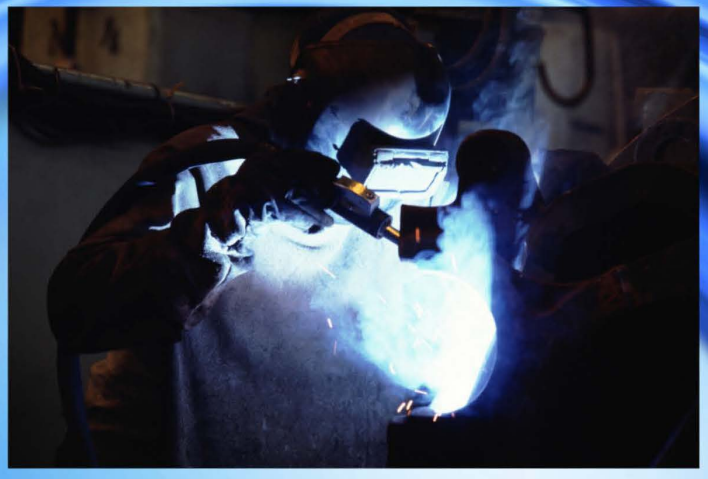
Beryllium-Associated Worker Registry 2015



DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA ·

EHSS

Office of Environment, Health, Safety and Security

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Beryllium-Associated Worker Registry Summary
Data Cumulative Through 2015

It is the responsibility of the U.S. Department of Energy (DOE) to protect the health and safety of DOE employees, contractors, and subcontractors. The Office of Environment, Health, Safety and Security (AU) provides the corporate-level leadership and strategic vision necessary to establish clear expectations for health, safety, environment, and security programs. In support of this mission, the AU Office of Health and Safety (AU-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 to help DOE conduct and improve its chronic beryllium disease prevention programs (CBDPP), the purpose of which are 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 2002, 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.

The BAWR report for 2015 includes data cumulative through calendar year 2015 submitted or corrected by the end of March 2016. Health data were collected through the operation of current worker medical surveillance programs for all 27 sites and subcontractors submitting data. Exposure sampling data were submitted by industrial hygiene programs for 25 sites and subcontractors.

A few caveats are in order when interpreting the results of analyses presented in this report:

- The BAWR does not receive health outcome information about workers other than the development of beryllium sensitization (BeS) or chronic beryllium disease (CBD). To be considered beryllium sensitized, an individual must have 2 abnormal blood tests, or 1 abnormal and 2 borderline blood tests, or 1 abnormal bronchoalveolar lavage BeLPT, or a clinical evaluation with a diagnosis of beryllium sensitization.

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

- Frequently, the Registry cannot be certain about date of first hire because some organizations characterize 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.

- The Registry collects no personally identified information on any workers. Each reporting organization is free to choose its own encryption algorithm to assign a unique identifier for a given worker. While this approach greatly increases 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.

- Although the vast majority of workers represented in the figures and tables of this report are unique, there undoubtedly are some workers counted more than once. This issue can arise when a worker moves from one reporting organization to another, e.g., from site to site, where he or she may be assigned a new identifier based on a different encryption algorithm. Although the number of affected workers is believed small, without personally identified information about 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.

Observations:

- The 2015 report includes 1,781 more workers than the 2014 report.

- Beryllium screening was reported for 794 more workers than in 2014.

- A total of 235 additional employees were monitored for exposure through CY2015 (6,086 versus 5,851). This increase is lower than observed last year (i.e., 344 additional employees between 2013 and 2014 reports).

- 5,466 additional exposure sampling results were received during calendar year 2015. Some of these data were reported for years prior to 2015; the monitoring results for CY2015 alone were 4,886.

- From 2014 to 2015, organizations reporting to the Registry identified 38 additional sensitized employees and no additional employees with CBD. (In this report, the numbers of employees who are sensitized and the numbers of employees with CBD are mutually exclusive, i.e., the sensitized category excludes individuals diagnosed with CBD.) Only 7 of the newly identified sensitization cases had dates of sensitization in 2015. The remaining 31 cases had dates of sensitization from 1993 to 2013 and were reported by Y-12 National Security Complex.

- There has been no increase in the number of employees diagnosed with CBD (i.e., 146) from 2012 to 2015.

- For the 146 employees who are reported as diagnosed with CBD, 47 have at least one exposure sampling measurement. Of these 47 employees, 30 have exposure sampling data later than their reported date of CBD diagnosis. Workers diagnosed with CBD are often monitored after the disease is diagnosed to ensure compliance with restricted duty.

- For the 457 employees who are sensitized and have not progressed to CBD, only 153 have any exposure sampling data. Of the 153 employees, 83 have exposure sampling data later than their reported date of beryllium sensitization.

- Twenty-four (24) samples exceeded the action level of 0.2 µg/m^3 compared with 15 in 2014., 7 in 2013, and 40 in 2012. Exceedances above the action level in 2015 were more frequent than in 2013 or 2014 but still fewer than in previous years (i.e., 2012 and earlier). In 2015, exceedances were largely for operational support work at Sandia National Laboratory. In most cases, the potential for these exceedances was identified by work planning processes and appropriate respiratory protection was in use.

- Through 2015, the highest percentage of action level exceedances by work history activity (a high level rollup of job functions) is among workers where the work activity is unknown or not reported.

- Data coordinator turnover remained below the level observed in 2014.

Reporting Organizations with Data Coordinator Changes in Calendar Years 2013-2015			
Year	Number (and Percentage) of Reporting Organizations	Total Data Coordinator Changes	Reporting Organizations with 2 or More Data Coordinator Changes in Same Year
2013	5 (19%)	6	1
2014	10 (37%)	15	5
2015	6 (22%)	9	3

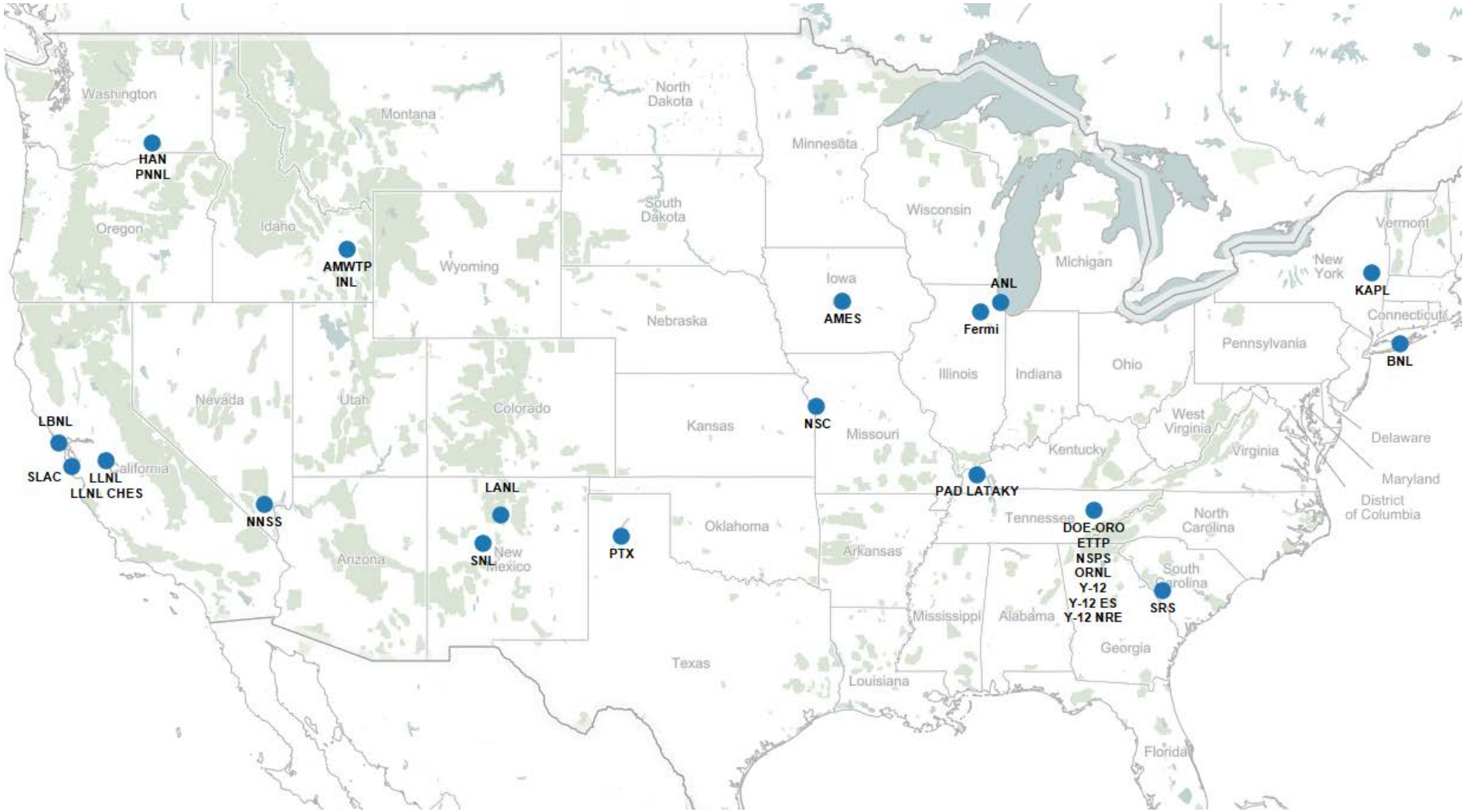
The BAWR program remains a key component of AU evaluation and analysis to inform management and stakeholders of the continued vigilance and success of the DOE sites in protecting worker health. The absence of new CBD diagnoses since 2012 suggests that improved safety procedures and ongoing monitoring programs are having desired results. Although exceedances above the action level were more frequent in 2015 than in 2013 or 2014, they remained well below the frequency recorded before 2013, an overall downward trend. A major limitation in interpreting the occurrence of sensitizations and CBD in relation to exposure levels and time since exposure is a lack of exposure monitoring data for the majority of both sensitized workers and those diagnosed with CBD.

As always, reader comments are welcome,

Cliff Strader

Cliff Strader, PhD
Program Manager, BAWR

Location of 27 Reporting Organizations Currently Submitting Data to BAWR



This map of the continental United States shows the locations of the reporting organizations.

27 Reporting Organizations Currently Submitting Data to BAWR

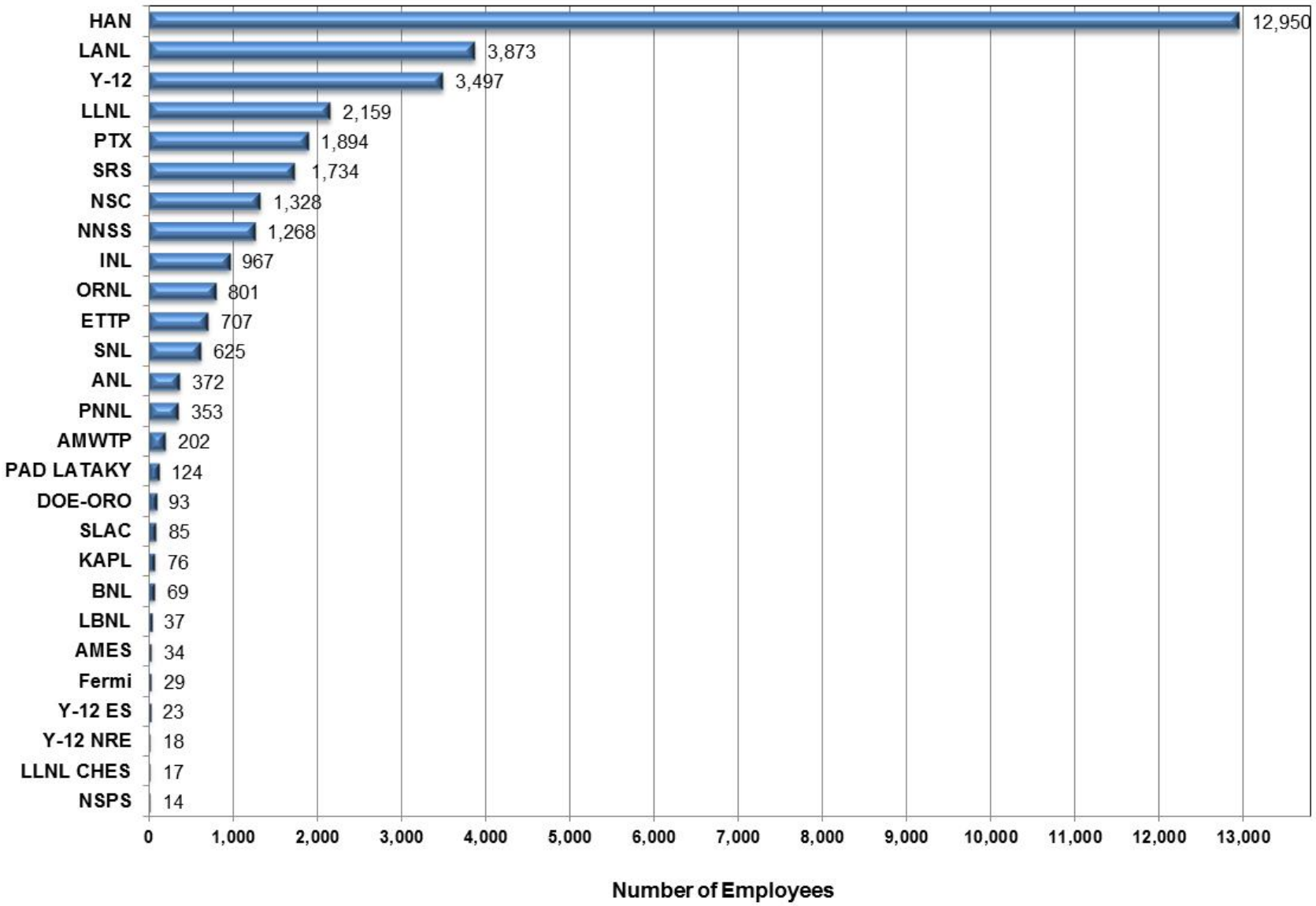
Advanced Mixed Waste Treatment Project (AMWTP)	Los Alamos National Laboratory (LANL)
Ames Laboratory (AMES)	National Security Campus (NSC)
Argonne National Laboratory (ANL)	National Strategic Protective Services, LLC for ETTP and ORNL (NSPS)
Brookhaven National Laboratory (BNL)	Nevada National Security Site (NNSS)
DOE Oak Ridge Office (DOE-ORO)	Oak Ridge National Laboratory (ORNL)
East Tennessee Technology Park (ETTP)	Pacific Northwest National Laboratory (PNNL)
Fermi National Accelerator Laboratory (Fermi)	Pantex Plant (PTX)
Hanford Site (HAN)	Sandia National Laboratories (SNL)
Idaho National Laboratory (INL)	Savannah River Site (SRS)
Knolls Atomic Power Laboratory (KAPL)	Stanford Linear Accelerator Center (SLAC)
LATA Environmental Services of Kentucky, LLC (PAD LATAKY)	Y-12 EnergySolutions (Y-12 ES)
Lawrence Berkeley National Laboratory (LBNL)	Y-12 National Security Complex (Y-12)
Lawrence Livermore National Laboratory (LLNL)	Y-12 Navarro Research and Engineering (Y-12 NRE)
LLNL Clean Harbors Environmental Services (LLNL CHES)	

6 Inactive BAWR Reporting Organizations

LLNL Boston University (LLNL BU)	Southwestern Power Administration (SWPA)
LLNL Envirocon, Inc. (LLNL ENVC)	Wackenhut Security Services Inc. for ETTP, ORNL, and Y-12 (WSI)
Rocky Flats Closure Project (RF)	Y-12 URS Corporation (Y-12 URS)

These tables show the organizations that are submitting or have previously submitted data to the Registry.

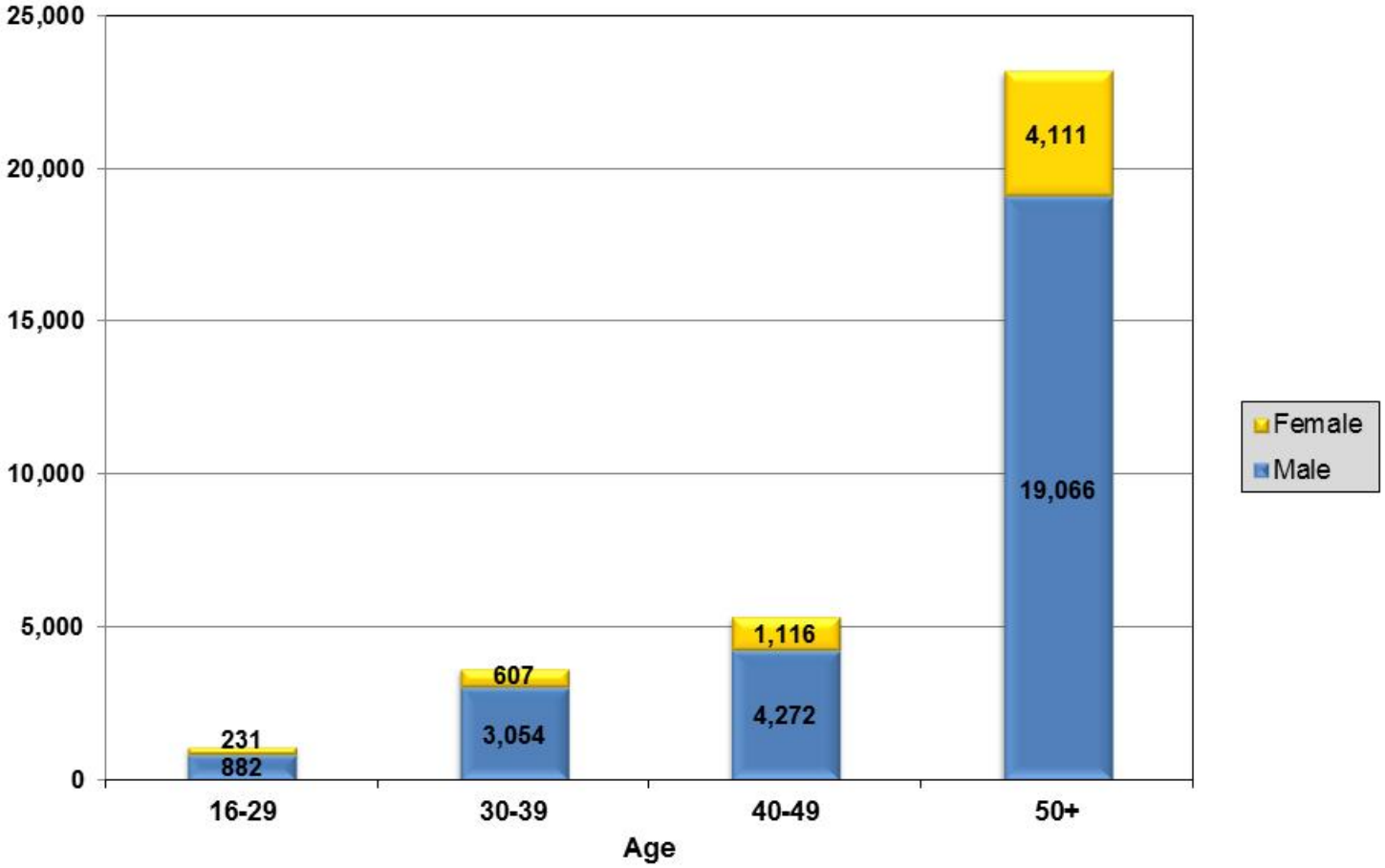
Total 33,349 Employees by BAWR Reporting Organization Through 2015*



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

The figure above shows the cumulative numbers of beryllium-associated workers reported to the Registry by reporting organization.

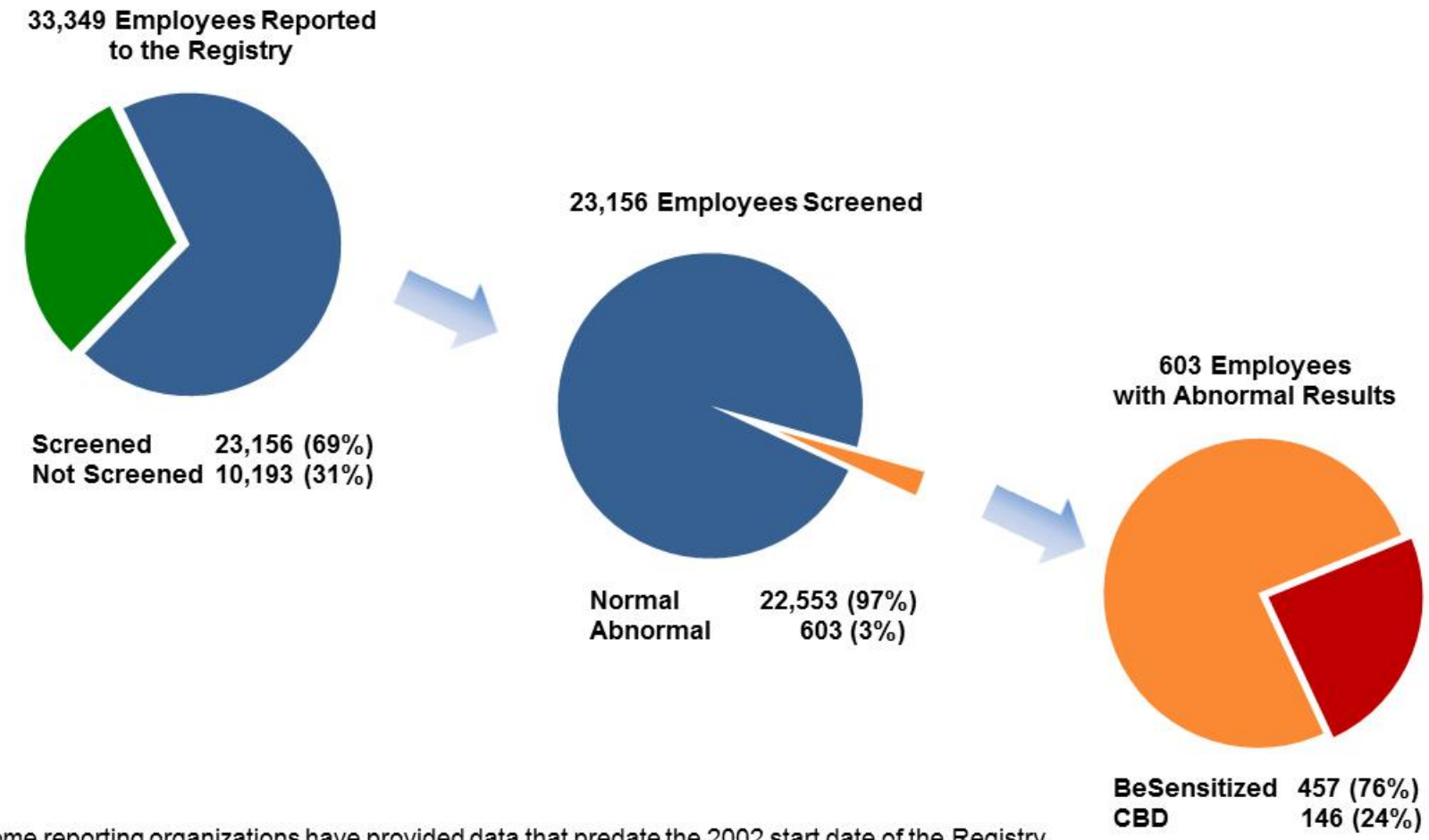
Gender and Age Distribution of Employees Reported to BAWR Through 2015*



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

These stacked bars depict the gender and age distribution of beryllium-associated workers reported to the Registry through 2015, showing they are predominantly male and long-term workers. Ten workers, for whom demographic data were not available, are excluded from this chart.

Screening Status and Progression from BeLPT Testing to "Sensitized" to CBD Through 2015*



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

From 2014 to 2015, the 27 organizations currently reporting to the Registry identified 38 additional sensitized employees and no additional employees with CBD. Only 7 of the newly identified sensitization cases had dates of sensitization in 2015; the remaining 31 cases had dates of sensitization in 2013 and earlier.

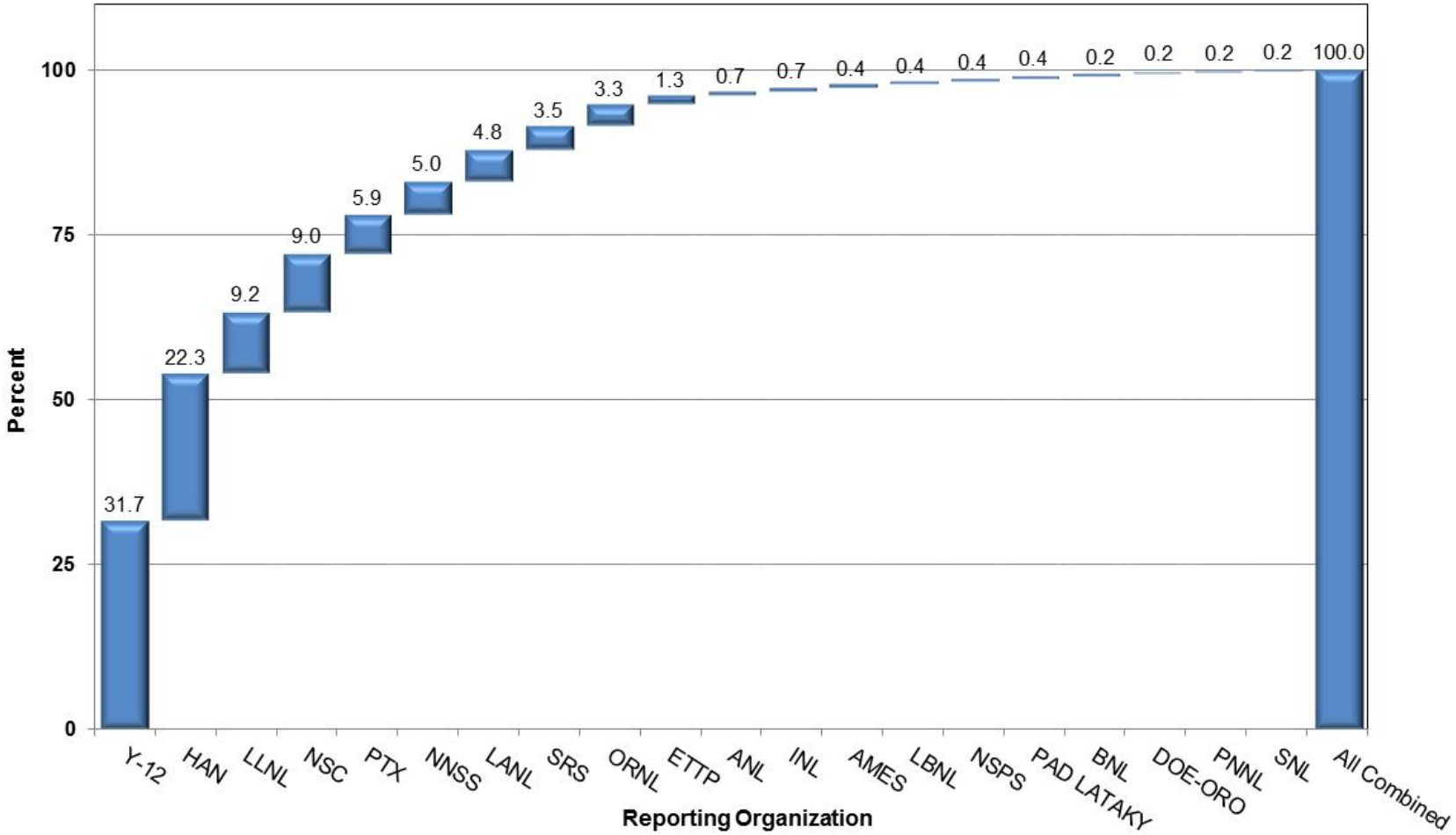
Number of Employees BeLPT Tested, "Sensitized," or CBD by Reporting Organization Through 2015*

Reporting Organization	Number of:		
	Employees with BeLPT Results	"Sensitized" Employees	Employees with CBD
HAN	8,227	102 (1.2 %)	34 (0.4 %)
Y-12	2,818	145 (5.1 %)	62 (2.2 %)
LANL	2,668	22 (0.8 %)	3 (0.1 %)
PTX	1,808	27 (1.5 %)	15 (0.8 %)
LLNL	1,444	42 (2.9 %)	3 (0.2 %)
NSC	1,230	41 (3.3 %)	14 (1.1 %)
NNSS	1,126	23 (2.0 %)	4 (0.4 %)
SRS	750	16 (2.1 %)	6 (0.8 %)
ORNL	718	15 (2.1 %)	0
SNL	621	1 (0.2 %)	0
ETTP	402	6 (1.5 %)	4 (1.0 %)
INL	385	3 (0.8 %)	0
PNNL	299	1 (0.3 %)	0
ANL	159	3 (1.9 %)	0
PAD LATAKY	112	2 (1.8 %)	0
DOE-ORO	93	1 (1.1 %)	0
SLAC	49	0	1 (2.0 %)
BNL	40	1 (2.5 %)	0
KAPL	38	0	0
AMES	34	2 (5.9 %)	0
LBNL	26	2 (7.7 %)	0
AMWTP	22	0	0
Y-12 ES	22	0	0
Fermi	20	0	0
Y-12 NRE	18	0	0
NSPS	14	2 (14.3 %)	0
LLNL CHES	13	0	0
Total	**23,156**	**457 (2.0 %)**	**146 (0.6 %)**

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

This table shows the cumulative numbers of beryllium-associated workers reported to the Registry who have been screened using BeLPT testing, have BeLPT results indicating they are "sensitized," or have been diagnosed with CBD.

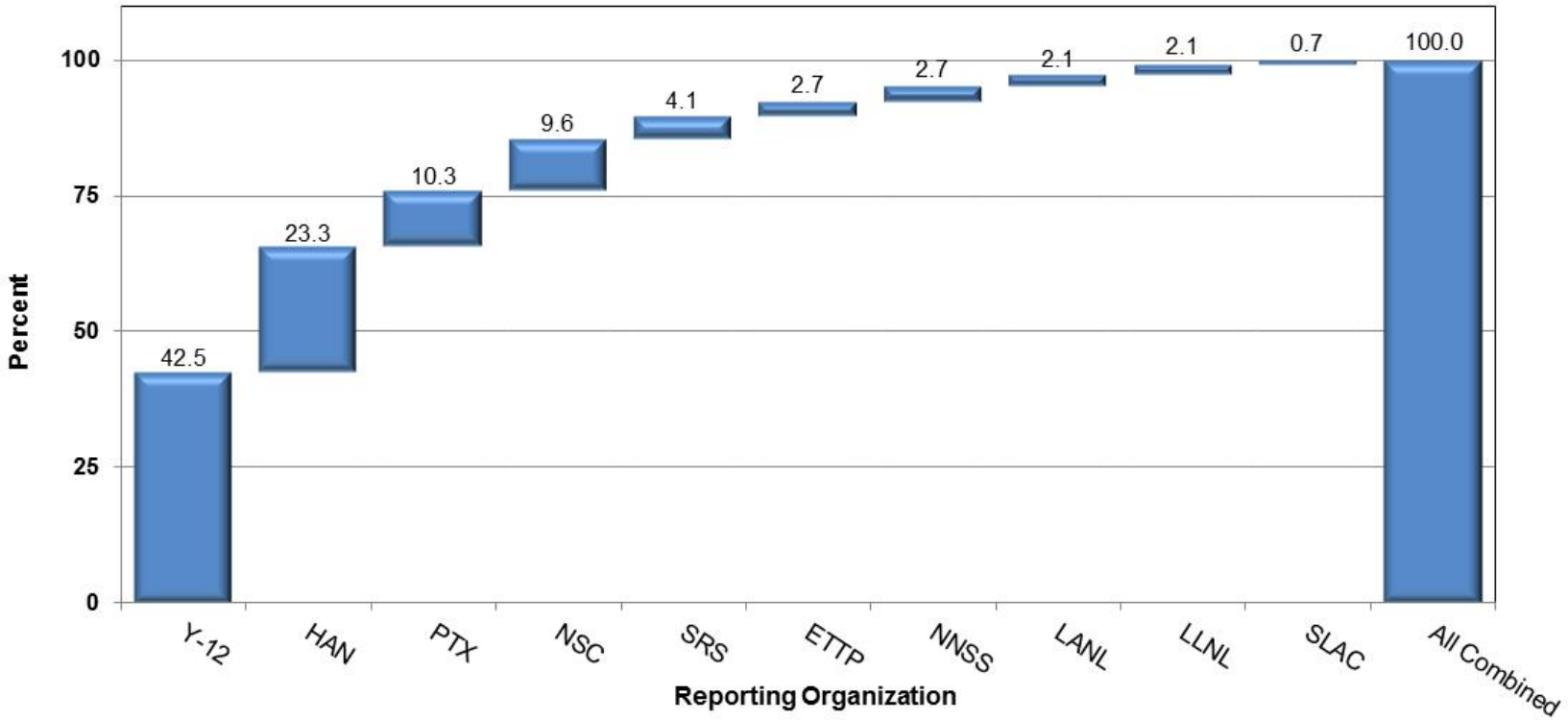
Percentage Distribution by Reporting Organization of 457 BeSensitized Employees Through 2015*



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

The chart above depicts the percentage distribution of beryllium sensitized employees by reporting organization.

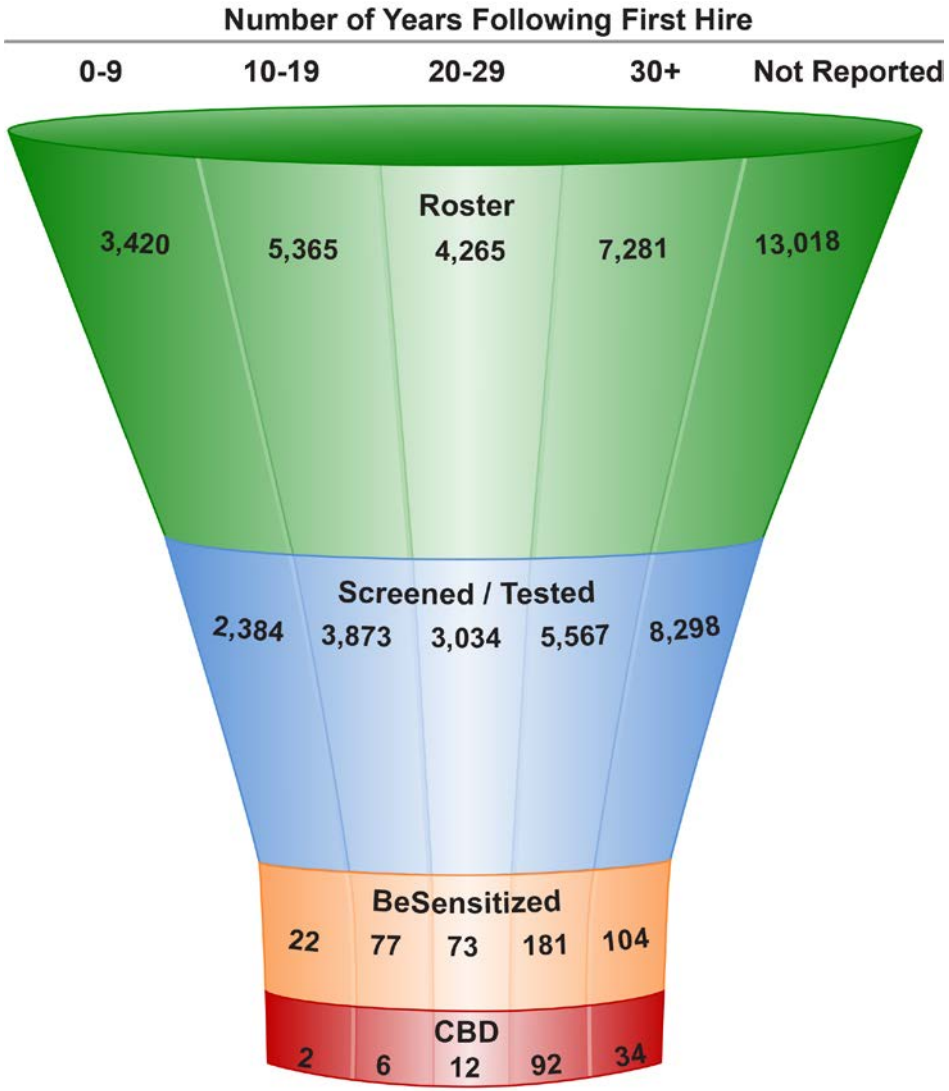
Percentage Distribution by Reporting Organization of 146 Employees Diagnosed with CBD Through 2015*



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

This chart illustrates the percentage distribution of employees diagnosed with CBD by reporting organization.

Number of Years Following Year of First Hire for Employees Who Are "Sensitized" or CBD



The above chart categorizes beryllium-associated workers by years following first hire, including roster total and those who have been diagnosed as either beryllium sensitized or having CBD.

Year of First Positive or Abnormal BeLPT Result for Beryllium-Associated Workers Who Have Been Tested

Year of BeLPT Result	Number of:		
	Employees Tested	"Sensitized" Employees	Employees with CBD
<2000	708	35	10
2000	1,630	29	17
2001	3,236	43	17
2002	3,967	43	15
2003	3,967	13	5
2004	3,814	13	3
2005	5,115	27	6
2006	4,870	44	9
2007	4,583	45	5
2008	5,077	28	7
2009	6,225	45	2
2010	6,894	29	1
2011	7,927	21	0
2012	6,175	5	0
2013	5,567	7	0
2014	5,994	8	0
2015	5,976	6	0
Year Not Reported	0	16	49

The table above lists the numbers of beryllium-associated workers BeLPT tested each year, and the year of first positive or abnormal BeLPT result for those beryllium sensitized or diagnosed as having CBD.

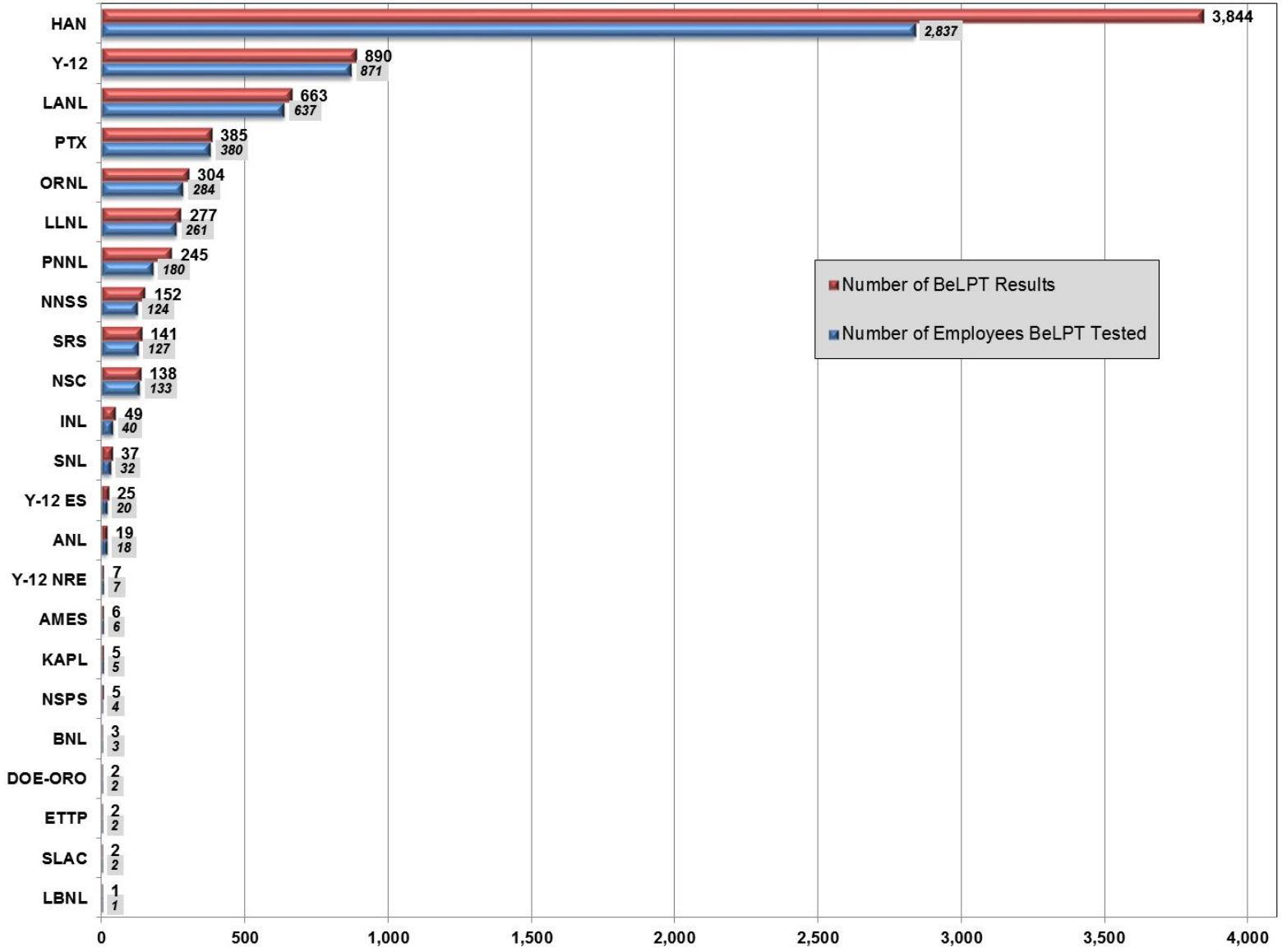
Work History Activity and BeLPT Status for 23,156 Beryllium-Associated Workers Screened Through 2015*

Work History Activity	Number of: Employees with BeLPT Results	"Sensitized" Employees	Employees with CBD
Management	1,641	37	11
Administrative Support	1,028	30	10
In-House Professionals	1,565	38	14
Field Professionals	2,029	43	6
Technical Support	3,007	57	13
Service	1,363	28	12
Security and Fire	1,456	23	7
Crafts	4,015	93	35
Line Operators	2,631	71	23
Guests	61	0	0
Unknown	701	12	11
Not Reported	3,659	25	4
Totals	**23,156**	**457**	**146**

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

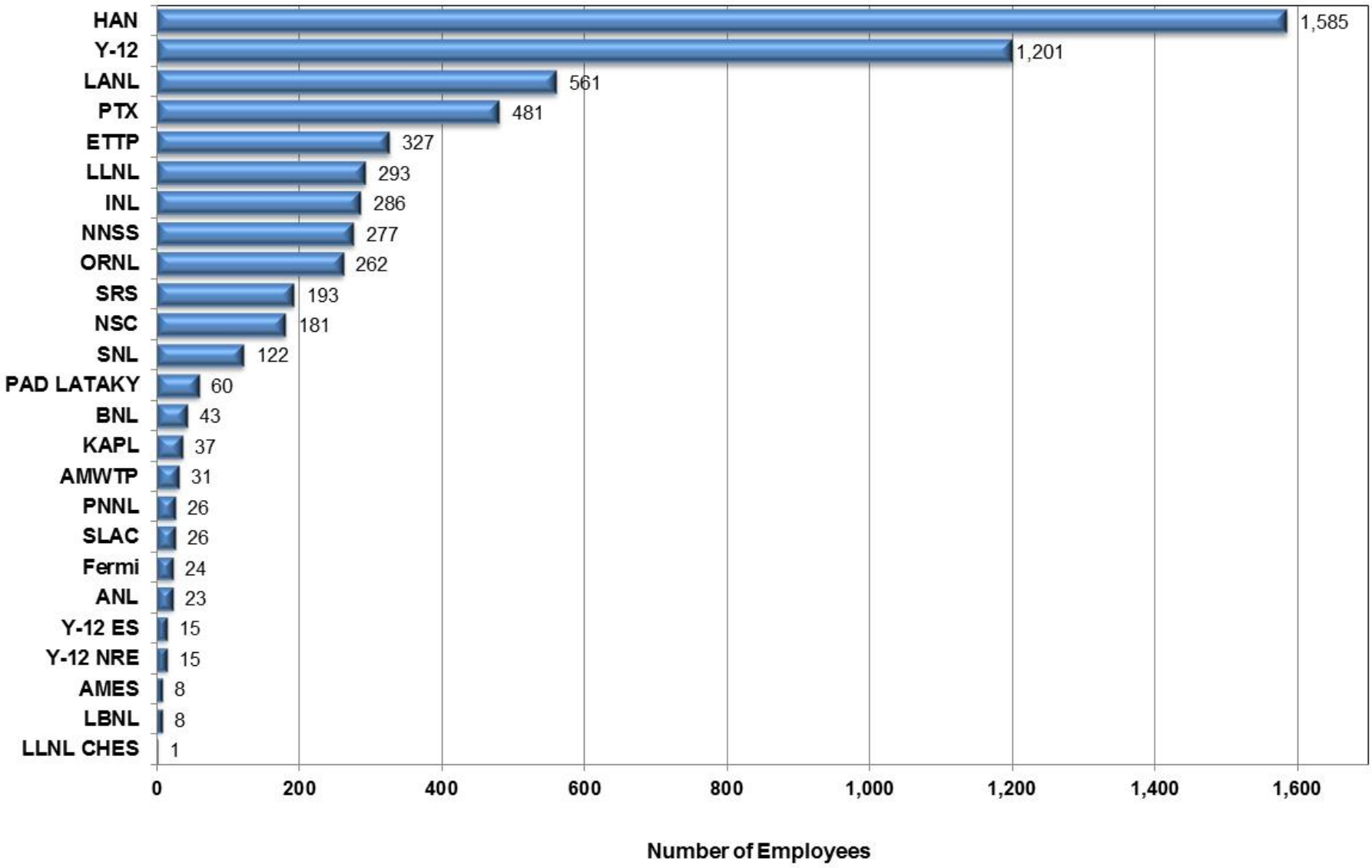
The above table lists beryllium sensitized or CBD diagnosed beryllium-associated workers through 2015 grouped by their work history activity, which is a high level rollup of job function.

Distribution of 7,202 BeLPT Results for 5,976 Employees by Reporting Organization for Calendar Year 2015



This chart compares the number of BeLPT tests conducted to the number of employees tested for reporting organizations. Employees with Abnormal or Borderline BeLPT results will probably be tested multiple times in a year.

Distribution by Reporting Organization of 6,086 Beryllium-Associated Workers Exposure Monitored Through 2015*



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

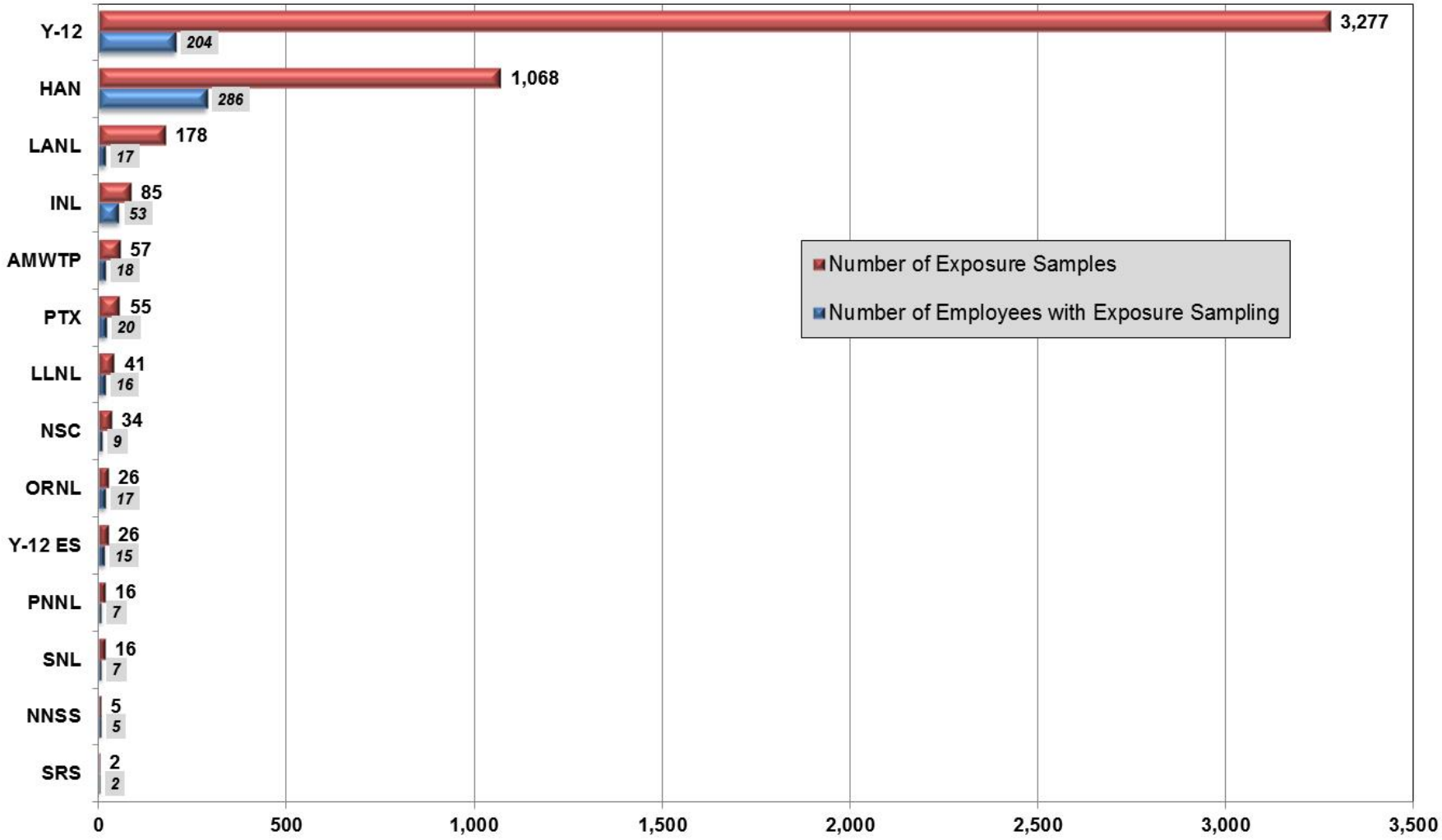
This chart shows the distribution of beryllium-associated workers by reporting organization who have been monitored for beryllium exposure.

Annual Number of Employees Exposure Monitored by Reporting Organization for 2006 – 2015

Reporting Organization	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
AMES				6	1	2			2	
AMWTP	5	4	4	4	2	2	2	1	1	18
ANL	8	3	1							
BNL	1	8	8	3	7	1	19		2	
DOE-ORO										
ETTP	64	38		19	42	30	3	9	2	
Fermi	1								1	
HAN	149	103	163	135	313	395	249	287	325	286
INL	76	81	49	57	44	39	5	42	45	53
KAPL		5	5	5	5	4	4	3	2	
LANL	139	95	52	65	46	40	38	30	65	17
LBNL			1			2		1	3	
LLNL	36	74	76	100	78	63	59	34	29	16
LLNL CHES						1				
NNSS	26	14	43	18	18	19	22	14	17	5
NSC	24	24	18	15	18	17	43	27	18	9
NSPS										
ORNL	59	53	46	48	44	47	46	58	24	17
PAD LATAKY				9	47	3	5	4	5	
PNNL								1	19	7
PTX	38	50	38	35	30	42	51	23	21	20
SLAC	1	2	2			2				
SNL	17	7		5	16	19	17	3	5	7
SRS	6	18	34	28	19	2	10	1	5	2
Y-12	160	225	216	307	433	362	244	237	219	204
Y-12 ES										15
Y-12 NRE		3	4	10	8	5	4	5	4	

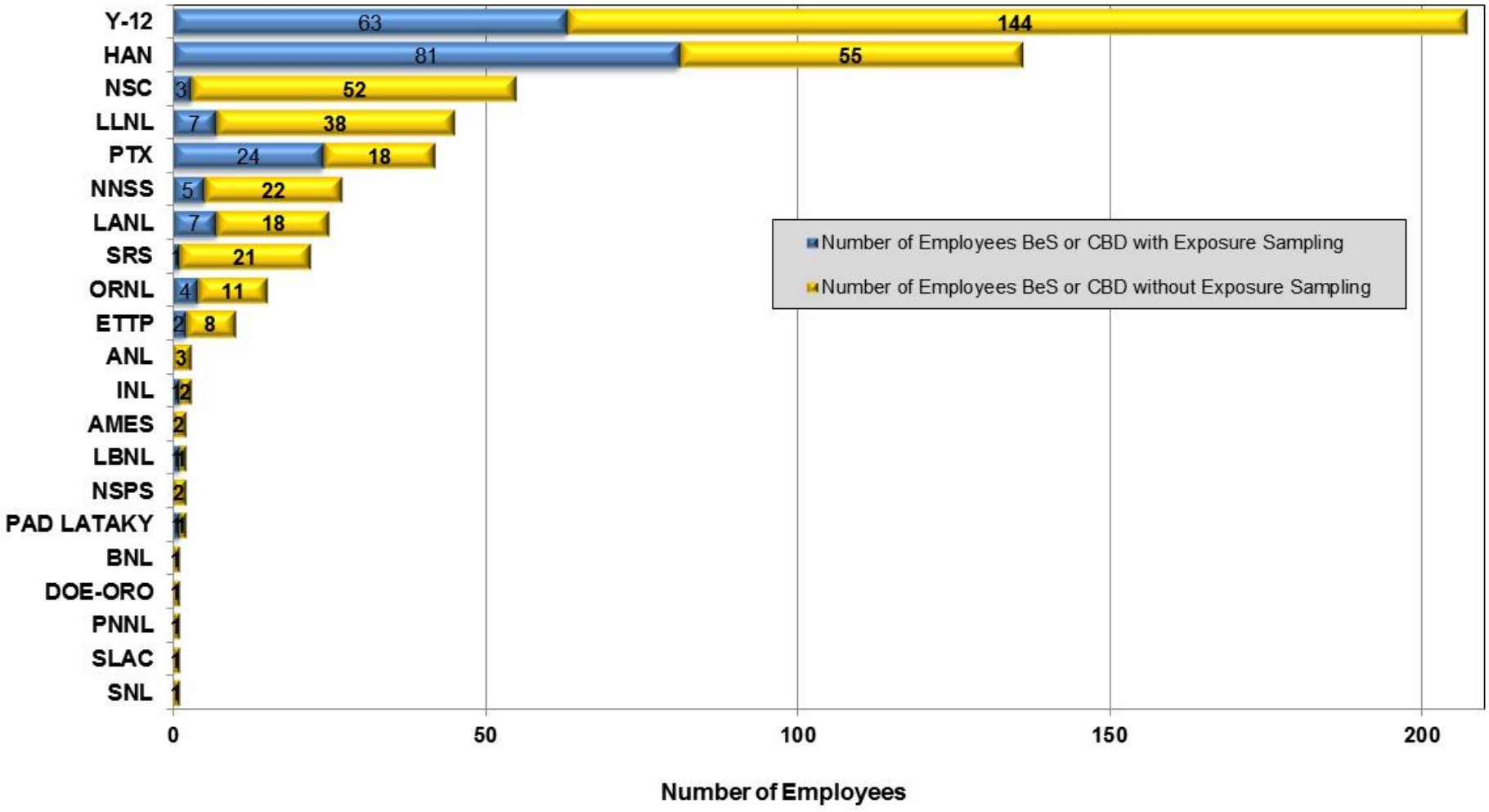
The table above shows the numbers of individuals by reporting organization whose exposures were monitored by an industrial hygienist at least once in each year in the past 10 years. Fourteen reporting organizations provided exposure monitoring results with monitoring dates in 2015. Organization-specific totals for a given year may change from totals in previous annual reports due to late reporting and/or corrections.

Distribution of 4,886 Exposure Samples for 676 Employees by Reporting Organization for Calendar Year 2015



The chart above illustrates the distribution of exposure samples and employees monitored across 14 reporting organizations during 2015.

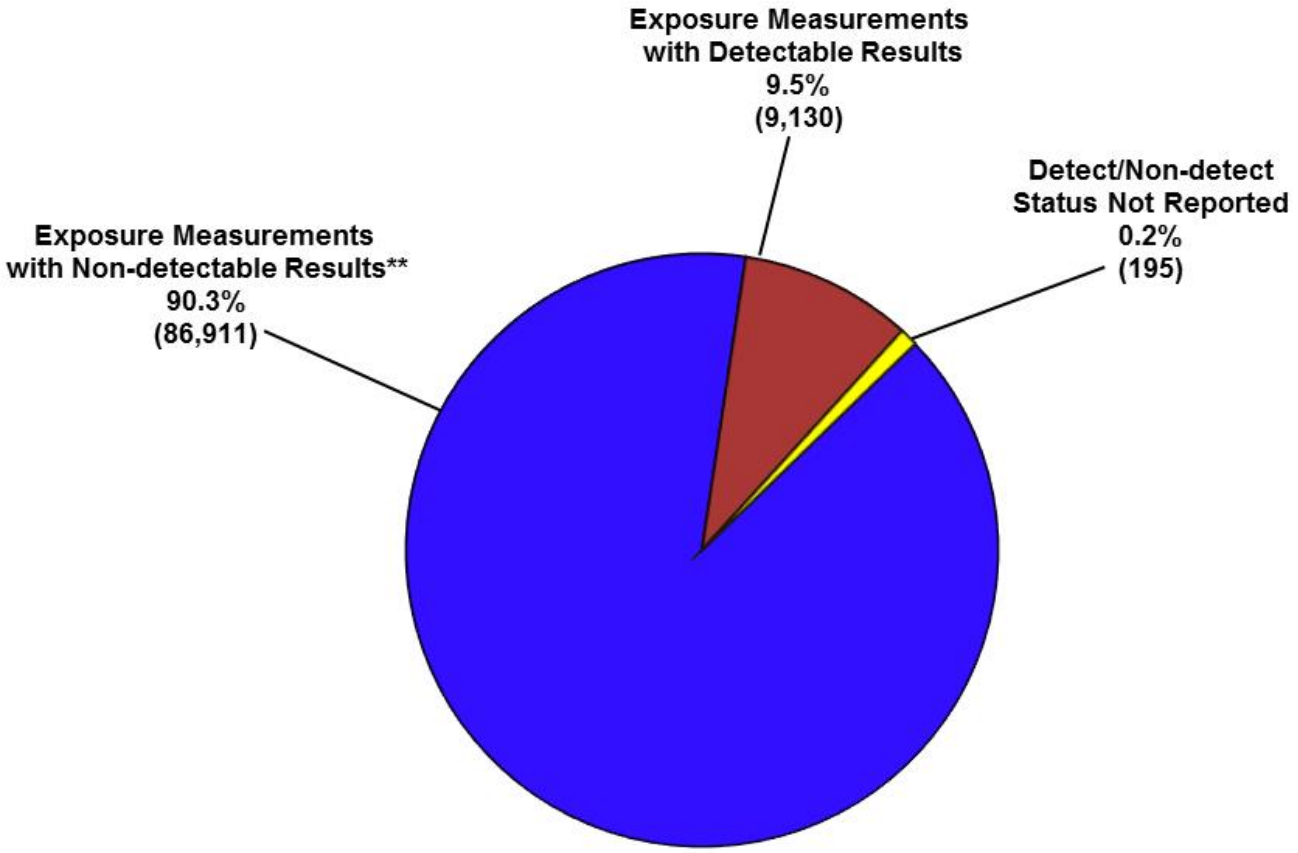
Distribution of Employees BeSensitized or CBD by Reporting Organization and Exposure Sampling Status Through 2015*



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

Reporting from the Registry shows that no exposure sampling data have been reported for 403 (67 percent) of the 603 employees who are BeSensitized or diagnosed with CBD.

Distribution of 96,236 Reported Exposure Levels Through 2015*

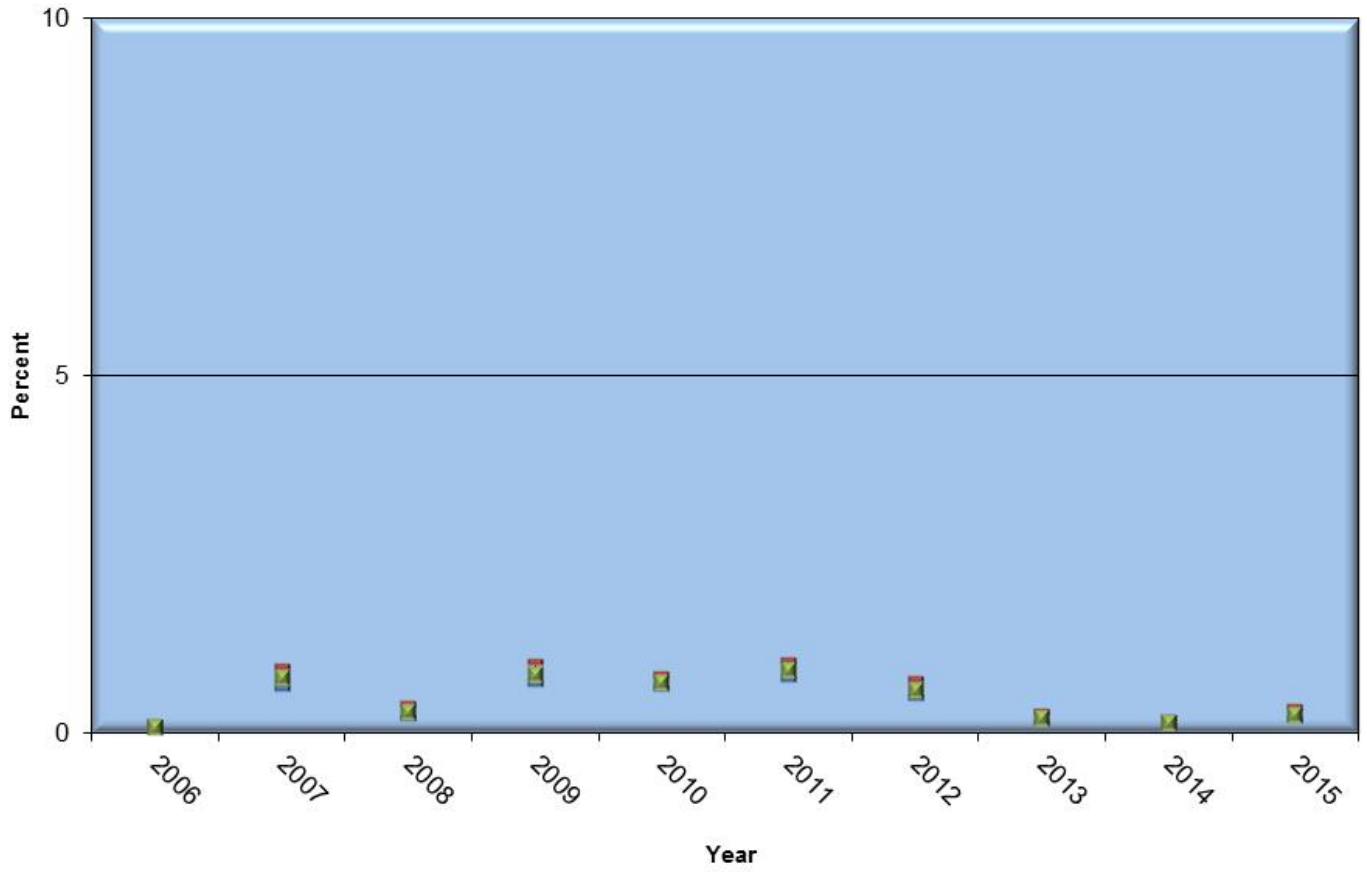


*Some reporting organizations have provided data that predate the 2002 start date of the Registry.
**Non-detectable indicates that analysis results were reported as less than the laboratory's reporting limit.

Of the 96,236 exposure monitoring records submitted to the Registry, 90 percent 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.

DOE-wide Exposure Trend for 2006 – 2015

Percent Exceeding 0.2 µg/m^3 Based on 95 Percent Confidence Limits



This figure is a DOE-wide rollup of 8-hour time weighted average personal exposure monitoring results. Detailed data are presented on the following page. Totals for an individual year may vary from previous reports due to late reporting and/or corrections. These data indicate that the CBD prevention programs being 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.

The metrics are distribution-free product limit estimates of percent exceeding, which are used to accommodate the high percentage of non-detect results in these data sets. Non-detected values greater than 0.2 µg/m^3 were excluded from this analysis. 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, http://www.csm.ornl.gov/esh/aoed/ORNLTM2005-52.pdf.

Summary Statistics for 2006 – 2015 8-Hour Time Weighted Average Exposure Monitoring Results

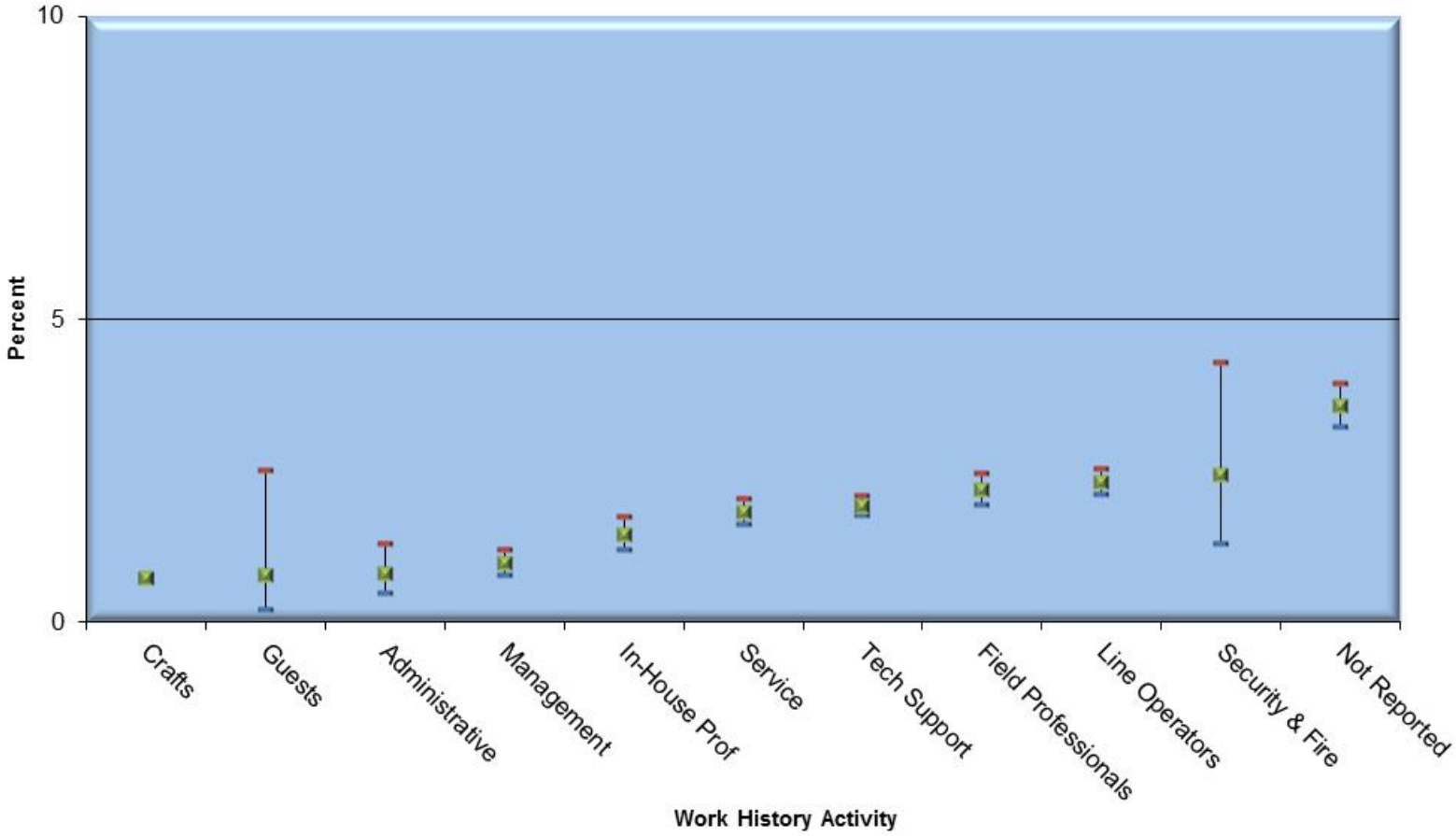
Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	All Years
Number of reported monitoring results	6,236	5,902	5,160	6,644	13,374	10,186	6,045	5,262	5,322	4,864	68,995
Number of detected values	235	344	156	251	633	528	301	217	170	125	2,960
Percent non-detects	96.2	94.2	97.0	96.2	95.3	94.8	95.0	95.9	96.8	97.4	95.7
Number of individuals monitored	800	806	756	868	1,169	1,097	821	780	808	675	4,310*
Arithmetic mean (EX) ($\mu g/m^3$)	0.002	0.021	0.006	0.254	0.033	0.094	0.032	0.003	0.002	0.008	0.020
Lower confidence limit of EX ($\mu g/m^3$)	0.002	0.012	0.003	0.063	0.020	0.046	0.015	0.002	0.002	0.003	0.016
Upper confidence limit of EX ($\mu g/m^3$)	0.002	0.035	0.012	1.019	0.055	0.192	0.069	0.005	0.004	0.022	0.024
Observed 95th percentile of data ($\mu g/m^3$)	0.007	0.012	< 0.001	0.001	0.009	0.009	0.007	0.005	0.003	0.004	0.007
95% upper tolerance limit of the 95th percentile ($\mu g/m^3$)	0.052	0.036	0.032	0.021	0.020	0.021	0.017	0.015	0.017	0.016	0.021
Largest value ($\mu g/m^3$)	0.310	12.513	1.774	11.762	79.330	18.023	4.013	0.804	0.876	1.847	79.330
Percent exceeding 0.2 $\mu g/m^3$ (F)	0.1	0.8	0.3	0.8	0.7	0.9	0.6	0.2	0.2	0.3	0.5
Lower confidence limit for F	0.1	0.6	0.2	0.7	0.6	0.8	0.5	0.2	0.1	0.2	0.5
Upper confidence limit for F	0.1	0.9	0.4	1.0	0.8	1.0	0.8	0.3	0.2	0.4	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 2006 through 2015 is 4,310.

This table provides additional summary statistics for the DOE-wide rollup of 8-hour time weighted average personal exposure monitoring results. Arithmetic mean, 95th percentile, and percent exceeding metrics are Kaplan-Meier product limit estimates. The very high percent of non-detected results from workplaces compliant with the 0.2 $\mu g/m^3$ action level points to the need to develop more sensitive exposure monitoring methods to support estimates of individuals' actual exposure levels.

Exposure by Work History Activity Through 2015 (Ranked by Percent Exceeding)*

Percent Exceeding 0.2 µg/m^3 Based on 95 Percent Confidence Limits



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

Shown above are exposure data grouped by work activity. The data are through calendar year 2015 and detailed data are presented on the following page. The work activities are the high level rollup of job functions used in the table "Work History Activity and BeLPT Status for 23,156 Beryllium-Associated Workers Screened Through 2015." Direct comparison with prior years' reports may be problematic due to late reporting and/or corrections.

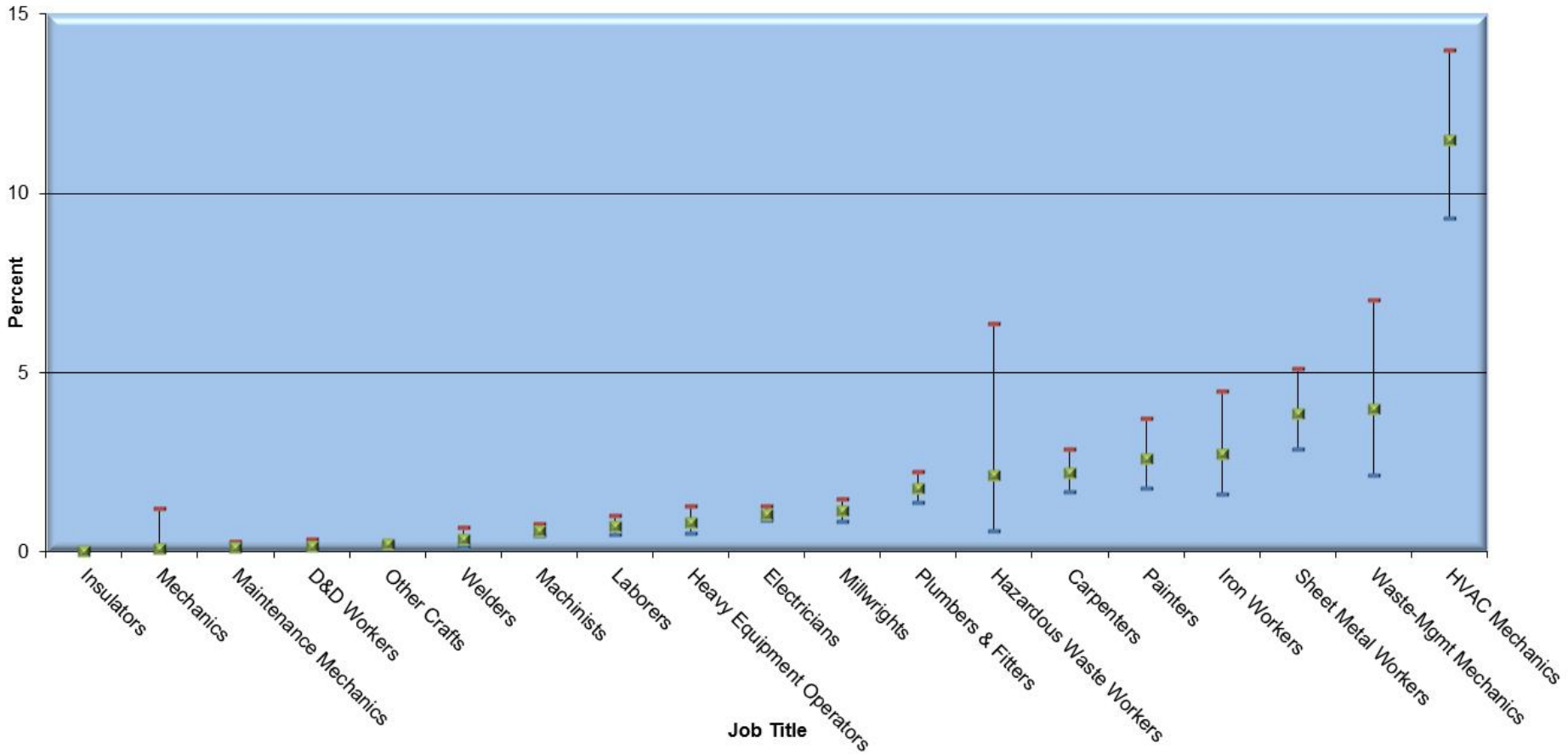
Summary Statistics for 8-Hour Time Weighted Average Exposure Monitoring Results by Work History Activity Through 2015

Work History Activity	Admin	Crafts	Field Prof	Guests	In-House Prof	Line Operators	Management	Security & Fire	Service	Tech Support	Not Reported	All Combined
Number of reported monitoring results	899	41,865	6,251	96	3,539	10,291	3,897	261	7,327	13,328	4,638	92,392
Number of detected values	65	1,854	781	28	319	1,039	312	12	592	1,836	1,647	8,485
Percent non-detects	92.8	95.6	87.5	70.8	91.0	89.9	92.0	95.4	91.9	86.2	64.5	90.8
Number of individuals monitored	78	1,898	562	7	284	999	271	61	532	1,048	256	5,996
Observed 95th percentile of data (ug/m^3)	0.016	0.007	0.054	0.028	0.030	0.062	0.018	0.002	0.025	0.057	0.142	0.029
95% upper tolerance limit of the 95th percentile (ug/m^3)	0.050	0.050	0.094	0.291	0.050	0.100	0.050	0.990	0.051	0.082	0.181	0.057
Largest value (ug/m^3)	2.600	51.895	26.678	0.313	12.611	575.930	11.762	11.700	84.933	29.852	7.670	575.930
Percent exceeding 0.2 ug/m^3 (F)	0.8	0.7	2.2	0.8	1.4	2.3	1.0	2.4	1.8	1.9	3.6	1.5
Lower confidence limit for F	0.5	0.7	1.9	0.2	1.2	2.1	0.8	1.3	1.6	1.8	3.2	1.5
Upper confidence limit for F	1.3	0.8	2.4	2.5	1.7	2.5	1.2	4.3	2.0	2.1	3.9	1.6

This table provides additional summary statistics for 8-hour time weighted average exposure monitoring results grouped by work activity.

Exposure by Job Title for Craft Workers Through 2015 (Ranked by Percent Exceeding)*

Percent Exceeding 0.2 µg/m^3 Based on 95 Percent Confidence Limits



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

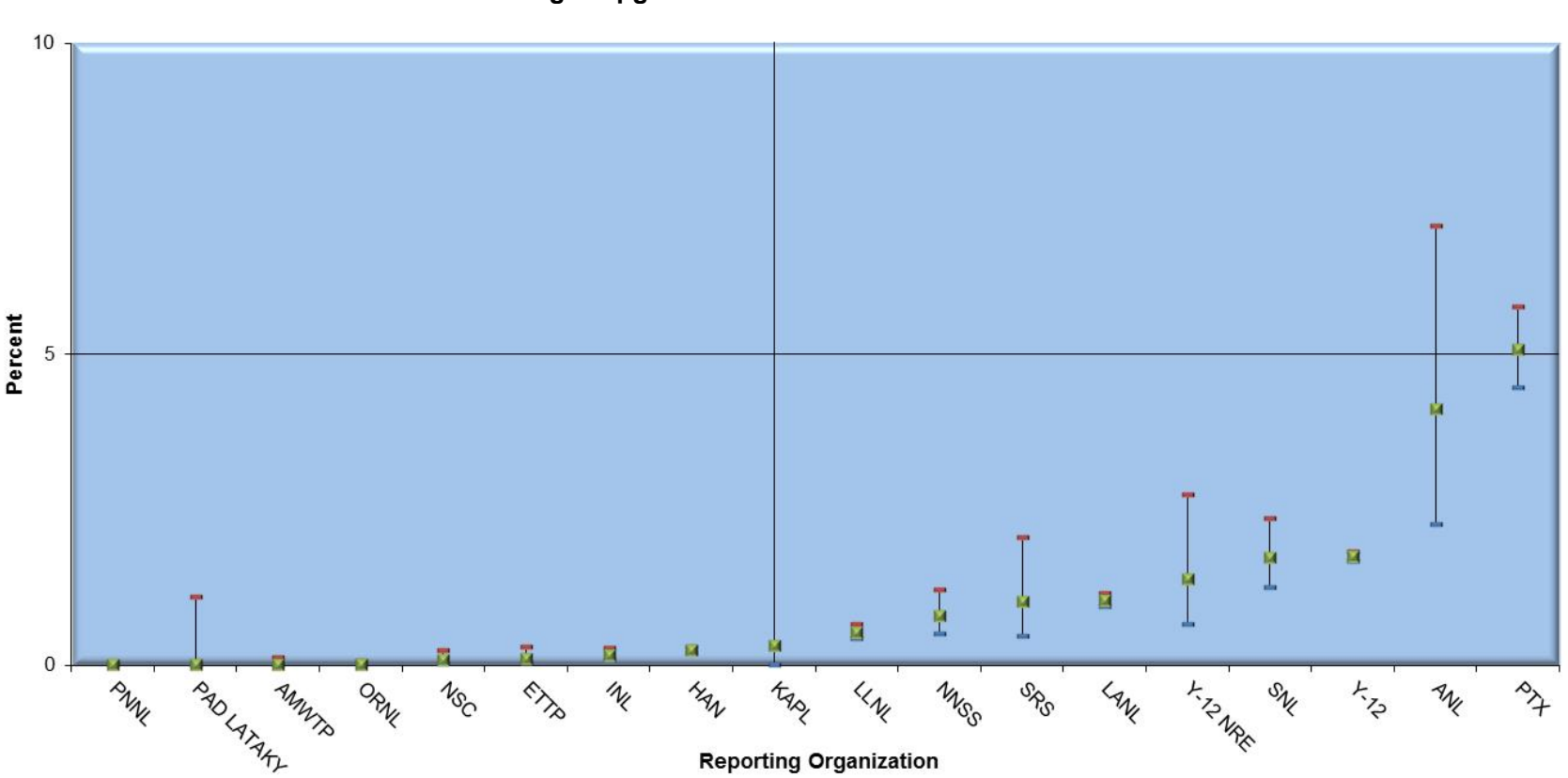
The figure displays differences in exposure level for individuals with job titles that were grouped together in the Craft work activity category. Detailed data are presented on the following page. Heavy Equipment Operators, Electricians, Millwrights, Plumbers & Fitters, Hazardous Waste Workers, Carpenters, Painters, Iron Workers, Sheet Metal Workers, Waste-Management Mechanics, and HVAC Mechanics have exceedance rates significantly higher than all Crafts combined (0.7 µg/m^3, as shown in the table on page 26). Direct comparison with prior years' reports may be problematic due to late reporting and/or corrections.

Summary Statistics for 8-Hour Time Weighted Average Exposure Monitoring Results for Craft Job Titles Through 2015 (Ranked by Percent Exceeding)

Craft Job Title	Number of reported monitoring results	Number of detected values	Percent non-detects	Number of individuals monitored	Observed 95th percentile of data (ug/m^3)	95% upper tolerance limit of the 95th percentile (ug/m^3)	Largest value (ug/m^3)	Percent exceeding 0.2 ug/m^3 (F)	Lower confidence limit for F	Upper confidence limit for F
Insulators	660	14	97.9	27	0.001	0.030	0.200	< 0.1	< 0.1	0.1
Mechanics	94	9	90.4	32	0.017	0.070	0.091	0.1	< 0.1	1.2
Maintenance Mechanics	906	25	97.2	89	0.002	0.052	0.200	0.1	< 0.1	0.3
D&D Workers	1,034	55	94.7	124	0.015	0.037	0.100	0.2	0.1	0.3
Other Crafts	19,998	318	98.4	236	0.004	0.018	6.314	0.2	0.2	0.2
Welders	1,014	35	96.5	34	0.007	0.021	0.356	0.3	0.2	0.7
Machinists	4,141	127	96.9	89	< 0.001	0.050	51.895	0.6	0.4	0.8
Laborers	1,702	72	95.8	246	0.007	0.053	10.340	0.7	0.5	1.0
Heavy Equipment Operators	976	60	93.9	102	0.005	0.021	16.697	0.8	0.5	1.3
Electricians	4,191	336	92.0	322	0.021	0.050	6.957	1.0	0.9	1.3
Millwrights	2,167	135	93.8	158	0.014	0.050	20.176	1.1	0.8	1.5
Plumbers & Fitters	1,847	159	91.4	158	0.028	0.050	5.735	1.8	1.4	2.2
Hazardous Waste Workers	77	9	88.3	13	0.075	0.176	0.176	2.1	0.6	6.4
Carpenters	1,187	136	88.5	105	0.045	0.066	3.176	2.2	1.7	2.8
Painters	530	71	86.6	44	0.074	0.137	7.423	2.6	1.8	3.7
Iron Workers	274	31	88.7	31	0.092	0.263	1.847	2.7	1.6	4.5
Sheet Metal Workers	574	80	86.1	45	0.260	0.455	4.872	3.8	2.9	5.1
Waste-Mgmt Mechanics	147	17	88.4	15	0.093	1.290	2.390	4.0	2.1	7.0
HVAC Mechanics	346	165	52.3	28	0.535	0.949	6.404	11.5	9.3	14.0
All Combined	41,865	1,854	95.6	1,898	0.007	0.050	51.895	0.7	0.7	0.8

This table provides summary statistics for 8-hour time weighted average monitoring results by craft job title.

Percent of Exposure Monitoring Results Exceeding the Action Level by Reporting Organization Through 2015 (Ranked by Percent Exceeding)*



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

This figure summarizes 8-hour time weighted average exposure monitoring results by reporting organization. Detailed data are presented on the following page. Exceedance rates at Fermi (not included in this figure), SNL, Y-12, ANL, and PTX were significantly higher than those for all organizations combined.

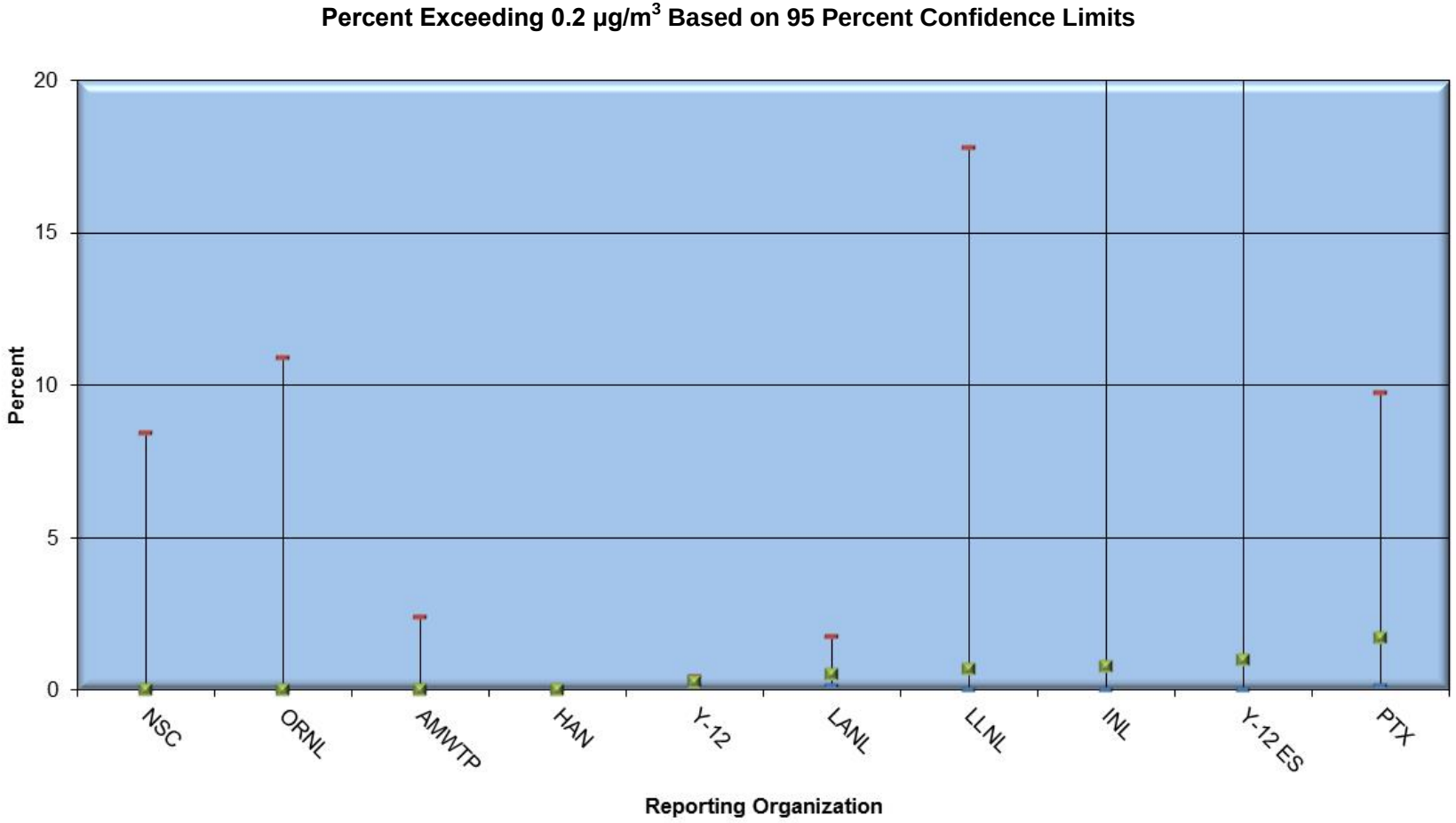
Results from AMES, BNL, Fermi, LBNL, LLNL CHES, SLAC, and Y-12 ES were not included in this figure because of the small number of total samples and/or low percent exceeding the action level. Direct comparison with prior years' reports may be problematic due to late reporting and/or corrections.

Summary Statistics for 8-Hour Time Weighted Average Exposure Monitoring Results by Reporting Organization Through 2015

Reporting Organization	Number of reported monitoring results	Number of detected values	Percent non-detects	Number of individuals monitored	Observed 95th percentile of data (ug/m^3)	95% upper tolerance limit of the 95th percentile (ug/m^3)	Largest value (ug/m^3)	Percent exceeding 0.2 ug/m^3 (F)	Lower confidence limit for F	Upper confidence limit for F
AMES	49	0	100	8	0.026	NA	0.028	0	0	5.9
AMWTP	125	9	92.8	31	0.005	0.010	0.036	< 0.1	< 0.1	0.1
ANL	155	18	88.4	23	0.145	1.100	2.390	4.1	2.3	7.0
BNL	72	0	100	42	0.067	NA	0.100	0	0	4.1
ETTP	903	31	96.6	295	0.007	0.080	2.264	0.1	< 0.1	0.3
Fermi	48	23	52.1	17	1.296	NA	4.800	18.7	11.7	27.7
HAN	9,857	409	95.9	1,552	0.004	0.020	12.513	0.2	0.2	0.3
INL	1,658	102	93.8	285	0.016	0.058	0.843	0.2	0.1	0.3
KAPL	234	2	99.1	37	0.007	0.200	0.200	0.3	< 0.1	27.5
LANL	12,276	2,515	79.5	561	0.045	0.059	26.678	1.0	0.9	1.1
LBNL	18	0	100	8	NA	NA	0.100	0	0	15.3
LLNL	6,568	311	95.3	293	0.013	0.034	5.133	0.5	0.4	0.6
LLNL CHES	3	0	100	1	NA	NA	0.042	0	0	63.2
NNSS	1,093	70	93.6	277	0.009	0.052	0.317	0.8	0.5	1.2
NSC	1,636	18	98.9	179	0.002	0.148	0.196	0.1	< 0.1	0.2
ORNL	1,267	8	99.4	262	0.002	0.011	0.157	< 0.1	< 0.1	< 0.1
PAD LATAKY	566	4	99.3	60	0.004	0.011	0.019	< 0.1	< 0.1	1.1
PNNL	89	9	89.9	26	0.003	0.004	0.004	< 0.1	< 0.1	< 0.1
PTX	2,209	279	87.4	468	0.296	0.550	575.930	5.1	4.5	5.8
SLAC	42	0	100	26	0.040	NA	0.150	0	0	6.9
SNL	799	247	69.1	122	0.059	0.100	2.800	1.7	1.2	2.4
SRS	347	19	94.5	192	0.012	0.072	0.320	1.0	0.5	2.0
Y-12	52,061	4,394	91.6	1,201	0.045	0.050	79.330	1.7	1.7	1.8
Y-12 ES	26	2	92.3	15	0.013	NA	0.150	1.0	< 0.1	93.2
Y-12 NRE	291	15	94.8	15	0.009	0.039	1.111	1.4	0.6	2.7
All Combined	92,392	8,485	90.8	5,996	0.029	0.057	575.930	1.5	1.5	1.6

This table provides additional summary statistics for organizations reporting exposure data. While the majority have acceptable sampling programs, these data show some organizations could revisit their sampling strategies and consider increasing the number of samples taken.

Percent of Exposure Monitoring Results Exceeding the Action Level by Reporting Organization for Calendar Year 2015 (Ranked by Percent Exceeding)



While Pantex Plant had the greatest percentage of reported exposure monitoring results exceeding the action level in 2015, Y-12 had the greatest number (as shown on page 30). Detailed data are presented on the following page. The upper confidence limit is above 5 percent at organizations that reported 62 or fewer sampling results in 2015 or reported similar time weighted average values for detects and non-detects.

Results from NNSS, PNNL, SNL, and SRS were not included in this figure because of the small number of total samples.

Summary Statistics for 8-Hour Time Weighted Average Exposure Monitoring Results by Reporting Organization for Calendar Year 2015

Reporting Organization	Number of reported monitoring results	Number of detected values	Percent non-detects	Number of individuals monitored	Observed 95th percentile of data (ug/m^3)	95% upper tolerance limit of the 95th percentile (ug/m^3)	Largest value (ug/m^3)	Percent exceeding 0.2 ug/m^3 (F)	Lower confidence limit for F	Upper confidence limit for F
AMWTP	57	5	91.2	18	0.006	NA	0.009	< 0.1	< 0.1	2.4
HAN	1,055	21	98	285	< 0.001	0.015	0.049	< 0.1	< 0.1	0.1
INL	85	2	97.6	53	0.002	0.843	0.843	0.8	< 0.1	48.3
LANL	178	18	89.9	17	0.017	0.060	1.847	0.5	0.1	1.7
LLNL	41	3	92.7	16	0.008	NA	0.300	0.7	< 0.1	17.8
NNSS	5	4	20	5	0.007	NA	0.004	0	0	1.3
NSC	34	0	100	9	0.023	NA	0.024	0	0	8.4
ORNL	26	0	100	17	0.010	NA	0.011	0	0	10.9
PNNL	16	1	93.8	7	NA	NA	0.003	0	0	17.1
PTX	55	4	92.7	20	0.027	NA	0.382	1.7	0.2	9.8
SNL	8	5	37.5	7	0.346	NA	0.410	28.4	8.2	59.9
SRS	2	0	100	2	NA	NA	0.002	0	0	77.6
Y-12	3,276	60	98.2	204	0.007	0.012	0.805	0.3	0.2	0.4
Y-12 ES	26	2	92.3	15	0.013	NA	0.150	1.0	< 0.1	93.2
All Combined	4,864	125	97.4	675	0.004	0.016	1.847	0.3	0.2	0.4

The table above gives additional summary statistics for organizations reporting exposure data to the BAWR during 2015. Organizations that did not report data for calendar year 2015 are not included in this table.

Exposure Monitoring Results Above the 0.2 µg/m³ Action Level for Calendar Years 2015, 2014, 2013, and 2012

Calendar Year 2015:

Reporting Organization	Process Description	Job Title	8-Hour Time Weighted Average, ug/m³	Respirator Assigned Protection Factor
LANL	IRONWORKER	IRONWORKER	1.85	1000
HAN		INDUSTRIAL HYGIENE TECH	1.57	1
HAN		Electricians	1.56	1
INL	Waste Processing	Operator	0.84	1000
Y-12	SUPPORT	Other Laborers and General Services	0.80	100
Y-12	SUPPORT	Other Laborers and General Services	0.71	100
Y-12	PRODUCTION	Other Crafts	0.67	50
Y-12	SUPPORT	Other Laborers and General Services	0.53	100
SNL	OPERATIONAL SUPPORT	Technician	0.41	10
PTX	BERYLLIUM WORK	ASSOCIATE WASTE OPS TECH	0.38	25
SNL	OPERATIONAL SUPPORT	Technician	0.32	10
SNL	OPERATIONAL SUPPORT	Technician	0.32	100
Y-12	SUPPORT	Other Laborers and General Services	0.32	100
LLNL	clean out valve	Scientific Technician	0.30	1000
Y-12	SUPPORT	Other Laborers and General Services	0.29	100
SNL	OPERATIONAL SUPPORT	Technician	0.25	100
SNL	OPERATIONAL SUPPORT	Technician	0.25	10
SNL	OPERATIONAL SUPPORT	Technician	0.24	100
SNL	OPERATIONAL SUPPORT	Technician	0.24	10
SNL	OPERATIONAL SUPPORT	Technician	0.24	100
SNL	OPERATIONAL SUPPORT	Technician	0.23	100
Y-12	SUPPORT	Other Laborers and General Services	0.22	100
SNL	OPERATIONAL SUPPORT	Technician	0.21	100
SNL	OPERATIONAL SUPPORT	Technician	0.21	100

Calendar Year 2014:

Reporting Organization	Process Description	Job Title	8-Hour Time Weighted Average, ug/m³	Respirator Assigned Protection Factor
HAN		Vehicle and Mobile Equipment Mechanics	3.59	1000
Y-12	SUPPORT	Other Crafts	0.88	50
PTX	BERYLLIUM WORK	AREA MECHANIC	0.67	25
Y-12	SUPPORT	Plumbers and Pipefitters	0.65	100
Y-12	PRODUCTION	Other Crafts	0.62	1
Y-12	SUPPORT	Other Crafts	0.54	50
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	0.45	25
Y-12	SUPPORT	Laboratory Technicians	0.42	100
Y-12	PRODUCTION	Other Crafts	0.42	50
NNSS	Exposure Assessment	Miner	0.32	10
PTX	BERYLLIUM WORK	ASSOCIATE WASTE OPS TECH	0.31	25
LLNL	Decontamination	Sr. Technologist C/MS	0.28	1000
Y-12	SUPPORT	Millwrights	0.27	100
Y-12	SUPPORT	Other Crafts	0.27	50
Y-12	SUPPORT	Plumbers and Pipefitters	0.26	100

Calendar Year 2013:

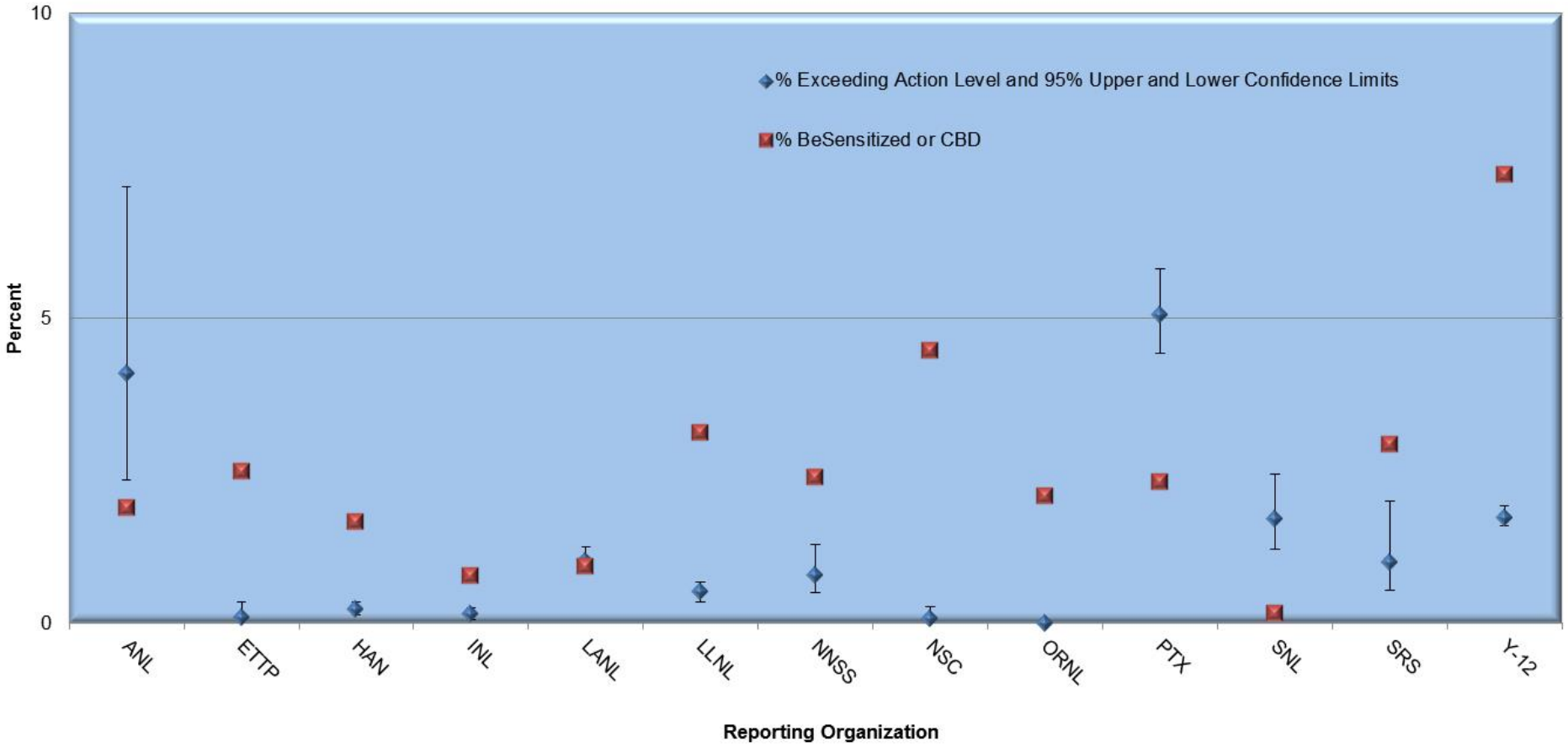
Reporting Organization	Process Description	Job Title	8-Hour Time Weighted Average, ug/m³	Respirator Assigned Protection Factor
NSC	Decontamination	Laborer	18.00	50
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	0.80	25
LANL	RESEARCH TEC 5		0.30	100
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	0.30	25
PTX	BERYLLIUM WORK	ASSOCIATE WASTE OPS TECH	0.29	25
Y-12	PRODUCTION	Machinists	0.26	50
Y-12	PRODUCTION	Engineering Technicians	0.22	50

Calendar Year 2012:

Reporting Organization	Process Description	Job Title	8-Hour Time Weighted Average, ug/m³	Respirator Assigned Protection Factor
SNL	DECONTAMINATION	Technician	5.32	25
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	4.01	100
PTX	BERYLLIUM WORK	ENG TECH. II (WASTE OPER)	3.21	100
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	2.47	100
PTX	BERYLLIUM WORK	ASSOCIATE WASTE OPS TECH	2.25	100
LLNL	Not identified	Technologist - C/MS	2.08	1000
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	1.55	100
PTX	BERYLLIUM WORK	ASSOCIATE WASTE OPS TECH	1.35	100
PTX	BERYLLIUM WORK	ASSOCIATE WASTE OPS TECH	0.84	100
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	0.81	1
LLNL	Not identified	Technologist - C/MS	0.75	1000
PTX	BERYLLIUM WORK	ASSOCIATE WASTE OPS TECH	0.75	100
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	0.73	100
PTX	BERYLLIUM WORK	ASSOCIATE WASTE OPS TECH	0.73	100
LANL	INSPECT DRUM CONTENTS	STAFF MEMBER	0.58	100
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	0.49	100
LANL	R&D ENGINEER 4	TEAM LEADER	0.46	1000
LLNL	Not identified	Scientific Technician	0.43	1000
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	0.42	100
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	0.42	100
LANL	WET MACHINING	MACH/FAB TEC-S	0.40	1
LLNL	Not identified	Sr. Technologist C/MS	0.40	1000
LANL	ENGINEERED SYSTEMS T	EXPLOSIVES TEC 4	0.37	1000
LANL	INSPECT DRUM CONTENTS	STAFF MEMBER	0.36	10
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	0.36	100
PTX	BERYLLIUM WORK	ENG TECH (WASTE OPERATIONS)	0.34	100
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	0.33	100
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	0.33	100
LLNL	Not identified	Sr. Technologist C/MS	0.30	1000
LLNL	Not identified	Sr. Technologist C/MS	0.29	1000
LLNL	Not identified	Sr. Hydro Tech - S-300	0.27	1000
PTX	BERYLLIUM WORK	ASSOCIATE WASTE OPS TECH	0.27	100
LANL	ENGINEERED SYSTEMS T	EXPLOSIVES TEC 4	0.26	1000
LLNL	Not identified	Sr. Technologist C/MS	0.24	1000
LLNL	Not identified	Sr. Technologist C/MS	0.23	1000
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATION:	0.23	100
Y-12	PRODUCTION	Other Crafts	0.22	100
LANL	INSPECT DRUM CONTENTS	MTRLS SCI TEC	0.21	100
SNL	WASTE TREATMENT PROCES	Technician	0.21	100
SNL	WASTE TREATMENT PROCES	Technician	0.21	1000

Exceedances for 2015 were greater than in 2013 or 2012 but fewer than in previous years. Twenty-four samples exceeded the action level in 2015 compared with 15 in 2014, only 7 in 2013, and 40 in 2012. Nevertheless, the total number of reported exposure sampling results continued to decrease (page 22). In both 2013 and 2012 exceedances were primarily associated with waste operations work at Pantex Plant. In 2014 exceedances were primarily for support and production work at Y-12. And in 2015 exceedances were largely for operational support work at SNL. In most cases, work planning processes identified the potential for beryllium exposure and workers were wearing respiratory protection.

Cumulative Rates of Beryllium Sensitization or CBD versus Exposure Levels Through 2015*



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

Medical monitoring results for beryllium sensitization or CBD and beryllium exposure monitoring results have no correlation (Pearson product moment correlation coefficient = 0.098). A likely explanation for this is that the sensitization or CBD being detected are due to past working conditions rather than those currently being monitored. However, it is also possible that monitoring programs are missing significant sources of exposure that are ongoing. Reporting organizations with low exposure monitoring results and high sensitization or CBD rates can investigate cases to determine if the possibility of ongoing exposure can be ruled out.