Beryllium-Associated Worker Registry Summary

Through 2013

Office of Environment, Health, Safety and Security

Table of Contents

Beryllium-Associated Worker Registry Summary

Data Cumulative Through 2013

The U.S. Department of Energy (DOE) Beryllium-Associated Worker Registry (BAWR) is a collection of health and exposure information for individuals potentially at risk for chronic beryllium disease (CBD) due to their work at DOE facilities. 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 to determine whether employees are at risk for CBD. Subpart C, Section 850.39, requires that responsible employers transmit all records generated as required by this rule to the DOE Assistant Secretary for Environment, Health, Safety and Security (EHSS, formerly Environment, Safety and Health) while protecting their workers' confidentiality. To facilitate management of these data, a BAWR Data Center has been established at the Oak Ridge Institute for Science and Education, operated by Oak Ridge Associated Universities (ORAU), to receive and process the data and provide descriptive summaries that are included in the annual reports. The Registry includes, but is not limited to, an encrypted unique identifier, date of birth, gender, site, job history, medical screening test results, exposure measurements, and results of referrals for specialized medical evaluations.

Beryllium is a silver-gray metallic element found in approximately 30 minerals. It is a lightweight but strong, hard metal that has many industrial applications. The primary commercial use of beryllium is for hardening other metals, especially copper. Copper-beryllium alloys have many applications in electronic industries and other fields where strength and the ability to be fabricated into complex shapes and conduct electricity are desirable. The light weight and ability to dissipate heat of beryllium oxide ceramics have led to applications in the electronic, nuclear, and aerospace industries. Beryllium's transparency to x-rays and its ability to scatter and generate, but not absorb, neutrons when bombarded by protons have led to its use in nuclear weapons, experimental reactors, and accelerators.

EHSS has taken the approach that summarization and periodic reporting of the results of ongoing data collection are within the Regulation's requirements to "…inventory and assess beryllium exposure hazards to determine whether employees are at risk for CBD." Annual reports organize the data into basic information with descriptive analyses in order to address 3 goals: (1) to perform basic data quality evaluation as part of continuous quality improvement, (2) to identify unusual patterns in a given year or over time that may warrant further evaluation, and (3) to provide feedback to site industrial hygienists, occupational medicine staff, management, and others with an interest in this aspect of worker safety and health.

The current annual report summarizes data cumulative through calendar year 2013 from sites that have determined that employees are at risk due to ongoing or past work. These sites have implemented CBD prevention programs that include the reporting of health and exposure data every 6 months to the DOE BAWR (see DOE-STD-1187-2007 for the operating protocol). Data summarized in this report include calendar 2013 data submitted or corrected by the end of March 2014. Health data were collected through the operation of current worker medical surveillance programs for all 27 sites and subcontractors submitting data (page 5). Exposure sampling data were submitted by the industrial hygiene programs for 24 sites and subcontractors that have continuing beryllium operations or cleanup efforts due to a legacy of beryllium use from the past.

The beryllium lymphocyte proliferation test (BeLPT) is a blood test that examines how lymphocytes (white blood cells in the immune system that fight disease) react to beryllium. A BeLPT is considered abnormal if a person's lymphocytes are shown to proliferate more rapidly when exposed to beryllium. An abnormal BeLPT may indicate that an individual is more likely than others with similar exposure to develop CBD in the future or

may be an early sign of CBD. Individuals who have abnormal results are offered confirmatory testing that involves splitting blood samples, which are then tested in 2 laboratories. To be considered beryllium sensitized (BeSensitized), 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. In this annual report, the "Number Sensitized" and "Number with CBD" are mutually exclusive categories; the "Number Sensitized" category does not include individuals who have been diagnosed as having CBD.

The category "beryllium-associated worker" describes individuals who were screened for CBD or monitored for beryllium exposure while employed at a DOE site. The workers include both long-term employees who worked with beryllium years ago and workers exposed recently. Current workers who identify themselves or are identified by supervisors as beryllium-associated workers are offered screening for CBD.

The BAWR Summary Report for 2013 includes 1,440 more workers than the 2012 report and reflects 5,094 additional exposure sampling results, 4 additional beryllium sensitizations, and no additional CBD diagnoses. At least partial data were submitted by 27 sites for 2013; 5 sites were inactive.

The 38 exceedances above the 0.2 µg/m^3 action level reported in 2012 were reduced to 6 exceedances reported in 2013. In both 2013 and 2012, the exceedances observed were heavily associated with waste operations at Pantex Plant, although the potential for these exceedances was generally identified by work planning processes and appropriate respiratory protection was in use (page 31).

Through 2013, the majority of both reported beryllium sensitizations (34.4 percent) and CBD cases (39.7 percent) occurred among the broad occupational groups of Craft and Line Operators. Among craft workers, HVAC mechanics continue to show percentages exceeding the 0.2 µg/m^3 action level, much higher than the percentages experienced by other craft workers, but the percentage reflects exposure monitoring results for only 24 individuals (page 26).

The data at hand suggest that the prevention programs implemented by DOE sites have consistently provided a high level of compliance with the 10 CFR 850.23 action level of 0.2 µg/m^3 since 2004, as indicated in the table on page 22. Reported monitoring levels remained consistent from approximately 2006 through the current period, although a marked upturn in monitoring accompanied the initiation of the American Recovery and Reinvestment Act of 2009 and declined after the program's closure in 2011. A source of some concern is that two-thirds of the workers currently identified as sensitized or diagnosed with CBD have no exposure sampling data. The availability of more complete exposure measurement could help to clarify the patterns of sensitization and CBD occurrence observed.

Direct comparison with prior years' reports may be problematic due to late reporting and/or corrections. Readers wishing to compare total numbers or changes between report years 2012 and 2013 should also be aware that the population of sites changed between the 2 reports. In 2013 there was 1 new contractor, National Strategic Protective Services, LLC (NSPS). However, 3 sites had become inactive by 2013 and are not reflected in the 2013 report; these are Wackenhut Security Services Inc. (WSI) and 2 subcontractors for Lawrence Livermore National Laboratory, Boston University (LLNL BU) and Envirocon (LLNL ENVC). While National Strategic Protective Services and Envirocon did not have any employees who were reported as BeSensitized or diagnosed with CBD, Wackenhut had 1 employee who was BeSensitized and none with CBD. Boston University, conducting tests for LLNL, identified 3 LLNL employees who had become BeSensitized but none with CBD.

In summary, 4 employees who were BeSensitized were not included in the 2013 report because they were at inactive sites. There were no changes in total CBD cases between the 2 report years; the same 146 employees remain as reported CBD cases in 2013. However, the changes in the number of BeSensitized for the 26 sites that were included in both reports reflected 8 additional cases reported by 2013, the difference between 399 BeSensitized rather than 403 included for 2012, and 407 employees in the 2013 report. The additional 8 BeSensitized workers who were reported in the 2013 data included 3 employees at Hanford Site (HAN), 2 employees at Lawrence Livermore National Laboratory (LLNL), 1 employee at Nevada National Security Site (NNSS), 1 employee at Los Alamos Technical Associates Environmental Services of Kentucky, LLC (PAD LATAKY), and 1 employee at Y-12 National Security Complex (Y-12).

A continuing concern is that demolition and decontamination activities have revealed unexpected beryllium contamination as these activities progressed. The potential for discovery of new cases of beryllium sensitization and CBD have not yet been eliminated.

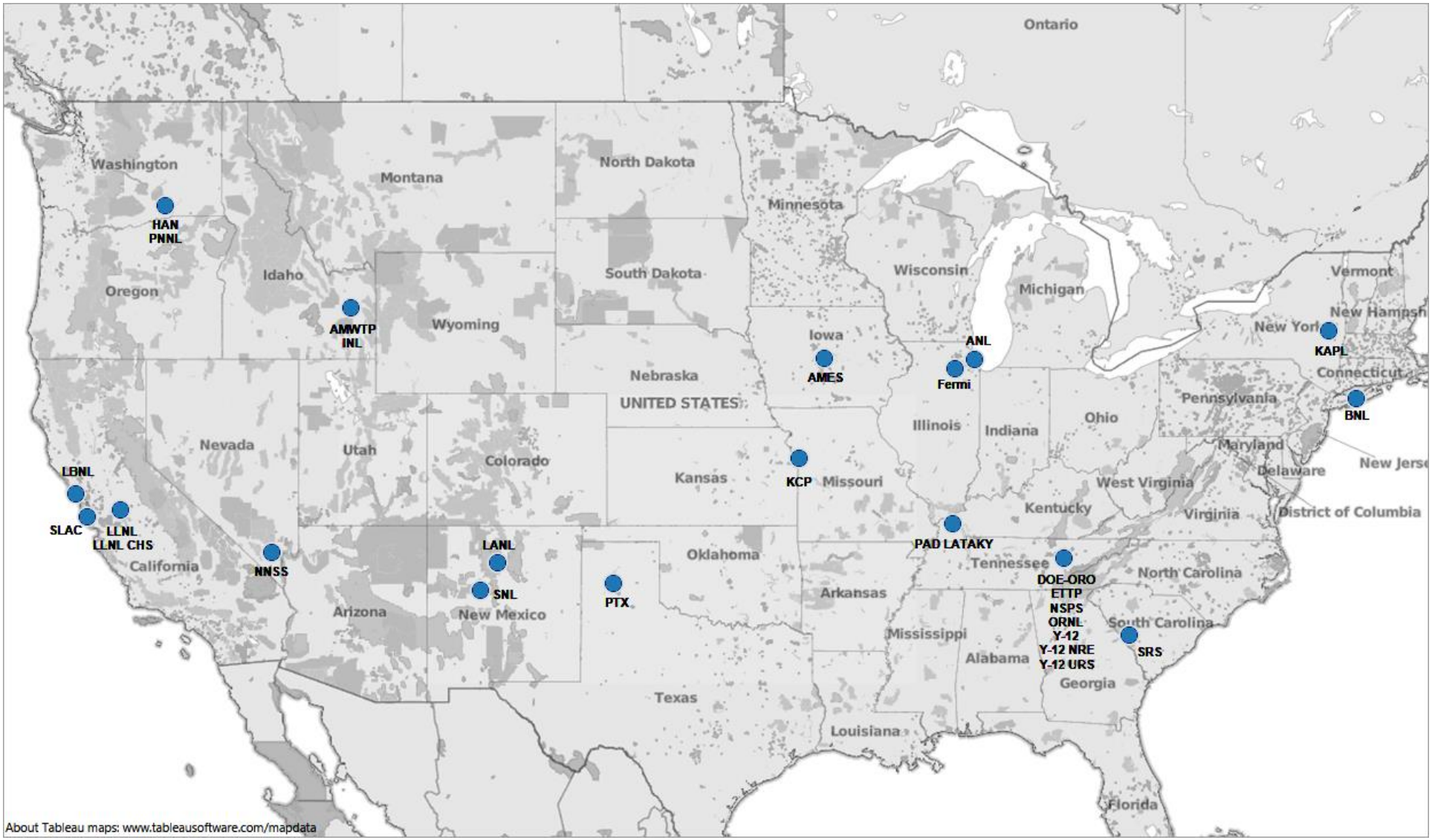
A further concern is potential confusion about who is eligible for inclusion in reporting to the BAWR. Eligible workers include current beryllium workers, current workers who worked with beryllium in past activities, and workers who self-identify as potentially exposed to beryllium in past work activities, whether or not such exposures can be documented. In all cases, continued industrial hygiene surveillance of these workers is required and, whether or not they have become sensitized to beryllium or have developed CBD, their inclusion in the BAWR is not optional. Rather, continued reporting of these workers is expected once they are identified.

As with previous reports, the 2013 Annual Report provides a basic evaluation of worker protection in beryllium work, both historical and current. Analyses in this report may indicate areas of continued success and provide information of potential use in identifying areas in which further work may be of benefit in the prevention of CBD. As always, reader comments are welcome.

Cliff Strader

Manager, Beryllium-Associated Worker Registry

Location of 27 Sites and Subcontractors Currently Submitting Data to BAWR



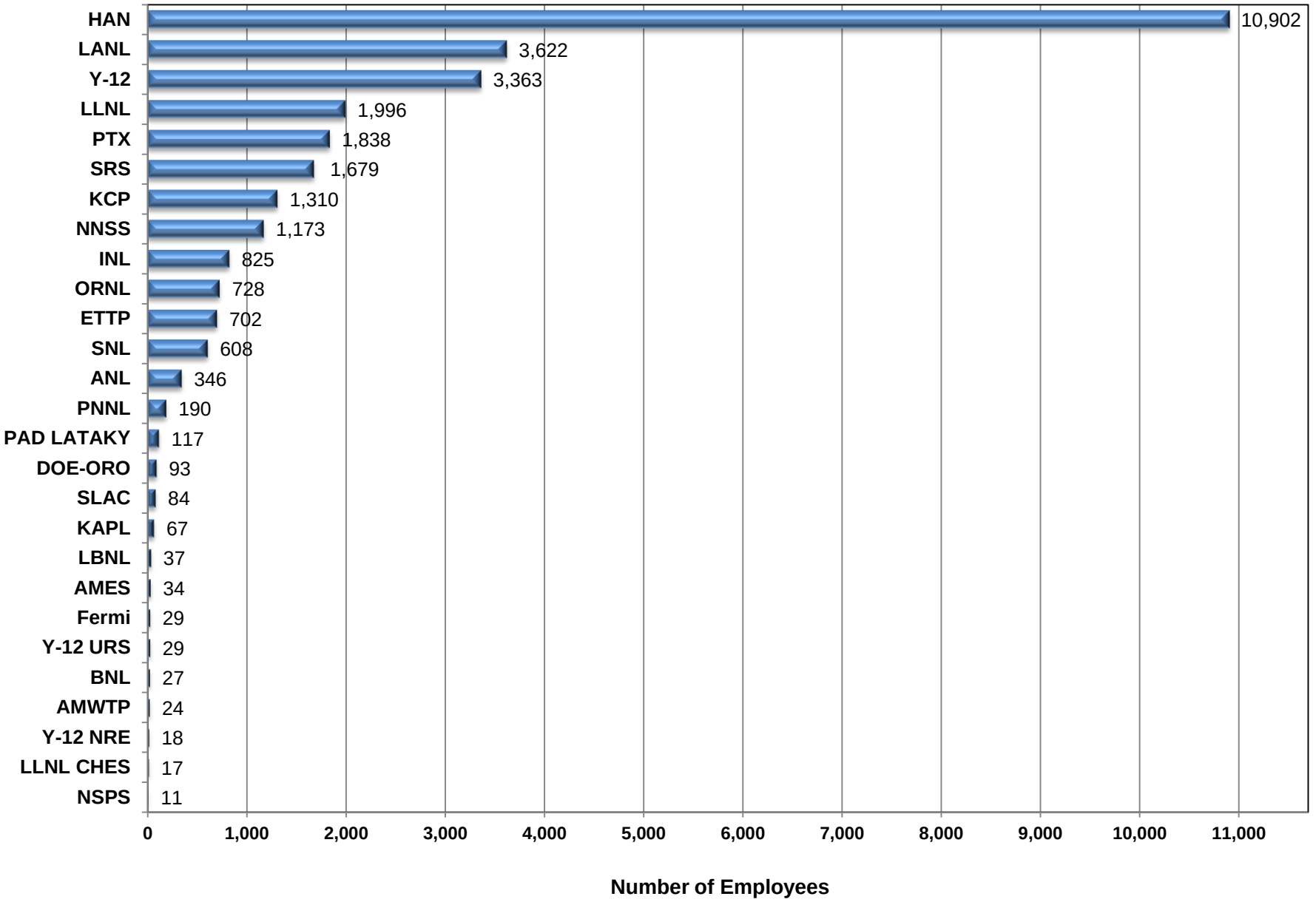
27 Sites and Subcontractors Currently Submitting Data to BAWR

Advanced Mixed Waste Treatment Project (AMWTP)	LLNL Clean Harbors Environmental Services (LLNL CHES)
Ames Laboratory (AMES)	Los Alamos National Laboratory (LANL)
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)
Kansas City Plant (KCP)	Stanford Linear Accelerator Center (SLAC)
Knolls Atomic Power Laboratory (KAPL)	Y-12 National Security Complex (Y-12)
LATA Environmental Services of Kentucky, LLC (PAD LATAKY)	Y-12 Navarro Research and Engineering (Y-12 NRE)
Lawrence Berkeley National Laboratory (LBNL)	Y-12 URS Corporation (Y-12 URS)
Lawrence Livermore National Laboratory (LLNL)	

5 Inactive BAWR Sites

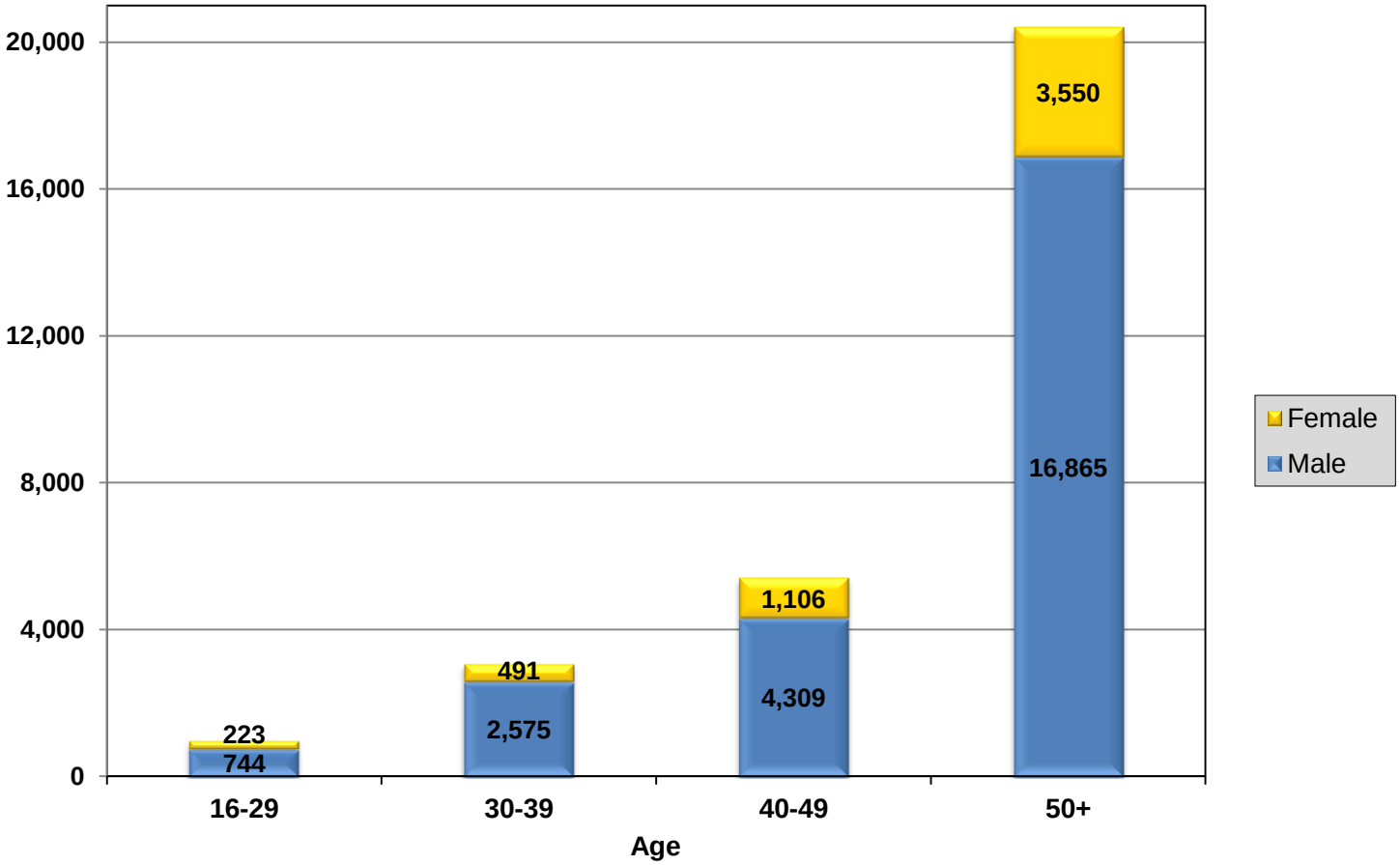
LLNL Boston University (LLNL BU	Southwestern Power Administration (SWPA)
LLNL Envirocon, Inc. (LLNL ENVC)	Wackenhut Security Services Inc. for ETTP, ORNL, and Y-12 (WSI)
Rocky Flats Closure Project (RF)	

Total 29,869 Employees Reported to BAWR by Site Through 2013*



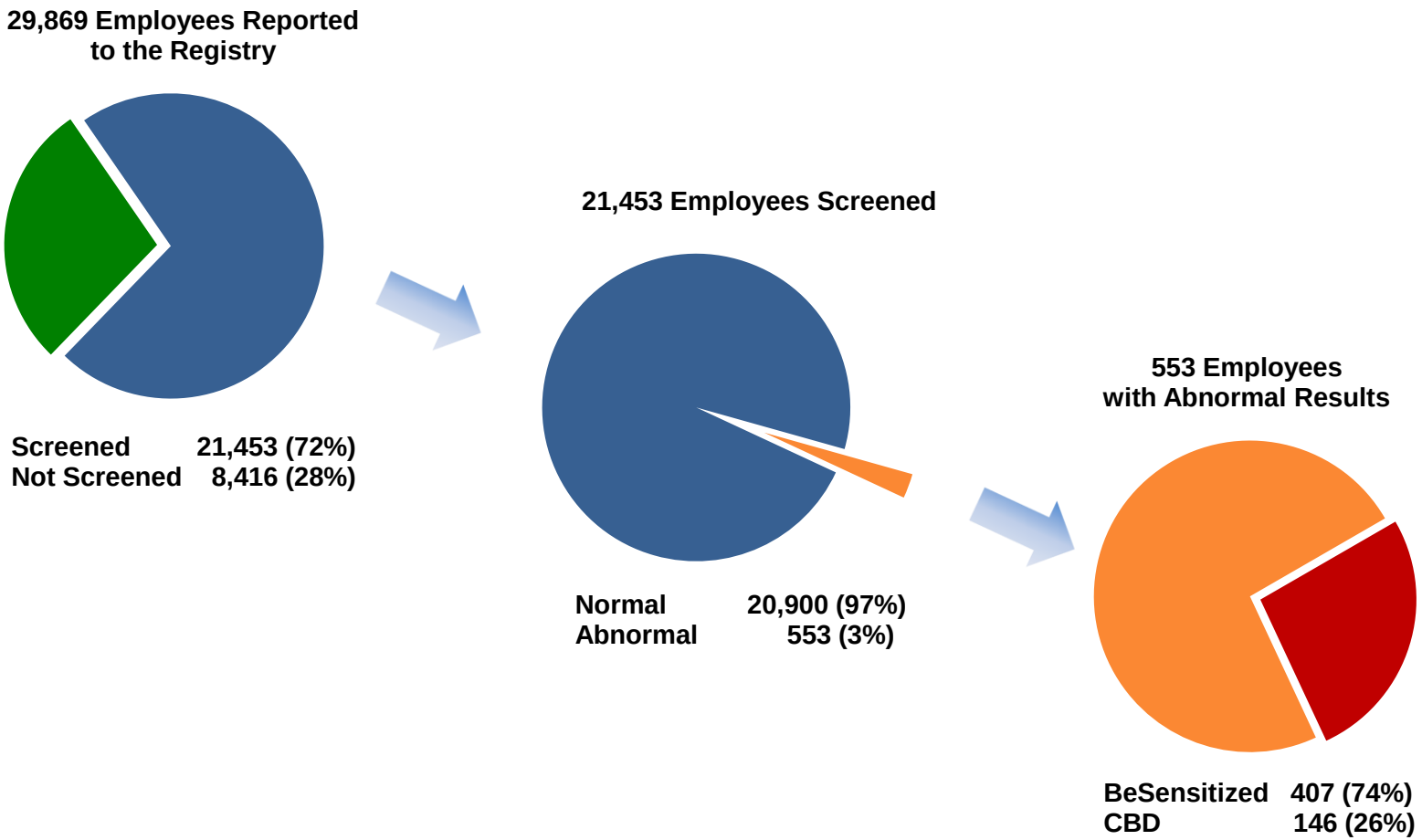
*Some sites have provided data that predate the 2002 start date of the Registry.

Gender and Age Distribution of Employees Reported to BAWR Through 2013*



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

Progression from BeLPT Testing to "Sensitized" to CBD Through 2013*



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

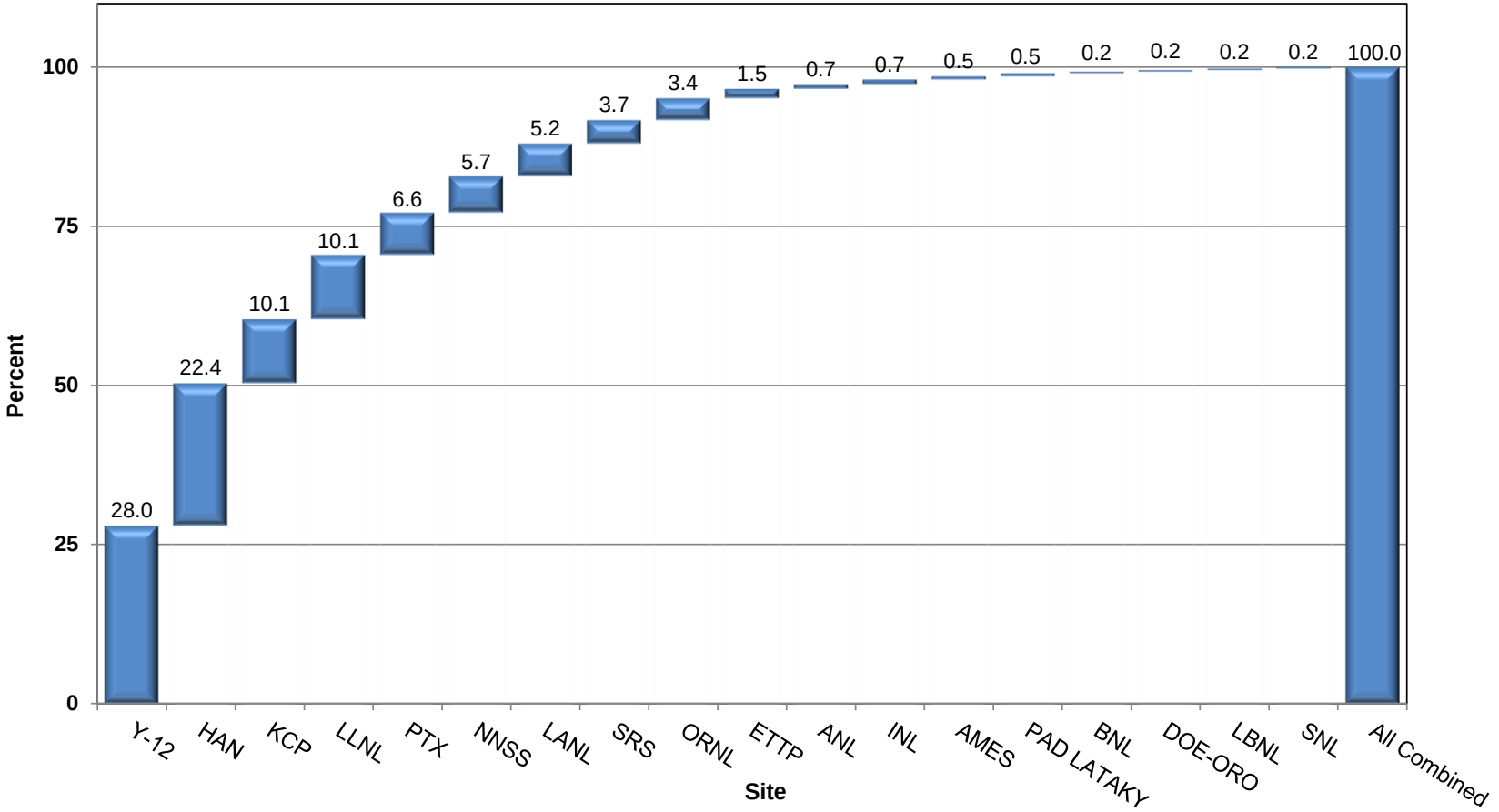
From 2012 to 2013, the 27 sites and subcontractors currently reporting to the Registry identified 8 additional sensitized employees and no additional employees with CBD.

Number of Employees BeLPT Tested, "Sensitized," or CBD by Site Through 2013*

Site	Employees with BeLPT Results	Employees Who Are "Sensitized"	Employees with CBD
HAN	7,480	91 (1.2 %)	34 (0.5 %)
Y-12	2,691	114 (4.2 %)	62 (2.3 %)
LANL	2,474	21 (0.8 %)	3 (0.1 %)
PTX	1,756	27 (1.5 %)	15 (0.9 %)
LLNL	1,337	41 (3.1 %)	3 (0.2 %)
KCP	1,208	41 (3.4 %)	14 (1.2 %)
NNSS	1,028	23 (2.2 %)	4 (0.4 %)
SRS	713	15 (2.1 %)	6 (0.8 %)
ORNL	639	14 (2.2 %)	0
SNL	604	1 (0.2 %)	0
ETTP	399	6 (1.5 %)	4 (1.0 %)
INL	355	3 (0.8 %)	0
PNNL	151	0	0
ANL	142	3 (2.1 %)	0
PAD LATAKY	112	2 (1.8 %)	0
DOE-ORO	93	1 (1.1 %)	0
SLAC	47	0	1 (2.1 %)
AMES	34	2 (5.9 %)	0
KAPL	29	0	0
Y-12 URS	28	0	0
LBNL	26	1 (3.8 %)	0
BNL	25	1 (4.0 %)	0
AMWTP	21	0	0
Fermi	20	0	0
Y-12 NRE	18	0	0
LLNL CHES	13	0	0
NSPS	10	0	0
Total	**21,453**	**407 (1.9 %)**	**146 (0.7 %)**

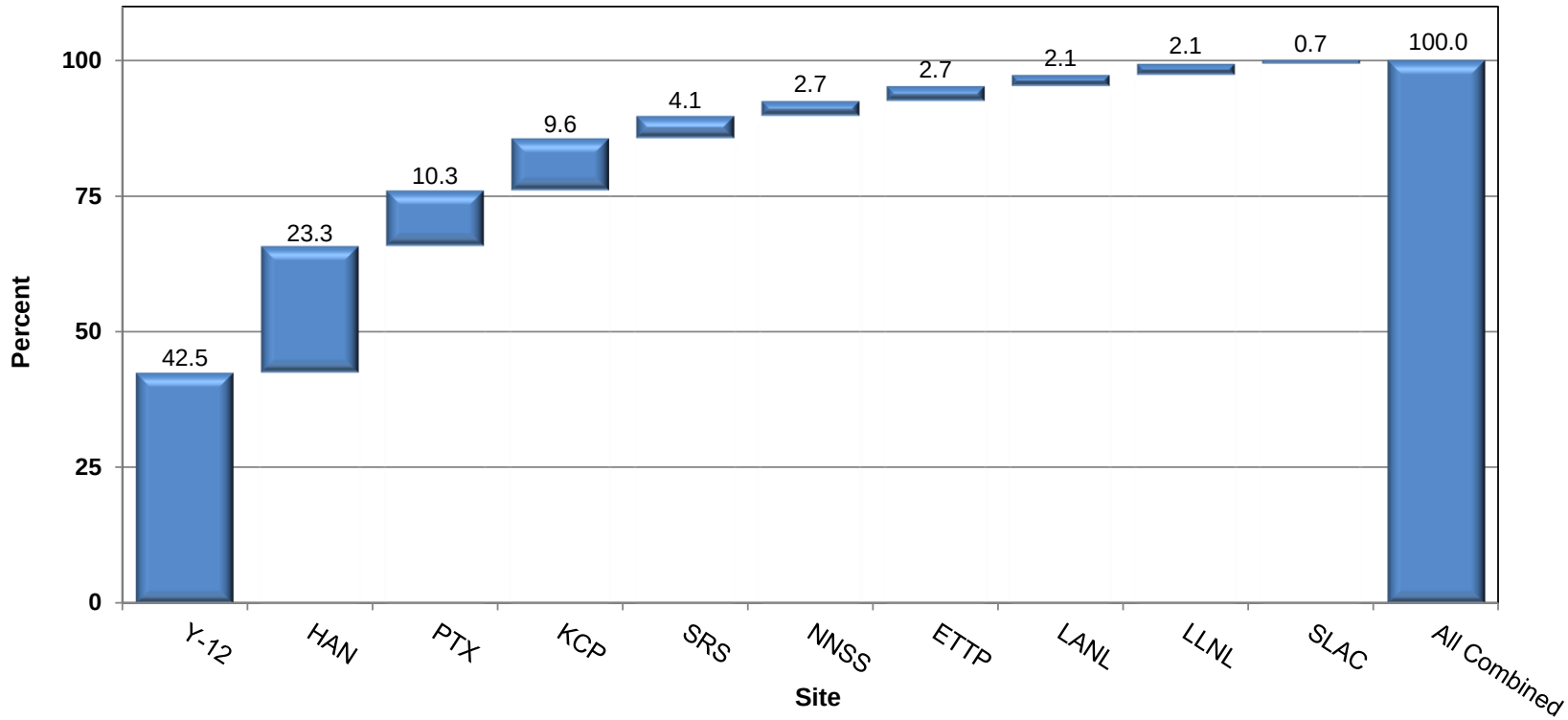
*Some sites have provided data that predate the 2002 start date of the Registry.

Percentage Distribution by Site of 407 BeSensitized Employees Through 2013*



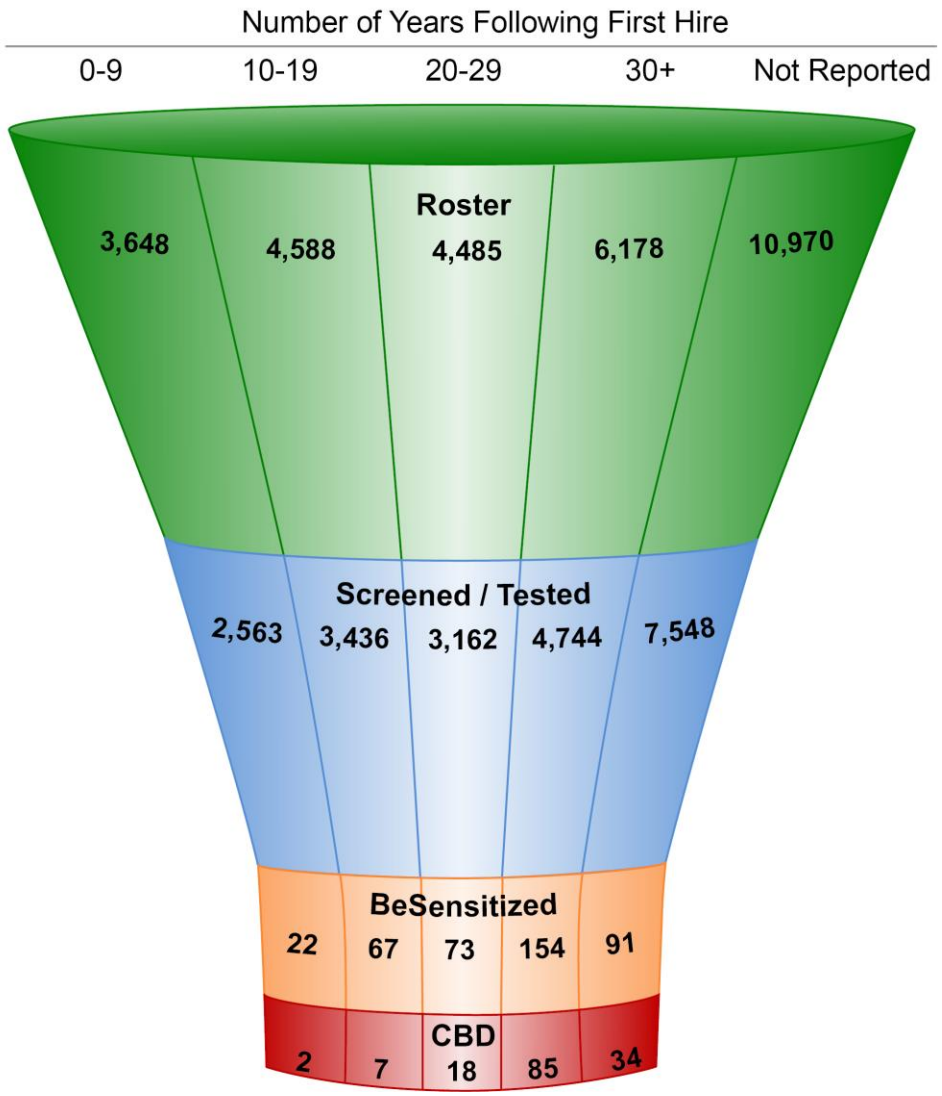
*Some sites have provided data that predate the 2002 start date of the Registry.

Percentage Distribution by Site of 146 Employees Diagnosed with CBD Through 2013*



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

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



Year of First Positive or Abnormal BeLPT Result for Employees Who Are "Sensitized" or CBD

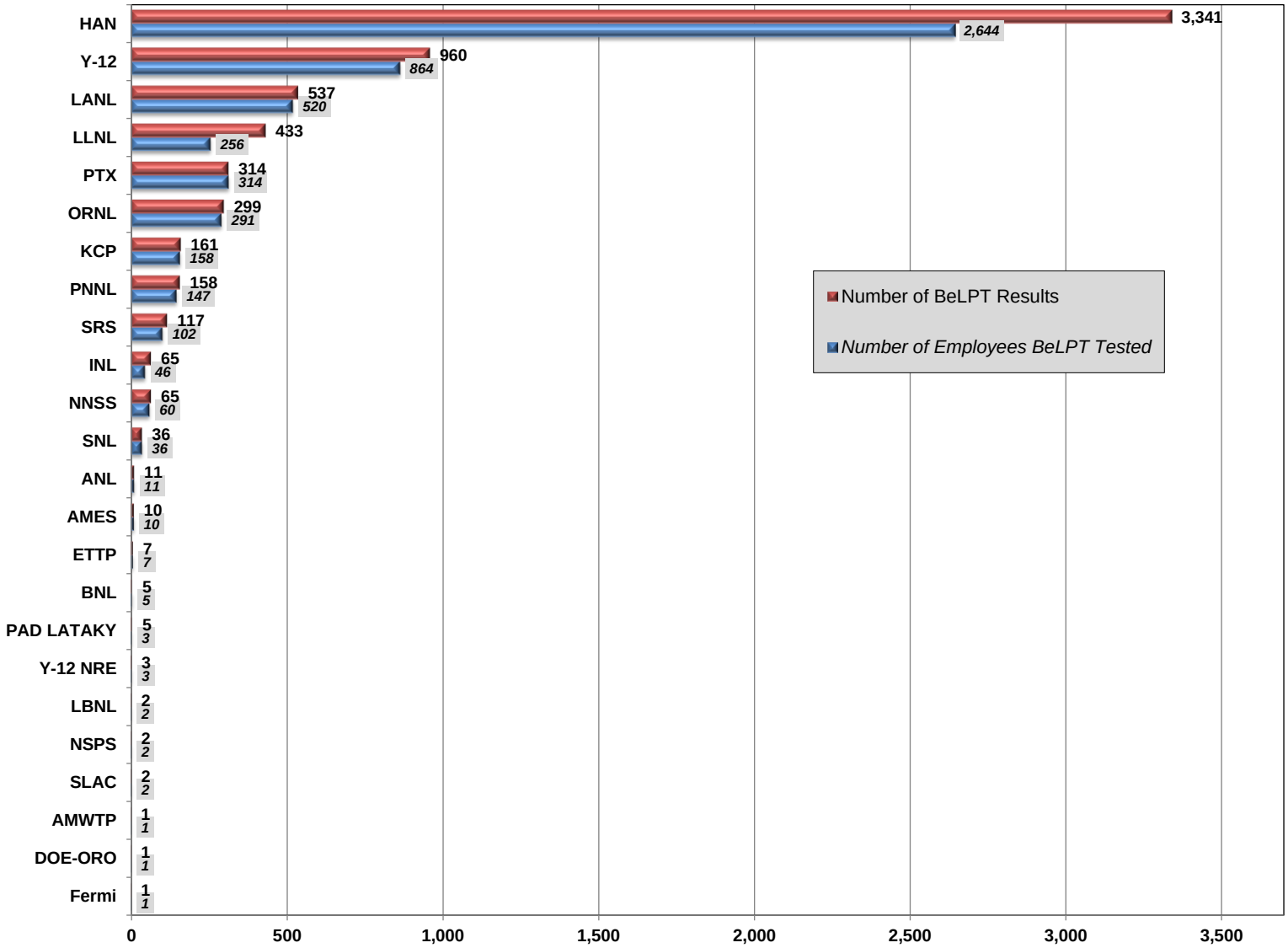
Year of BeLPT Result	Employees Tested	Employees Who Are "Sensitized"	Employees with CBD
<2000	708	35	10
2000	1,630	29	17
2001	3,236	43	17
2002	3,967	42	15
2003	3,967	13	5
2004	3,814	13	3
2005	5,115	26	6
2006	4,870	42	9
2007	4,583	40	5
2008	5,086	23	7
2009	6,177	36	2
2010	6,911	27	1
2011	7,944	16	0
2012	6,187	4	0
2013	5,486	5	0
Not Reported	0	13	49

Work History Activity for Employees Who Are "Sensitized" or CBD Through 2013*

Work History Activity	Employees with BeLPT Results	Employees Who Are "Sensitized"	Employees with CBD
Management	1,497	32	10
Administrative Support	990	31	10
In-House Professionals	1,416	30	14
Field Professionals	1,961	43	7
Technical Support	2,885	55	13
Service	1,327	29	12
Security and Fire	1,423	18	7
Crafts	3,736	75	35
Line Operators	2,471	65	23
Guests	56	0	0
Unknown	723	12	11
Not Reported	2,968	17	4
Totals	**21,453**	**407**	**146**

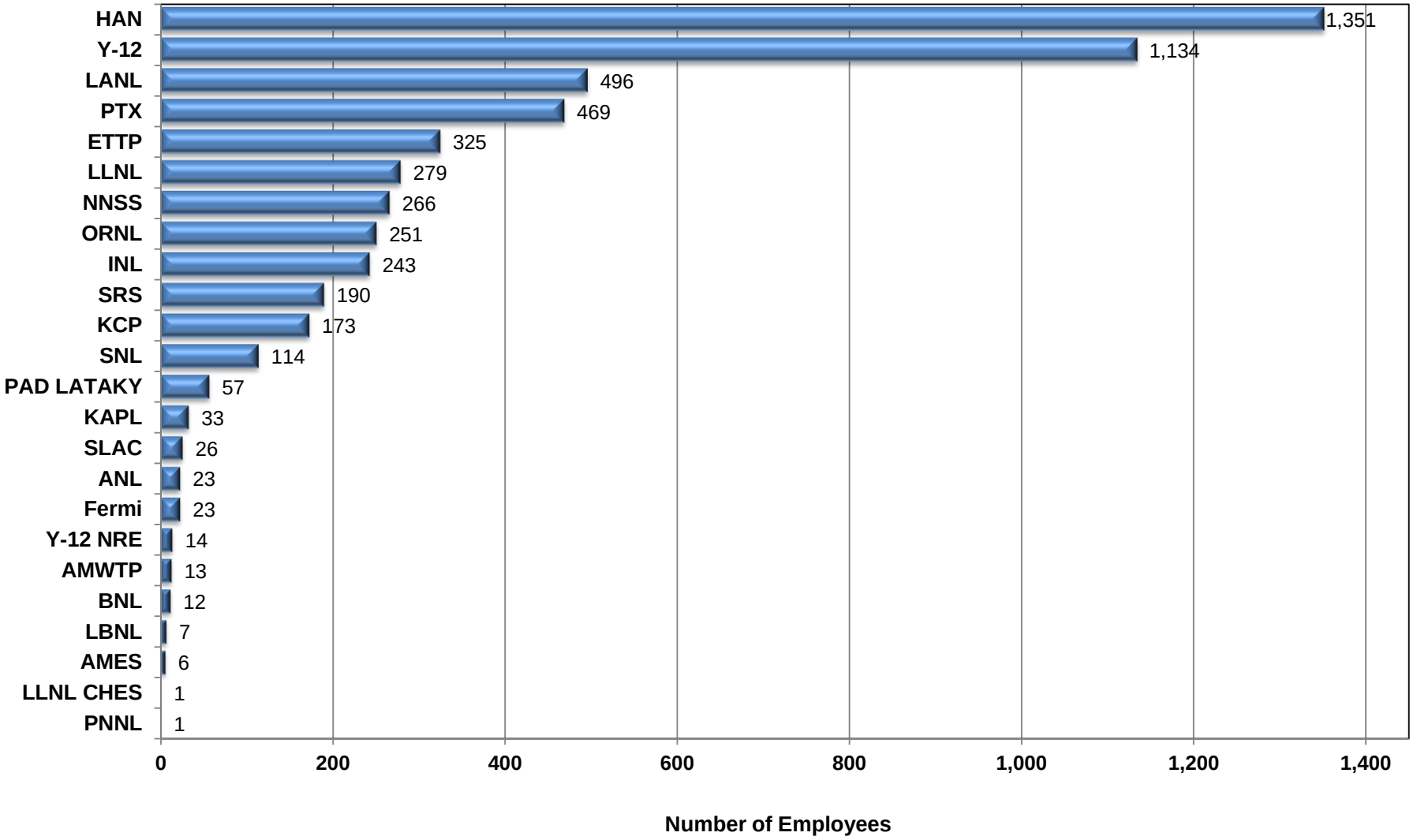
*Some sites have provided data that predate the 2002 start date of the Registry.

Distribution of 6,536 BeLPT Results for 5,486 Employees by Site for Calendar Year 2013



Employees with Abnormal or Borderline BeLPT results will probably be tested multiple times in a year.

Distribution of 5,507 Employees Exposure Monitored by Site Through 2013*



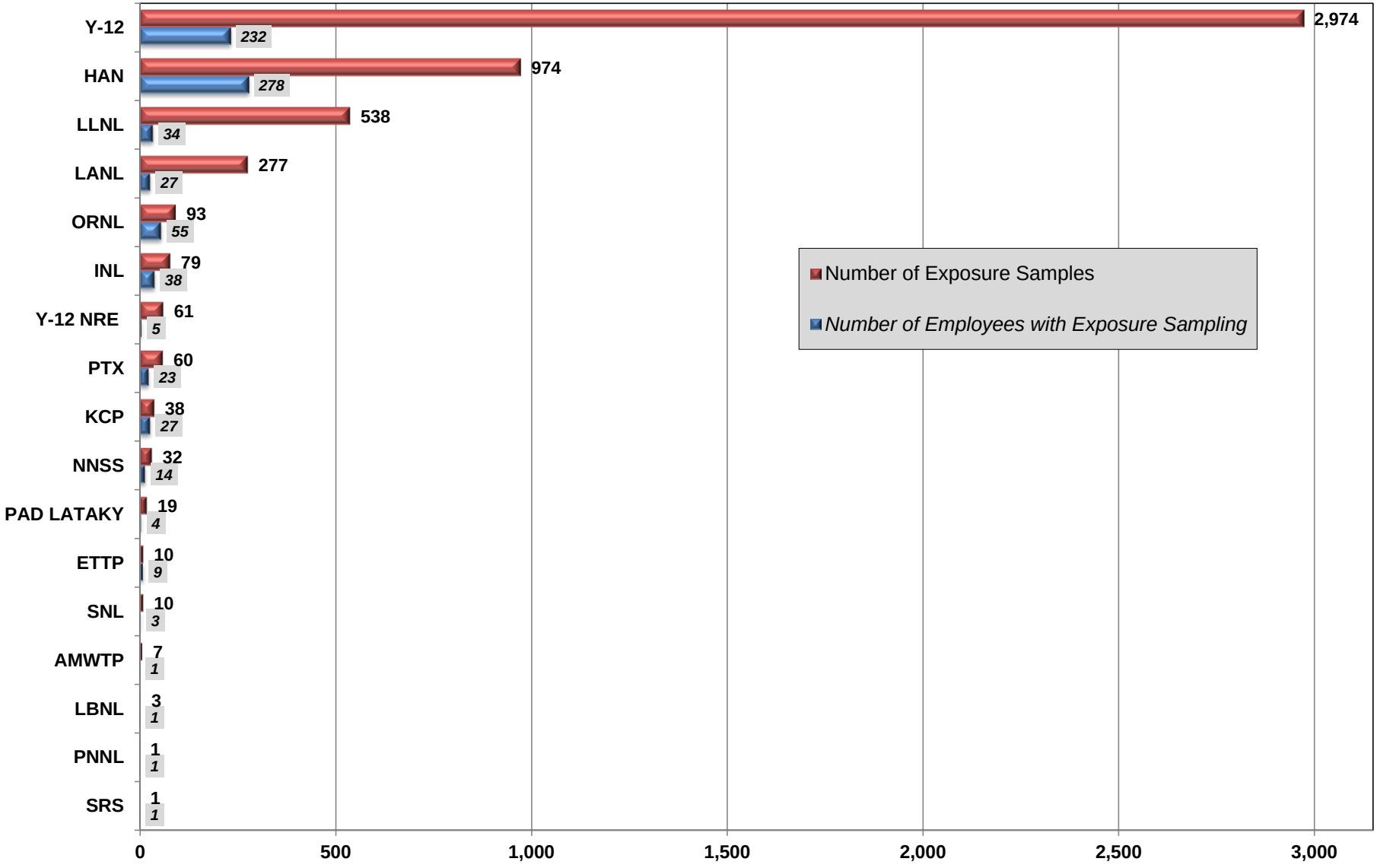
*Some sites have provided data that predate the 2002 start date of the Registry.

Number of Employees Exposure Monitored by Site for 2004 – 2013

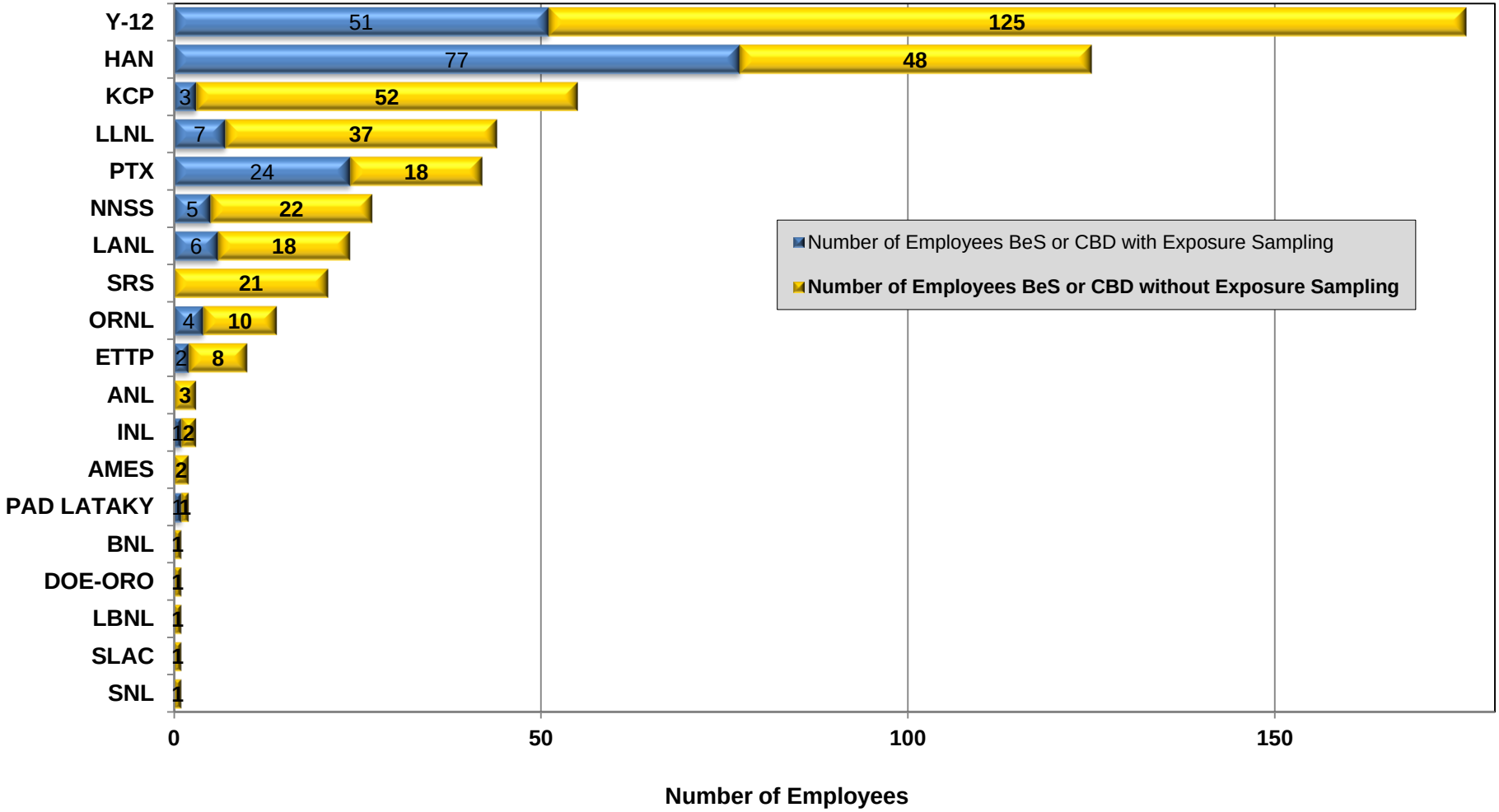
Site	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AMES						6	1	2		
AMWTP	2	10	5	4	4	4	2	2	2	1
ANL			8	3	1					
BNL		1		2	2		4		5	
DOE-ORO										
ETTP	34	79	64	38		19	42	30	3	9
Fermi	2	2	1							
HAN	96	70	149	103	163	135	313	395	249	278
INL	3	53	76	81	49	57	44	39	5	38
KAPL		1		5	5	5	5	4		
KCP	11	13	24	24	18	15	18	17	43	27
LANL	76	158	135	94	51	65	46	40	38	27
LBNL	1	1			1			2		1
LLNL	25	51	36	74	76	100	78	63	59	34
LLNL CHES								1		
NNSS	33	26	26	14	43	18	18	19	22	14
NSPS										
ORNL	50	38	59	53	46	48	44	47	46	55
PAD LATAKY						9	47	3	5	4
PNNL										1
PTX	17	26	38	50	38	35	30	42	51	23
SLAC	6	9	1	2	2			2		
SNL	38	21	17	7		5	16	19	17	3
SRS	34	35	6	18	34	28	19	2	10	1
Y-12	85	101	160	225	215	304	430	359	239	232
Y-12 NRE				3	4	10	8	5	4	5
Y-12 URS										

The figure above shows the numbers of individuals by site whose exposures were monitored by an industrial hygienist at least once in each year in the past 10 years. Seventeen sites provided exposure monitoring results with monitoring dates in 2013. Site-specific totals for a given year may change from totals in previous annual reports due to late reporting and/or corrections.

Distribution of 5,177 Exposure Samples for 753 Employees-by Site for Calendar Year 2013



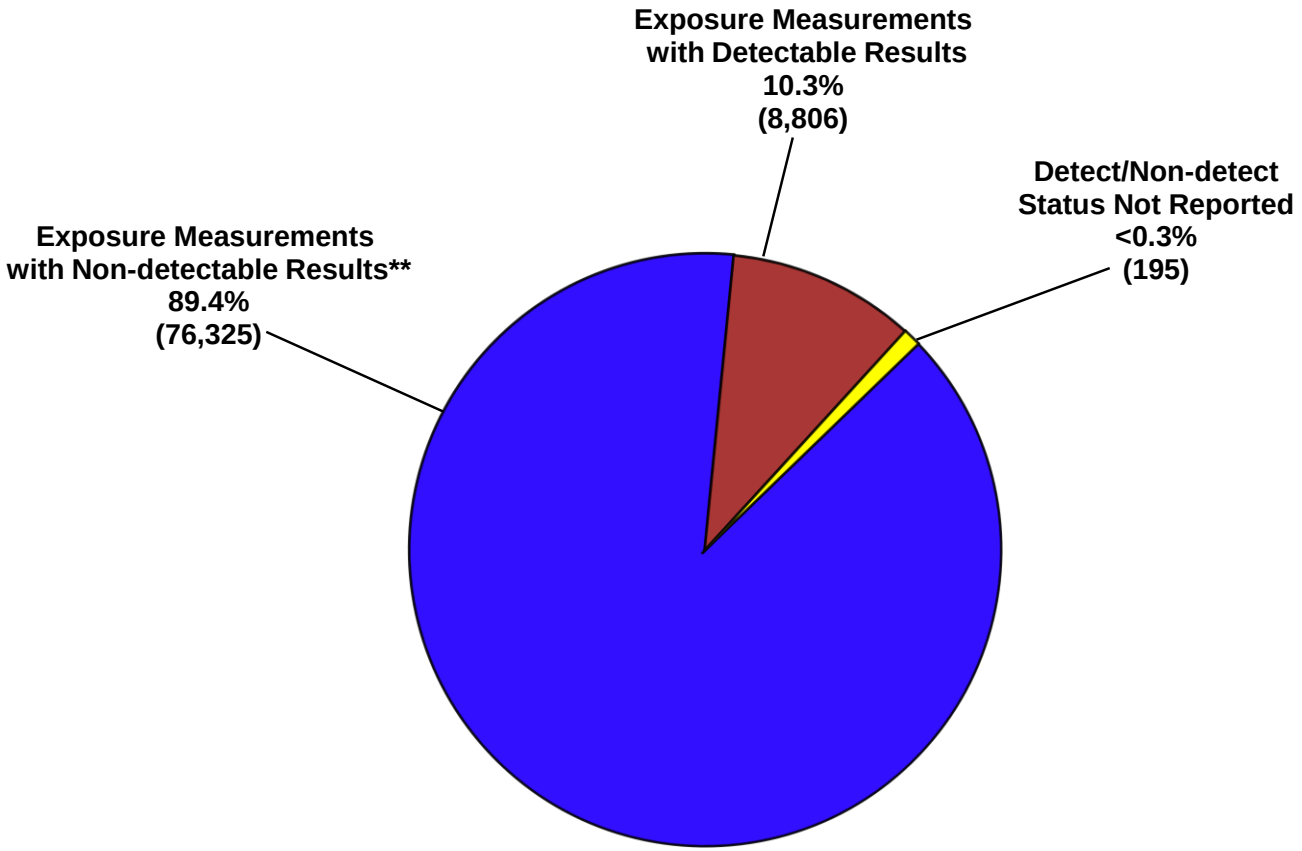
Distribution of Employees BeSensitized or CBD by Site and Exposure Sampling Status Through 2013*



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

Reporting from the Registry shows that for the 553 employees (representing 19 sites) who are BeSensitized or diagnosed with CBD, 372 employees (or 67 percent) have no exposure sampling data.

Distribution of 85,326 Reported Exposure Levels Through 2013*

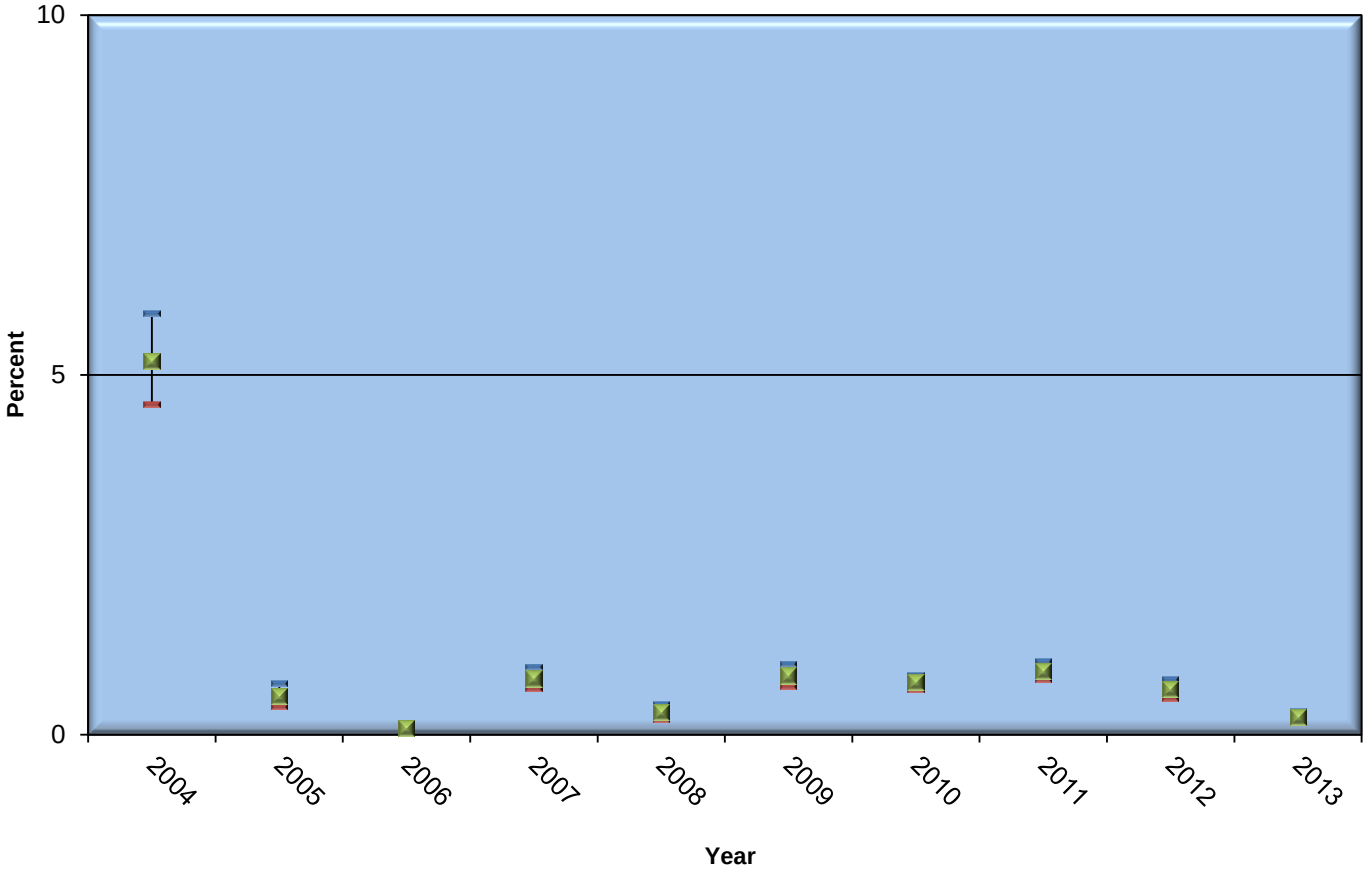


*Some sites have provided data that predate the 2002 start date of the Registry.
**Non-detectable indicates that analysis results were reported as less than the laboratory's reporting limit.

Of the 85,326 exposure monitoring records submitted to the Registry, over 89 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 2004 – 2013

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 achieved a high level of compliance with the 10 CFR 850 action level of 0.2 µg/m^3 since 2004.

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.

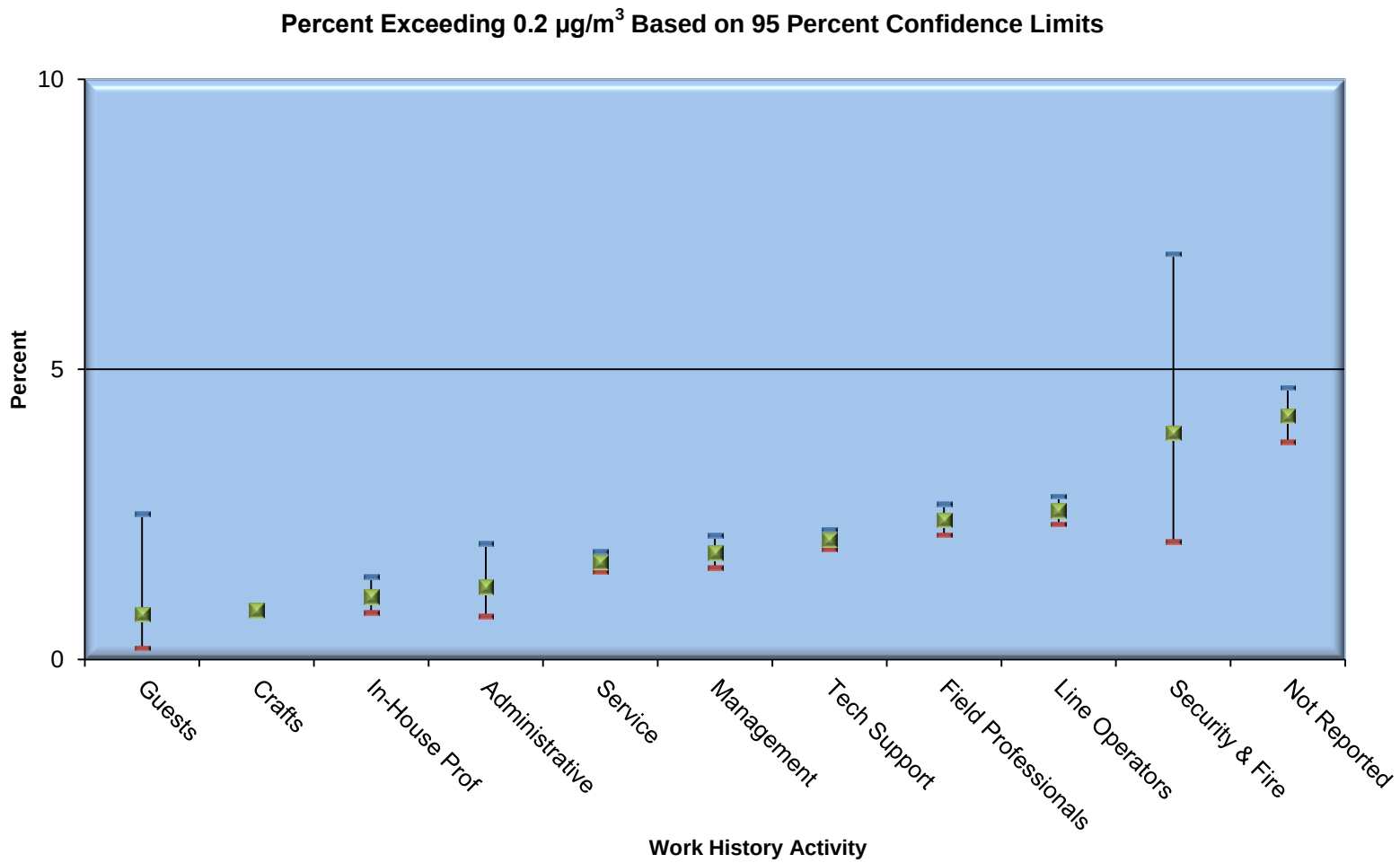
Summary Statistics for 2004 – 2013 8-Hour Time Weighted Average Exposure Monitoring Results

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	All Years
Number of reported monitoring results	2,318	3,640	6,228	5,895	5,138	6,596	13,267	10,100	5,948	5,158	64,288
Number of detected values	563	144	234	344	152	240	632	525	301	216	3,351
Percent non-detects	75.7	96	96.2	94.2	97	96.4	95.2	94.8	94.9	95.8	94.8
Number of individuals monitored	510	663	795	799	748	862	1,163	1,092	798	753	4,283*
Arithmetic mean (EX) (µg/m^3)	0.056	0.008	0.002	0.011	0.003	0.009	0.019	0.014	0.007	0.002	0.012
Lower confidence limit of EX (µg/m^3)	0.045	0.005	0.002	0.007	0.002	0.006	0.007	0.009	0.005	0.001	0.009
Upper confidence limit of EX (µg/m^3)	0.068	0.011	0.002	0.015	0.003	0.012	0.031	0.019	0.009	0.002	0.014
Observed 95th percentile of data (µg/m^3)	0.223	0.010	0.007	0.012	< 0.001	0.001	0.009	0.009	0.007	0.005	0.009
95% upper tolerance limit of the 95th percentile (µg/m^3)	0.212	0.010	0.006	0.013	0.004	0.005	0.008	0.008	0.006	0.004	0.009
Largest value (µg/m^3)	8.420	5.133	0.310	12.513	1.774	11.762	79.330	18.023	4.013	0.804	79.330
Percent exceeding 0.2 µg/m^3 (F)	5.2	0.5	0.1	0.8	0.3	0.8	0.7	0.9	0.6	0.2	0.8
Lower confidence limit for F	4.6	0.4	0.1	0.6	0.2	0.7	0.6	0.8	0.5	0.2	0.7
Upper confidence limit for F	5.9	0.7	0.1	0.9	0.4	1.0	0.8	1.0	0.8	0.3	0.8

*Many individuals were monitored in more than 1 year. The total number of individuals measured at least once in the 10-year period from 2004 through 2013 is 4,283.

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 µg/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 2013 (Ranked by Percent Exceeding)*



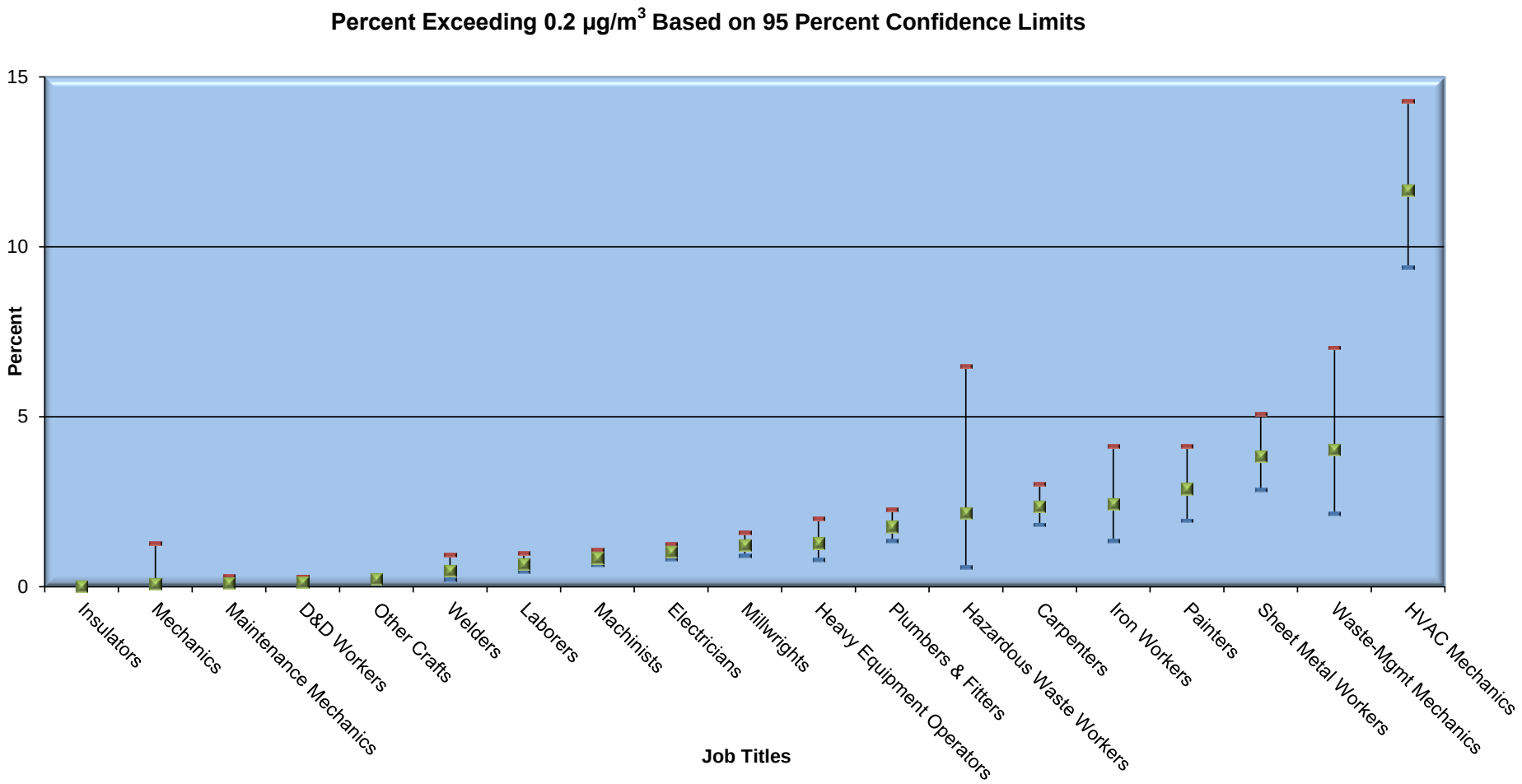
*Some sites have provided data that predate the 2002 start date of the Registry.

Shown above are exposure data grouped by work activity. The data are through calendar year 2013 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 for Employees Who Are "Sensitized" or CBD Through 2013." 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 2013

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	608	34,902	5,897	96	2,004	8,157	3,937	154	10,112	12,568	3,215	81,650
Number of detected values	60	1,689	840	28	128	891	693	11	802	1,811	1,218	8,171
Percent non-detects	90.1	95.2	85.8	70.8	93.6	89.1	82.4	92.9	92.1	85.6	62.1	90
Number of individuals monitored	63	1,746	507	7	238	885	230	54	513	959	215	5,417
Observed 95th percentile of data (ug/m^3)	0.025	0.008	0.064	0.028	0.018	0.093	0.058	0.546	0.025	0.060	0.151	0.036
95% upper tolerance limit of the 95th percentile (ug/m^3)	0.030	0.009	0.067	0.061	0.015	0.055	0.067	0.062	0.025	0.061	0.170	0.036
Largest value (ug/m^3)	2.600	51.895	26.678	0.313	7.500	575.930	11.762	11.700	84.933	29.852	7.670	575.930
Percent exceeding 0.2 ug/m^3 (F)	1.2	0.8	2.4	0.8	1.1	2.6	1.8	3.9	1.7	2.1	4.2	1.7
Lower confidence limit for F	0.8	0.8	2.1	0.2	0.8	2.3	1.6	2.0	1.5	1.9	3.8	1.6
Upper confidence limit for F	2.0	0.9	2.7	2.5	1.4	2.8	2.1	7.0	1.9	2.2	4.7	1.7

Exposure by Job Title for Craft Workers Through 2013 (Ranked by Percent Exceeding)*



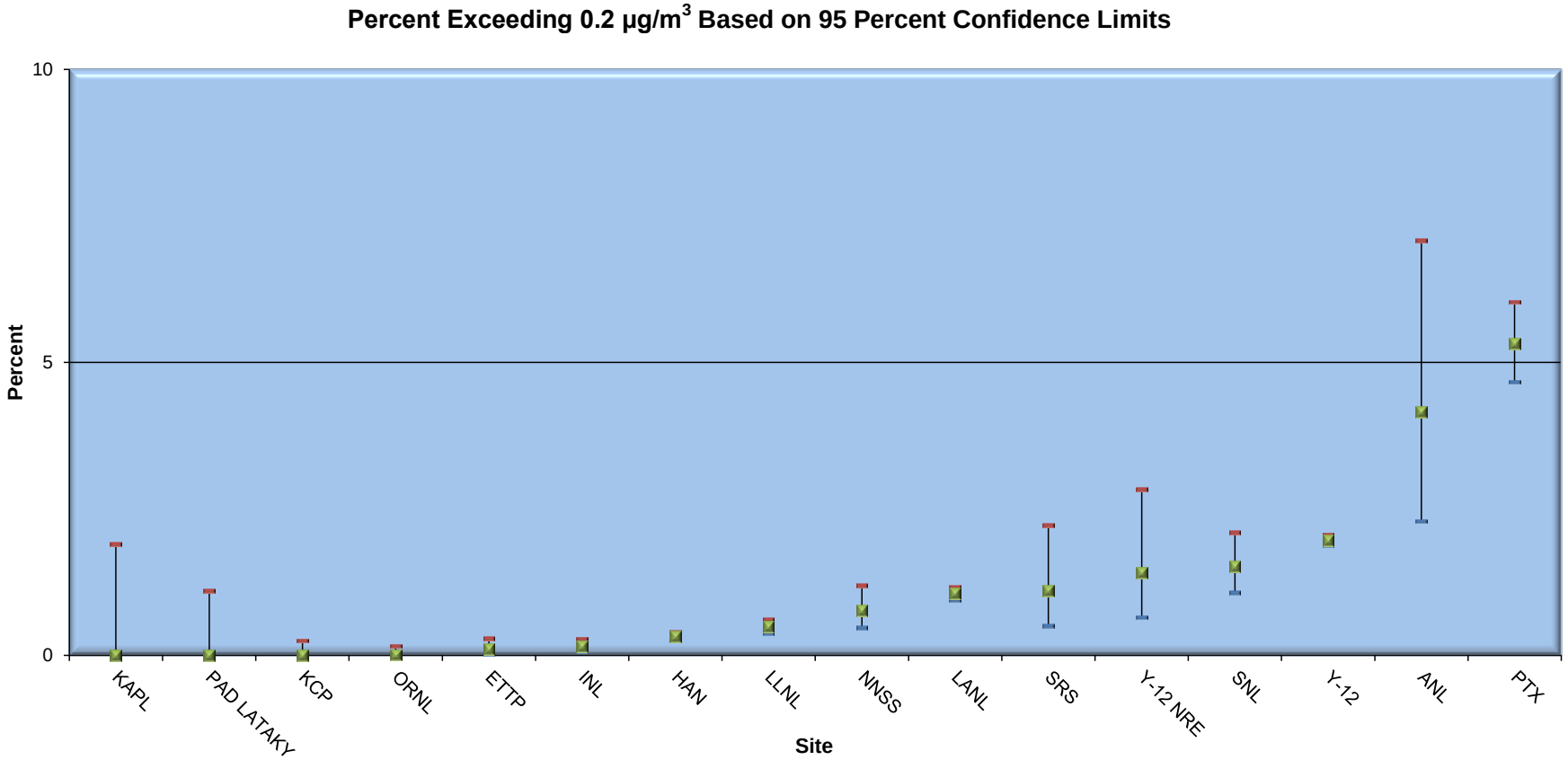
*Some sites have provided data that predate the 2002 start date of the Registry.

The figure above provides an indication of 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. Electricians, Millwrights, Heavy Equipment Operators, Plumbers & Fitters, Hazardous Waste Workers, Carpenters, Iron Workers, Painters, Sheet Metal Workers, Waste-Management Mechanics, and HVAC Mechanics have exceedance rates significantly higher than all Crafts combined (0.8 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 2013 (Ranked by Percent Exceeding)

Craft Job Titles	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	641	14	97.8	26	0.001	0.003	0.150	< 0.1	< 0.1	0.1
Mechanics	89	9	89.9	30	0.017	0.019	0.091	0.1	< 0.1	1.3
Maintenance Mechanics	833	23	97.2	85	0.003	0.002	0.158	0.1	< 0.1	0.3
D&D Workers	956	42	95.6	107	0.012	0.011	0.095	0.1	< 0.1	0.3
Other Crafts	15,331	242	98.4	209	0	0.001	6.314	0.2	0.2	0.3
Welders	779	33	95.8	29	0.008	0.007	0.356	0.5	0.2	0.9
Laborers	1,679	64	96.2	239	0.006	0.005	10.340	0.7	0.4	1.0
Machinists	3,653	133	96.4	82	< 0.001	0.007	51.895	0.8	0.7	1.1
Electricians	3,609	268	92.6	281	0.020	0.018	1.999	1.0	0.8	1.3
Millwrights	2,039	149	92.7	156	0.020	0.019	20.176	1.2	0.9	1.6
Heavy Equipment Operators	615	62	89.9	83	0.007	0.019	16.697	1.3	0.8	2.0
Plumbers & Fitters	1,603	143	91.1	144	0.029	0.031	5.735	1.8	1.4	2.3
Hazardous Waste Workers	75	9	88.0	13	0.076	0.089	0.176	2.2	0.6	6.5
Carpenters	1,225	150	87.8	103	0.060	0.057	3.176	2.4	1.8	3.0
Iron Workers	267	27	89.9	31	0.070	0.046	1.006	2.4	1.4	4.1
Painters	463	67	85.5	45	0.092	0.080	7.423	2.9	2.0	4.2
Sheet Metal Workers	572	79	86.2	44	0.264	0.119	4.872	3.8	2.9	5.1
Waste-Mgmt Mechanics	147	18	87.8	15	0.093	0.129	2.390	4.0	2.2	7.0
HVAC Mechanics	326	157	51.8	24	0.535	0.674	6.404	11.7	9.4	14.3
All Combined	34,902	1,689	95.2	1,746	0.008	0.009	51.895	0.8	0.8	0.9

Percent of Exposure Monitoring Results Exceeding the Action Level by Site Through 2013 (Ranked by Percent Exceeding)*



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

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

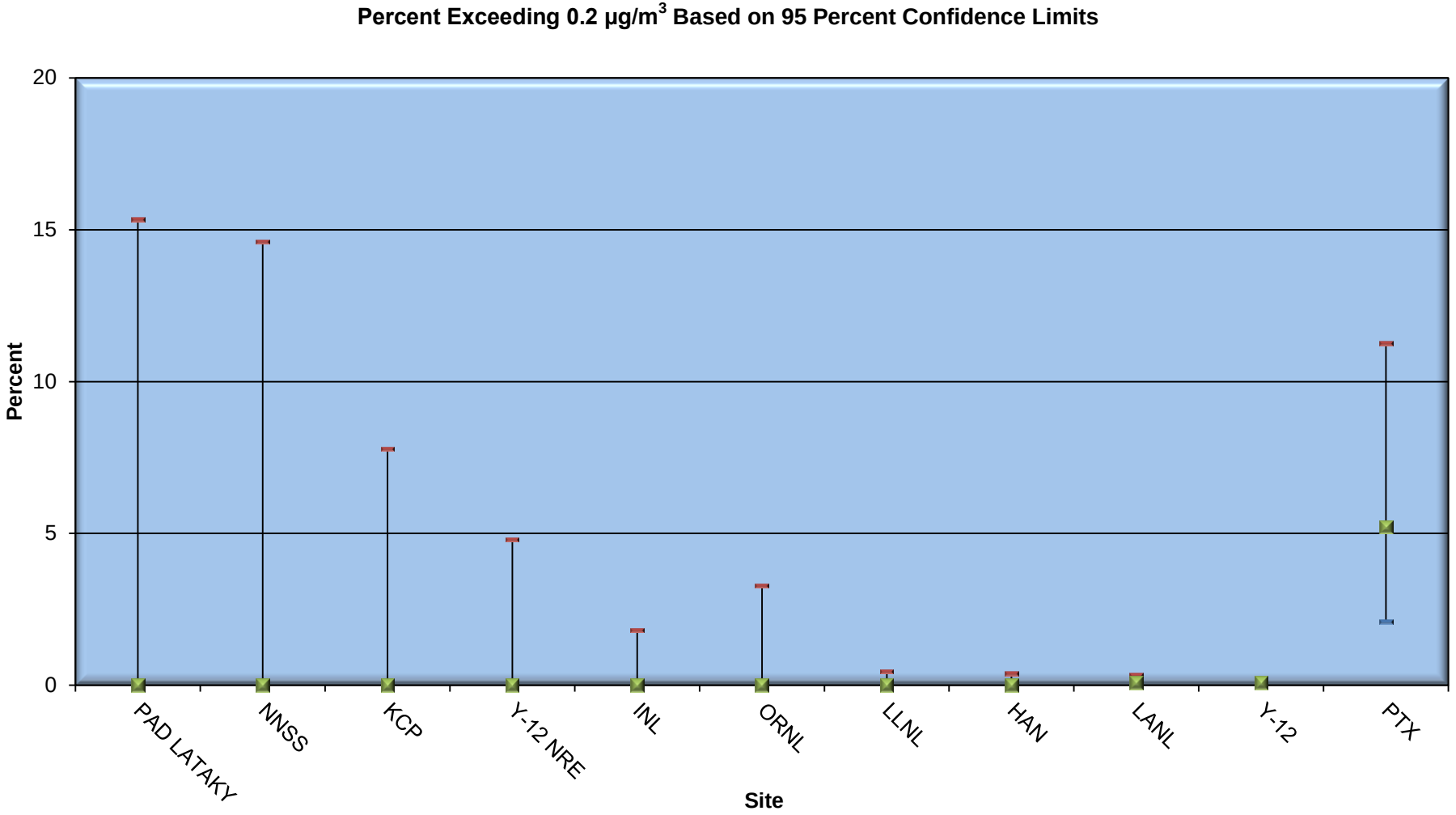
Results from AMES, AMWTP, BNL, Fermi, LBNL, LLNL CHES, PNNL, and SLAC were not included in this figure because of the small number of total samples or low percent exceeding the action level. Direct comparison with prior years' reports may be problematic due to late reporting and/or corrections.

Summary Statistics for 8-Hour Time Weighted Average Exposure Monitoring Results by Site Through 2013

Sites	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	47	0	100	6	0	0	0.028	0	0	6.2
AMWTP	67	4	94.0	13	0.004	0.004	0.036	0	0	4.2
ANL	155	19	87.7	23	0.145	0.136	2.390	4.2	2.3	7.1
BNL	18	0	100	12	NA	NA	0.100	0	0	15.3
ETTP	899	31	96.6	291	0.007	0.007	2.264	0.1	< 0.1	0.3
Fermi	47	23	51.1	16	1.369	0.958	4.800	19.2	12.1	28.4
HAN	7,753	361	95.3	1,321	0.004	0.003	12.513	0.3	0.3	0.4
INL	1,435	83	94.2	242	0.017	0.017	0.330	0.1	0.1	0.3
KAPL	154	2	98.7	32	0.007	0.150	0.200	0	0	1.9
KCP	1,544	17	98.9	171	0.002	0.005	0.196	0	0	0.2
LANL	11,594	2,470	78.7	496	0.050	0.060	26.678	1.0	0.9	1.2
LBNL	14	0	100	7	NA	NA	0.100	0	0	19.3
LLNL	6,440	299	95.4	279	0.013	0.013	5.133	0.5	0.4	0.6
LLNL CHES	3	0	100	1	NA	NA	0.042	0	0	63.2
NNSS	1,061	60	94.3	266	0.008	0.005	0.197	0.8	0.5	1.2
ORNL	1,190	6	99.5	251	0.002	0.001	0.157	< 0.1	0	0.2
PAD LATAKY	561	4	99.3	57	0.004	0.002	0.019	0	0	1.1
PNNL	1	0	100	1	NA	NA	0.029	0	NA	NA
PTX	2,084	276	86.8	455	0.323	0.236	575.930	5.3	4.7	6.0
SLAC	42	0	100	26	0.144	0	0.150	0	0	6.9
SNL	784	243	69	114	0.050	0.055	2.800	1.5	1.1	2.1
SRS	340	16	95.3	189	0.013	0.010	0.320	1.1	0.5	2.2
Y-12	45,139	4,243	90.6	1,134	0.056	0.039	79.330	2.0	1.9	2.1
Y-12 NRE	278	14	95.0	14	0.006	0.006	1.111	1.4	0.7	2.8
All Combined	81,650	8,171	90	5,417	0.036	0.036	575.930	1.7	1.6	1.7

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

Percent of Exposure Monitoring Results Exceeding the Action Level by Site for Calendar Year 2013 (Ranked by Percent Exceeding)



PTX reported the majority of results above the action level in 2013. Detailed data are presented on the following page. The upper confidence limit is above 5 percent at sites that reported fewer than 60 sampling results in 2013.

Results from AMWTP, ETTP, LBNL, 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 Site for Calendar Year 2013

Sites	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	7	1	85.7	1	NA	NA	0.010	0	0	34.8
ETTP	10	0	100	9	NA	NA	0.010	0	0	25.9
HAN	960	59	93.9	278	0.004	0.003	0.056	0.2	0.1	0.4
INL	79	7	91.1	38	0.015	0.014	0.104	0	0	1.8
KCP	37	0	100	27	0.018	NA	0.021	0	0	7.8
LANL	277	50	81.9	27	0.021	0.025	0.297	0.1	< 0.1	0.3
LBNL	3	0	100	1	NA	0.051	0.005	0	0	63.2
LLNL	538	43	92	34	0.013	0.014	0.175	0.2	0.05	0.4
NNSS	32	4	87.5	14	0.057	0.033	0.174	1.8	0.09	14.6
ORNL	90	0	100	55	0.005	NA	0.035	0	0	3.3
PAD LATAKY	18	0	100	4	NA	NA	0.011	0	0	15.3
PNNL	1	0	100	1	NA	NA	0.003	NA	NA	NA
PTX	60	11	81.7	23	0.168	0.218	0.804	5.2	2.1	11.3
SNL	10	3	70.0	3	0.094	0.128	0.120	3.1	< 0.1	50.2
SRS	1	0	100	1	NA	NA	< 0.001	NA	NA	NA
Y-12	2,974	37	98.8	232	0.007	0.001	0.259	0.08	< 0.1	0.2
Y-12 NRE	61	1	98.4	5	0.017	NA	0.063	0	0	4.8
All Combined	5,158	216	95.8	753	0.005	0.004	0.804	0.2	0.2	0.3

Sites that did not report data for calendar year 2013 are not included in this table.

Exposure Monitoring Results Above the 0.2 µg/m^3 Action Level for Calendar Years 2013 and 2012

Calendar Year 2013:

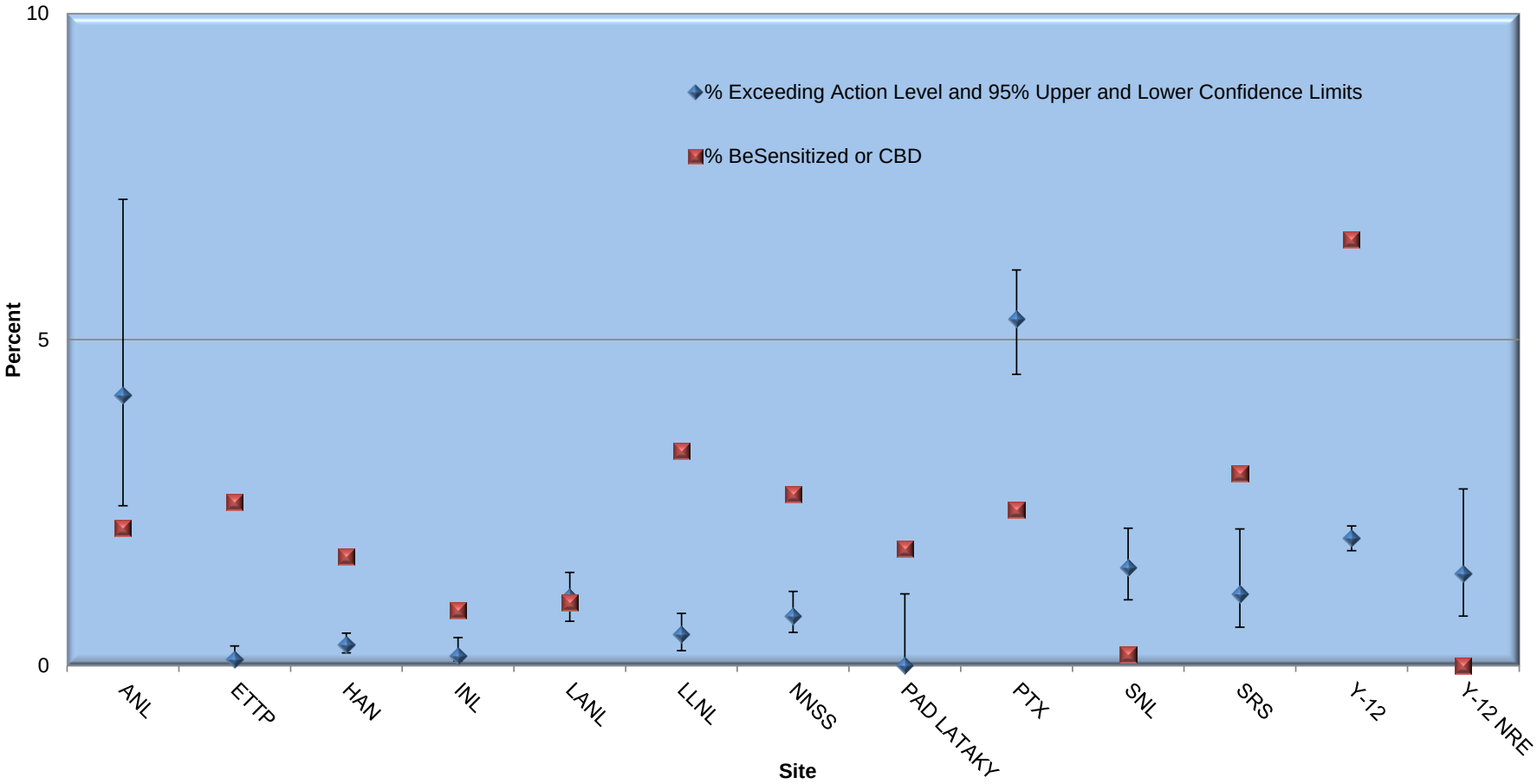
Site	Process Description	Job Title	8-Hour Time Weighted Average, ug/m^3	Respirator Assigned Protection Factor
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATIONS)	0.80	25
LANL	RESEARCH TEC 5		0.30	100
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATIONS)	0.30	25
PTX	BERYLLIUM WORK	ASSOCIATE WASTE OPS TECH	0.29	25
Y-12	PRODUCTION	Machinists	0.26	50
Y-12	PRODUCTION	Engineering Technicians	0.22	50

Calendar Year 2012:

Site	Process Description	Job Title	8-Hour Time Weighted Average, ug/m^3	Respirator Assigned Protection Factor
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATIONS)	4.01	100
PTX	BERYLLIUM WORK	ENG TECH. II (WASTE OPER)	3.21	100
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATIONS)	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 OPERATIONS)	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 OPERATIONS)	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 OPERATIONS)	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 OPERATIONS)	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 OPERATIONS)	0.42	100
LANL	WET MACHINING	MACH/FAB TEC-S	0.41	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	0.37	10
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATIONS)	0.36	100
PTX	BERYLLIUM WORK	ENG TECH (WASTE OPERATIONS) I	0.34	100
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATIONS)	0.33	100
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATIONS)	0.33	100
LLNL	Not identified	Sr. Technologist C/MS	0.30	1000
LLNL	Not identified	Sr. Technologist C/MS	0.29	1000
PTX	BERYLLIUM WORK	ASSOCIATE WASTE OPS TECH	0.27	100
LLNL	Not identified	Sr. Hydro Tech - S-300	0.27	1000
LANL	ENGINEERED SYSTEMS T	EXPLOSIVES TEC 4	0.26	1000
LLNL	Not identified	Sr. Technologist C/MS	0.24	1000
PTX	BERYLLIUM WORK	ENG TECH. I (WASTE OPERATIONS)	0.23	100
LLNL	Not identified	Sr. Technologist C/MS	0.23	1000
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
LLNL	Not identified	Sr. Technologist C/MS	0.20	1000

Exceedances for 2013 were fewer than in previous years. In 2013 only 6 samples exceeded the action level compared with 38 in 2012, while exposure sampling results decreased from 5,948 to 5,158. In both 2013 and 2012 exceedences continued to be primarily associated with waste operations work at Pantex Plant. 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 2013**



*Some sites 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 are very weakly correlated (Pearson product moment correlation coefficient = 0.13). 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. Sites 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.