former contractor. Resetting this date negatively impacts the Beryllium-Associated Worker Registry analyses to examine latency from possible exposure to development of sensitization to disease onset.

Duplication of Worker Counts

Although most workers represented in the figures and tables are unique cases, there is potential duplication of workers and counts. This issue can arise when a worker moves from one reporting organization to another and is assigned a new identifier based on a different encryption algorithm. Although the number of workers in this category is believed to be small, given the absence of personally identified information on individuals, we cannot be absolutely certain that the total numbers of individuals shown in figures and tables represent unique individuals. We have used this approach to err on the site of protecting the workers' privacy.

Data Reporting Delays

Significant delays in reporting impact the Beryllium-Associated Worker Registry (BAWR) analyses and conclusions drawn from them. Such delays also impact the ability to identify problems and defer refinement of protocols.

Timely and complete reporting of exposure monitoring data is necessary to characterize beryllium-related work at a site and analyze workers' actual exposure levels and time weighted averages. Timely and complete reporting of beryllium sensitization (BeS) and chronic beryllium disease (CBD) cases (and their related work history) is critical to identifying problems, assessing the effectiveness of CBD Prevention Programs, and refining protocols.

In recent years, reporting organizations observed BeS among security guards, administrative personnel, and field engineers. These workers had no expected exposure, are not covered in sites' industrial hygiene sampling plans, and did not use personal protective equipment. These cases highlight the importance of proactive hazard assessments and sampling approaches. Timely reporting of data is critical to earlier identification of potential work areas or sources of beryllium exposure, particularly locations or work activities not anticipated to be significant sources of beryllium exposure.

There are reasons contributing to delayed reporting of data:

- Turnover in data coordinators often results in the need for additional training and subsequent delays in data submissions. Therefore, significant data coordinator turnover can impact the timely acquisition of data and subsequent reporting of results.

- Exposure monitoring records for previous monitoring years are sometimes received late. This results in a delay in data collection and an impact on data analysis. For example, of the 3,430 exposure records submitted to BAWR during the Calendar Year 2022 (CY2022), 3,149 had monitoring dates in CY2021 and 226 records (7%) were for monitoring years prior to CY2022. Some of these records for prior monitoring years include higher-than-average exposure levels which can significantly impact trend analysis. As the number of annual exposure records has decreased in recent years, the impact of these records on BAWR analyses has increased.

There have been delays in reporting of BeS and CBD cases, most often for those cases where workers did not hold beryllium-related jobs. Therefore, several years elapsed before beryllium was identified as a factor. As a result, workers were enrolled in medical surveillance programs, or were referred to a pulmonary laboratory, for further testing and evaluation.

Data Metrics & Results

BAWR Reporting Sites and Target Population

Beryllium-Associated Worker Registry (BAWR) Reporting Organizations are owned by the U.S. Department of Energy (DOE)-operated facilities with current workers who:

- Have been exposed, or have had the potential for exposure, to airborne concentrations of beryllium due to their work at the present or a previous DOE site;

- Self-identify and indicate a history of possible exposure; or

- Exhibit symptoms of beryllium exposure or are receiving medical removal protection benefits.

The site's Chronic Beryllium Disease Prevention Program (CBDPP) may also include other workers in the BAWR reporting for their site, as appropriate. Subcontractors who are not included under the main site's CBDPP must have their own CBDPP and report data separately. The *10 CFR 850* contains further information on beryllium and beryllium-associated workers, and which organizations should have CBDPPs.

Active BAWR Reporting Organizations

Through the 2023 calendar year, the BAWR received data from the following 27 DOE-affiliated reporting organizations:

- Ames Laboratory (AMES)
- Argonne National Laboratory (ANL)
- Brookhaven National Laboratory (BNL)
- DOE Oak Ridge Office (DOE-ORO)
- East Tennessee Technology Park (ETTP)
- Fermi National Accelerator Laboratory (Fermi)
- Golden SVCS, LLC (GSVCS)
- Hanford Site (HAN)
- Idaho National Laboratory (INL)
- Kansas City National Security Campus (KCNSC)
- Knolls Atomic Power Laboratory (KAPL)
- Lawrence Berkeley National Laboratory (LBNL)
- Lawrence Livermore National Laboratory (LLNL)
- LLNL Clean Harbors Environmental Services (LLNL CHES)
- LLNL North Wind (LLNL NW)
- Los Alamos National Laboratory (LANL)
- LANL N3B (LANL N3B)
- Nevada National Security Site (NNSS)
- Oak Ridge National Laboratory (ORNL)
- Pacific Northwest National Laboratory (PNNL)
- Paducah Site (PADUCAH)
- Pantex Plant (PTX)
- Sandia National Laboratories (SNL)
- Savannah River Site (SRS)
- SLAC National Accelerator Laboratory (SLAC)
- Y-12 Atkins Nuclear Secured (Y-12 ANS)
- Y-12 National Security Complex (Y-12)

All but one of the 27 active reporting organizations collected health data through the operation of their medical surveillance programs. At least one site, the employees have refused medical surveillance.

Twenty-five (25) organizations conducted exposure sampling through their industrial hygiene programs. Sixteen of these organizations reported exposure sampling in CY2023. Golden SVCS, LLC (GSVCS) and DOE Oak Ridge Operations (DOE-ORO) do not submit exposure sampling data since their workers are in the BAWR due to prior work at another DOE site and have no potential for exposure.

Inactive BAWR Reporting Organizations

There are 9 reporting organizations that previously participated in the program, but due to contract changes or work completion, no longer submit data. The previously submitted data from these organizations, referred to as inactive reporting organizations, remain in the BAWR. Years in parentheses are the years the organization actively reported to BAWR.

The inactive reporting organizations are:

- Advanced Mixed Waste Treatment Project (AMWTP) (2005-2016)
- LLNL Boston University (LLNL BU) (2008-2009)
- LLNL Envirocon, Inc. (LLNL ENVC) (2010-2012)
- National Strategic Protective Services, LLC for ETTP and ORNL (NSPS) (2008-2018)
- Rocky Flats Closure Project (RF) (1984-2005)
- Southwestern Power Administration (SWPA) (2002)
- Wackenhut Security Services, Inc. for ETTP, ORNL, and Y-12 (WSI) (2002-2012)
- Y-12 Navarro Research and Engineering (Y-12 NRE) (2007-2014)
- Y-12 URS Corporation (Y-12 URS) (2008-2014)

Geographical Locations for 27 Active BAWR Reporting Organizations (2023)
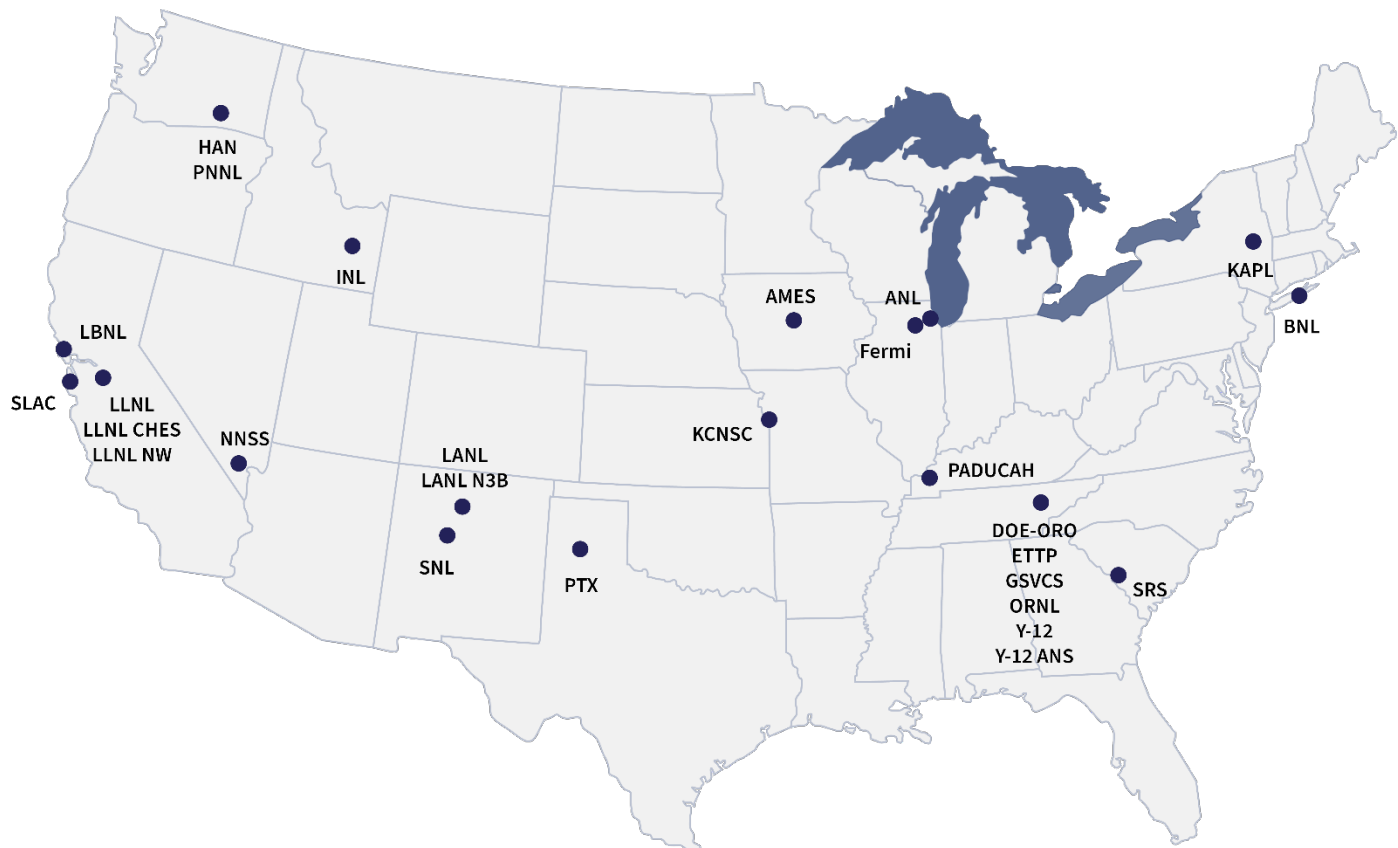
Click here for List of Acronyms

This map shows the geographical locations of the 27 DOE-affiliated actively reporting organizations.

Infographic Details for CY2002-2023

Ames Laboratory (AMES)

Number of Workers:				
Roster	**BeLPT Tested**	**Be Sensitized**	**CBD**	**Exposure Monitored**
53	53	2	0	12

Argonne National Laboratory (ANL)

Number of Workers:				
Roster	**BeLPT Tested**	**Be Sensitized**	**CBD**	**Exposure Monitored**
407	197	3	0	23

Brookhaven National Laboratory (BNL)

Number of Workers:				
Roster	**BeLPT Tested**	**Be Sensitized**	**CBD**	**Exposure Monitored**
83	57	1	0	48

Fermi National Accelerator Laboratory (Fermi)

Number of Workers:				
Roster	**BeLPT Tested**	**Be Sensitized**	**CBD**	**Exposure Monitored**
28	21	0	0	23

Richland Area Reporting Locations

Hanford Site (HAN)

Number of Workers:				
Roster	**BeLPT Tested**	**Be Sensitized**	**CBD**	**Exposure Monitored**
22,042	15,477	123	34	2,460

Pacific Northwest National Laboratory (PNNL)

Number of Workers:				
Roster	**BeLPT Tested**	**Be Sensitized**	**CBD**	**Exposure Monitored**
522	474	10	0	67

Idaho National Laboratory (INL)

Number of Workers:				
Roster	**BeLPT Tested**	**Be Sensitized**	**CBD**	**Exposure Monitored**
1,310	524	3	0	430

Knolls Atomic Power Laboratory (KAPL)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
79	39	0	0	39

Los Alamos Area Reporting Locations

Los Alamos National Laboratory (LANL)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
6,003	4,734	35	8	999

LANL N3B Project (LANL N3B)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
170	173	0	0	23

Lawrence Berkeley National Laboratory (LBNL)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
39	26	2	0	8

Livermore Area Reporting Locations

Lawrence Livermore National Laboratory (LLNL)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
3,092	2,025	72	4	337

LLNL Clean Harbors Environmental Services (LLNL CHES)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
49	38	0	0	1

LLNL North Wind (LLNL NW)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
45	38	0	0	1

Kansas City National Security Campus (KCNSC)

Number of Workers:

Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
1,405	1,321	41	14	200

Nevada National Security Site (NNSS)

Number of Workers:

Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
1,471	1,324	23	6	313

Oak Ridge Area Reporting Locations

DOE Oak Ridge Office (DOE-ORO)

Number of Workers:

Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
103	107	1	0	1

Golden SVCS, LLC (GSVCS)

Number of Workers:

Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
7	6	1	0	0

East Tennessee Technology Park (ETTP)

Number of Workers:

Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
1,506	1,275	6	4	641

Oak Ridge National Laboratory (ORNL)

Number of Workers:

Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
1,064	1,019	21	0	330

Y-12 National Security Complex (Y-12)

Number of Workers:

Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
4,842	5,377	146	62	1,727

Y-12 Atkins Nuclear Secured (Y-12 ANS)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
49	56	0	0	31

Paducah Site (PADUCAH)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
378	294	6	0	91

Pantex Plant (PTX)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
2,661	2,265	27	15	643

Sandia National Laboratories (SNL)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
696	683	1	1	175

Savannah River Site (SRS)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
1,963	914	22	6	212

SLAC National Accelerator Laboratory (SLAC)

Number of Workers:				
Roster	BeLPT Tested	Be Sensitized	CBD	Exposure Monitored
88	54	0	1	26

Data Coordinator Changes by Reporting Organization (2016–2023)

Each reporting organization designates a data coordinator who is responsible for coordinating activities at the site related to data collection, timely submittal of data, and responding to inquiries from the U.S. Department of Energy (DOE) Program Manager and the Oak Ridge Institute for Science and Education Data Center as outlined in the DOE technical standard, DOE-STD-1187-2019. The following table shows that there were 7 data coordinator changes in Calendar Year 2023. Two sites had more than one data coordinator change during CY2023.

Year	Number (%) of Reporting Organizations	Total Data Coordinator Changes	Organizations with ≥2 Data Coordinator Changes in Same Year
2016	6 (22%)	7	1
2017	5 (19%)	7	2
2018	7 (27%)	9	2
2019	11 (41%)	12	0
2020	4 (15%)	5	1
2021	11 (41%)	12	1
2022	2 (7%)	2	0
2023	5 (19%)	7	2

Changes in data coordinators often result in the need for additional training and subsequent delays in data submissions. Therefore, significant data coordinator turnover can impact the timely acquisition of data and subsequent reporting of results.

Workers reported to the BAWR by Reporting Organization (2002–2023) *

Legend of Acronyms

Ames Laboratory (AMES)
Argonne National Laboratory (ANL)
Brookhaven National Laboratory (BNL)
East Tennessee Technology Park (ETTP)
Fermi National Accelerator Laboratory (Fermi)
Golden SVCS, LLC (GSVCS)
Hanford Site (HAN)
Idaho National Laboratory (INL)
Kansas City National Security Campus (KCNSC)
Knolls Atomic Power Laboratory (KAPL)
Lawrence Berkeley National Laboratory (LBNL)
Lawrence Livermore National Laboratory (LLNL)
LLNL Clean Harbors Environmental Services (LLNL CHES)
LLNL North Wind Services, LLC (LLNL NW)
Los Alamos National Laboratory (LANL)
Nevada National Security Site (NNSS)
Newport News Nuclear BWXT Los Alamos (LANL N3B)
Oak Ridge National Laboratory (ORNL)
Pacific Northwest National Laboratory (PNNL)
Paducah Site (PADUCAH)
Pantex Plant (PTX)
Sandia National Laboratories (SNL)
Savannah River Site (SRS)
SLAC National Accelerator Laboratory (SLAC)
U.S. Department of Energy - Oak Ridge Office (DOE-ORO)
Y-12 Atkins Nuclear Secured (Y-12 ANS)
Y-12 National Security Complex (Y-12)

* Some reporting organizations have provided data that predate the 2002 start date of the Registry.

This figure shows the cumulative numbers of beryllium-associated workers reported to the Beryllium-Associated Worker Registry (BAWR) by reporting organization. Through Calendar Year 2023 (CY2023), there were 50,155 workers in the cumulative roster as compared to 47,374 workers in the cumulative roster through CY2022, for an increase of 2,781 workers. Hanford site has 22,042 workers in the roster, constituting the largest number (44%) in the cumulative roster.

Gender and Age Distribution for Workers (2002–2023) *
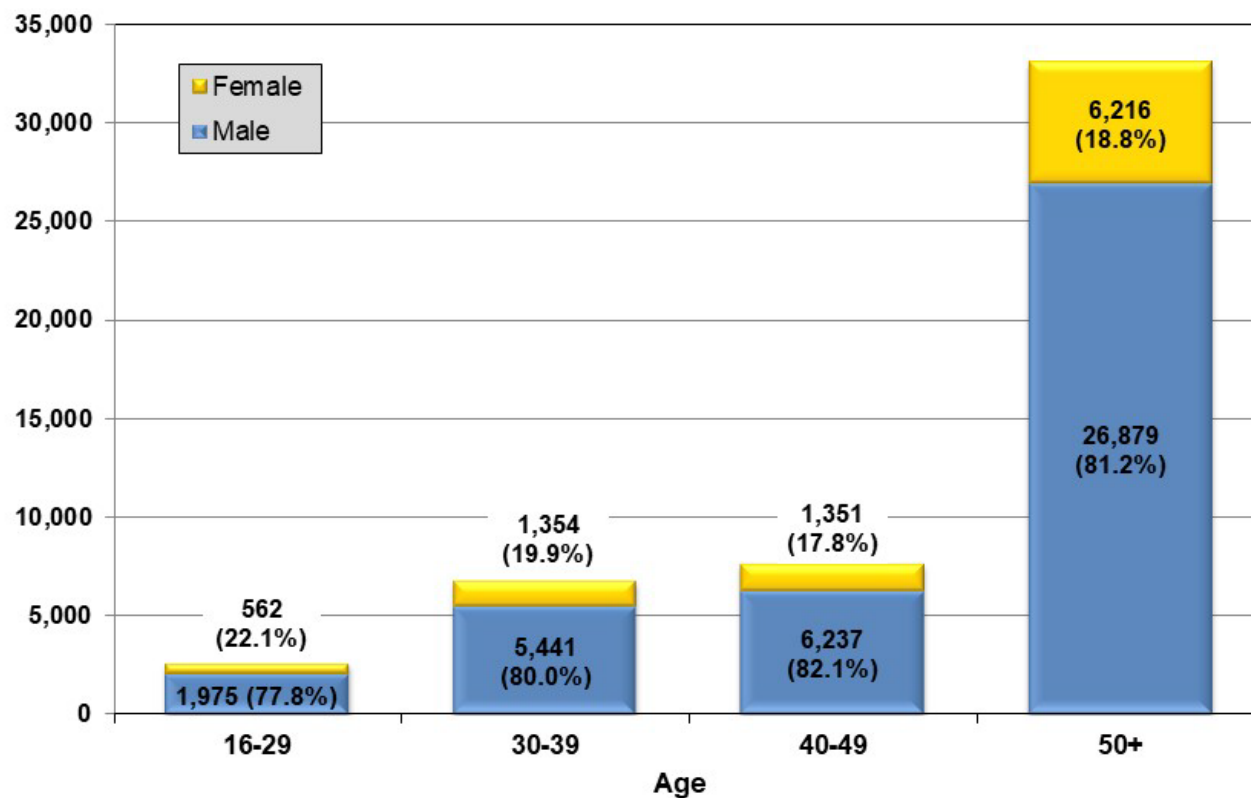
* Some reporting organizations have provided data that predate the 2002 start date of the Registry.

Workers are predominantly male (approximately 81%) and greater than 50 years old (54%). This chart excludes 140 workers (<0.1%) for whom demographic data were not available.

Health Monitoring Results

Sites' health clinics collect medical surveillance data on workers identified by their beryllium rosters. These data sets contain beryllium-related health monitoring information and the results of any specialized medical testing. The Site Occupational Medical Director determines the content and frequency of surveillance evaluations and tests based on policies, standards, and the worker's health and work history. The most vital information collected and reported on an annual basis are the number of workers monitored for beryllium sensitization (BeS) using the beryllium lymphocyte proliferation test (BeLPT), the number of new BeS cases identified, and the number of new cases of chronic beryllium disease (CBD).

Some workers in the roster may decline testing for sensitization. As a result, no records will be available for individuals who refuse this diagnostic evaluation. Some workers may have testing done independently (for example, as part of a former worker program), and in these cases results may be unavailable for Registry reporting unless the worker releases their evaluation report, and it becomes part of the organization's electronic medical records. Also, advanced medical testing results when workers are referred (after findings suggestive of possible CBD) to a pulmonary medicine or other specialized clinic for follow-up diagnosis and care may not be reported and/or can be difficult to collect.

Sensitization and CBD Screening

The cumulative number of workers with BeLPT screening results submitted to the Beryllium-Associated Worker Registry (BAWR) through Calendar Year 2023 (CY2023) was 38,571. When compared with the 34,911 workers screened through CY2022, this corresponds to an additional 3,660 workers tested.

There was a total of 546 sensitized workers (1 additional worker) included in the BAWR, and medical staff diagnosed 155 workers as having CBD through CY2023. BeS and CBD are mutually exclusive categories, (i.e., if a person who is BeS receives a CBD diagnosis, the person's diagnosis moves to the CBD category and is no longer counted in the BeS category).

Number and Proportion of Workers undergoing BeLPT Testing and Diagnosed with BeS or Diagnosed with CBD by Reporting Organization (n=38,571) (2002–2023) *

Reporting Organization	No. Workers with BeLPT Results	No. Sensitized Workers	No. Workers with CBD
HAN	15,477	123 (0.6%)	34 (0.2%)
Y-12	5,377	146 (3%)	62 (1.3%)
LANL	4,734	35 (0.6%)	8 (0.1%)
PTX	2,265	27 (1%)	15 (0.6%)
LLNL	2,025	72 (2.9%)	4 (1%)
NNSS	1,324	23 (0.4%)	6 (0.3%)
KCNSC	1,321	41 (1.6%)	14 (0.4%)
ETTP	1,275	6 (2%)	4 (0%)
ORNL	1,019	21 (1.1%)	0 (0.3%)
SRS	914	22 (2.3%)	6 (0.1%)
SNL	683	1 (0.1%)	1 (0.1%)
INL	524	3 (0.2%)	0 (0%)
PNNL	474	10 (1.9%)	0 (0%)
PADUCAH	294	6 (1.6%)	0 (0%)
ANL	197	3 (0.7%)	0 (0%)
LANL N3B	173	0 (0%)	0 (0%)
DOE-ORO	107	1 (1%)	0 (0%)
BNL	57	1 (1.2%)	0 (0%)
Y-12 ANS	56	0 (0%)	0 (0%)
SLAC	54	0 (0%)	1 (1.1%)
AMES	53	2 (3.8%)	0 (0%)
KAPL	39	0 (0%)	0 (0%)
LLNL CHES	38	0 (0%)	0 (0%)
LLNL NW	38	0 (0%)	0 (0%)
LBNL	26	2 (5.1%)	0 (0%)
Fermi	21	0 (0%)	0 (0%)
GSVCS	6	1 (14.3%)	0 (0%)
Totals	38,571	546 (1.1%)	155 (0.3%)

Click here for List of Acronyms

* Some reporting organizations have provided data that predate the 2002 start date of the Registry.

This table provides the numbers of beryllium-associated workers with Beryllium Lymphocyte Proliferation Testing (BeLPT) test results submitted to the Beryllium-Associated Worker Registry each year, and the total number of beryllium-sensitized (BeS) workers increased by 1 through Calendar Year 2023 (CY2023) (546 total BeS cases reported). The newly reported BeS cases were from 1 reporting organization (LANL).

Twenty (20) of the reporting organizations have BeS workers and 11 have workers who have been diagnosed with chronic beryllium disease (CBD).

Number and Percent Proportion of Workers Undergoing BeLPT Testing, and Yielding Abnormal BeS or CBD Results (n=50,155) (2002–2023) *
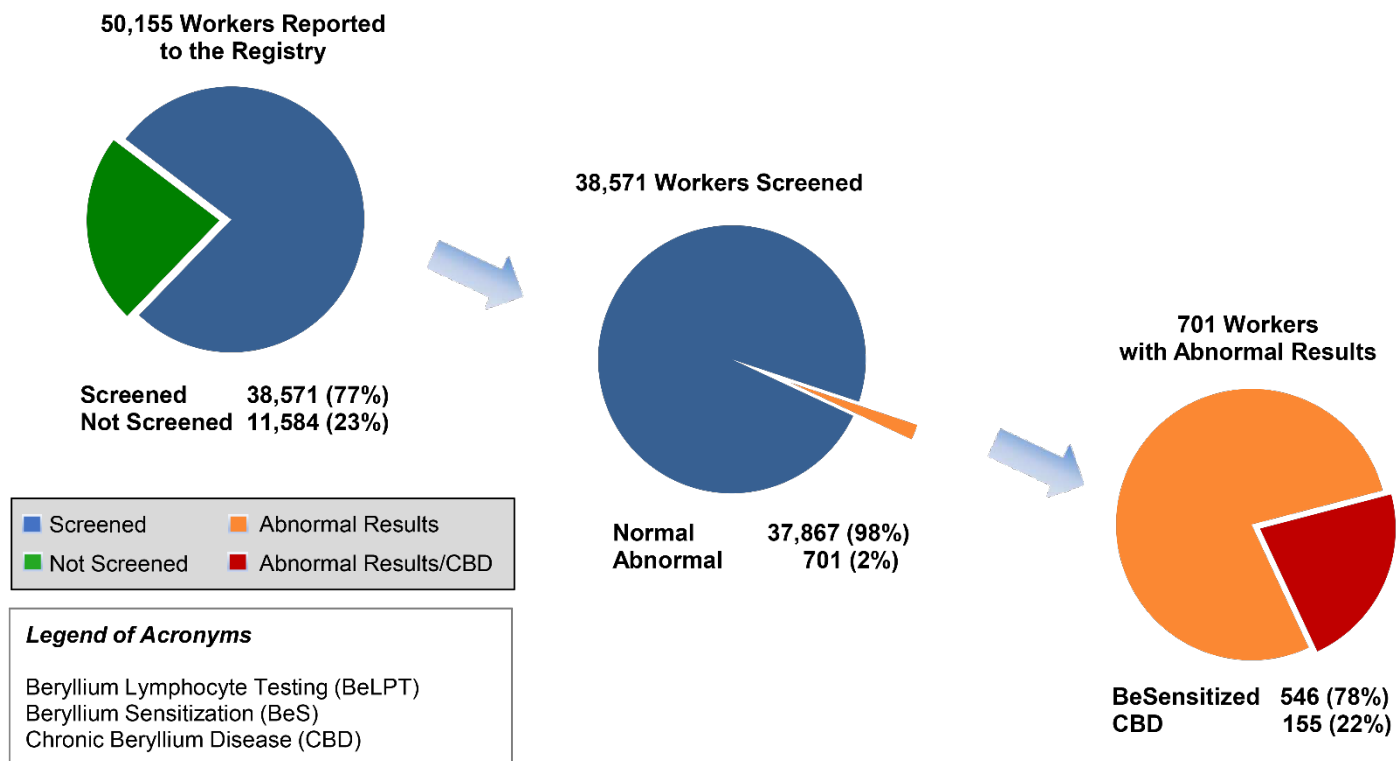
50,155 Workers Reported to the Registry

Screened   38,571 (77%)
Not Screened   11,584 (23%)

■ Screened	■ Abnormal Results
■ Not Screened	■ Abnormal Results/CBD

Legend of Acronyms

Beryllium Lymphocyte Testing (BeLPT)
Beryllium Sensitization (BeS)
Chronic Beryllium Disease (CBD)

38,571 Workers Screened

Normal   37,867 (98%)
Abnormal   701 (2%)

701 Workers with Abnormal Results

BeSensitized   546 (78%)
CBD   155 (22%)
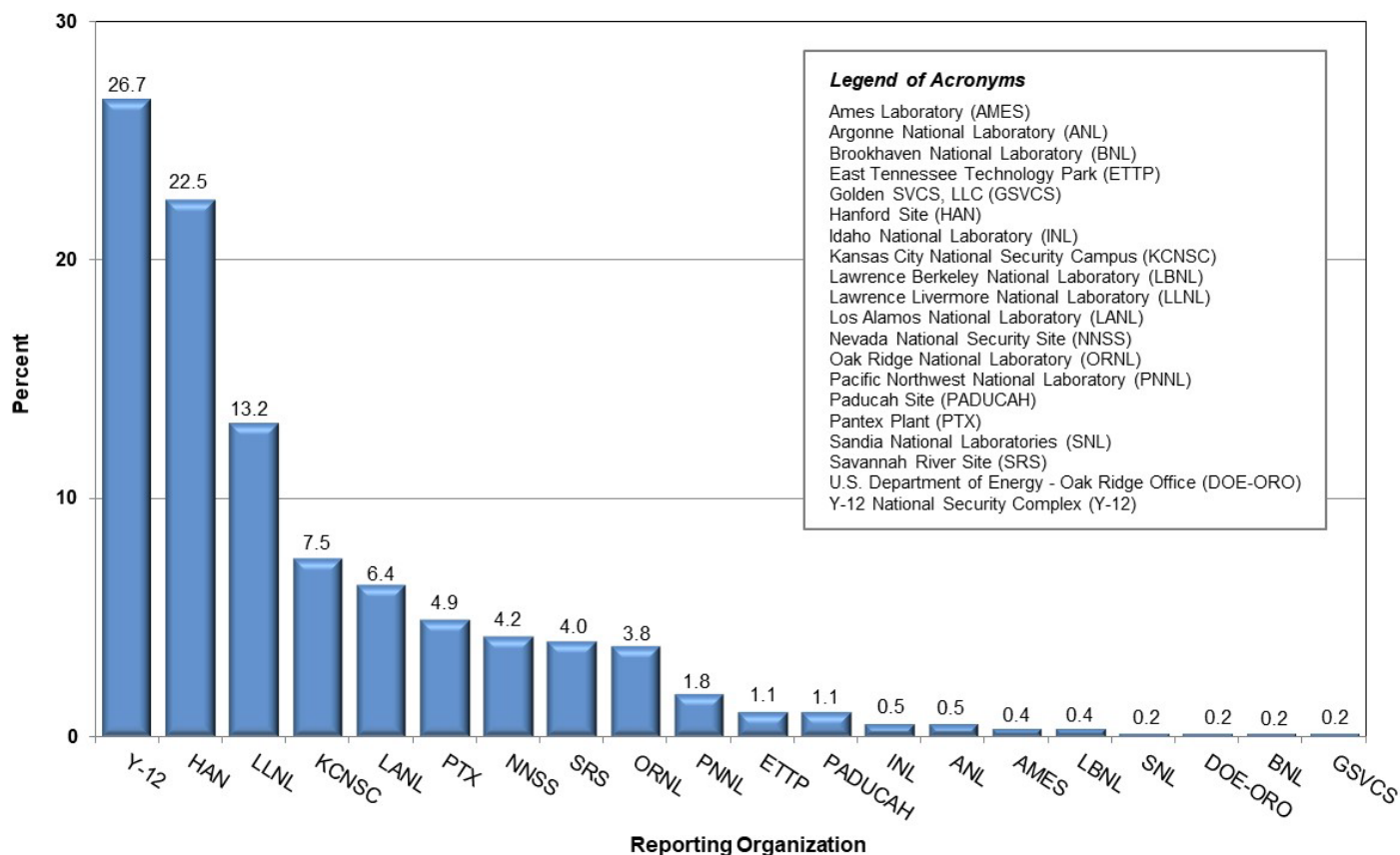
* Some reporting organizations have provided data that predate the 2002 start date of the Registry.
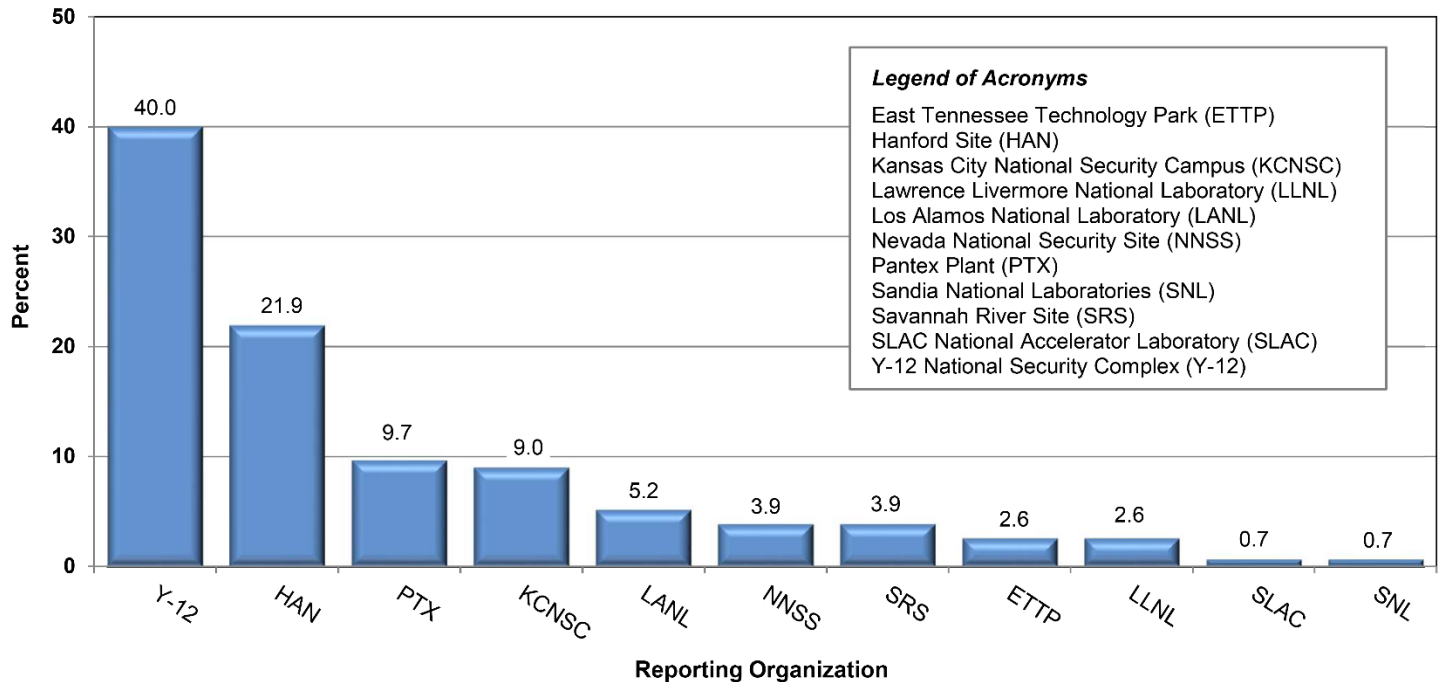
This figure depicts the numbers and percentages across the U.S. Department of Energy (DOE) complex of workers screened using the BeLPT and among those workers having abnormal results, how many are sensitized or have developed CBD. Comparison with previous years' reports show that these DOE-wide percentage distributions have remained consistent.

Percent Proportion of Workers Diagnosed as BeS by Reporting Organization (n=546) (2002–2023) *

Legend of Acronyms

Ames Laboratory (AMES)
Argonne National Laboratory (ANL)
Brookhaven National Laboratory (BNL)
East Tennessee Technology Park (ETTP)
Golden SVCS, LLC (GSVCS)
Hanford Site (HAN)
Idaho National Laboratory (INL)
Kansas City National Security Campus (KCNSC)
Lawrence Berkeley National Laboratory (LBNL)
Lawrence Livermore National Laboratory (LLNL)
Los Alamos National Laboratory (LANL)
Nevada National Security Site (NNSS)
Oak Ridge National Laboratory (ORNL)
Pacific Northwest National Laboratory (PNNL)
Paducah Site (PADUCAH)
Pantex Plant (PTX)
Sandia National Laboratories (SNL)
Savannah River Site (SRS)
U.S. Department of Energy - Oak Ridge Office (DOE-ORO)
Y-12 National Security Complex (Y-12)

* Some reporting organizations have provided data that predate the 2002 start date of the Registry.
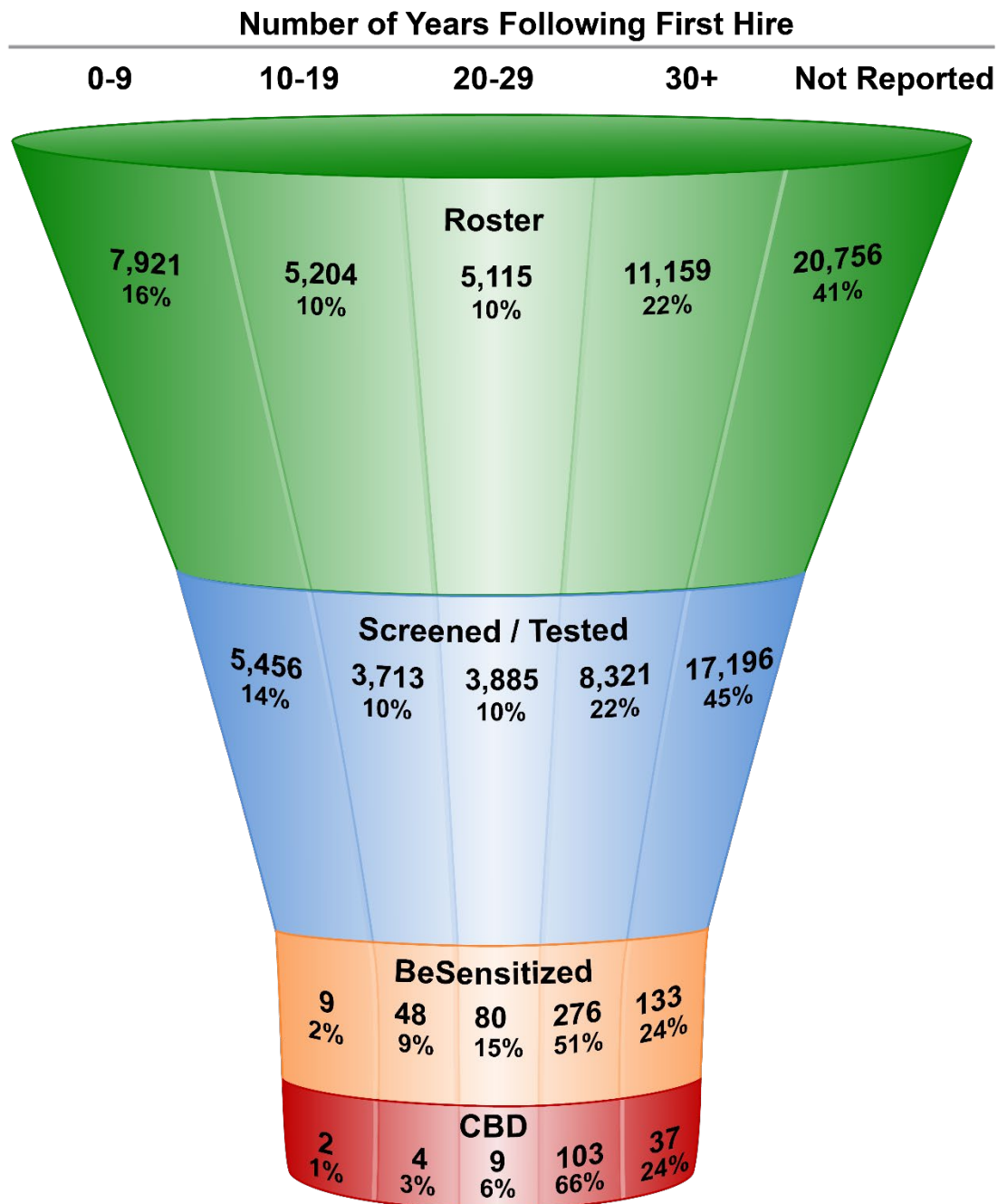
This figure presents the distribution in percent of beryllium sensitization (BeS) cases by reporting organization. Of the 20 reporting organizations with at least 1 reported Be sensitization, about 50% of total BeS cases are associated with the Y-12 and HAN sites.

Percent Proportion of Workers Diagnosed as CBD by Reporting Organization (n=155) (2002–2023) *

Legend of Acronyms

East Tennessee Technology Park (ETTP)
Hanford Site (HAN)
Kansas City National Security Campus (KCNSC)
Lawrence Livermore National Laboratory (LLNL)
Los Alamos National Laboratory (LANL)
Nevada National Security Site (NNSS)
Pantex Plant (PTX)
Sandia National Laboratories (SNL)
Savannah River Site (SRS)
SLAC National Accelerator Laboratory (SLAC)
Y-12 National Security Complex (Y-12)

Chart — Percent (y-axis) by Reporting Organization (x-axis):

Reporting Organization	Percent
Y-12	40.0
HAN	21.9
PTX	9.7
KCNSC	9.0
LANL	5.2
NNSS	3.9
SRS	3.9
ETTP	2.6
LLNL	2.6
SLAC	0.7
SNL	0.7

* Some reporting organizations have provided data that predate the 2002 start date of the Registry.

Of the 27 active sites, 11 reporting organizations have reported at least one worker diagnosed with chronic beryllium disease (CBD). This figure presents the distribution in percent for those 11 reporting organizations with workers diagnosed with CBD. Approximately 61% of total CBD cases are associated with the Y-12 and HAN sites.

Number and Percent of Workers Categorized by Number of Years Following Hire Date, Undergoing BeLPT and Diagnosed with BeS or Diagnosed with CBD (n=50,155) (2002–2023) *

Number of Years Following First Hire

0-9	10-19	20-29	30+	Not Reported

Roster

| 7,921 16% | 5,204 10% | 5,115 10% | 11,159 22% | 20,756 41% |

Screened / Tested

| 5,456 14% | 3,713 10% | 3,885 10% | 8,321 22% | 17,196 45% |

BeSensitized

| 9 2% | 48 9% | 80 15% | 276 51% | 133 24% |

CBD

| 2 1% | 4 3% | 9 6% | 103 66% | 37 24% |

* Some reporting organizations have provided data that predate the 2002 start date of the Registry.

This figure shows the number of beryllium-associated workers categorized by years following first hire, undergoing Beryllium Lymphocyte Proliferation Testing (BeLPT) tests. This includes roster total, those screened, and those with beryllium sensitization (BeS) or chronic beryllium disease (CBD).

Number of Workers Undergoing BeLPT and Diagnosed with BeS or Diagnosed with CBD (n=38,571) (2002–2023) *

This table provides the numbers of beryllium-associated workers with Beryllium Lymphocyte Proliferation Testing (BeLPT) test results submitted to the Beryllium-Associated Worker Registry each year, and the year of first positive or abnormal BeLPT result for those who were beryllium-sensitized (BeS) or diagnosed as having chronic beryllium disease (CBD). First positive or abnormal BeLPT result is an important medical surveillance sentinel, resulting in earlier or more frequent repeat testing, hence, earlier diagnosis, earlier work restrictions, and more successful treatment. It is also a criterion for eligibility for compensation and payment of medical expenses under the Energy Employees Occupational Illness Compensation Program Act (EEOICPA). Two (2) abnormal BeLPT results or 1 abnormal and 2 borderline BeLPT results are required to categorize a worker as BeS. Since a worker may choose not to have repeat BeLPT measurements, may change work and have long lags between measurements, or may not test abnormal for a period of time, the year of first BeLPT provides a more reliable metric than the year a worker becomes BeS.

Year of BeLPT Result	No. Workers Tested	No. Sensitized Workers	No. Workers with CBD
<2000	708	34	11
2000	1,629	29	17
2001	3,236	43	17
2002	3,968	42	16
2003	3,968	12	6
2004	3,814	14	3
2005	5,115	28	6
2006	4,860	46	9
2007	4,578	49	5
2008	5,072	30	7
2009	6,219	52	2
2010	6,892	36	2
2011	7,920	23	0
2012	6,172	5	0
2013	5,574	8	0
2014	6,008	10	1
2015	6,049	13	0
2016	6,060	2	0
2017	6,683	11	0
2018	6,768	11	2
2019	7,044	6	0
2020	7,280	10	0
2021	7,982	2	0
2022	9,425	1	0
2023	6,444	1	0

*The number of "Workers Tested" includes all testing with results of Normal, Negative, Borderline, Positive, Abnormal, and Unsatisfactory. Workers tested periodically are included in each year they were tested. Data capture includes prior to the year 2002.

Number and Percent Proportion of Workers with Abnormal BeLPT Results BeS or CBD Results (n=38,571) (2002–2023) *

The yearly average for workers developing sensitization, whose first abnormal Beryllium Lymphocyte Proliferation Test (BeLPT) results were between Calendar Year 2001 (CY2001) and CY2010, was 35. This rate dropped to an average of 6.7 from CY2014 to CY2023. These results provide evidence that programs are serving to improve worker protection and reduce the risk of chronic beryllium disease (CBD).

This table lists beryllium-sensitized (BeS), or CBD diagnosed workers, through CY2023 grouped by their work history activity, which is a high-level rollup of job function. Based on the data submitted through CY2023 and as presented in the table, the majority of both reported BeS (35%) and CBD cases (39%) occurred among the broad occupational groups of Crafts and Line Operators.

Work History Activity	Workers with BeLPT Results (n=38,571)	No. Sensitized Workers (n=546)	Beryllium Sensitization (%)	No. Workers with CBD (n=155)	Chronic Beryllium Disease (%)
Management	2,130	46 (2.2%)	8%	10 (0.5%)	6%
Administrative Support	1,178	33 (2.8%)	6%	11 (1.0%)	7%
In-House Professionals	2,086	43 (2.1%)	8%	14 (0.7%)	9%
Field Professionals	2,871	50 (1.7%)	9%	8 (0.3%)	5%
Technical Support	4,472	73 (1.6%)	13%	15 (0.3%)	10%
Service	1,810	33 (1.8%)	6%	12 (0.7%)	8%
Security and Fire	1,636	26 (1.6%)	5%	9 (0.6%)	6%
Crafts	6,205	106 (1.7%)	19%	37 (0.7%)	24%
Line Operators	3,460	90 (2.6%)	16%	23 (0.7%)	15%
Guests	103	1 (1.0%)	<1%	0 (0%)	0%
Unknown	804	14 (1.7%)	3%	11 (1.5%)	7%
Not Reported	11,816	31 (0.3%)	6%	5 (0.1%)	3%
Totals	38,571	546 (1.4%)		155 (0.5%)	

* Some reporting organizations have provided data that predate the 2002 start date of the Registry.

Comparison of the Number and Percent Proportion of Workers Undergoing BeLPT to the Number of Workers with BeLPT Results by Reporting Organization (n=6,444) (2023)
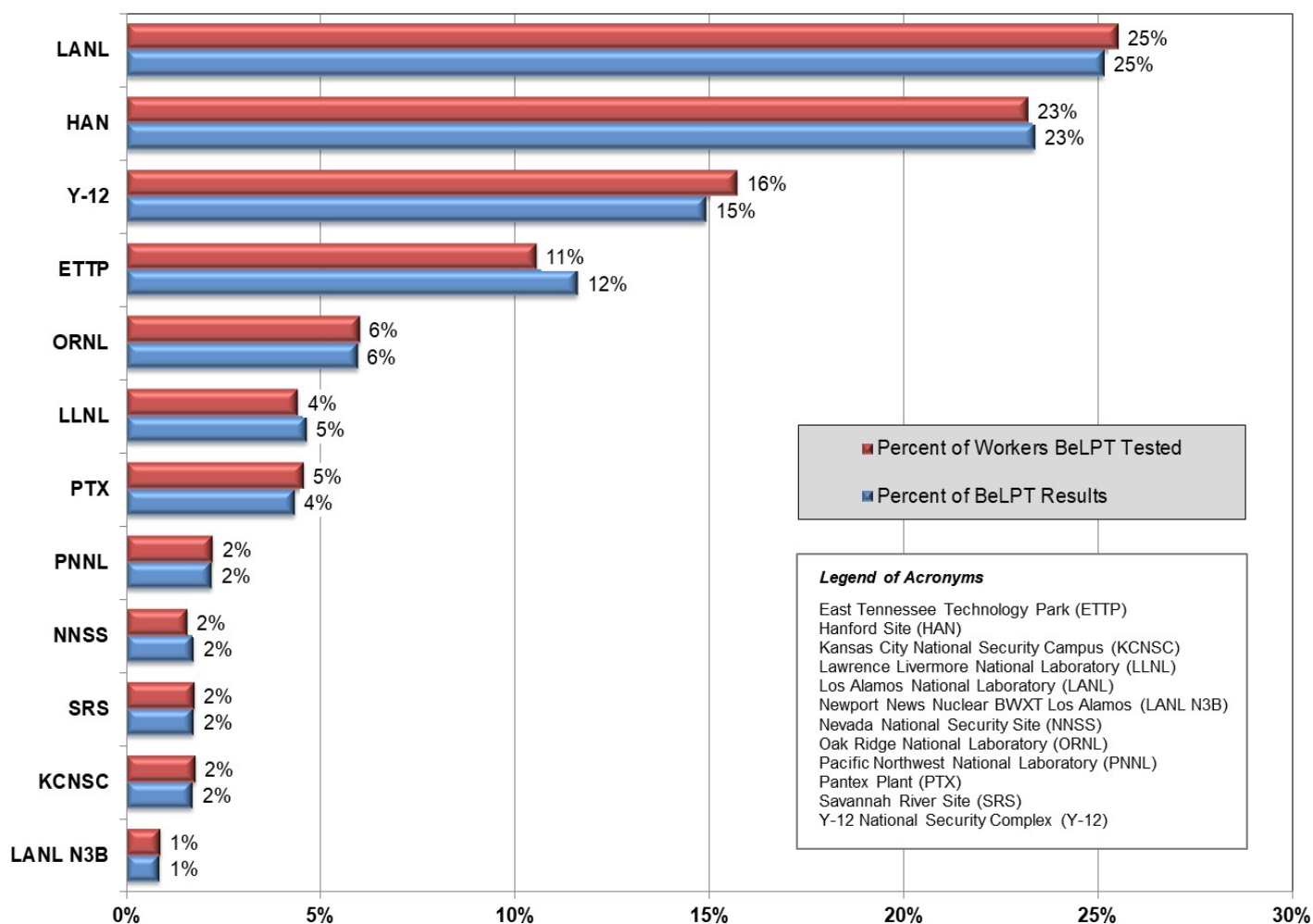
This figure compares the percent of Beryllium Lymphocyte Proliferation Testing (BeLPT) tests conducted to the number of workers tested for each reporting organization in Calendar Year 2023. Workers may be BeLPT tested multiple times in a year if they have abnormal or borderline results. Therefore, the number of BeLPT tests conducted are higher than the number of workers tested.

Exposure Monitoring Results

The Beryllium-Associated Worker Registry receives beryllium work history and exposure data. The submission contains information about all activities with the potential for beryllium exposure including where the beryllium-associated worker currently works or previously worked, and the exposures associated with those activities. Reporting organization staff collect retrospective work history information through questionnaires and interviews with the worker or from records if accessible. This information includes location, organization, and job title for workers who work directly with beryllium, work in areas of potential beryllium exposure even if not working directly with beryllium, and activities with potential casual exposure to beryllium, such as working near an area where others are working directly with beryllium.

Exposure Monitoring Trends - Workers

The cumulative number of workers monitored through Calendar Year 2023 (CY2023) was 8,861 compared to 8,541 workers monitored through CY2022 as reported in the Beryllium-Associated Worker Registry 2022 Dashboard. This equates to an increase of 320 workers monitored for exposure to beryllium through CY2023.

Sixteen (16) reporting organizations provided exposure monitoring results with monitoring dates in CY2023. Organization-specific totals for a given year may change from totals in previous annual reports due to late reporting and/or corrections.

Number and Percent of Workers Monitored by Reporting Organization (unique workers n=4,216) (2014–2023) *
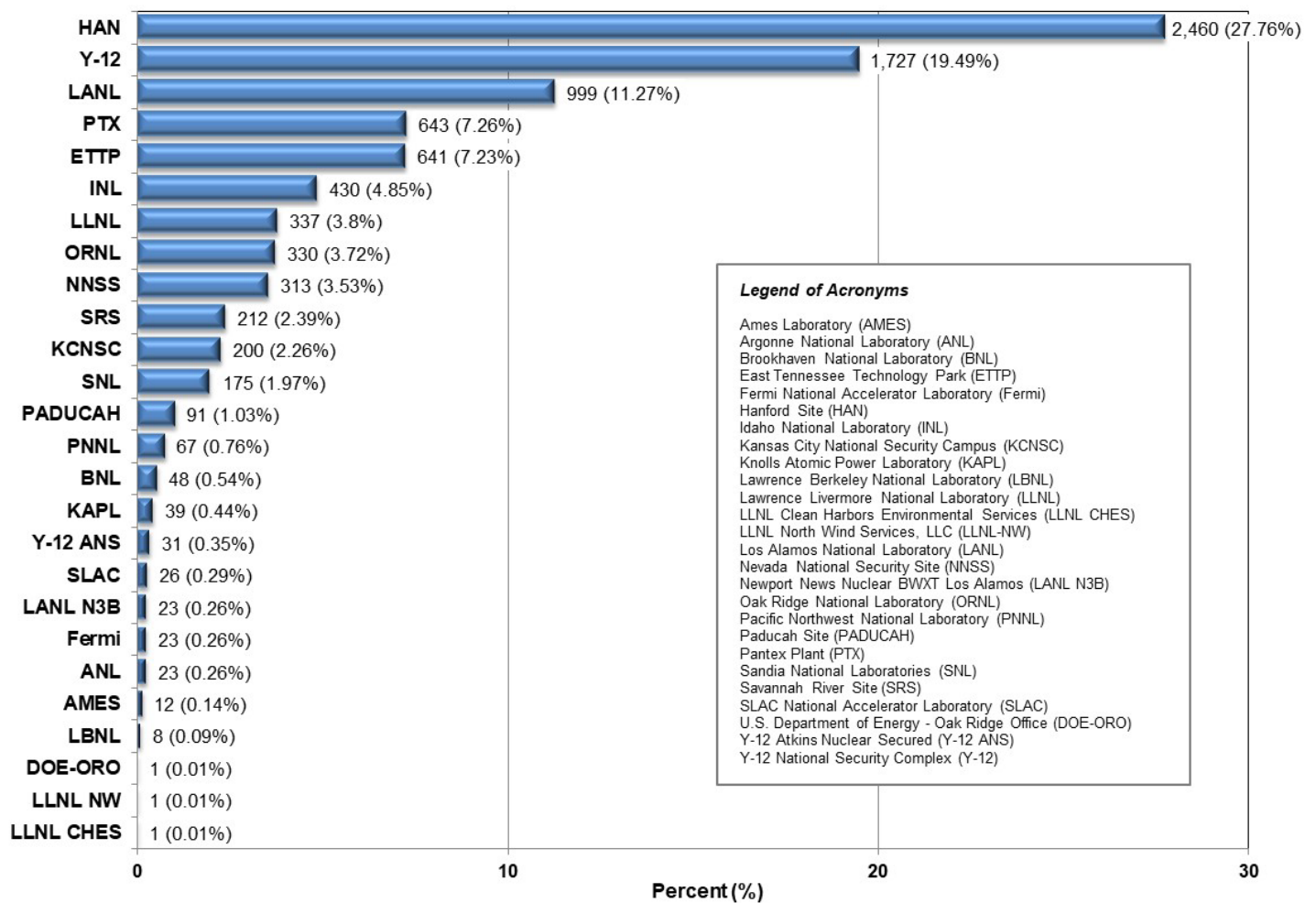
Reporting Organization	2014 n=829	2015 n=712	2016 n=697	2017 n=731	2018 n=683	2019 n=803	2020 n=708	2021 n=1,090	2022 n=746	2023 n=439
AMES	2 (0.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (0.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
BNL	2 (0.2%)	3 (0.4%)	4 (0.6%)	4 (0.5%)	1 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
DOE-ORO	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.1%)	1 (0.1%)	0 (0.0%)
ETTP	2 (0.2%)	0 (0.0%)	2 (0.3%)	0 (0.0%)	0 (0.0%)	8 (1.0%)	85 (12.0%)	168 (15.4%)	153 (20.5%)	157 (35.8%)
Fermi	1 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
HAN	325 (39.2%)	290 (40.7%)	265 (38.0%)	359 (49.1%)	244 (35.7%)	324 (40.3%)	211 (29.8%)	225 (20.6%)	192 (25.7%)	115 (26.2%)
INL	45 (5.4%)	55 (7.7%)	45 (6.5%)	31 (4.2%)	62 (9.1%)	52 (6.5%)	36 (5.1%)	45 (4.1%)	32 (4.3%)	26 (5.9%)
KAPL	2 (0.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
KCNSC	18 (2.2%)	9 (1.3%)	9 (1.3%)	7 (1.0%)	3 (0.4%)	2 (0.2%)	4 (0.6%)	7 (0.6%)	7 (0.9%)	4 (0.9%)
LANL	87 (10.5%)	32 (4.5%)	64 (9.2%)	49 (6.7%)	84 (12.3%)	127 (15.8%)	93 (13.1%)	50 (4.6%)	29 (3.9%)	4 (0.9%)
LANL N3B	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	10 (1.2%)	7 (1.0%)	5 (0.5%)	4 (0.5%)	0 (0.0%)
LBNL	3 (0.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
LLNL	25 (3.0%)	32 (4.5%)	21 (3.0%)	19 (2.6%)	16 (2.3%)	18 (2.2%)	3 (0.4%)	6 (0.6%)	12 (1.6%)	10 (2.3%)
LLNL NW	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.5%)
NNSS	17 (2.1%)	5 (0.7%)	5 (0.7%)	1 (0.1%)	4 (0.6%)	15 (1.9%)	0 (0.0%)	0 (0.0%)	10 (1.3%)	8 (1.8%)
ORNL	24 (2.9%)	20 (2.8%)	15 (2.2%)	11 (1.5%)	7 (1.0%)	10 (1.2%)	14 (2.0%)	28 (2.6%)	11 (1.5%)	7 (1.6%)
PADUCAH	5 (0.6%)	0 (0.0%)	0 (0.0%)	13 (1.8%)	15 (2.2%)	5 (0.6%)	12 (1.7%)	6 (0.6%)	5 (0.7%)	2 (0.5%)
PNNL	19 (2.3%)	7 (1.0%)	10 (1.4%)	8 (1.1%)	19 (2.8%)	9 (1.1%)	0 (0.0%)	4 (0.4%)	13 (1.7%)	6 (1.4%)
PTX	21 (2.5%)	20 (2.8%)	53 (7.6%)	27 (3.7%)	34 (5.0%)	32 (4.0%)	43 (6.1%)	42 (3.9%)	19 (2.5%)	42 (9.6%)
SNL	5 (0.6%)	16 (2.2%)	10 (1.4%)	8 (1.1%)	3 (0.4%)	9 (1.1%)	7 (1.0%)	6 (0.6%)	9 (1.2%)	13 (3.0%)
SRS	5 (0.6%)	2 (0.3%)	3 (0.4%)	6 (0.8%)	4 (0.6%)	3 (0.4%)	6 (0.8%)	4 (0.4%)	3 (0.4%)	4 (0.9%)
Y-12	221 (26.7%)	206 (28.9%)	181 (26.0%)	178 (24.4%)	174 (25.5%)	156 (19.4%)	166 (23.4%)	475 (43.6%)	232 (31.1%)	30 (6.8%)
Y-12 ANS	0 (0.0%)	15 (2.1%)	10 (1.4%)	10 (1.4%)	13 (1.9%)	18 (2.2%)	19 (2.7%)	18 (1.7%)	14 (1.9%)	9 (2.1%)
Totals	829 (100%)	712 (100%)	697 (100%)	731 (100%)	683 (100%)	803 (100%)	708 (100%)	1,090 (100%)	746 (100%)	439 (100%)

Click here for List of Acronyms

* Some reporting organizations have provided data that predate the 2002 start date of the Registry

An industrial hygienist monitored exposure for workers by reporting organization at least once in each year for the past 10 years (i.e., between 2014 and 2023).

Number and Percent Proportion of Workers Undergoing Beryllium Exposure Monitoring by Reporting Organization (n=8,861) (2002-2023) *


Legend of Acronyms

Ames Laboratory (AMES)
Argonne National Laboratory (ANL)
Brookhaven National Laboratory (BNL)
East Tennessee Technology Park (ETTP)
Fermi National Accelerator Laboratory (Fermi)
Hanford Site (HAN)
Idaho National Laboratory (INL)
Kansas City National Security Campus (KCNSC)
Knolls Atomic Power Laboratory (KAPL)
Lawrence Berkeley National Laboratory (LBNL)
Lawrence Livermore National Laboratory (LLNL)
LLNL Clean Harbors Environmental Services (LLNL CHES)
LLNL North Wind Services, LLC (LLNL-NW)
Los Alamos National Laboratory (LANL)
Nevada National Security Site (NNSS)
Newport News Nuclear BWXT Los Alamos (LANL N3B)
Oak Ridge National Laboratory (ORNL)
Pacific Northwest National Laboratory (PNNL)
Paducah Site (PADUCAH)
Pantex Plant (PTX)
Sandia National Laboratories (SNL)
Savannah River Site (SRS)
SLAC National Accelerator Laboratory (SLAC)
U.S. Department of Energy - Oak Ridge Office (DOE-ORO)
Y-12 Atkins Nuclear Secured (Y-12 ANS)
Y-12 National Security Complex (Y-12)

* Some reporting organizations have provided data that predate the 2002 start date of the registry.

This figure displays the cumulative 8,861 beryllium-associated workers monitored for beryllium exposure in Calendar Years 2002–2023 by reporting organization.

Exposure Monitoring Trends - Samples

Number and Percent Proportion of Exposure Sample Results by Year (n=37,768) (2014–2023) *
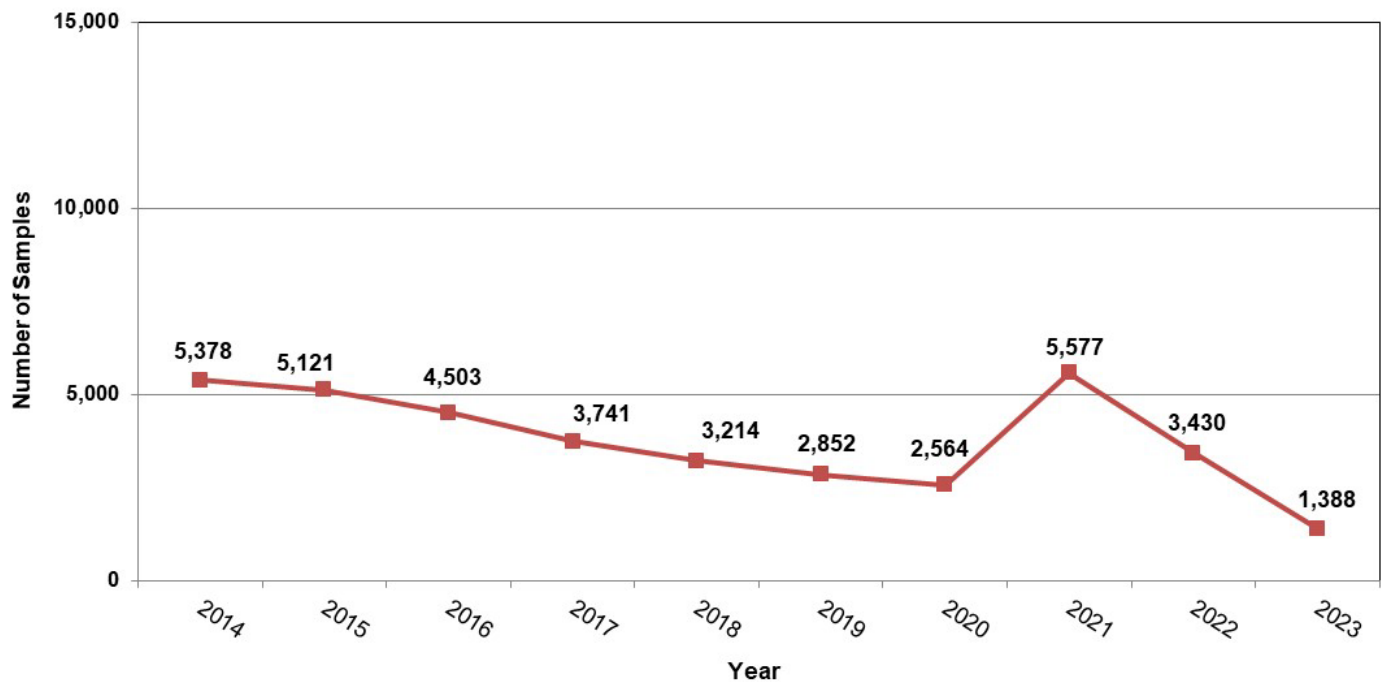
The numbers of exposure sampling results in the Beryllium-Associated Worker Registry (BAWR) by year monitored for each of the past 10 years are shown in the line chart.

As can be seen, the numbers have steadily declined in recent years, with an uptick in CY2021. The reporting organizations that collected and submitted exposure monitoring sample data show a downward trend which, in some cases, impact the analysis and interpretation of results in BAWR. The small sample size reduces accuracy and causes higher variability in the statistical models used for the BAWR analyses. In Calendar Year 2023, the number of exposure records submitted were lower than the 10 year average of 3,162 records.

Comparison of the Number and Percent Proportion of Exposure Samples to Workers with Exposure Sampling Results by Reporting Organizations (n=439) (2023)
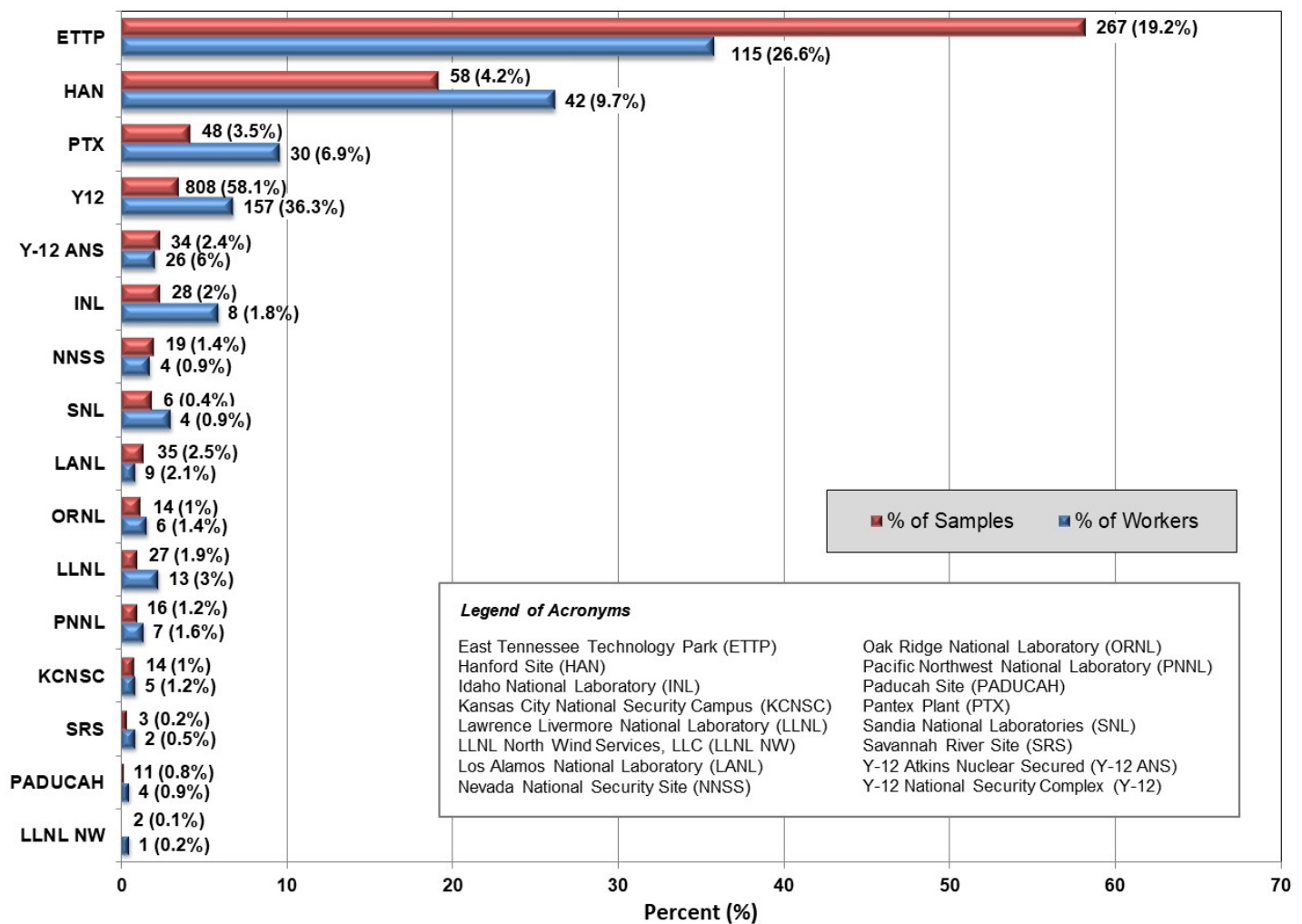
Only 16 of the 27 active sites have reported exposure samples to BAWR. This graphic illustrates the distribution of exposure samples and workers monitored across those 16 reporting organizations during CY2023. Similar to the beryllium screening results, most workers monitored for beryllium exposure have multiple exposure measurements throughout the year. The frequency of monitoring is dependent on the worker's specific type of work and their employer's monitoring schemes.

Reporting organizations submitted a total of 123,887 exposure measurements to the Beryllium-Associated Worker Registry (BAWR) through Calendar Year 2023 (CY2023). This equates to an additional 1,388 exposure sampling results collected and submitted through CY2023.

Number and Percent Proportion of Non-Detectable Results Exposure Measurements, Detectable Exposure Measurement Results and Exposure Measurement Status Not Reported (n=123,887) (2002–2023) *
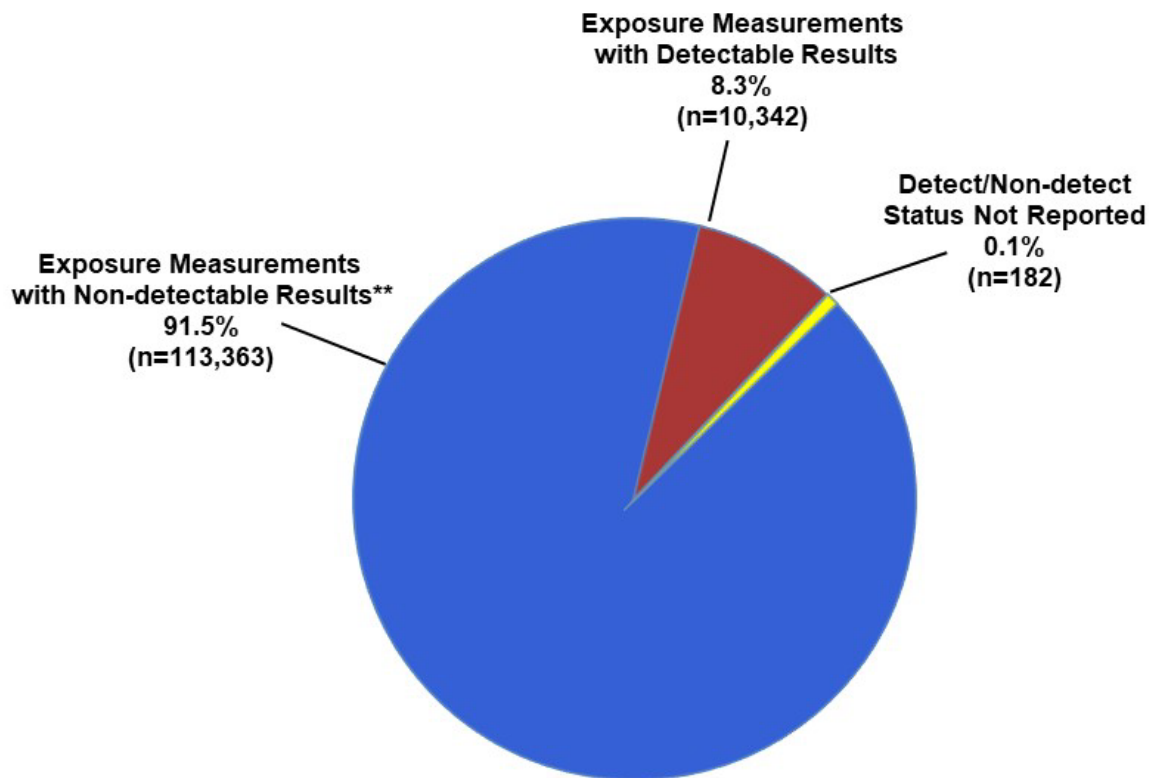
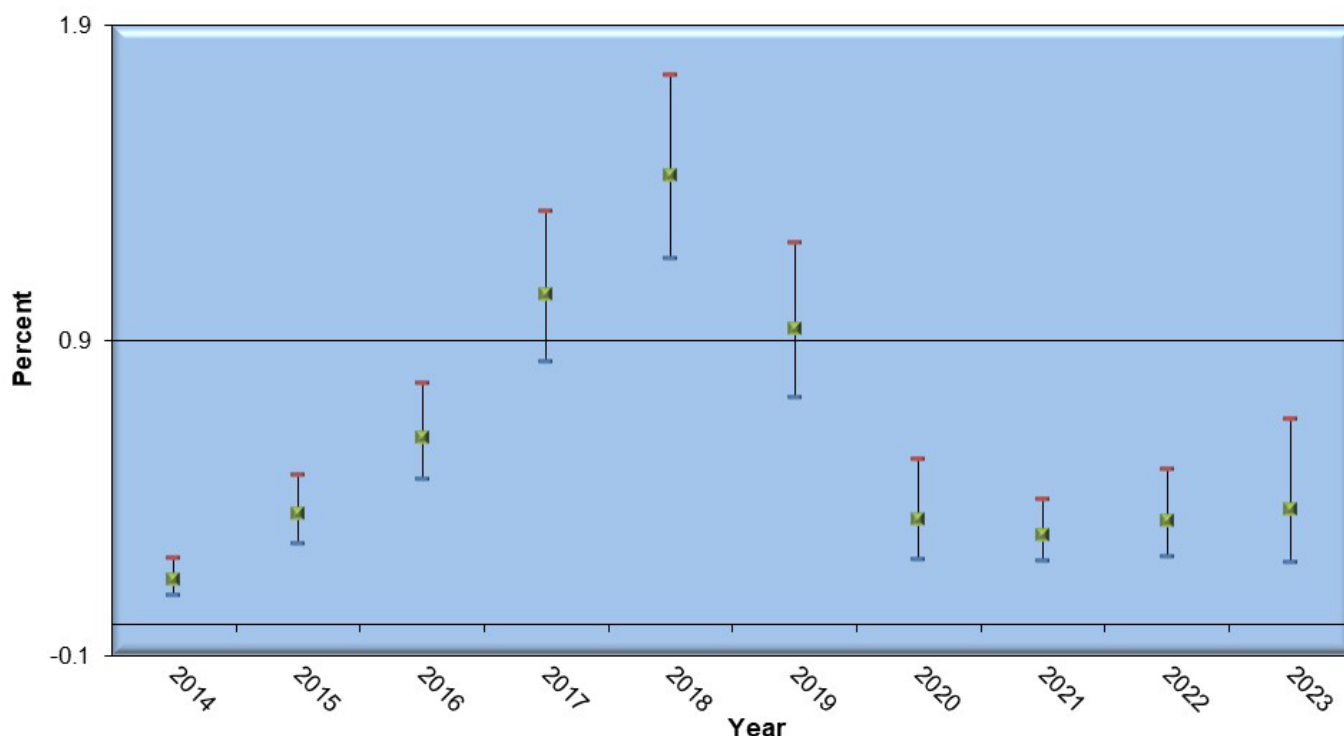* Some reporting organizations have provided data that predate the 2002 start date of the registry.
** Non-detectable indicates that analysis results were reported as less than the laboratory's reporting limit.

Of the 123,887 cumulative exposure monitoring records submitted to the Registry through Calendar Year 2023 (CY2023), 91.5% have "non-detectable" results, indicating that the sample analysis results were less than the laboratory's reporting limit. The reporting limit can vary from sample to sample because of differing flow rates of the sampling equipment used and because of the presence of other materials on the sample that can interfere with the analysis. Reporting limits typically vary from 0.01 to 0.05 µg/m^3, which is one-twentieth to one-quarter of the action level of 0.2 µg/m^3.

In comparison, 122,499 cumulative exposure monitoring results were submitted through CY2022, for an increase through CY2023 of 1,388 records (including those monitoring dates in CY2022 and earlier). This 1,388 increase in sampling results is lower than the 5,577 records submitted in CY2021 and 3,430 records submitted in CY2022.

Trends in Exposure Levels

Percent of 8-hour time weighted average (TWA) Exceeding Action Level 0.2 μg/m³ by Year (2014–2023) *

* Some reporting organizations have provided data that predate the 2002 start date of the registry. Percent exceeding 0.2 μg/m³ based on 95% Confidence Limits.

This figure shows the percent of DOE-wide 8-hour time weighted average (TWA) personal exposure monitoring results that exceeded the action level of 0.2 μg/m³ in each of the 10 years from Calendar Year 2014 (CY2014) to CY2023.

Infographic Details

2014
Upper confidence limit for F: 0.2
Percent exceeding 0.2 μg/m³ (F): 0.1
Lower confidence limit for F: 0.1

2015
Upper confidence limit for F: 0.5
Percent exceeding 0.2 μg/m³ (F): 0.3
Lower confidence limit for F: 0.3

2016
Upper confidence limit for F: 0.8
Percent exceeding 0.2 μg/m³ (F): 0.6
Lower confidence limit for F: 0.5

2017
Upper confidence limit for F: 1.3
Percent exceeding 0.2 μg/m³ (F): 1.0
Lower confidence limit for F: 0.8

2018
Upper confidence limit for F: 1.7
Percent exceeding 0.2 μg/m³ (F): 1.4
Lower confidence limit for F: 1.2

2019
Upper confidence limit for F: 1.2
Percent exceeding 0.2 μg/m³ (F): 0.9
Lower confidence limit for F: 0.7

2020
Upper confidence limit for F: 0.5
Percent exceeding 0.2 μg/m3 (F): 0.3
Lower confidence limit for F: 0.2

2021
Upper confidence limit for F: 0.4
Percent exceeding 0.2 μg/m³ (F): 0.3
Lower confidence limit for F: 0.2

2022
Upper confidence limit for F: 0.5
Percent exceeding 0.2 μg/m³ (F): 0.3
Lower confidence limit for F: 0.2

2023
Upper confidence limit for F: 0.6
Percent exceeding 0.2 μg/m³ (F): 0.4
Lower confidence limit for F: 0.2

Summary Statistics for 2014–2023 8-Hour Time Weighted Average Exposure Monitoring Results *

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	10-year Summary
Number of reported monitoring results	5,378 (14.2%)	5,121 (13.6%)	4,503 (11.9%)	3,741 (9.9%)	3,214 (8.5%)	2,852 (7.6%)	2,564 (6.8%)	5,577 (14.8%)	3,430 (9.1%)	1,388 (3.7%)	37,768 (100%)
Number of detected values	177 (12.4%)	159 (11.2%)	241 (16.9%)	175 (12.3%)	240 (16.8%)	168 (11.8%)	71 (5.0%)	88 (6.2%)	73 (5.1%)	34 (2.4%)	1,426 (100%)
Percent non-detects	96.7	96.9	94.6	94.9	92.4	94	97.2	98.4	97.8	97.4	96.1
Number of individuals monitored	828 (19.8%)	729 (17.4%)	704 (16.8%)	730 (17.5%)	683 (16.3%)	803 (19.2%)	708 (16.9%)	1,090 (26.1%)	721 (17.3%)	417 (10.0%)	4,179 (100%)
Arithmetic mean (EX) ($\mu g/m^3$)	0.002	0.012	0.016	0.842	0.369	0.165	0.021	0.155	0.074	0.082	0.045
Lower confidence limit of EX ($\mu g/m^3$)	0.002	0.005	0.008	0.128	0.101	0.039	0.003	0.010	0.006	0.002	0.029
Upper confidence limit of EX ($\mu g/m^3$)	0.003	0.030	0.031	5.521	1.353	0.708	0.141	2.512	0.946	2.743	0.069
Observed 95th percentile of data ($\mu g/m^3$)	0.004	0.004	0.005	0.006	0.020	0.011	0.001	<0.001	<0.001	<0.001	0.004
95% upper tolerance limit of the 95th percentile ($\mu g/m^3$)	0.017	0.017	0.020	0.020	0.030	0.026	0.012	0.011	0.013	0.011	0.017
Largest value ($\mu g/m^3$)	0.876	1.847	8.865	87.419	16.712	23.084	17.340	6.609	2.897	0.754	87.419
Percent exceeding 0.2 $\mu g/m^3$ (F)	0.1	0.3	0.6	1.0	1.4	0.9	0.3	0.3	0.3	0.4	0.5
Lower confidence limit for F	0.1	0.3	0.5	0.8	1.2	0.7	0.2	0.2	0.2	0.2	0.5
Upper confidence limit for F	0.2	0.5	0.8	1.3	1.7	1.2	0.5	0.4	0.5	0.6	0.6

* Many individuals were monitored in more than 1 year. The total number of individuals measured at least once in the 10-year period from CY2014 through CY2023 is 4,216. Some reporting organizations have provided data that predate the CY2002 start date of the registry. Percent exceeding 0.2 $\mu g/m^3$ based on 95% Confidence Limits.
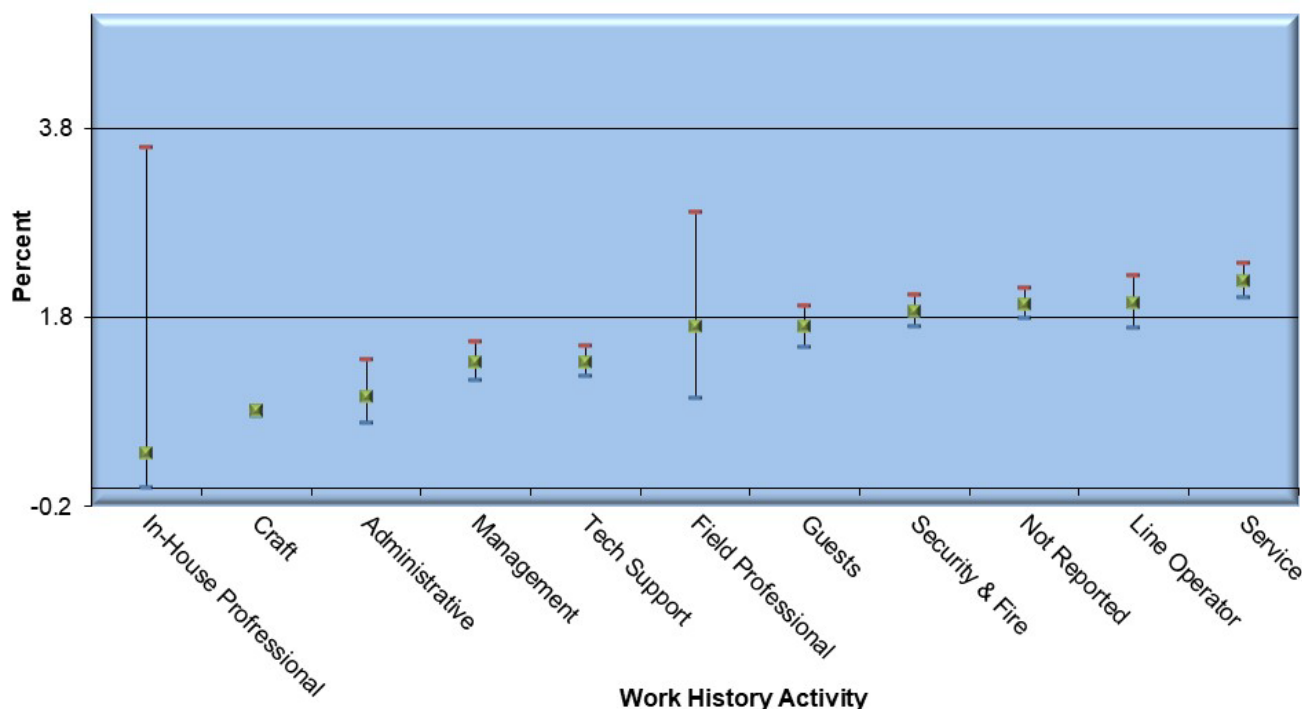
The detailed data presented in the table above provide additional summary statistics for the DOE-wide 8-hour TWA results for each of the past 10 years. The very high percentage of non-detected results from workplaces compliant with the 0.2 µg/m^3 action level points to the need to develop more sensitive exposure monitoring methods to support estimates of individuals' actual exposure levels.

These statistical methods accommodate the high percentage of non-detect results (left censored) in these data sets. These analyses exclude non-detected values greater than 0.2 µg/m^3. For details, see "*Statistical Methods and Software for the Analysis of Occupational Exposure Data with Non-Detectable Values*" Frome EL and Wambach PF, ORNL/TM-2005/52.

Totals for an individual year may vary from previous reports due to late reporting and/or corrections. The data reported in the Beryllium-Associated Worker Registry indicate that the chronic beryllium disease prevention programs operated at DOE sites have continued to maintain a high level of compliance with the 10 CFR 850 action level of 0.2 µg/m^3 over the past 10 years.

Exceedances Observed through 2023

Percent of 8-hour time weighted average (TWA) Exceeding Action Level 0.2 µg/m³ by Work History Activity (2002–2023) *

* Some reporting organizations have provided data that predate the 2002 start date of the registry. Percent exceeding 0.2 µg/m³ based on 95% Confidence Limits.

The graphic shows the percent of 8-hour time weighted average (TWA) exposure monitoring results that exceed the action level, grouped by work activity for the cumulative data through CY2023. The detailed data in the table provide additional summary statistics for the composite 8-hour TWA results by work activity.

For the cumulative data, the highest percentage of action level exceedances by work history activity is among workers where the work activity is unknown or not reported.

Infographic Details for CY2023

In-House Professional
Upper confidence limit for F: 3.6
Percent exceeding 0.2 µg/m³ (F): 0.4
Lower confidence limit for F: <0.1

Craft
Upper confidence limit for F: 0.9
Percent exceeding 0.2 µg/m³ (F): 0.8
Lower confidence limit for F: 0.8

Administrative
Upper confidence limit for F: 1.3
Percent exceeding 0.2 µg/m³ (F): 1.0
Lower confidence limit for F: 0.7

Management
Upper confidence limit for F: 1.5
Percent exceeding 0.2 µg/m³ (F): 1.3
Lower confidence limit for F: 1.1

Tech Support
Upper confidence limit for F: 1.5
Percent exceeding 0.2 µg/m³ (F): 1.3
Lower confidence limit for F: 1.2

Field Professionals
Upper confidence limit for F: 2.9
Percent exceeding 0.2 µg/m³ (F): 1.7
Lower confidence limit for F: 0.9

Guests
Upper confidence limit for F: 1.9
Percent exceeding 0.2 µg/m³ (F): 1.7
Lower confidence limit for F: 1.5

Security & Fire
Upper confidence limit for F: 2.0
Percent exceeding 0.2 µg/m³ (F): 1.9
Lower confidence limit for F: 1.7

Not Reported
Upper confidence limit for F: 2.1
Percent exceeding 0.2 µg/m³ (F): 1.9
Lower confidence limit for F: 1.8

Line Operators
Upper confidence limit for F: 2.2
Percent exceeding 0.2 µg/m³ (F): 2.0
Lower confidence limit for F: 1.7

Service
Upper confidence limit for F: 2.4
Percent exceeding 0.2 µg/m³ (F): 2.2
Lower confidence limit for F: 2.0

Summary Statistics for 8-hour time weighted average (TWA) Exceeding Action Level 0.2 µg/m^3 by Work History Activity (2002–2023) *

Work History Activity	Admin	Craft	Field Prof	Guests	In-House Prof	Line Operator	Management	Security & Fire	Service	Tech Support	Not Reported	Total
No. reported monitoring results	1,820 (1.0%)	56,035 (30.5%)	3,507 (1.9%)	6,460 (3.5%)	111 (0.1%)	4,627 (2.5%)	5,922 (3.2%)	67,638 (36.8%)	13,543 (7.4%)	9,815 (5.3%)	14,256 (7.8%)	183,734 (100%)
No. detected values	158 (0.9%)	2,619 (14.6%)	3,006 (16.7%)	616 (3.4%)	72 (0.4%)	533 (3.0%)	517 (2.9%)	6,823 (38%)	1,246 (6.9%)	670 (3.7%)	1,701 (9.5%)	17,961 (100%)
% non-detects	96.7	95.1	96.3	90.3	82.4	88.5	91.1	83.1	90.5	93.2	87.9	91.9
No. individuals monitored	123 (1.2%)	2,940 (27.7%)	151 (1.4%)	835 (7.9%)	9 (0.1%)	386 (3.6%)	372 (3.5%)	2,851 (26.9%)	1,540 (14.5%)	924 (8.7%)	1,521 (14.3%)	10,609 (100%)
Observed 95th percentile of data (µg/m^3)	0.001	0.008	0.001	0.034	0.019	0.046	0.021	0.063	0.050	0.016	0.050	0.021
95% UTL of 95th percentile (µg/m^3)	0.038	0.050	0.050	0.058	<0.001	0.053	0.050	0.082	0.096	0.050	0.080	0.050
Largest value (µg/m^3)	28.475	84.933	11.700	26.678	0.172	12.611	87.419	7.670	575.930	79.330	29.852	575.930
% > 0.2 µg/m^3 (F)	1.0	0.8	1.7	1.7	0.4	2.0	1.3	1.9	2.2	1.3	1.9	1.4
Lower confidence limit for F	0.7	0.8	0.9	1.5	<0.1	1.7	1.1	1.7	2.0	1.2	1.8	1.3
Upper confidence limit for F	1.3	0.9	2.9	1.9	3.6	2.2	1.5	2.0	2.4	1.5	2.1	1.4

* Some reporting organizations have provided data that predate the 2002 start date of the registry. Percent exceeding 0.2 µg/m^3 based on 95% Confidence Limits.

Percent of 8-hour time weighted average (TWA) Exceeding Action Level 0.2 μg/m³ by Job Title for Craft Workers (2002–2023) *
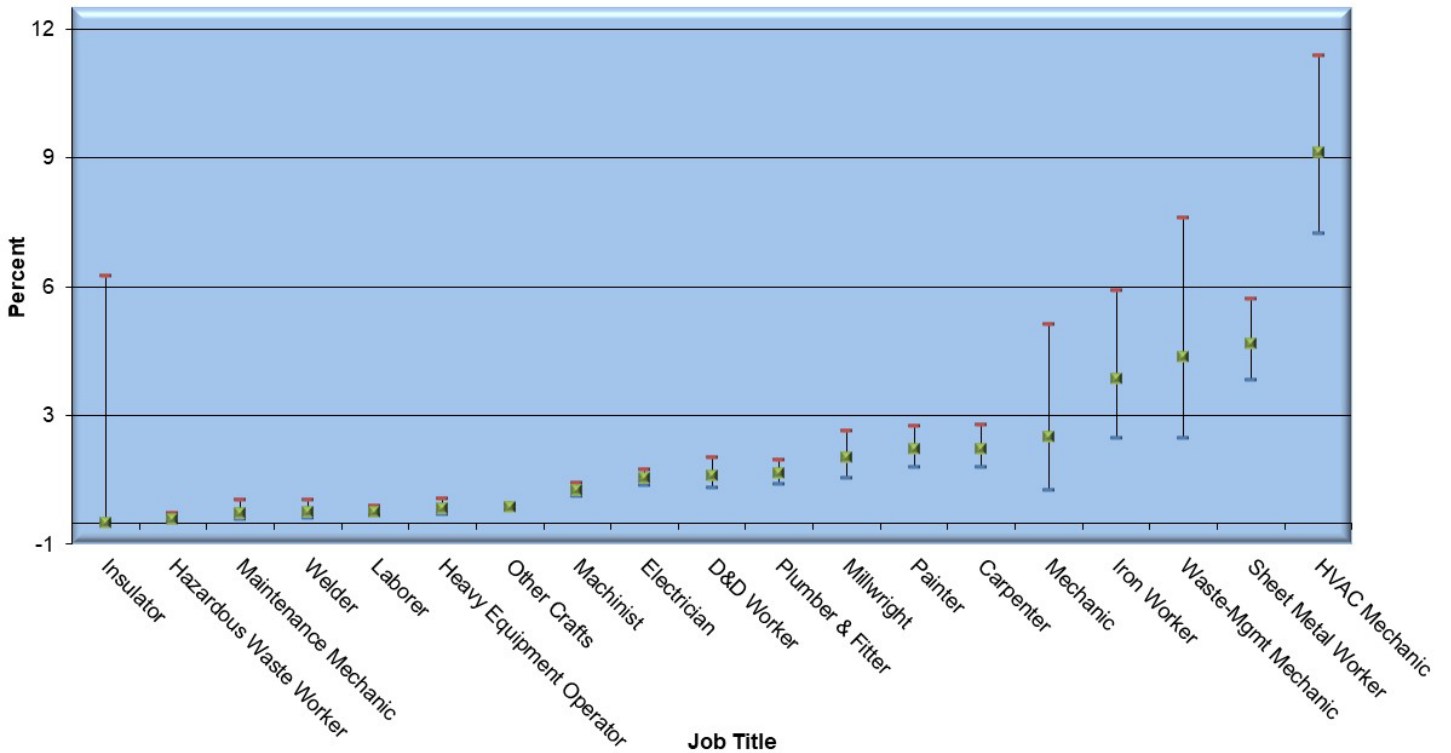
* Some reporting organizations have provided data that predate the 2002 start date of the registry. Percent exceeding 0.2 μg/m³ based on 95% Confidence Limits.

This graphic shows individuals with job titles in the craft work activity category. The detailed data through 2023 presented in the accompanying table include the summary statistics for cumulative 8-hour TWA monitoring results by craft job title. Machinist, Electrician, Deactivation & Decommissioning (D&D Worker), Plumber & Fitter, Millwright, Painter, Carpenter, Mechanic, Iron Worker, Waste-Management Mechanic, Sheet Metal Worker, and Heating, Ventilation, and Air Conditioning (HVAC) Mechanic individually have percent exceedances that are higher than when all crafts are combined (0.8% to 6.7% as compared to 0.8%, as shown in the table below).

Among craft workers, HVAC Mechanics, Waste-Management Mechanics, and Sheet Metal Workers show percentages exceeding the 0.2 μg/m³ action level that are higher than the percentages experienced by other craft workers. However, the percentage for HVAC mechanics reflects exposure monitoring results for only 145 individuals, and for sheet metal workers only 127 individuals.

Infographic Details for CY2023

Insulator
Upper confidence limit for F: <0.1
Percent exceeding 0.2 µg/m3 (F): 5.7
Lower confidence limit for F: 0.0

Machinist
Upper confidence limit for F: 0.6
Percent exceeding 0.2 µg/m³ (F): 0.9
Lower confidence limit for F: 0.8

Mechanic
Upper confidence limit for F: 0.7
Percent exceeding 0.2 µg/m³ (F): 4.6
Lower confidence limit for F: 2.0

Hazardous Waste Worker
Upper confidence limit for F: <0.1
Percent exceeding 0.2 µg/m³ (F): 0.2
Lower confidence limit for F: 0.1

Electrician
Upper confidence limit for F: 0.9
Percent exceeding 0.2 µg/m³ (F): 1.2
Lower confidence limit for F: 1.0

Iron Worker
Upper confidence limit for F: 2.0
Percent exceeding 0.2 µg/m3 (F): 5.4
Lower confidence limit for F: 3.3

Maintenance Mechanic
Upper confidence limit for F: 0.1
Percent exceeding 0.2 µg/m³ (F): 0.5
Lower confidence limit for F: 0.2

D&D Worker
Upper confidence limit for F: 0.8
Percent exceeding 0.2 µg/m³ (F): 1.5
Lower confidence limit for F: 1.1

Waste-Mgmt Mechanic
Upper confidence limit for F: 2.0
Percent exceeding 0.2 µg/m³ (F): 7.1
Lower confidence limit for F: 3.9

Welder
Upper confidence limit for F: 0.1
Percent exceeding 0.2 µg/m³ (F): 0.5
Lower confidence limit for F: 0.2

Plumber & Fitter
Upper confidence limit for F: 0.9
Percent exceeding 0.2 µg/m³ (F): 1.4
Lower confidence limit for F: 1.1

Sheet Metal Worker
Upper confidence limit for F: 3.3
Percent exceeding 0.2 µg/m³ (F): 5.2
Lower confidence limit for F: 4.2

Laborer
Upper confidence limit for F: 0.2
Percent exceeding 0.2 µg/m³ (F): 0.4
Lower confidence limit for F: 0.3

Millwright
Upper confidence limit for F: 1.0
Percent exceeding 0.2 µg/m³ (F): 2.1
Lower confidence limit for F: 1.5

HVAC Mechanic
Upper confidence limit for F: 6.7
Percent exceeding 0.2 µg/m³ (F): 10.9
Lower confidence limit for F: 8.6

Heavy Equip Operator
Upper confidence limit for F: 0.2
Percent exceeding 0.2 µg/m³ (F): 0.6
Lower confidence limit for F: 0.3

Painter
Upper confidence limit for F: 1.3
Percent exceeding 0.2 µg/m³ (F): 2.3
Lower confidence limit for F: 1.7

Other Crafts
Upper confidence limit for F: 0.3
Percent exceeding 0.2 µg/m³ (F): 0.4
**Lower confidence limit for F:** 0.3

Carpenter
Upper confidence limit for F: 1.3
Percent exceeding 0.2 µg/m³ (F): 2.3
Lower confidence limit for F: 1.7

Summary Statistics for 8-hour time weighted average (TWA) Exceeding Action Level 0.2 µg/m³ by Job Title (2002–2023) *

Craft Job Title	Number of reported monitoring results	Number of detected values	Percent non-detects	Number of individuals monitored	Observed 95th% of data (µg/m³)	95% UTL of 95th% (µg/m³)	Largest value (µg/m³)	Percent exceeding 0.2 µg/m³ (F)	Lower confidence limit for F	Upper confidence limit for F
Insulator	175 (0%)	3 (0%)	98.3	30 (1%)	<0.01	0.20	0.20	<0.1	<0.1	5.7
Hazardous Waste Worker	2,225 (4%)	26 (1%)	98.8	44 (1%)	<0.01	0.10	0.43	0.1	<0.1	0.2
Maintenance Mechanic	785 (1%)	19 (1%)	97.6	121 (4%)	<0.01	0.03	0.20	0.2	0.1	0.5
Welder	1,144 (2%)	33 (1%)	97.1	56 (2%)	0.01	0.02	0.36	0.2	0.1	0.5
Laborer	3,957 (7%)	86 (3%)	97.8	434 (15%)	<0.01	0.04	10.34	0.3	0.2	0.4
Heavy Equipment Operator	1,424 (3%)	71 (3%)	95.0	160 (5%)	<0.01	0.02	10.44	0.3	0.2	0.6
Other Crafts	24,755 (44%)	677 (26%)	97.3	565 (19%)	<0.01	0.02	84.93	0.3	0.3	0.4
Machinist	6,842 (12%)	310 (12%)	95.5	146 (5%)	0.01	0.05	51.89	0.8	0.6	0.9
Electrician	4,885 (9%)	369 (14%)	92.4	465 (16%)	0.02	0.05	14.42	1.0	0.9	1.2
Deactivation & Decommissioning (D&D) Worker	1,557 (3%)	160 (6%)	89.7	179 (6%)	0.03	0.05	12.51	1.1	0.8	1.5
Plumber & Fitter	2,928 (5%)	175 (7%)	94.0	300 (10%)	0.01	0.05	5.73	1.1	0.9	1.4
Millwright	974 (2%)	54 (2%)	94.5	153 (5%)	0.01	0.05	23.08	1.5	1.0	2.1
Painter	1,359 (2%)	185 (7%)	86.4	64 (2%)	0.05	0.07	7.42	1.7	1.3	2.3
Carpenter	1,315 (2%)	119 (5%)	91.0	157 (5%)	0.04	0.05	3.18	1.7	1.3	2.3
Mechanic	136 (0%)	12 (0%)	91.2	46 (2%)	0.02	0.07	0.14	2.0	0.7	4.6
Iron Worker	231 (0%)	31 (1%)	86.6	58 (2%)	0.13	0.35	1.85	3.3	2.0	5.4
Waste-Mgmt Mechanic	129 (0%)	17 (1%)	86.8	14 (0%)	0.09	1.10	2.39	3.9	2.0	7.1
Sheet Metal Worker	864 (2%)	127 (5%)	85.3	127 (4%)	0.23	0.39	8.87	4.2	3.3	5.2
Heating, Ventilation, and Air Conditioning (HVAC) Mechanic	350 (1%)	145 (6%)	58.6	32 (1%)	0.35	0.67	6.33	8.6	6.7	10.9
All Combined Craft	56,035 (100%)	2,619 (100%)	95.3	2,940 (100%)	0.01	0.05	84.93	0.741	0.7	0.791

*Some reporting organizations have provided data that predate the 2002 start date of the registry. Percent exceeding 0.2 µg/m³ based on 95% Confidence Limits.

Percent of 8-hour time weighted average (TWA) Exceeding Action Level 0.2 µg/m³ by Reporting Organization (2002–2023) *
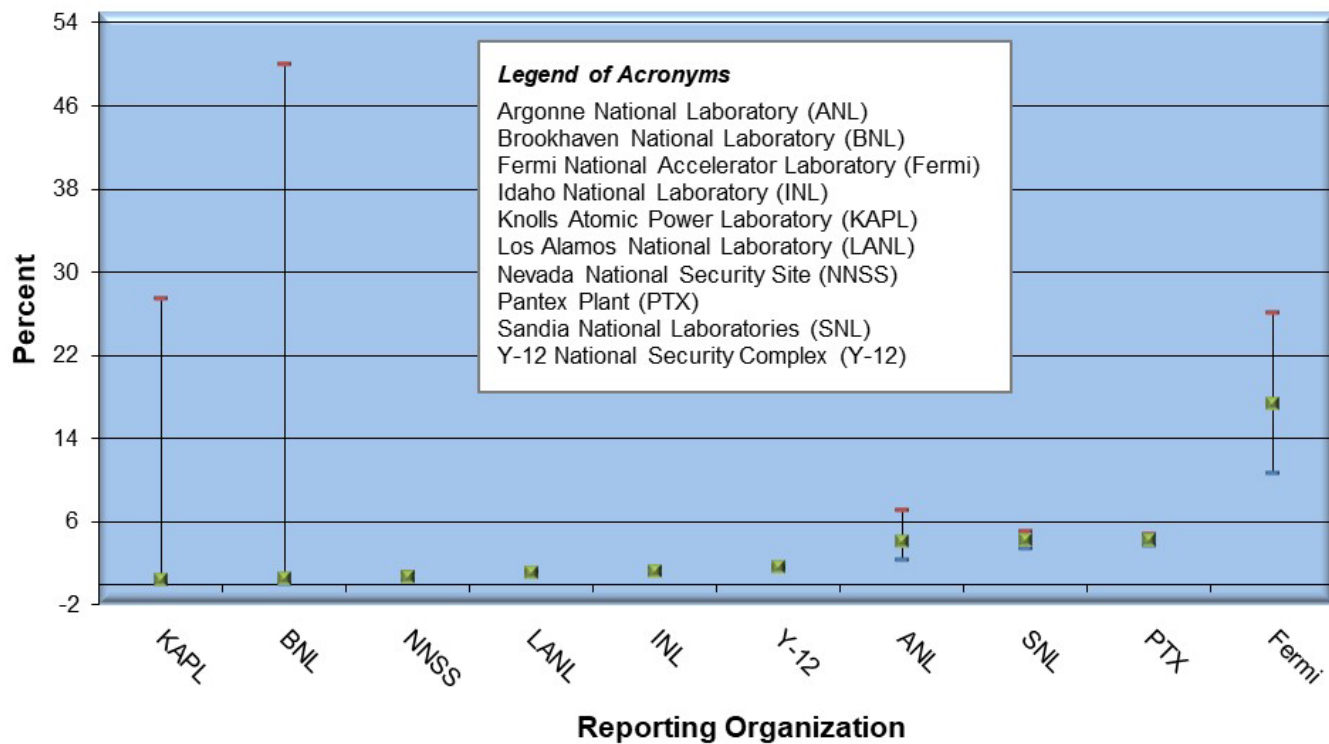
* Some reporting organizations have provided data that predate the 2002 start date of the registry. Percent exceeding 0.2 µg/m³ based on 95% Confidence Limits.

This chart summarizes the cumulative 8-hour TWA exposure monitoring results through Calendar Year 2023 by reporting organization. The detailed data presented below include the summary statistics for the cumulative 8-hour TWA monitoring results for each reporting organization that reported workers with a percentage exceeding the action level. The percent of monitoring results exceeding the action level at INL, Y-12, ANL, SNL and Fermi (ranging from 1.2 to 17.2%) were higher than the overall percent exceedances when data across all organizations are combined (1.1%).

The graphic does not include results from AMES, ETTP, HAN, KCNSC, LANL N3B, LBNL, LLNL CHES, ORNL, PADUCAH, PNNL, SLAC, SRS, and Y-12 ANS because of the small number of total samples and/or low percent exceeding the action level. Collectively, these data indicate that the majority of reporting organizations have acceptable sampling programs. However, the data also show that some organizations with ongoing beryllium activities, but small numbers of exposure monitoring samples could revisit their sampling strategies and consider increasing the volume of sampling.

Infographic Details for CY2023

KAPL
Upper confidence limit for F: 27.4
Percent exceeding 0.2 μg/m^3 (F): 0.3
Lower confidence limit for F: < 0.1

BNL
Upper confidence limit for F: 50.0
Percent exceeding 0.2 μg/m^3 (F): 0.5
Lower confidence limit for F: < 0.1

NNSS
Upper confidence limit for F: 1.0
Percent exceeding 0.2 μg/m^3 (F): 0.7
Lower confidence limit for F: 0.4

LANL
Upper confidence limit for F: 1.2
Percent exceeding 0.2 μg/m^3 (F): 1.1
Lower confidence limit for F: 1.0

INL
Upper confidence limit for F: 1.5
Percent exceeding 0.2 μg/m^3 (F): 1.2
Lower confidence limit for F: 0.9

Y-12
Upper confidence limit for F: 1.6
Percent exceeding 0.2 μg/m^3 (F): 1.5
Lower confidence limit for F: 1.5

ANL
Upper confidence limit for F: 7.0
Percent exceeding 0.2 μg/m^3 (F): 4.1
Lower confidence limit for F: 2.3

SNL
Upper confidence limit for F: 5.0
Percent exceeding 0.2 μg/m^3 (F): 4.1
Lower confidence limit for F: 3.4

PTX
Upper confidence limit for F: 4.7
Percent exceeding 0.2 μg/m^3 (F): 4.2
Lower confidence limit for F: 3.7

Fermi
Upper confidence limit for F: 26.1
Percent exceeding 0.2 μg/m^3 (F): 17.2
Lower confidence limit for F: 10.6

Not Shown in Graph
AMES
Upper confidence limit for F: 91.1
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

ETTP
Upper confidence limit for F: 0.0
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

HAN
Upper confidence limit for F: 1.1
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

KCNSC
Upper confidence limit for F: 31.2
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

LANL N3B
Upper confidence limit for F: 5.5
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

LBNL
Upper confidence limit for F: 15.3
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

LLNL
Upper confidence limit for F: 77.6
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

LLNL CHES
Upper confidence limit for F: 63.2
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

ORNL
Upper confidence limit for F: 17.1
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

Paducah
Upper confidence limit for F: 63.2
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

PNNL
Upper confidence limit for F: 77.6
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

SLAC
Upper confidence limit for F: 6.9
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

SRS
Upper confidence limit for F: 52.7
Percent exceeding 0.2 μg/m^3 (F): < 0.1
Lower confidence limit for F: < 0.1

Y-12 ANS
Upper confidence limit for F: 8.2
Percent exceeding 0.2 μg/m^3 (F): < 0.1
**Lower confidence limit for F:** < 0.1

Summary Statistics for 8-hour time weighted average (TWA) Exceeding Action Level 0.2 µg/m^3 by Reporting Organization (2002–2023) *

Reporting Organization	No. monitoring results	No. detected values	% non-detects	No. individ. monitored	Obs. 95th percentile (µg/m^3)	95% UTL/ 95th % (µg/m^3)	Largest value (µg/m^3)	% > 0.2 µg/m^3 (F)	Lower confidence limit for F	Upper confidence limit for F
AMES	57 (0.0%)	3 (0.0%)	94.7	12 (2.9%)	<0.001	<0.001	0.028	<0.1	<0.1	91.1
ETTP	808 (0.4%)	1 (0.0%)	100.0	157 (37.6%)	0.010		0.064	<0.1	<0.1	0.4
HAN	267 (0.1%)	1 (0.0%)	100.0	157 (37.6%)	0.009		0.009	<0.1	<0.1	1.1
KCNSC	8 (0.0%)	0 (0.0%)	100.0	4 (1.0%)	<0.001		<0.001	<0.1	<0.1	31.2
LANL N3B	53 (0.0%)	1 (0.0%)	98.0	23 (5.5%)	0.014		0.015	<0.1	<0.1	5.5
LBNL	18 (0.0%)	0 (0.0%)	100.0	8 (1.9%)	0.100		0.100	<0.1	<0.1	15.3
LLNL	2 (0.0%)	0 (0.0%)	100.0	1 (0.2%)	0.078		0.080	<0.1	<0.1	77.6
LLNL CHES	3 (0.0%)	0 (0.0%)	100.0	1 (0.2%)	0.040		0.042	<0.1	<0.1	63.2
ORNL	16 (0.0%)	0 (0.0%)	100.0	2 (0.5%)	0.010		0.010	<0.1	<0.1	17.1
PADUCAH	3 (0.0%)	0 (0.0%)	100.0	2 (0.5%)	0.011		0.011	<0.1	<0.1	63.2
PNNL	2 (0.0%)	0 (0.0%)	100.0	4 (1.0%)	<0.001		<0.001	<0.1	<0.1	77.6
SLAC	42 (0.0%)	0 (0.0%)	100.0	26 (6.2%)	0.040		0.150	<0.1	<0.1	6.9
SRS	4 (0.0%)	0 (0.0%)	100.0	4 (1.0%)	0.004		0.004	<0.1	<0.1	52.7
Y-12 ANS	35 (0.0%)	1 (0.0%)	97.1	9 (2.2%)	0.009		0.014	<0.1	<0.1	8.2
KAPL	236 (0.1%)	2 (0.0%)	99.2	39 (9.4%)	0.006	0.200	0.200	0.3	<0.1	27.4
BNL	105 (0.1%)	2 (0.0%)	98.1	8 (1.9%)	0.002	0.100	0.100	0.5	<0.1	50.0
NNSS	1,129 (0.6%)	94 (0.5%)	91.7	297 (71.2%)	0.010	0.052	0.317	0.7	0.4	1.0
LANL	14,174 (7.7%)	2,725 (15.2%)	80.8	1 (0.2%)	0.040	0.054	26.678	1.1	1.0	1.2
INL	2,327 (1.3%)	274 (1.5%)	88.2	115 (27.6%)	0.036	0.093	2.897	1.2	0.9	1.5
Y-12	65,278 (35.5%)	4,927 (27.4%)	92.5	30 (7.2%)	0.032	0.050	87.419	1.5	1.5	1.6
ANL	155 (0.1%)	18 (0.1%)	88.4	23 (5.5%)	0.145	1.100	2.390	4.1	2.3	7.0
SNL	1,024 (0.6%)	382 (2.1%)	62.7	13 (3.1%)	0.129	0.180	3.820	4.1	3.4	5.0
PTX	2,780 (1.5%)	307 (1.7%)	89.0	9 (2.2%)	0.165	0.260	575.930	4.2	3.7	4.7
Fermi	48 (0.0%)	22 (0.1%)	54.2	26 (6.2%)	1.296		4.800	17.2	10.6	26.1
All	88,574 (100%)	8,760 (100%)	90.2	971 (100%)	0.022	0.050	575.930	1.1	1.1	1.1

Click here for List of Acronyms

* Some reporting organizations have provided data that predate the 2002 start date of the registry. Percent exceeding 0.2 µg/m^3 based on 95% Confidence Limits.

Exposure Monitoring Results Exceeding Action Level 0.2 μg/m^3 by Reporting Organization (2023) *
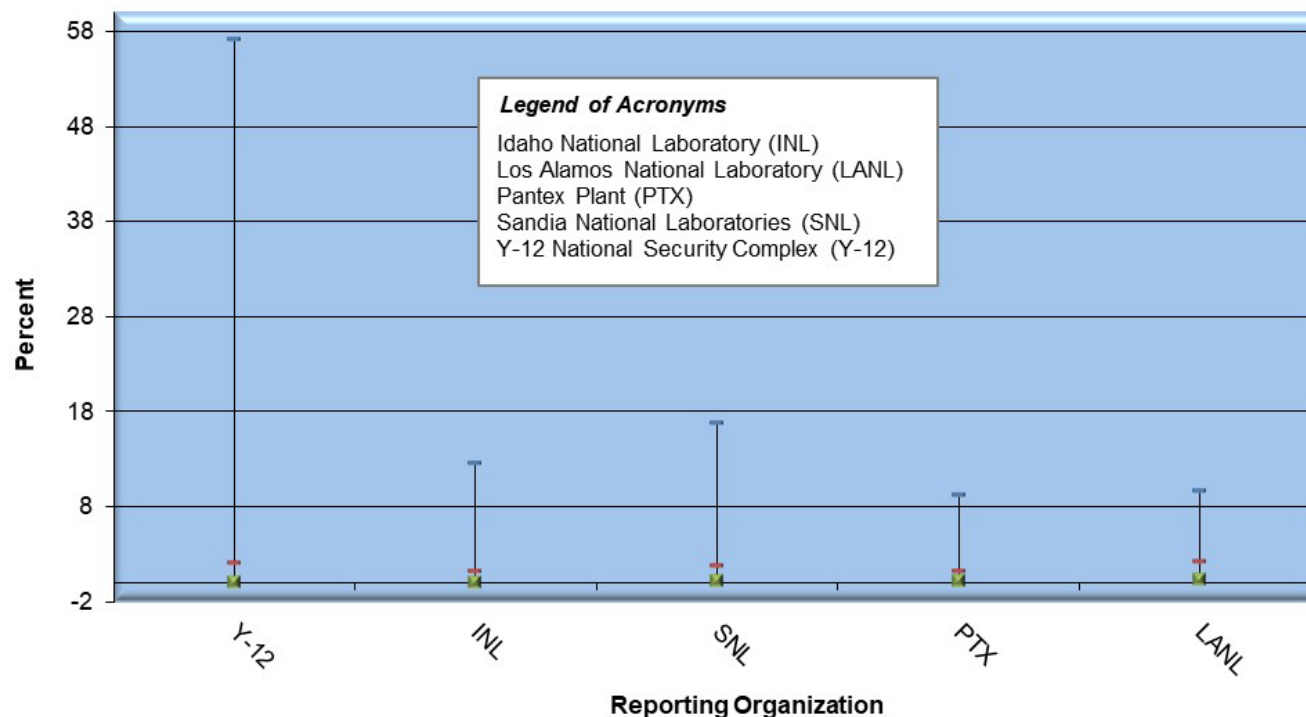
* Percent exceeding 0.2 μg/m^3 based on 95% Confidence Limits.

This graphic provides the percent of exposure monitoring results that exceeded the action level by reporting organization for Calendar Year 2023 (CY2023). Fewer organizations reported exposure monitoring in recent years, and those organizations submitting data have also reported fewer sampling results. This downward trend impacts the analysis and interpretation of results in the Beryllium-Associated Worker Registry (BAWR). The small sample size reduces accuracy and causes higher variability in the statistical models used. Certainly, the wide confidence intervals in the single year CY2023 analysis demonstrate the reduction of statistical power and confidence in the interpretation when compared to similar but larger samples of the population.

The table below gives additional summary statistics for organizations reporting exposure data to the BAWR during CY2023. Organizations that did not report data for CY2023 are not included in this table.

The data in the graphic and table show that LANL (had the greatest percentage (2.1%) of reported exposure monitoring results exceeding the action level in CY2023.

Infographic Details for CY2023

Y-12
Upper confidence limit for F: 57.2
Percent exceeding 0.2 μg/m3 (F): 2.0
Lower confidence limit for F: 0.0

SNL
Upper confidence limit for F: 16.7
Percent exceeding 0.2 μg/m3 (F): 1.8
Lower confidence limit for F: 0.1

LANL
Upper confidence limit for F: 9.6
Percent exceeding 0.2 μg/m3 (F): 2.1
Lower confidence limit for F: 0.3

INL
Upper confidence limit for F: 12.5
Percent exceeding 0.2 μg/m3 (F): 1.1
Lower confidence limit for F: 0.0

PTX
Upper confidence limit for F: 9.2
Percent exceeding 0.2 μg/m3 (F): 1.2
Lower confidence limit for F: 0.1

Summary Statistics for Exposure Monitoring Results Exceeding Action Level 0.2 µg/m^3 by Reporting Organization (2023) *

Reporting Organization	No. monitoring results	No. detected values	% non-detects	No. individ. monitored	Obs. 95th percentile (µg/m^3)	95% UTL /95th % (µg/m^3)	Largest value (µg/m^3)	% > 0.2 µg/m^3 (F)	Lower confidence limit for F	Upper confidence limit for F
ETTP	808 (58%)	1 (0%)	99.9	157 (36%)						
HAN	267 (19%)	1 (0%)	100.0	115 (26%)						
INL	34 (2%)	4 (11%)	88.2	26 (6%)	0.020	<0.001	0.159	1.1	0.0	12.5
KCNSC	11 (1%)	0 (0%)	100.0	4 (1%)						
LANL	19 (1%)	17 (89%)	10.5	4 (1%)	0.331	<0.001	0.356	2.1	0.3	9.6
LLNL	14 (1%)	0 (0%)	100.0	10 (2%)						
LLNL NW	2 (0%)	0 (0%)	100.0	2 (0%)						
NNSS	28 (2%)	0 (0%)	100.0	8 (2%)						
ORNL	16 (1%)	0 (0%)	100.0	7 (2%)						
PADUCAH	3 (0%)	0 (0%)	100.0	2 (0%)						
PNNL	14 (1%)	0 (0%)	100.0	6 (1%)						
PTX	56 (4%)	4 (11%)	92.9	42 (10%)	0.036	<0.001	0.150	1.2	0.1	9.2
SNL	27 (2%)	4 (11%)	85.2	13 (3%)	0.057	<0.001	0.120	1.8	0.1	16.7
SRS	6 (0%)	0 (0%)	100.0	4 (1%)						
Y-12	48 (3%)	2 (6%)	95.8	30 (7%)	0.008	<0.001	0.754	2.0	0.0	57.2
Y-12 ANS	35 (32%)	1 (0%)	100.0	9 (2%)						
All	1,388 (100%)	34 (100%)	97.4	439 (100%)	0.003	0.011	0.754	0.4	0.2	0.6

Click here for List of Acronyms

* Percent exceeding 0.2 µg/m^3 based on 95% Confidence Limits.

Exposure Monitoring Results Exceeding Action Level 0.2 µg/m³ by Reporting Organization (2023)

This table provides the reporting organization, process description, 8-hour time weighted average (TWA), and the respirator assigned protection factor (APF) for the results observed above the action level through Calendar Year 2023 (CY2023).

There were fewer exceedances for CY2023 compared to CY2022 with four (4) samples exceeding the action level in CY2023, compared with 12 in CY2022, and 12 in CY2021. Since the total reported exposure sampling results continue to decrease over time, the proportion of exceedances is greater than in previous years. In all cases, work planning processes identified the potential for beryllium exposure and workers wore appropriate respiratory protection.

Reporting Organization	Process Description	Job Title	8-hr TWA µg/m³	Respirator APF
Y-12			0.75	1,000
Y-12			0.63	1,000
LANL	Field professional	Explosives Tech 4	0.36	1,000
LANL	Field professional	Engineering Technologist 3	0.33	1,000

Click here for List of Acronyms

* Percent exceeding 0.2 µg/m³ based on 95% Confidence Limits.

Exposure Monitoring Results Exceeding Action Level 0.2 µg/m³ by Reporting Organization (2022)

This table provides the reporting organization, process description, 8-hour time weighted average (TWA), and the respirator assigned protection factor (APF) for the results observed above the action level through Calendar Year 2022 (CY2022).

Exceedances for CY2022 were greater than in CY2021 with twelve (12) samples exceeding the action level in CY2022, compared with 12 in CY2021, and 4 in CY2020. Since the total reported exposure sampling results continue to decrease over time, the proportion of exceedances is greater than in previous years. In all cases, work planning processes identified the potential for beryllium exposure and workers wore appropriate respiratory protection.

Reporting Organization	Process Description	Job Title	8-hr TWA µg/m³	Respirator APF
INL	D&D Workers	D & D Skilled Trade	2.90	1,000
LANL		Engineered Systems Technician	0.83	1,000
INL	D&D Workers	D & D Skilled Trade	0.65	1,000
INL	Other Craft	Other Craft	0.60	1,000
INL		Health Physics Technician	0.56	1,000
INL	D&D Workers	D & D Skilled Trade	0.34	1,000
INL	D&D Workers	D & D Skilled Trade	0.29	1,000
INL	Electrician	Electrician	0.29	1,000
SNL		Technician	0.24	50
SNL		Technician	0.24	25
INL	Other Craft	Other Craft	0.20	1,000
Y-12		Engineering Technician	0.20	1,000

Click here for List of Acronyms

* Percent exceeding 0.2 µg/m³ based on 95% Confidence Limits.

Exposure Monitoring Results Exceeding Action Level 0.2 µg/m³ by Reporting Organization (2021) *

This table provides the reporting organization, process description, 8-hour time weighted average (TWA), and the respirator assigned protection factor (APF) for the results observed above the action level through Calendar Year 2021 (CY2021).

Exceedances for CY2021 were less than in CY2020 with 12 (12) samples exceeding the action level in CY2021, compared with 4 in CY2020, and 21 in CY2019. Since the total reported exposure sampling results continue to decrease over time, the proportion of exceedances is greater than in previous years. In all cases work planning processes identified the potential for beryllium exposure and workers wore appropriate respiratory protection.

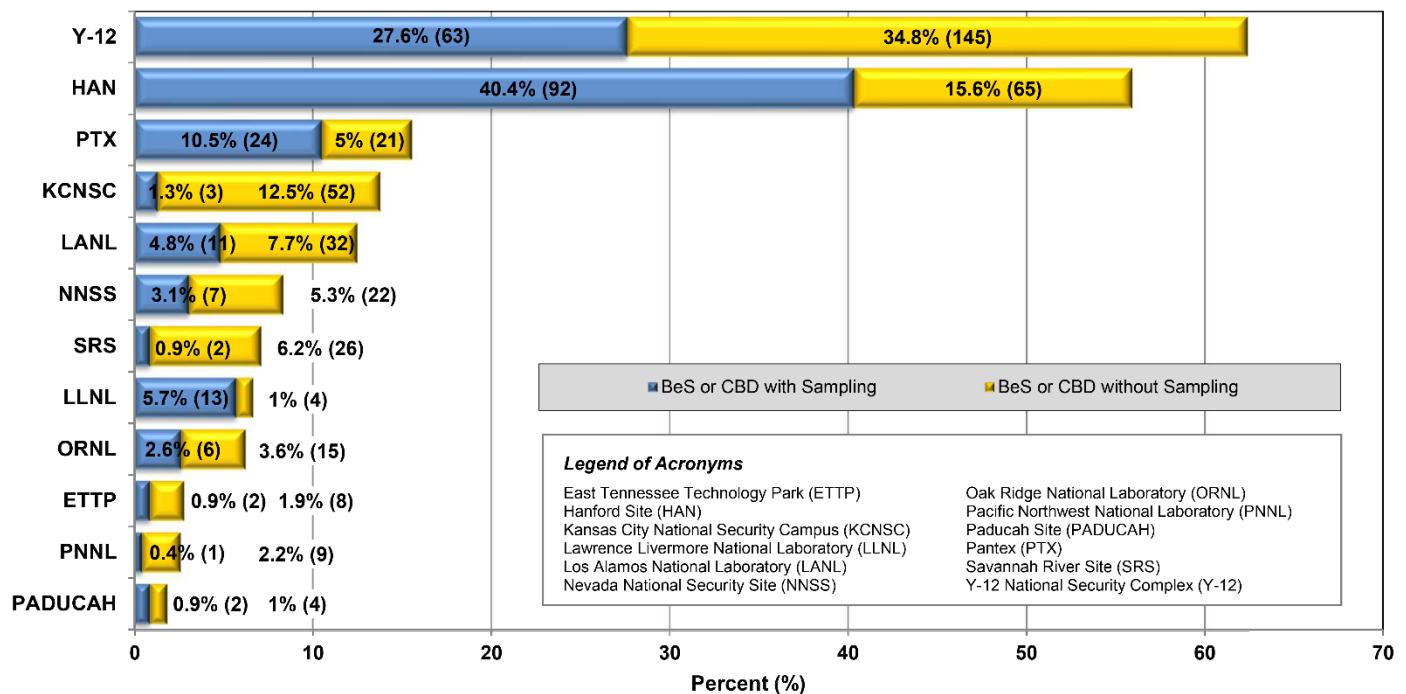| Reporting Organization	Process Description	Job Title	8-hr TWA µg/m³	Respirator APF
PTX	Production Technician	Crafts	6.61	1,000
Y-12			1.56	1,000
Y-12			1.56	1,000
PTX	Material Handler	Other Crafts	1.50	1,000
Y-12		Other Crafts	1.31	1,000
SNL		Technician	0.50	50
SNL		Technician	0.33	25
PTX	Production Technician	Other Crafts	0.32	1,000
Y-12		Other Crafts	0.28	1,000
Y-12		Other Technicians	0.23	1
SNL		Technician	0.22	25
SNL		Technician	0.21	1,000

Click here for List of Acronyms

* Percent exceeding 0.2 µg/m³ based on 95% Confidence Limits.

Health and Monitoring Comparisons

Two different reporting organization groups collect the data associated with health monitoring and exposure monitoring. Occupational health and medical groups collect health monitoring data and industrial hygiene groups collect exposure monitoring data. In most cases, a data coordinator collates the data prior to submission to the Registry. In this section, the health screening data compared to the exposure monitoring data provides insight on the effectiveness of coordination between the 2 activities.

Comparison of the Number and Percent Proportion for Beryllium-Associated Workers Diagnosed with BeS or CBD with and without Exposure Sampling Results by Reporting Organizations (n=701) (2002-2023) *

Bar chart data:

Organization	BeS or CBD with Sampling	BeS or CBD without Sampling
Y-12	27.6% (63)	34.8% (145)
HAN	40.4% (92)	15.6% (65)
PTX	10.5% (24)	5% (21)
KCNSC	1.3% (3)	12.5% (52)
LANL	4.8% (11)	7.7% (32)
NNSS	3.1% (7)	5.3% (22)
SRS	0.9% (2)	6.2% (26)
LLNL	5.7% (13)	1% (4)
ORNL	2.6% (6)	3.6% (15)
ETTP	0.9% (2)	1.9% (8)
PNNL	0.4% (1)	2.2% (9)
PADUCAH	0.9% (2)	1% (4)

Legend of Acronyms

East Tennessee Technology Park (ETTP)
Hanford Site (HAN)
Kansas City National Security Campus (KCNSC)
Lawrence Livermore National Laboratory (LLNL)
Los Alamos National Laboratory (LANL)
Nevada National Security Site (NNSS)

Oak Ridge National Laboratory (ORNL)
Pacific Northwest National Laboratory (PNNL)
Paducah Site (PADUCAH)
Pantex (PTX)
Savannah River Site (SRS)
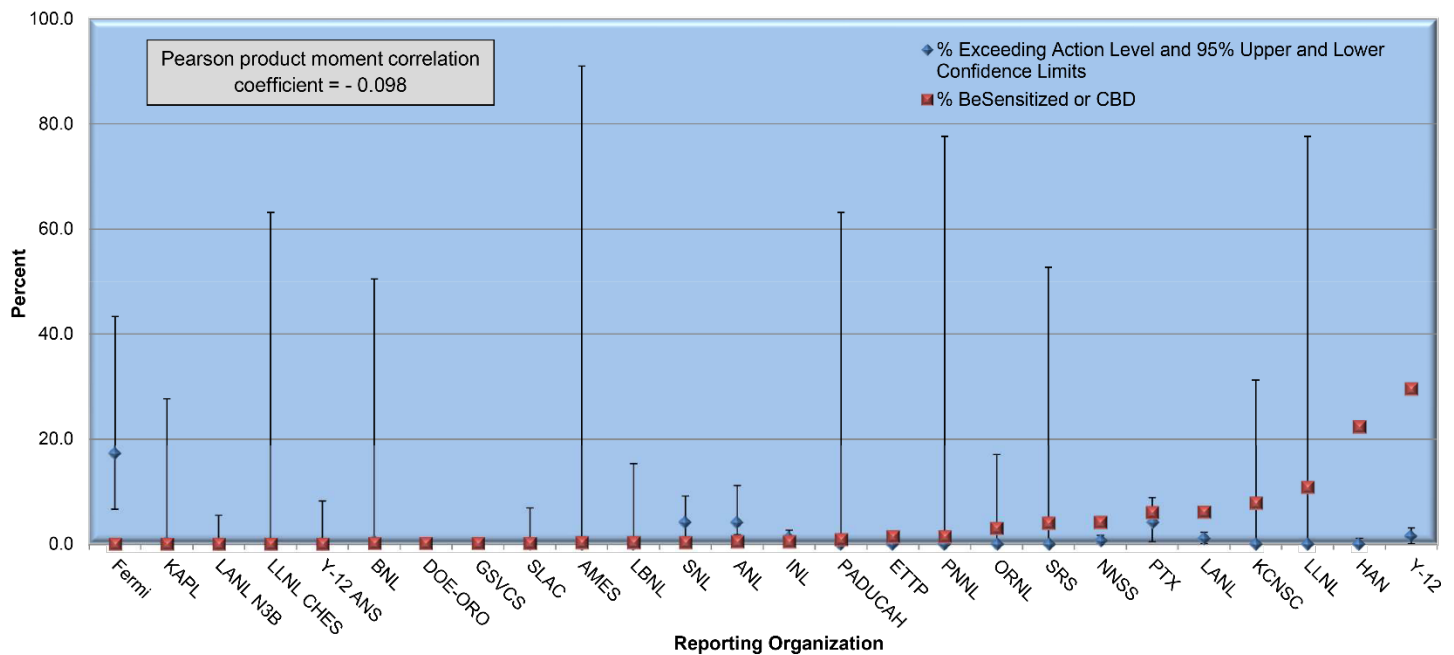Y-12 National Security Complex (Y-12)

X-axis: Percent (%)

* Some reporting organizations have provided data that predate the 2002 start date of the registry.

The data in the figure shows the collective number of Beryllium Sensitized (BeS) or Chronic Beryllium Disease (CBD) individuals through Calendar Year (2023) who have had exposure monitoring results submitted to the Registry. The figure also illustrates the collective number of individuals who have not had exposure data submitted to the Registry. Thirty-three percent of workers (178 of 546) identified as BeS and 32% of workers (83 of 158) identified as CBD do not have exposure monitoring results submitted to the Registry. The combined proportion reported in the annual summaries since 2018 averaged 68%.

Of the 178 sensitization cases with exposure sampling data, 83 cases only had exposure sampling data with monitoring dates later than their reported date of BeS. In other words, 47% of the BeS cases with exposure data had exposure monitoring initiated only after diagnosed as sensitized.

Of the 155 workers reported as diagnosed with CBD, 49 (32%) of the cases had at least one exposure sampling measurement submitted to the Registry. Industrial hygiene programs monitor workers diagnosed with CBD to ensure compliance with restricted duty. Nevertheless, of the 155 workers with CBD, only 34 (22%) CBD cases had at least one reported exposure record dated later than their date of CBD diagnosis. Of those 34 cases, 17 workers had exposure monitoring initiated only after diagnosed as CBD.

Comparison of the Percent of Workers Diagnosed with BeS or CBD with Percent Exceeding Action Level 0.2 μg/m³ by Reporting Organization (2002-2023) *

Click here for List of Acronyms

* Some reporting organizations have provided data that predate the 2002 start date of the registry. Percent exceeding 0.2 μg/m³ based on 95% Confidence Limits.

The figure compares the cumulative percent of workers diagnosed with beryllium-sensitized (BeS) or chronic beryllium disease (CBD) to the percent of exposure samples exceeding the 0.2 μg/m³ action level for each reporting agency. These data illustrate that no statistical correlation exists between the incidence of BeS/CBD and the percent of exceedances among the exposure sampling results submitted to the Registry (Pearson product moment correlation coefficient = -0.098). The lack of correlation could be due to sensitization and CBD cases associated with past work locations or conditions rather than the environment currently monitored.

However, it is also possible that the exposure monitoring programs are missing sources of exposure. Reporting organizations with low exposure monitoring results and high sensitization or CBD rates should investigate cases to determine if there is a possibility of ongoing exposures.

Supplementary

Acronym List

Acronym	Description
AMES	Ames Laboratory
AMWTP	Advanced Mixed Waste Treatment Project
ANL	Argonne National Laboratory
BAL	Bronchoalveolar Lavage
BAWR	Beryllium-Associated Worker Registry
Be	Beryllium
BeLPT	Beryllium Lymphocyte Proliferation Test
BeS	Beryllium Sensitization or Beryllium-Sensitized
BNL	Brookhaven National Laboratory
CBD	Chronic Beryllium Disease
CBDPP	Chronic Beryllium Disease Prevention Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CY	Calendar Year
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE-ORO	U.S. Department of Energy - Oak Ridge Office
DOL	U.S. Department of Labor
EEOICPA	Energy Employees Occupational Illness Compensation Program Act
EHSS	Office of the Associate Under Secretary for Environment, Health, Safety and Security
EHSS-10	Office of Health and Safety
ETTP	East Tennessee Technology Park
EX	Arithmetic Mean
F	Percent Exceeding 0.2 μg/m^3
Fermi	Fermi National Accelerator Laboratory
GSVCS	Golden SVCS, LLC
HAN	Hanford Site
INL	Idaho National Laboratory
KAPL	Knolls Atomic Power Laboratory
KCNSC	Kansas City National Security Campus
LANL	Los Alamos National Laboratory
LANL N3B	Newport News Nuclear BWXT Los Alamos
LBNL	Lawrence Berkeley National Laboratory
LLNL	Lawrence Livermore National Laboratory
LLNL BU	Lawrence Livermore National Laboratory Boston University (subcontractor)
LLNL CHES	Lawrence Livermore National Laboratory Clean Harbors Environmental Services (subcontractor)
LLNL ENVC	Lawrence Livermore National Laboratory Envirocon, Inc. (subcontractor)
LLNL NW	Lawrence Livermore National Laboratory North Wind Services, LLC (subcontractor)
NA	Not Applicable
NETL	National Energy Technology Laboratory
NNSA	DOE National Nuclear Security Administration

Acronym	Description
NNSS	Nevada National Security Site
NSC	National Security Campus
NSPS	National Strategic Protective Services, LLC for ETTP and ORNL
NTS	Nevada Test Site
OIG	DOE Office of Inspector General
ORNL	Oak Ridge National Laboratory
ORISE	Oak Ridge Institute for Science and Education
OSHA	DOL Occupational Safety and Health Administration
PADUCAH	Paducah Site
PEL	Personal Exposure Limit
PII	Personally Identifiable Information
PNNL	Pacific Northwest National Laboratory
PRS	Paducah Remediation Services
PTX	Pantex Plant
RCRA	Resource Conservation and Recovery Act of 1976
Respirator APF	Respirator Assigned Protection Factor
RF	Rocky Flats Closure Project
SLAC	SLAC National Accelerator Laboratory
SNL	Sandia National Laboratories
SOMD	Site Occupational Medical Director
SRS	Savannah River Site
SWPA	Southwestern Power Administration
TWA	Time Weighted Average
µg/m³	Micrograms per Cubic Meter
UTL	Upper Tolerance Limit
WSHP	Worker Safety and Health Program
WSI	Wackenhut Security Services, Inc. for ETTP, ORNL, and Y-12
Y-12	Y-12 National Security Complex
Y-12 ANS	Y-12 National Security Complex Atkins Nuclear Secured (subcontractor)
Y-12 NRE	Y-12 National Security Complex Navarro Research and Engineering (subcontractor)
Y-12 URS	Y-12 National Security Complex URS Corporation (subcontractor)

Calculations

Beryllium Sensitization Algorithm (current until revisions to 10 CFR 850 are passed): A worker is considered sensitized if any one of the following clinical criteria and incidence rules for the case definition of beryllium sensitizations is met. Often, a worker's data will satisfy multiple criteria, and their date of sensitization is calculated as the earliest date any one of these is met.

- 2 positive or abnormal beryllium proliferation test (BeLPT) results (based on 2 separate blood draws).
- 1 positive or abnormal plus 2 (or more) borderline BeLPT results.
- A positive or abnormal bronchoalveolar lavage (BAL) result.
- CBD evaluation with a finding of sensitization but no chronic beryllium disease (CBD).

Exposure Monitoring Statistics: These calculations are based on the methods described in the *Statistical Methods and Software for the Analysis of Occupational Exposure Data with Non-Detectable Values*. Due to the limitations in laboratory analytic methods approaching nano-scales much of the airborne exposure monitoring data are subject to left censoring with a measurement below the detectable limit. The methods applied estimate non-detectable levels using maximum likelihoods for randomly left censored, lognormal data with alternative non-parametric methods applied when the lognormal distribution is in doubt due to small sample sizes.

Pearson Product-Moment Correlation Coefficient: The *Pearson Product-Moment Correlation Coefficient* monitors the dose response represented by the Beryllium-Associated Worker Registry (BAWR) data, and is calculated by site with the percent exceeding the action level and the percent beryllium sensitized or diagnosed with CBD.

References and Resources

Chronic Beryllium Disease Prevention Program, 10 CFR Part 850 (1999). *https://www.govinfo.gov/app/details/FR-1999-12-08/99-31181*

Chronic Beryllium Disease Prevention Program, 10 CFR Part 850 (2012). https://www.govinfo.gov/app/details/CFR-2012-title10-vol4/CFR-2012-title10-vol4-part850

Proposed Changes to Chronic Beryllium Disease Prevention Program, 10 CFR Part 850 (2016). https://www.gpo.gov/fdsys/pkg/FR-2016-06-07/pdf/2016-12547.pdf

Department of Energy, Office of Environment, Health, Safety and Security. (2019). *DOE-SPEC-1142-2019, Beryllium Lymphocyte Proliferation Testing (BeLPT)*. Washington, DC: Department of Energy. Retrieved from https://www.standards.doe.gov/standards-documents/1100/1142-dspec-2019

Department of Energy, Office of Environment, Health, Safety and Security. (2019). *DOE-STD-1187-2019, Beryllium-Associated Worker Registry Data Collection and Management Guidance.* Washington, DC: Department of Energy. Retrieved from https://www.standards.doe.gov/standards-documents/1100/1187-astd-2019

Department of Energy, Office of the Associate Under Secretary for Environment, Health, Safety and Security. (2017). *Beryllium-Associated Worker Registry 2017 Annual Report*. Retrieved from *https://www.energy.gov/sites/prod/files/2019/05/f62/2017_Annual_BAWR_Report_Final.pdf*

Department of Labor, Occupational Safety and Health Administration. (n.d.). *Overview*. Retrieved from Beryllium: https://www.osha.gov/beryllium

Frome, E.L., Frome, D.P. (2015). STAND: Statistical Analysis of Non-Detects. R package version 4.0. https://CRAN.R-project.org/package=STAND

Frome, E.L., & Wambach, P.F. (2005). Statistical Methods and Software for the Analysis of Occupational Exposure Data with Non-Detectable Values. ORNL/TM-2005/52. *https://info.ornl.gov/sites/publications/Files/Pub57493.pdf*

Occupational Exposure to Beryllium and Beryllium Compounds in Construction and Shipyard Sectors, 29 CFR Parts 1915 and 1926 (2020). https://www.govinfo.gov/content/pkg/FR-2020-08-31/pdf/2020-18017.pdf

PEARSON function. Microsoft Excel. https://support.microsoft.com/en-us/office/pearson-function-0c3e30fc-e5af-49c4-808a-3ef66e034c18

R Core Team. (2023). R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/

Smith, D.E., Golden, A.P., Stange, A.W., Barker, E., Mroz, M., Barón, A.E., Ghosh, D., Maier, L., Cragle, D., & Newman, L.S. (2018). Clinical and laboratory factors contributing to uninterpretable beryllium lymphocyte proliferation tests (BeLPT). *American Journal of Industrial Medicine*, *61*(7), 592–604. https://doi.org/10.1002/ajim.22842

Van Dyke, M.V., Martyny, J.W., Mroz, M.M., Silveira, L.J., Strand, M., Cragle, D.L., Tankersley, W.G., Wells, S.M., Newman, L.S., & Maier, L.A. (2011). Exposure and genetics increase risk of beryllium sensitisation and chronic beryllium disease in the nuclear weapons industry. *Occupational and Environmental Medicine*, *68*(11), 842–848.https://doi.org/10.1136/oem.2010.064220

Watkins, J.P., Ellis, E.D., Girardi, D.J., Cragle, D.L., & Richter, B.S. (2014). Illness absences among beryllium sensitized workers. *American Journal of Public Health*, *104*(11), e165–e169. https://doi.org/10.2105/AJPH.2014.302132

Worker Safety and Health Program, 10 CFR § 851.10 (2006). https://www.govinfo.gov/app/details/CFR-2020-title10-vol4/CFR-2020-title10-vol4-sec851-10