Beryllium-Associated Worker Registry Summary

March 2011

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The DOE Beryllium-Associated Worker Registry (BAWR) 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 BAWR is a risk management tool for sites to use in managing their CBD prevention programs and other risk management operations. Sites are encouraged to use their Registry data to evaluate beryllium exposure risks. (Reported data are cumulative through March 2011.)

Table 1. Sites and Organizations Submitting Data to BAWR

Advanced Mixed Waste Treatment Project (AMWTP)	Argonne National Laboratory (ANL)
Brookhaven National Laboratory (BNL)	DOE Oak Ridge Office (DOE-ORO)
East Tennessee Technology Park (ETTP)	Fermi National Accelerator Laboratory (Fermi)
Hanford Site (HAN)	Idaho National Laboratory (INL)
Kansas City Plant (KCP)	Knolls Atomic Power Laboratory (KAPL)
Lawrence Berkeley National Laboratory (LBNL)	Lawrence Livermore National Laboratory (LLNL)
LLNL Boston University (LLNL BU)	LLNL Clean Harbors Environmental Services (LLNL CHES)
Los Alamos National Laboratory (LANL)	Nevada National Security Site (NNSS)
Oak Ridge National Laboratory (ORNL)	Paducah Remediation Services (PRS)
Pantex Plant (PTX)	Sandia National Laboratories (SNL)
Savannah River Site (SRS)	Stanford Linear Accelerator Center (SLAC)
Wackenhut Security Services Inc. for ETTP, ORNL, and Y-12 (WSI)	Y-12 National Security Complex (Y-12)
Y-12 Navarro-GEM Joint Venture (Y-12 NGJV)	Y-12 URS Corporation (Y-12 URS)

Twenty-six sites and operating organizations submitted data to the Beryllium-Associated Worker Registry (BAWR) through March 10, 2011. Health data were collected through the operation of current worker medical surveillance programs for all 26 sites and organizations. Exposure data were collected through the operation of industrial hygiene programs for 21 sites and organizations that have continuing beryllium operations or cleanup efforts due to a legacy of beryllium from the past. Chronic beryllium disease prevention programs are operated on a site-wide basis that includes all employers on the site in some cases and in other cases each employer operates its own program.

Table 2. Most Recent Submission Dates to BAWR by Site

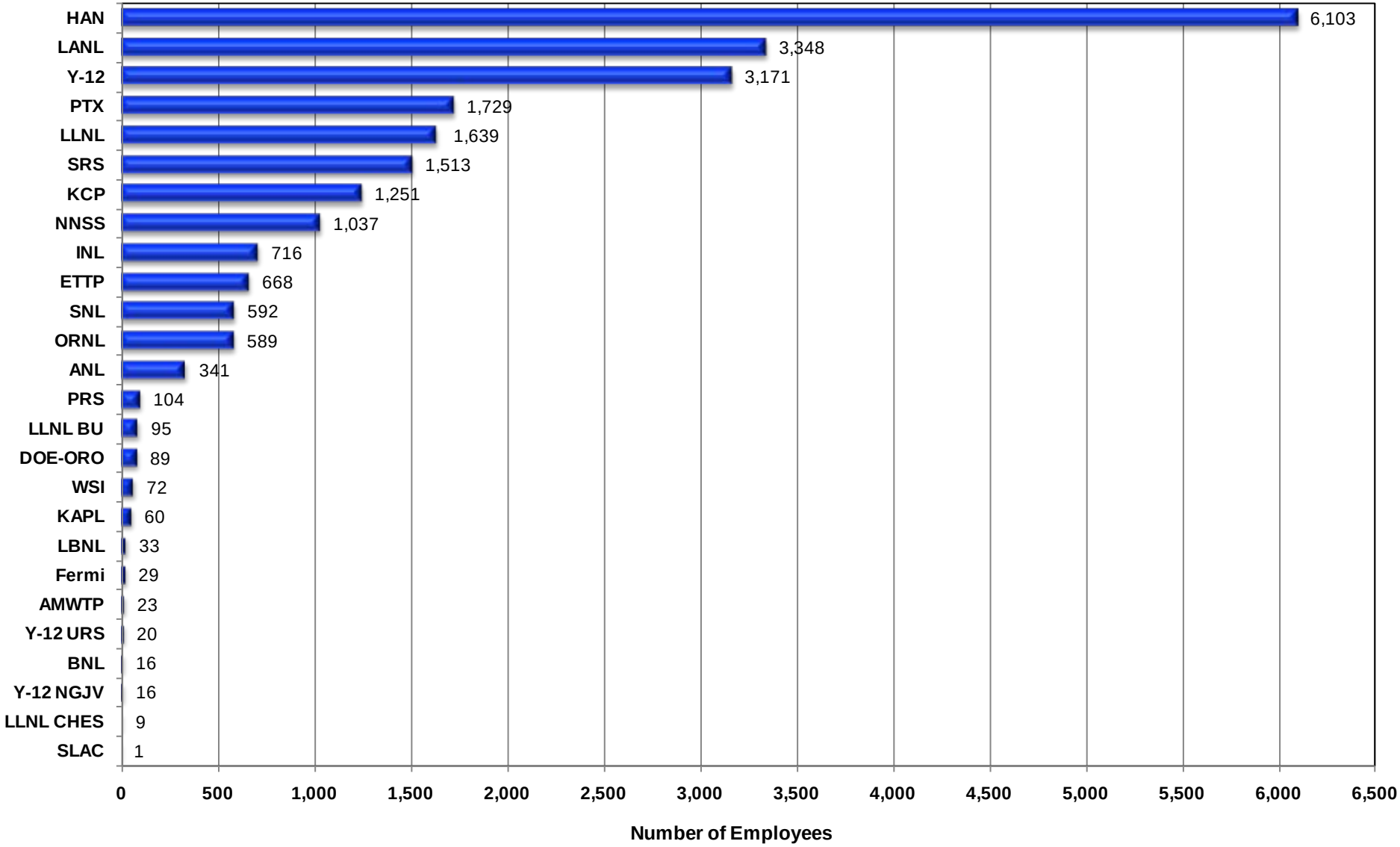
Site	Roster	BeLPT	Work History	Activities and Exposures
AMWTP	02/02/2011	02/02/2011	02/02/2011	02/02/2011
ANL	07/19/2010	07/19/2010	02/02/2009	02/02/2009
BNL	02/24/2011	03/10/2011	03/09/2011	03/20/2003
DOE-ORO	01/20/2011	01/20/2011	NR	NR
ETTP	02/10/2011	02/10/2011	02/10/2011	02/10/2011
Fermi	07/30/2010	08/20/2009	01/17/2007	07/31/2007
HAN	01/27/2011	01/27/2011	01/27/2011	01/27/2011
INL	01/31/2011	01/31/2011	01/31/2011	01/31/2011
KAPL	01/25/2011	01/25/2011	01/25/2011	01/25/2011
KCP	02/16/2011	01/27/2011	03/01/2011	01/27/2011
LANL	02/15/2011	02/03/2011	08/19/2010	02/03/2011
LBNL	01/20/2011	01/20/2011	07/30/2009	01/30/2009
LLNL	09/20/2010	08/03/2010	08/03/2010	08/03/2010
LLNL BU	05/03/2010	05/03/2010	05/03/2010	05/03/2010
LLNL CHES	04/20/2010	04/20/2010	NR	NR
NNSS	03/07/2011	03/07/2011	03/07/2011	03/07/2011
ORNL	01/26/2011	01/25/2011	01/26/2011	01/25/2011
PRS	02/02/2011	01/31/2011	01/31/2011	02/02/2011
PTX	01/28/2011	01/28/2011	01/28/2011	01/28/2011
SLAC	07/23/2007	07/23/2007	NR	NR
SNL	01/19/2011	01/19/2011	02/01/2011	02/01/2011
SRS	02/22/2011	01/31/2011	03/01/2011	01/31/2011
WSI	07/07/2008	03/01/2011	NR	NR
Y-12	01/13/2011	01/13/2011	01/13/2011	03/09/2011
Y-12 NGJV	05/05/2010	12/28/2010	05/05/2010	12/28/2010
Y-12 URS	08/05/2010	08/25/2010	NR	NR

NR - Not Reported (no records have been reported for this data element by this site).

See list of site abbreviations in table, "Sites and Organizations Submitting Data to BAWR."

The BAWR operating protocol specifies that reports be submitted every 6 months in January and July (see DOE-STD-1187-2007 for more information). Reports are submitted when new roster, medical testing, work history, and exposure data are available. This table provides an indication of whether there are ongoing CBD prevention program activities at a site and of the timeliness in reporting.

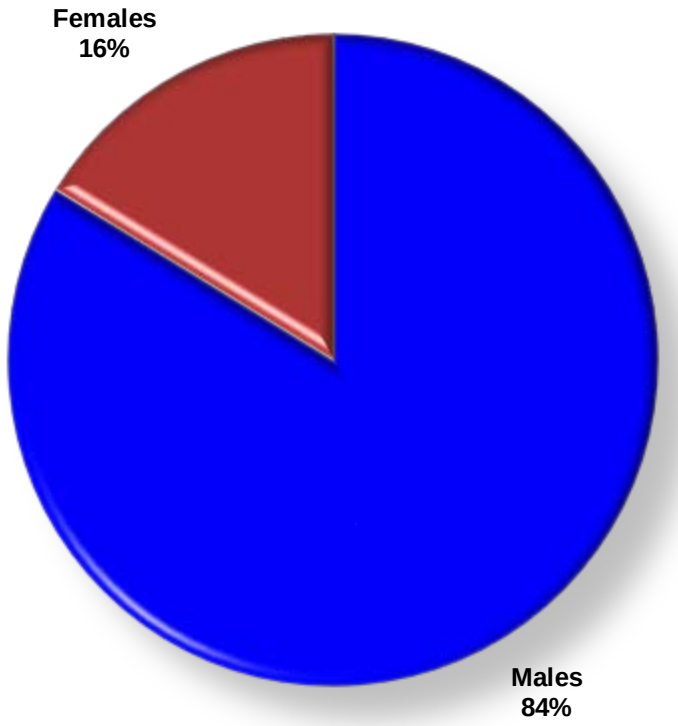
Figure 1. Number of Employees Reported to BAWR by Site



See list of site abbreviations in table, "Sites and Organizations Submitting Data to BAWR."

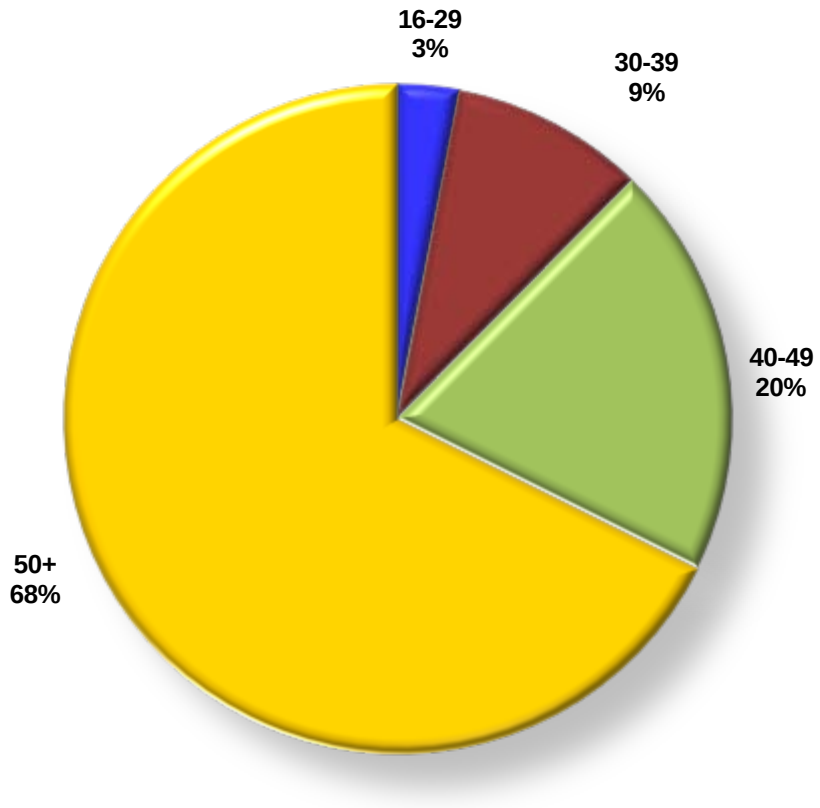
The figure above shows the cumulative numbers of beryllium-associated workers reported to the Registry by site. A total of 23,264 workers have been reported in rosters since 2002. Included are individuals who were screened for CBD or monitored for beryllium exposure while employed at a DOE site. Some of these individuals will have separated from employment since having been screened or monitored. Not included in these summaries are data from sites that have closed.

Figure 2. Gender Breakdown of Employees Reported to BAWR



Beryllium-associated workers reported to the Registry are predominantly male. Reporting on gender was nearly complete with only 0.01 percent of the records failing to include information on gender.

Figure 3. Age Breakdown of Employees Reported to BAWR



The median age of beryllium-associated workers reported to the Registry exceeds 50 years. Reporting on age was nearly complete with only 0.03 percent of the records failing to include information on age.

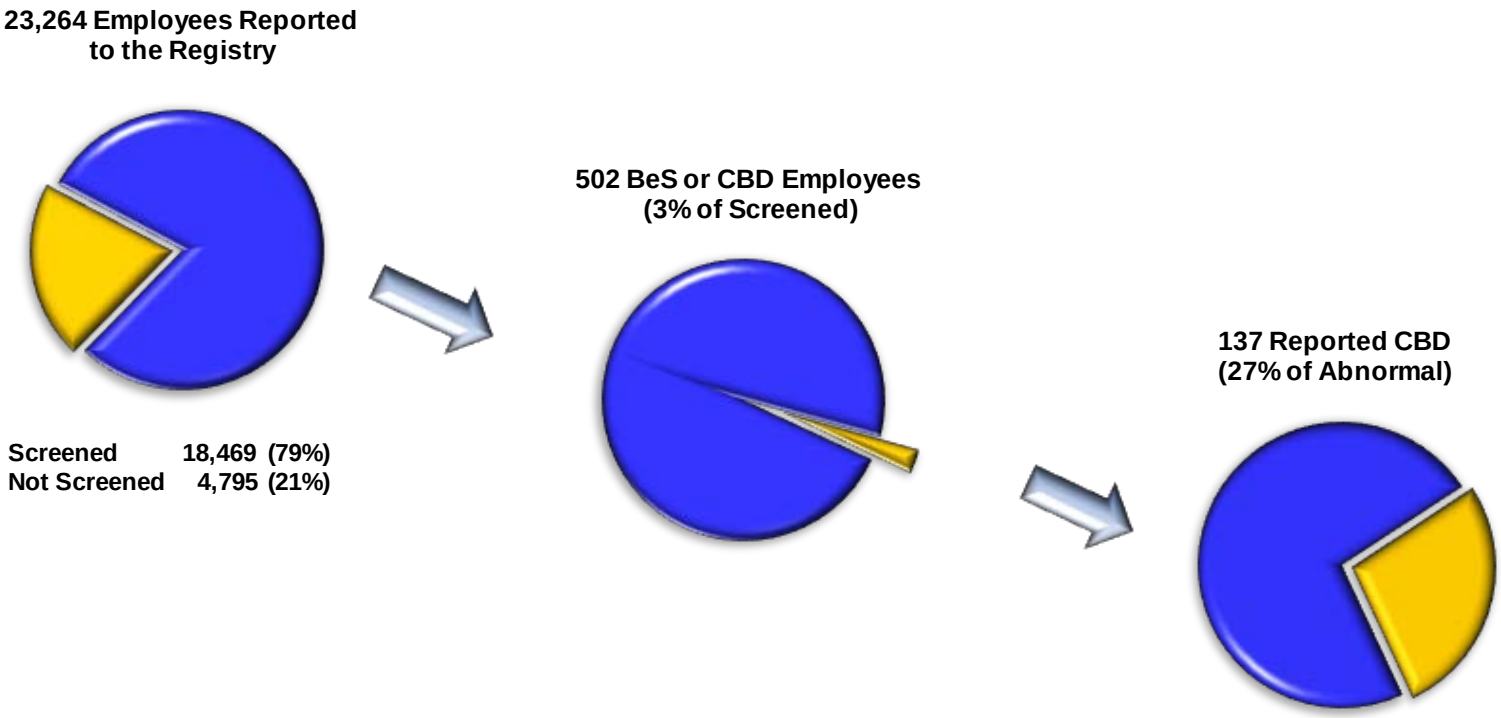
Table 3. Age Breakdown of 23,264 Employees Reported to BAWR by Site

Site	16-29	30-39	40-49	50+	Not Reported
AMWTP	0	2	7	14	0
ANL	2	11	65	263	0
BNL	0	0	4	12	0
DOE-ORO	0	5	10	74	0
ETTP	25	72	128	443	0
Fermi	0	1	3	24	1
HAN	383	718	1,359	3,643	0
INL	33	122	212	349	0
KAPL	1	9	25	25	0
KCP	5	32	76	1,138	0
LANL	62	341	767	2,178	0
LBNL	1	0	8	24	0
LLNL	19	159	350	1,111	0
LLNL BU	1	11	24	57	2
LLNL CHES	2	1	2	4	0
NNSS	12	101	167	757	0
ORNL	14	51	119	405	0
PRS	8	22	40	34	0
PTX	6	132	356	1,235	0
SLAC	0	0	0	1	0
SNL	4	58	112	413	5
SRS	26	84	340	1,063	0
WSI	0	2	9	61	0
Y-12	85	238	455	2,393	0
Y-12 NGJV	0	8	6	2	0
Y-12 URS	0	7	5	8	0
Totals	**689**	**2,187**	**4,649**	**15,731**	**8**

See list of site abbreviations in table, "Sites and Organizations Submitting Data to BAWR."

As shown above, the age distribution of beryllium-associated workers is consistently skewed towards older workers at all sites.

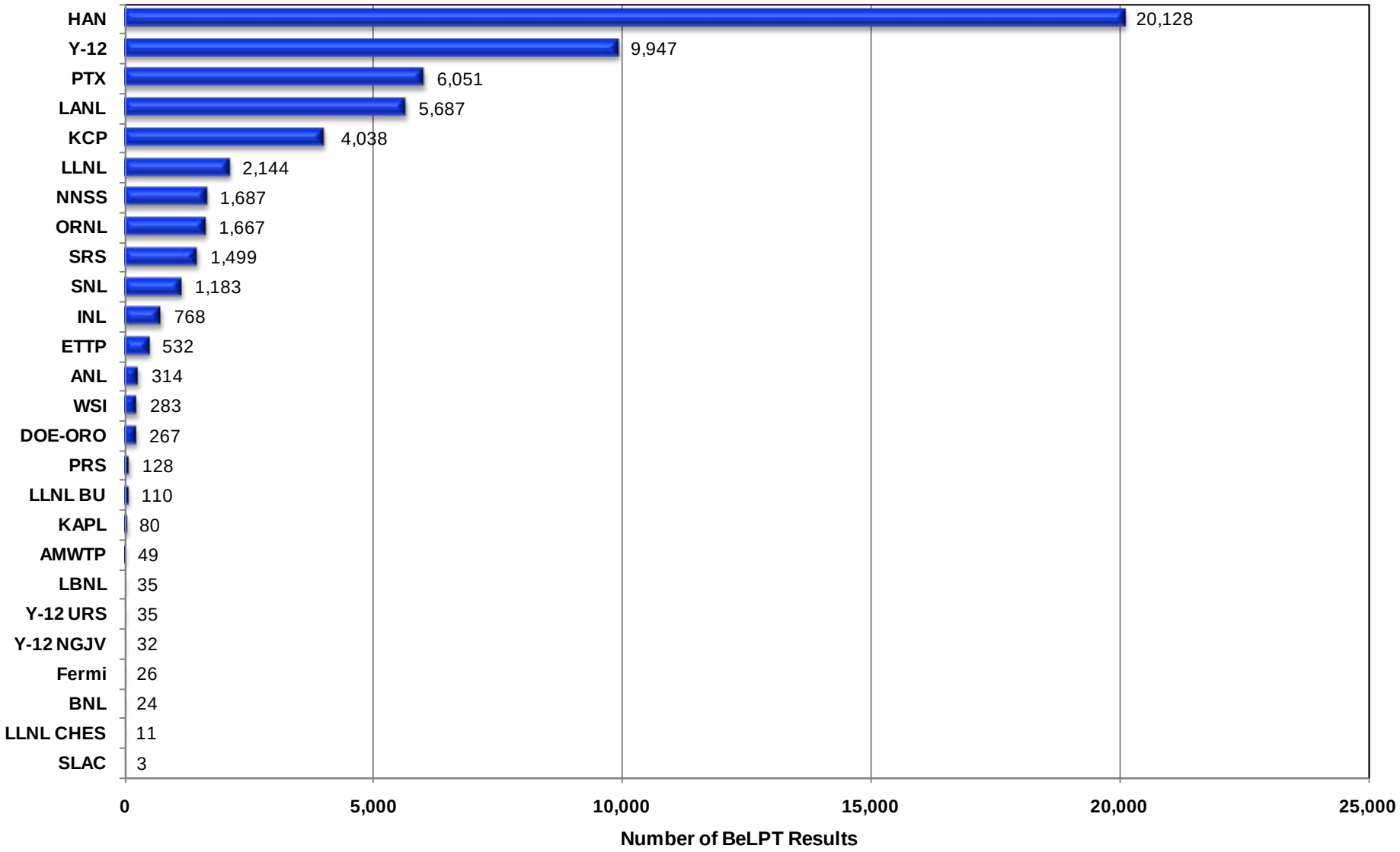
Figure 4. Progression from BeLPT Testing to "Sensitized" to CBD



"Sensitized" indicates the number of individuals found sensitized from 2 or more peripheral blood BeLPTs or from a bronchoalveolar lavage BeLPT, and does not include individuals who have been diagnosed as having CBD.

This figure summarizes the numbers and percentages of total employees reported to the Registry, employees screened using BeLPT tests, employees found to be sensitized from 2 or more peripheral blood BeLPT tests or from a bronchoalveolar lavage BeLPT, and employees diagnosed as having CBD. Of the 23,264 individuals included in rosters of beryllium-associated workers, 18,469 have reported BeLPT results. Of those screened, 137 have been diagnosed as having CBD and another 365 are sensitized for a total of 502 (3 percent of those tested). The difference in numbers from the individuals reported in rosters to those with BeLPT results is due to a combination of individuals declining offers for medical screening and individuals for whom the BeLPT results are not accessible or not reported. Similarly, those reported as sensitized without CBD include those who underwent clinical evaluations and were found not to have any signs of lung pathology, those who declined the offer of a clinical evaluation, those whose clinical evaluation is pending, and those whose clinical evaluation results are not accessible or not reported.

Figure 5. Number of BeLPT Results Reported to BAWR by Site



See list of site abbreviations in table, "Sites and Organizations Submitting Data to BAWR."

The total number of BeLPT results reported to the Registry is 56,728. The figure above shows the numbers of BeLPT results reported by each site. The number of BeLPT results is an indicator of the number of periodic medical screening examinations for CBD provided by DOE contractor-operated occupational medicine clinics. Individuals currently working with beryllium are offered screening examinations every year, and individuals who worked with beryllium in the past are offered screening examinations every 3 years. Individuals who have abnormal results are offered confirmatory testing that involves splitting blood samples, which are then tested in 2 laboratories.

Table 4. Number of Employees BeLPT Tested, "Sensitized," and CBD by Site

Site	Employees with BeLPT Results	"Sensitized" Employees	CBD Employees
HAN	6,028	81 (1.3%)	32 (0.5%)
Y-12	2,480	91 (3.7%)	58 (2.3%)
LANL	2,227	19 (0.9%)	3 (0.1%)
PTX	1,670	27 (1.6%)	15 (0.9%)
KCP	1,168	39 (3.3%)	13 (1.1%)
LLNL	951	39 (4.1%)	2 (0.2%)
NNSS	904	21 (2.3%)	4 (0.4%)
SRS	645	15 (2.3%)	6 (0.9%)
SNL	588	1 (0.2%)	0
ORNL	477	11 (2.3%)	0
ETTP	384	6 (1.6%)	4 (1.0%)
INL	312	3 (1.0%)	0
ANL	129	3 (2.3%)	0
PRS	104	1 (1.0%)	0
LLNL BU	95	3 (3.2%)	0
DOE-ORO	89	1 (1.1%)	0
WSI	70	1 (1.4%)	0
KAPL	26	0	0
LBNL	23	1 (4.3%)	0
AMWTP	21	0	0
Fermi	19	0	0
Y-12 URS	19	0	0
Y-12 NGJV	16	0	0
BNL	15	1 (6.7%)	0
LLNL CHES	8	0	0
SLAC	1	1 (100.0%)	0
Totals	**18,469**	**365 (2.0%)**	**137 (0.7%)**

"Sensitized" indicates the number of individuals found sensitized from 2 or more peripheral blood BeLPTs or from a brochoalveolar lavage BeLPT, and does not include individuals who have been diagnosed as having CBD.

See list of site abbreviations in table, "Sites and Organizations Submitting Data to BAWR."

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. These numbers are shown in total and by site, and do not include individuals who were screened or diagnosed with CBD after separating from employment at a DOE site.

Table 5. Year of First Hire for Employees that Are "Sensitized" and CBD

Year of First Hire	Employees with BeLPT Results	"Sensitized" Employees	CBD Employees
<1961	88	0	1 (1.1%)
1961 - 1965	110	3 (2.7%)	0
1966 - 1970	616	21 (3.4%)	23 (3.7%)
1971 - 1975	731	14 (1.9%)	12 (1.6%)
1976 - 1980	2,099	75 (3.6%)	30 (1.4%)
1981 - 1985	1,657	39 (2.4%)	20 (1.2%)
1986 - 1990	1,388	31 (2.2%)	4 (0.3%)
1991 - 1995	1,288	36 (2.8%)	6 (0.5%)
1996 - 2000	1,232	20 (1.6%)	4 (0.3%)
2001 - 2005	2,064	36 (1.7%)	2 (0.1%)
2006 - 2010	1,086	9 (0.8%)	3 (0.3%)
Not Reported	6,110	81 (1.3%)	32 (0.5%)
Totals	**18,469**	**365 (2.0%)**	**137 (0.7%)**

"Sensitized" indicates the number of individuals found sensitized from 2 or more peripheral blood BeLPTs or from a brochoalveolar lavage BeLPT, and does not include individuals who have been diagnosed as having CBD.

Beryllium-associated workers are overwhelmingly long-term workers and, as a result, sensitization and CBD cases occur primarily among individuals who have worked for many years. However, 45 sensitized cases and 5 CBD cases have occurred among individuals hired since January 2001, and new cases continue to be reported.

Table 6. Year of First Positive or Abnormal BeLPT Result for Employees that Are "Sensitized" and CBD

Year of BeLPT Result	Number of Employees Tested	"Sensitized" Employees	CBD Employees
<2000	693	35 (5.1%)	10 (1.4%)
2000	1,630	28 (1.7%)	17 (1.0%)
2001	3,234	43 (1.3%)	16 (0.5%)
2002	3,983	40 (1.0%)	15 (0.4%)
2003	3,966	13 (0.3%)	5 (0.1%)
2004	3,837	15 (0.4%)	3 (0.1%)
2005	5,131	28 (0.5%)	5 (0.1%)
2006	4,897	42 (0.9%)	7 (0.1%)
2007	4,601	33 (0.7%)	4 (0.1%)
2008	5,200	27 (0.5%)	5 (0.1%)
2009	6,150	31 (0.5%)	1 (<0.1%)
2010	6,555	17 (0.3%)	1 (<0.1%)
2011	2	0	0
Not Reported	2	13	48
Totals	**49,881**	**365 (0.7%)**	**137 (0.3%)**

The number of employees tested includes all testing with results of Normal, Negative, Borderline, Positive, Abnormal, and Unsatisfactory. Employees tested periodically are included in the number tested each year they were tested.

This table shows the initial positive screening results among cases who were eventually diagnosed as either beryllium sensitized (BeS) or CBD. Recent positive screening results among long-term workers may be due to false-positive results on initial tests, a latency period between exposure and development of BeS, or as a result of recent exposure.

Table 7. Work History Activity for Employees that Are "Sensitized" and CBD

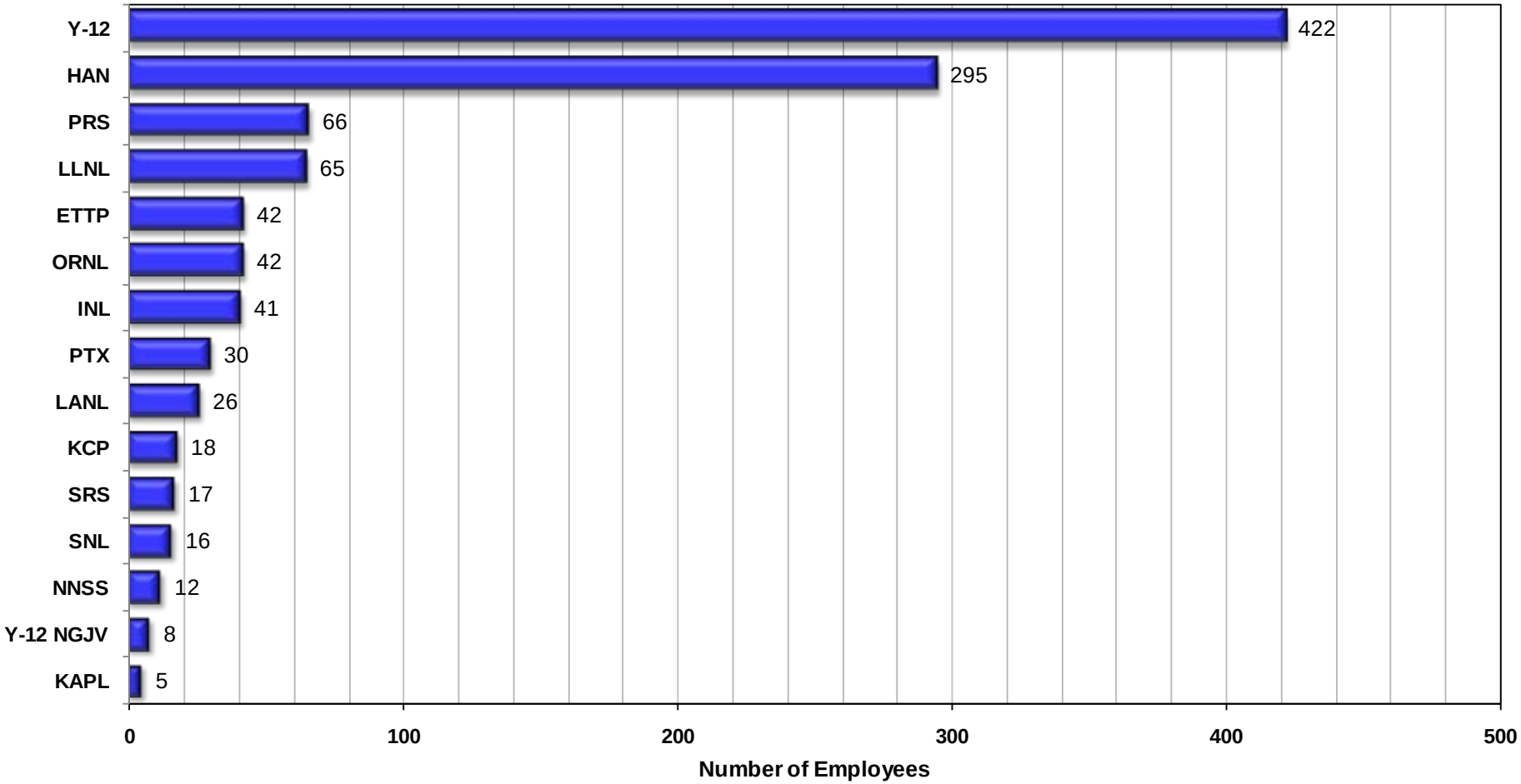
Work History Activity	Employees with BeLPT Results	"Sensitized" Employees	CBD Employees
Management (M)	1,391	25 (1.8%)	9 (0.6%)
Administrative Support (A)	937	31 (3.3%)	9 (1.0%)
In-House Professionals (I)	1,273	26 (2.0%)	13 (1.0%)
Field Professionals (F)	1,799	40 (2.2%)	7 (0.4%)
Technical Support (T)	2,615	45 (1.7%)	12 (0.5%)
Service (S)	1,216	24 (2.0%)	9 (0.7%)
Security and Fire (E)	1,211	18 (1.5%)	7 (0.6%)
Crafts (C)	3,280	69 (2.1%)	34 (1.0%)
Line Operators (O)	2,270	61 (2.7%)	22 (1.0%)
Guests (G)	44	0	0
Unknown (U)	728	12 (1.6%)	11 (1.5%)
Not Reported	1,705	14 (0.8%)	4 (0.2%)
Totals	**18,469**	**365 (2.0%)**	**137 (0.7%)**

"Sensitized" indicates the number of individuals found sensitized from 2 or more peripheral blood BeLPTs or from a bronchoalveolar lavage BeLPT, and does not include individuals who have been diagnosed as having CBD.

The table above reports the numbers of beryllium sensitization and CBD cases sorted by work history activity. Work activities are a high level rollup of job functions. Individuals are placed in a group by site personnel based on the following descriptions:

- Management – Predominately office work at a desk, first level supervisor and above.
- Administrative Support – Predominately office work at a desk; however, can include tasks that involve visiting, production areas, shops, and laboratories. This category includes, but is not limited to, information technology, clerical, and secretarial staff.
- In-House Professionals – Predominately office work at a desk, typically without supervisory responsibilities. Occasional tasks outside their offices create opportunities for exposure.
- Field Professionals – Frequently work outside of their offices in areas such as, but not limited to, laboratories, testing areas, and construction areas.
- Technical Support – Workers who typically support the field professionals and have hands-on work situations.
- Service – Typically includes, but is not limited to, custodians, drivers, laundry workers, stationary engineers, and utility workers. These workers support and maintain the facility's infrastructure. Most work is not performed sitting at a desk.
- Security and Fire – Typically includes protective forces and firefighters.
- Crafts – Typically includes building trades, laborers, and other workers whose job titles are defined by the bargaining unit to which they belong.
- Line Operators – Typically workers who are directly involved in process, operation, or line activities at the facility.
- Guests – Employees on short-term assignments or internships. Typically includes guest scientists, postdoctoral fellows, co-op students, and interns. Potential for exposure dependent on job assignment.
- Unknown – Job title is missing.

Figure 6. Number of Employees Monitored by Site in 2010



See list of site abbreviations in table, "Sites and Organizations Submitting Data to BAWR."

The figure above shows the numbers of individuals by site whose exposures were assessed by an industrial hygienist at least once in 2010. Fifteen sites provided exposure monitoring results with monitoring dates in 2010. The number of individuals monitored is a function of the number of people working with beryllium or beryllium-contaminated facilities and equipment and the judgments and resources of the industrial hygiene programs responsible for monitoring their exposures.

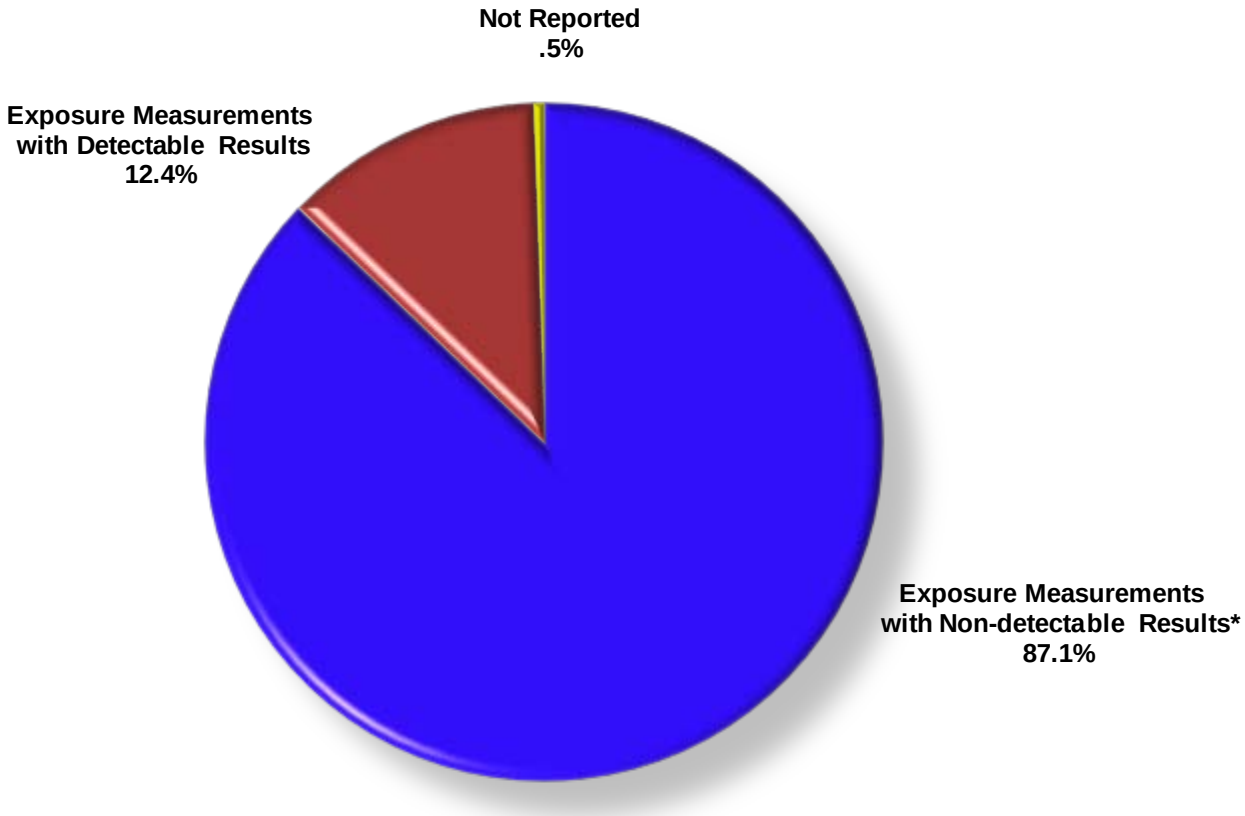
Table 8. Estimated Number of Employees Assigned Beryllium Job Activities 2007 – 2010

Site	Roster	Work History	Exposure	Total Unique IDs
Advanced Mixed Waste Treatment Project (AMWTP)	1	23	4	24
Argonne National Laboratory (ANL)	5	5	4	10
Brookhaven National Laboratory (BNL)	0	14	NR	14
DOE Oak Ridge Office (DOE-ORO)	2	NR	NR	2
East Tennessee Technology Park (ETTP)	29	114	92	114
Fermi National Accelerator Laboratory (Fermi)	0	2	0	2
Hanford Site (HAN)	NR	5,068	553	5,125
Idaho National Laboratory (INL)	84	675	133	675
Kansas City Plant (KCP)	11	1,094	43	1,096
Knolls Atomic Power Laboratory (KAPL)	4	23	14	31
Lawrence Berkeley National Laboratory (LBNL)	3	23	1	24
Lawrence Livermore National Laboratory (LLNL)	71	1,504	181	1,515
LLNL Boston University (LLNL BU)	4	95	NR	95
LLNL Clean Harbors Environmental Services (LLNL CHES)	6	NR	NR	6
Los Alamos National Laboratory (LANL)	91	2,906	113	2,959
Nevada National Security Site (NNSS)	51	311	74	311
Oak Ridge National Laboratory (ORNL)	89	542	122	542
Paducah Remediation Services (PRS)	42	86	69	126
Pantex Plant (PTX)	34	1,452	106	1,452
Sandia National Laboratories (SNL)	24	385	21	401
Savannah River Site (SRS)	104	1,257	66	1,257
Stanford Linear Accelerator Center (SLAC)	0	NR	NR	0
Wackenhut Security Services Inc. for ETTP, ORNL, and Y-12 (WSI)	0	NR	NR	0
Y-12 National Security Complex (Y-12)	357	2,099	660	2,102
Y-12 Navarro-GEM Joint Venture (Y-12 NGJV)	11	16	14	16
Y-12 URS Corporation (Y-12 URS)	10	NR	NR	10
Totals	**1,033**	**17,694**	**2,270**	**17,909**

The 10 CFR Part 850 CBD Prevention Program rule establishes a goal of “Minimizing the number of workers exposed and potentially exposed to beryllium.” This table provides an indication of the performance of sites in meeting that goal. Lags in reporting job end dates may result in overestimates. The reported work history data indicate that the majority of beryllium-associated workers continue to have jobs with duties that include performing tasks that have some potential for exposure to beryllium.

- Roster - The number of beryllium-associated employees with records indicating they were hired after 12/31/2006 and still employed.
- Work History - The number of beryllium-associated employees with records reporting a job start date for which the job end date is not reported or is later than 12/31/2006. Reported Work History are for employees that are working or have worked in beryllium exposure jobs, or for self-reported employees included in medical surveillance programs for beryllium.
- Exposure - The number of beryllium-associated employees with records reporting their beryllium exposure was monitored one or more times after 12/31/2006.
- Total Unique IDs - The total number of individuals reported in 1 or more of the 3 categories.
- NR - Not Reported (no records have been reported for this data element by this site).

Figure 7. Reported Exposure Levels

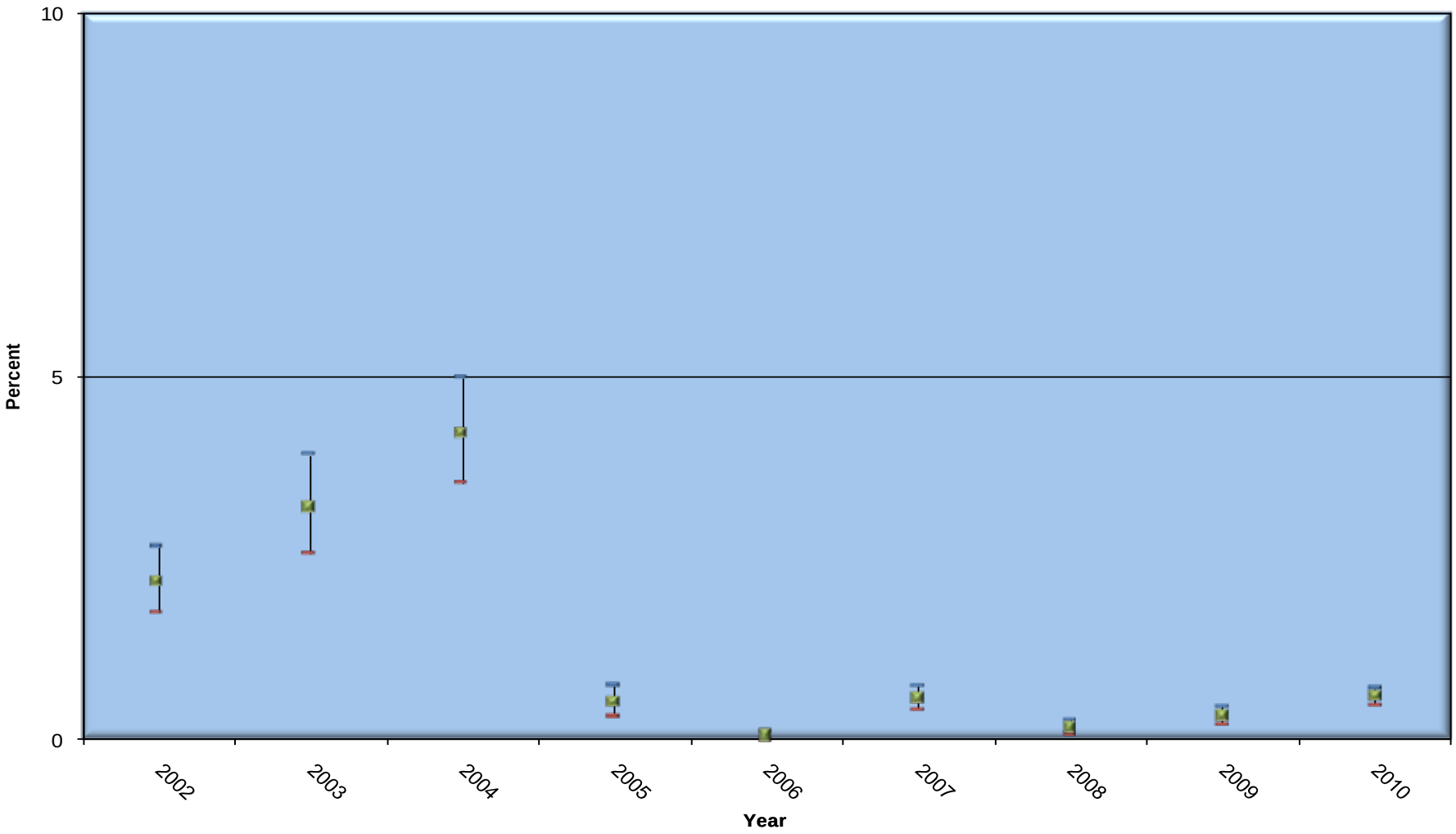


*Non-detectable indicates that analysis results were reported as less than the laboratory's reporting limit.

Participating sites have submitted 60,736 exposure monitoring records to the Beryllium-Associated Worker Registry (BAWR). The majority of these results (87.1 percent) were “non-detectable,” which indicates that 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.

Figure 8. DOE-wide Exposure Trend

Percent Exceeding 0.2 µg/m^3 and 95 Percent Upper and Lower Confidence Limits



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.hss.doe.gov/HealthSafety/IIPP/hservices/statmethods.pdf .

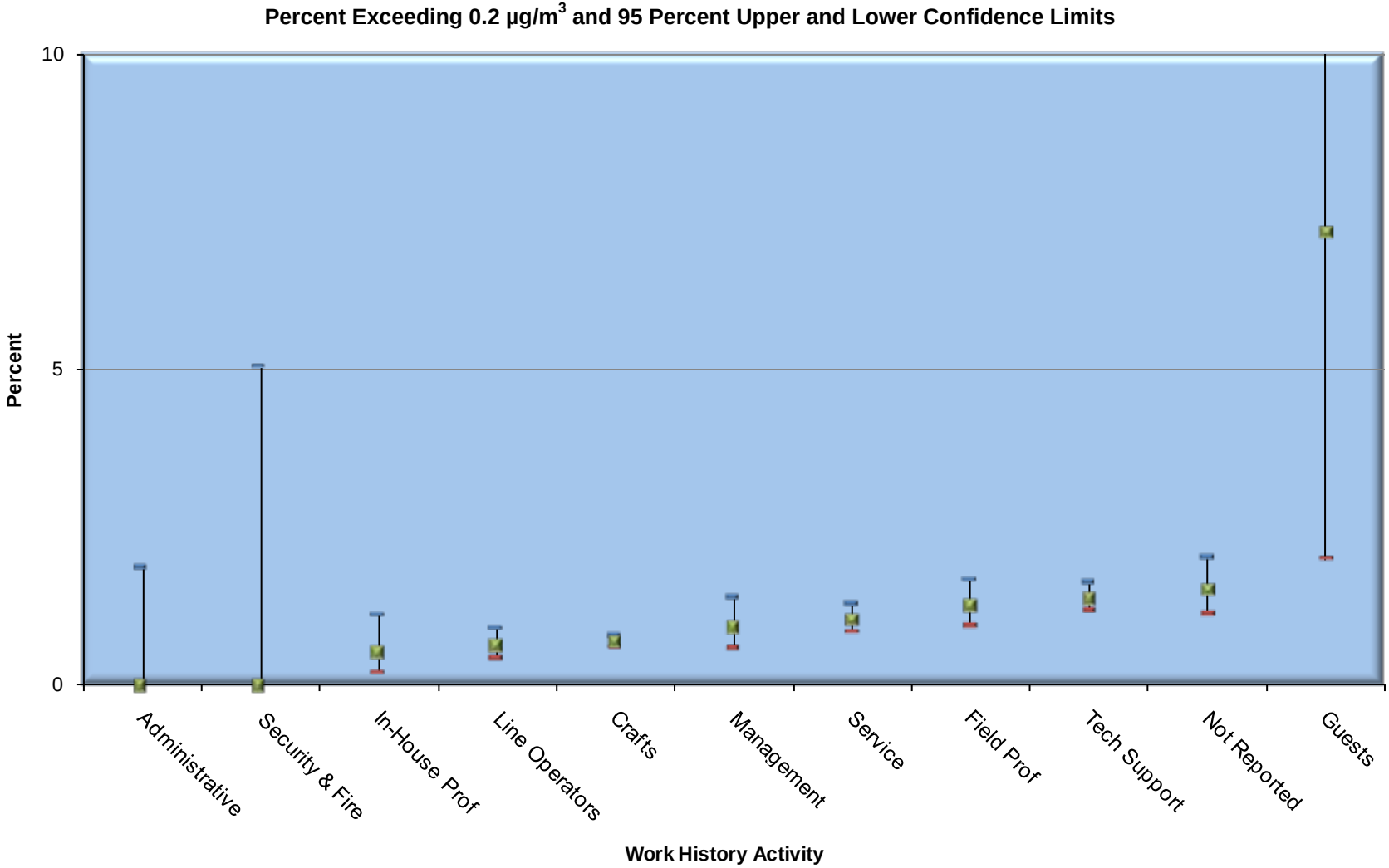
This figure is a DOE-wide rollup of 8-hour time weighted average personal exposure monitoring results. These data indicate that the CBD prevention programs being operated at DOE sites have achieved a high level of compliance with the 10 CFR 850 action level of 0.2 µg/m^3 since 2004.

Table 9. Summary Statistics for Annual 8-Hour Time Weighted Average Exposure Monitoring Results

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	Units
Number of reported monitoring results	3,006	1,982	2,237	3,377	6,074	5,719	5,055	6,027	11,933	
Number of detected values	1,180	412	558	129	230	317	145	126	578	
Percent non-detects	60.7	79.2	75.1	96.2	96.2	94.5	97.1	97.9	95.2	%
Number of individuals monitored	462	390	488	591	749	746	720	794	1,105	
Arithmetic mean (EX)	0.029	0.043	0.040	0.007	0.001	0.009	0.003	0.003	0.018	$\mu g/m^3$
Lower confidence limit of EX	0.023	0.025	0.031	0.004	0.001	0.005	0.002	0.002	0.005	$\mu g/m^3$
Upper confidence limit of EX	0.035	0.061	0.050	0.011	0.001	0.013	0.003	0.003	0.032	$\mu g/m^3$
Observed 95th percentile of data	0.088	0.121	0.157	0.009	0.006	0.011	0.0004	0.0005	0.009	$\mu g/m^3$
95% upper tolerance limit of the 95th percentile	0.110	0.174	0.200	0.100	0.034	0.035	0.027	0.020	0.020	$\mu g/m^3$
Largest value	7.423	15.947	8.420	5.133	0.310	12.513	1.774	1.111	79.330	$\mu g/m^3$
Percent exceeding 0.2 $\mu g/m^3$ (F)	2.16	3.18	4.20	0.50	0.05	0.56	0.16	0.32	0.59	%
Lower confidence limit for F	1.74	2.56	3.53	0.32	0.01	0.41	0.08	0.21	0.48	%
Upper confidence limit for F	2.65	3.91	4.97	0.75	0.13	0.75	0.29	0.46	0.72	%

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. The number of exposure monitoring results and number of individuals monitored indicate that sites have been expanding their exposure monitoring and control efforts.

Figure 9. Exposure by Work History Activity for Years 2002 – 2010



See "Work History Activity for Employees that Are "Sensitized" and CBD" for Work History Activity categories.

Shown above are exposure data grouped by work activity for years 2002 through 2010. The work activities are the high level rollup of job functions used in table "Work History Activity for Employees that Are "Sensitized" and CBD." For the administrative and security and fire groups there were no values above the action level.

Table 10. Summary Statistics for 2002 – 2010 8-Hour Time Weighted Average Exposure Monitoring Results by Work History Activity

Work History Activity	Admin	Crafts	Field Prof	Guests	In-House Prof	Line Operators	Management	Security and Fire	Service	Tech Support	Not Reported	Units
Number of reported monitoring results	160	20,057	2,780	42	939	3,643	1,842	58	6,082	7,563	2,182	
Number of detected values	8	920	429	27	50	266	175	1	456	812	528	
Percent non-detects	95	95.4	84.6	35.7	94.7	92.7	90.5	98.3	92.5	89.3	75.8	%
Number of individuals monitored	35	1,244	312	5	131	513	131	30	354	634	163	
Arithmetic mean (EX)	0.001	0.011	0.013	0.037	0.006	0.022	0.014	NA	0.026	0.013	0.019	$\mu g/m^3$
Lower confidence limit of EX	0.000	0.006	0.011	0.018	0.001	0.011	0.006	NA	0.004	0.011	0.014	$\mu g/m^3$
Upper confidence limit of EX	0.002	0.016	0.015	0.056	0.010	0.034	0.022	NA	0.047	0.015	0.024	$\mu g/m^3$
Observed 95th percentile of data	0.009	0.008	0.058	0.206	0.011	0.013	0.019	<0.022	0.023	0.028	0.073	$\mu g/m^3$
95% upper tolerance limit of the 95th percentile	0.032	0.062	0.075	NA	0.026	0.042	0.030	NA	0.043	0.052	0.086	$\mu g/m^3$
Largest value	0.041	51.895	1.774	0.313	2.221	15.947	8.420	<0.031	79.330	5.442	3.661	$\mu g/m^3$
Percent exceeding 0.2 $\mu g/m^3$ (F)	0	0.7	1.3	7.1	0.5	0.6	0.9	0	1.0	1.4	1.5	%
Lower confidence limit for F	0	0.6	0.9	2.0	0.2	0.4	0.6	0	0.8	1.2	1.1	%
Upper confidence limit for F	1.9	0.8	1.7	17.4	1.1	0.9	1.4	5.0	1.3	1.6	2.0	%

See "Work History Activity for Employees that Are "Sensitized" and CBD" for Work History Activity categories.

This table provides additional summary statistics for 8-hour time weighted average exposure monitoring results grouped by work activity. The Crafts category contains 44 percent of the measurements included in this analysis (20,057 of 45,348). The Tech Support, Not Reported, and Guests categories have significantly higher exceedance rates than the rates for all categories combined. The Guests category includes fixed-price subcontractor employees on site for short periods of time.

Table 11. Summary Statistics for 2010 8-Hour Time Weighted Average Exposure Monitoring Results by Work History Activity

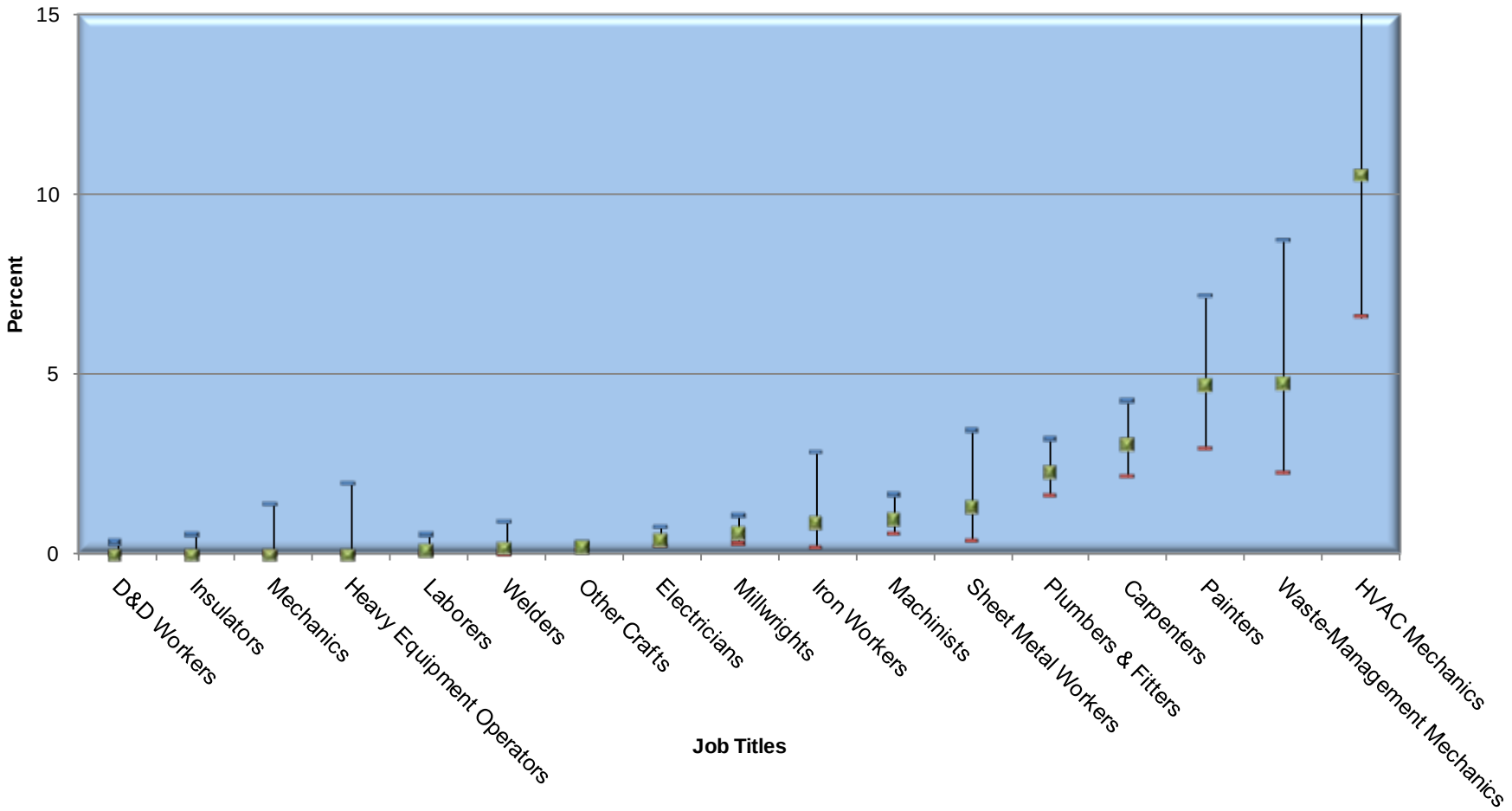
Work History Activity	Admin	Crafts	Field Prof	In-House Prof	Line Operators	Management	Service	Tech Support	Not Reported	Units
Number of reported monitoring results	56	5,882	338	118	269	501	3,614	714	428	
Number of detected values	2	217	8	5	12	31	277	18	7	
Percent non-detects	96.4	96.3	97.6	95.8	95.5	93.8	92.3	97.5	98.4	%
Number of individuals monitored	11	397	81	30	32	128	193	156	68	
Arithmetic mean (EX)	NA	0.017	0.001	0.022	0.009	0.013	0.035	0.001	0.003	$\mu g/m^3$
Lower confidence limit of EX	NA	0.002	0	0	0.001	0.004	0	0.001	0.003	$\mu g/m^3$
Upper confidence limit of EX	NA	0.031	0.002	0.067	0.016	0.022	0.071	0.002	0.003	$\mu g/m^3$
Observed 95th percentile of data	NA	0.006	0.000	0.002	0.003	0.011	0.021	0.002	0.003	$\mu g/m^3$
95% upper tolerance limit of the 95th percentile	NA	0.020	0.021	0.065	0.020	0.040	0.028	0.020	0.020	$\mu g/m^3$
Largest value	0.016	51.895	0.123	2.221	1.029	2.000	79.330	0.098	0.057	$\mu g/m^3$
Percent exceeding 0.2 $\mu g/m^3$ (F)	0	0.6	0.0	0.8	0.4	0.8	0.9	0	0	%
Lower confidence limit for F	0	0.4	0	0	0	0.3	0.6	0	0	%
Upper confidence limit for F	5.2	0.8	0.9	4.0	1.8	1.8	1.2	0.4	0.7	%

See "Work History Activity for Employees that Are "Sensitized" and CBD" for Work History Activity categories.

In 2010 there were small differences in the consistently low exposure levels for individuals in different work history activity categories.

Figure 10. Exposure by Job Title for Craft Workers for Years 2002 – 2010

Percent Exceeding 0.2 µg/m^3 and 95 Percent Upper and Lower Confidence Limits



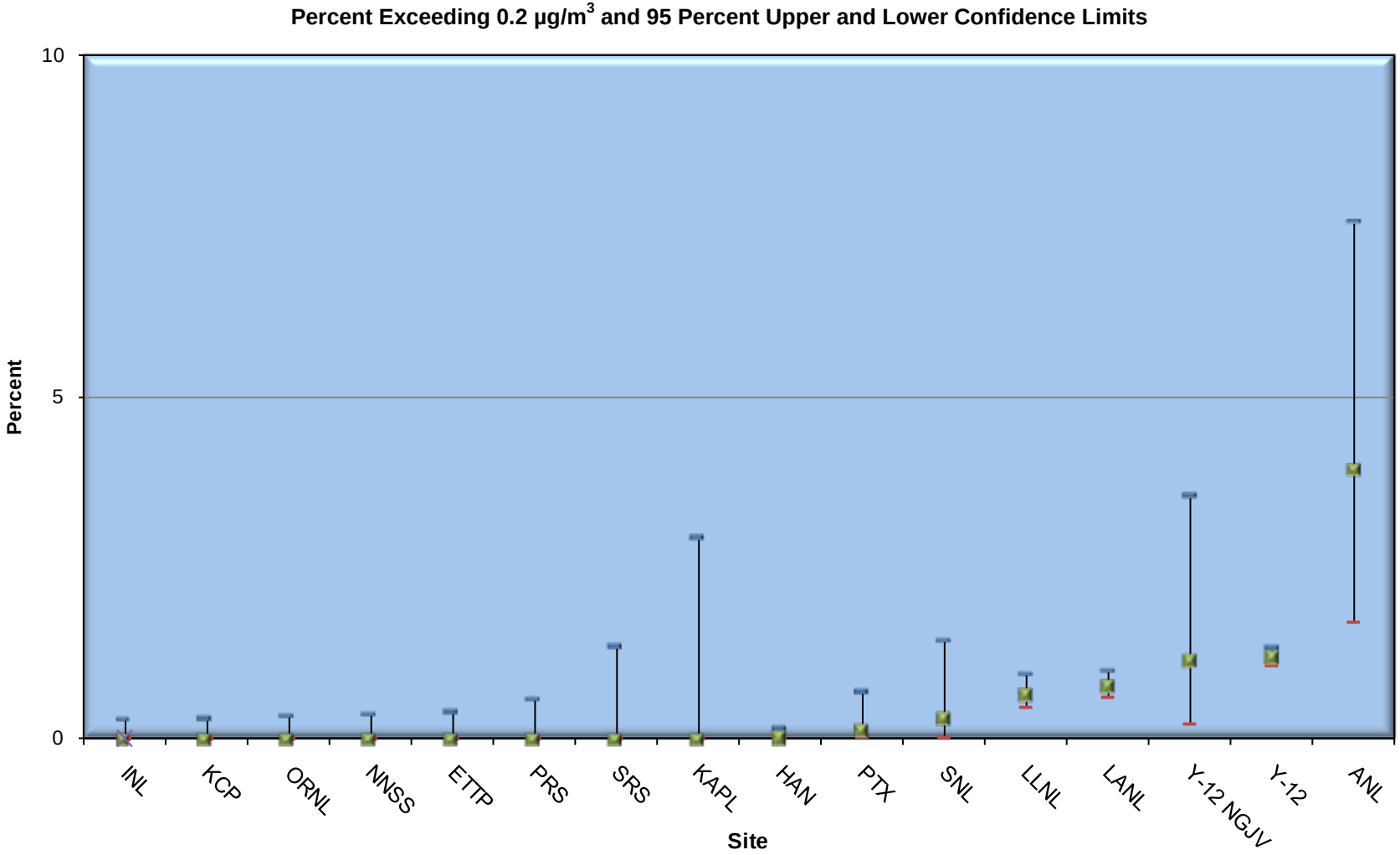
The figure above provides an indication of differences in exposure level for individuals with job titles that were grouped together in the Craft work activity category. HVAC Mechanics, Waste-Management Mechanics, Painters, Carpenters, and Plumbers & Fitters have exceedance rates significantly higher than all Crafts combined.

Table 12. Summary Statistics for 2002 – 2010 8-Hour Time Weighted Average Exposure Monitoring Results for Craft Job Titles

Job Titles	D&D Workers	Insulators	Mechanics	Heavy Equip Operators	Laborers	Welders	Other Crafts	Electricians	Millwrights	Iron Workers	Machinists	Sheet Metal Workers	Plumbers & Fitters	Carpenters	Painters	Waste-Mgmt Mechanics	HVAC Mechanics	Units
Number of reported monitoring results	883	555	216	153	895	519	7,961	2,116	1,361	222	1,103	224	1,093	819	319	148	143	
Number of detected values	39	12	14	10	20	24	135	158	80	11	56	17	94	80	63	19	70	
Percent non-detects	95.6	97.8	93.5	93.5	97.8	95.4	98.3	92.5	94.1	95	94.9	92.4	91.4	90.2	80.3	87.2	51	%
Arithmetic mean (EX)	0.003	0.001	0.002	0.003	0.001	0.003	0.002	0.006	0.013	0.007	0.056	0.022	0.034	0.030	0.054	0.061	0.141	$\mu g/m^3$
Lower confidence limit of EX	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.004	0.004	0.000	0	0.003	0.019	0.017	0.013	0.016	0.055	$\mu g/m^3$
Upper confidence limit of EX	0.003	0.001	0.003	0.004	0.002	0.005	0.003	0.007	0.022	0.013	0.135	0.041	0.050	0.043	0.095	0.106	0.226	$\mu g/m^3$
Observed 95th percentile of data	<0.013	<0.001	0.007	0.011	<0.002	<0.00001	<0.0004	0.015	0.010	0.006	0.009	0.018	0.027	0.053	0.144	0.092	0.407	$\mu g/m^3$
95% upper tolerance limit of the 95th percentile	0.080	0.019	0.046	0.055	0.050	0.033	0.015	0.027	0.020	0.134	0.021	0.054	0.054	0.107	0.388	1.290	1.547	$\mu g/m^3$
Largest value	0.176	0.030	0.091	0.119	0.220	0.356	1.803	1.999	7.038	0.680	51.895	2.203	5.735	3.176	7.423	2.390	6.329	$\mu g/m^3$
Percent exceeding 0.2 $\mu g/m^3$ (F)	0	0	0	0	0.1	0.2	0.2	0.4	0.6	0.9	1.0	1.3	2.3	3.1	4.7	4.7	10.5	%
Lower confidence limit for F	0	0	0	0	0.0	0.0	0.1	0.2	0.3	0.2	0.6	0.4	1.6	2.1	2.9	2.2	6.6	%
Upper confidence limit for F	0.3	0.5	1.4	1.9	0.5	0.9	0.3	0.7	1.1	2.8	1.6	3.4	3.2	4.2	7.1	8.7	15.7	%

This table provides additional summary statistics for Craft job titles. As data in the BAWR mature they support analyses that provide more specific guidance on the degree of risk.

Figure 11. Percent of Exposure Monitoring Results Exceeding the Action Level for 2002 – 2010 by Site



See list of site abbreviations in table, "Sites and Organizations Submitting Data to BAWR."

Results reported by KCP, ETTP, and PTX that were less than laboratory reporting limits but higher than 0.2 µg/m^3 were not included in this analysis.

This figure summarizes 8-hour time weighted average exposure monitoring results by site. Exceedance rates at ANL and Y-12 were significantly higher than those for all sites combined.

Table 13. Summary Statistics for 2002 – 2010 8-Hour Time Weighted Average Exposure Monitoring Results by Site

Site	AMWTP	ANL	ETTP	Fermi	HAN	INL	KAPL	KCP	LANL	LBNL	LLNL	NNSS	ORNL	PRS	PTX	SNL	SRS	Y-12	Y-12 NGJV	Units
Number of reported monitoring results	5	154	786	12	4,470	1,129	101	1,072	6,578	7	3,508	883	922	529	701	334	224	23,819	176	
Number of detected values	0	19	20	4	155	59	0	14	914	0	156	35	4	4	20	119	13	2,126	13	
Percent non-detects	100	87.7	97.5	66.7	96.5	94.8	100	98.7	86.1	100	95.6	96	99.6	99.2	97.1	64.4	94.2	91.1	92.6	%
Number of individuals monitored	4	22	245	4	716	190	15	81	311	3	229	221	199	69	208	80	118	838	14	
Arithmetic mean (EX)	NA	0.0292	0.004	0.0767	0.004	0.003	NA	0.002	0.012	NA	0.019	0.001	0.002	0.005	0.002	0.013	0.004	0.0175	0.015	$\mu g/m^3$
Lower confidence limit of EX	NA	0.0099	0.004	-0.027	-0.001	0.003	NA	0.002	0.009	NA	0.008	0.001	0.002	0.005	0.000	0	0.002	0.0108	-0.001	$\mu g/m^3$
Upper confidence limit of EX	NA	0.0485	0.005	0.1802	0.008	0.004	NA	0.003	0.015	NA	0.030	0.002	0.003	0.005	0.003	0.027	0.006	0.0242	0.031	$\mu g/m^3$
Observed 95th percentile of data	NA	0.066	0.006	0.274	0.003	0.014	NA	0.001	0.019	NA	0.014	0.006	0.002	0.004	0.000	0.027	0.023	0.0303	0.024	$\mu g/m^3$
95% upper tolerance limit of the 95th percentile	NA	0.3646	0.056	NA	0.025	0.041	<0.1	0.152	0.030	NA	0.022	0.052	0.011	0.007	0.021	0.052	0.062	0.034	0.073	$\mu g/m^3$
Largest value	<0.007	1.1	<0.200	0.37	12.513	0.195	<0.1	<0.196	8.420	<0.1	15.947	<0.158	0.157	0.019	0.517	2.800	0.083	79.33	1.111	$\mu g/m^3$
Percent exceeding 0.2 $\mu g/m^3$ (F)	0.0	3.8961	0	16.667	0.0	0	0.00	0	0.8	0.0	0.7	0	0	0	0.1	0.3	0	1.1881	1.1	%
Lower confidence limit for F	0.00	1.7101	0	3.046	0.0	0	0.00	0	0.6	0.00	0.4	0	0	0	0.0	0.0	0	1.075	0.2	%
Upper confidence limit for F	45.1	7.5446	0.4	43.811	0.1	0.3	2.9	0.3	1.0	34.8	0.9	0.3	0.3	0.6	0.7	1.4	1.3	1.3102	3.5	%

See list of site abbreviations in table, "Sites and Organizations Submitting Data to BAWR."

Results reported by KCP, ETTP, and PTX that were less than laboratory reporting limits but higher than 0.2 $\mu g/m^3$ were not included in this analysis.

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.

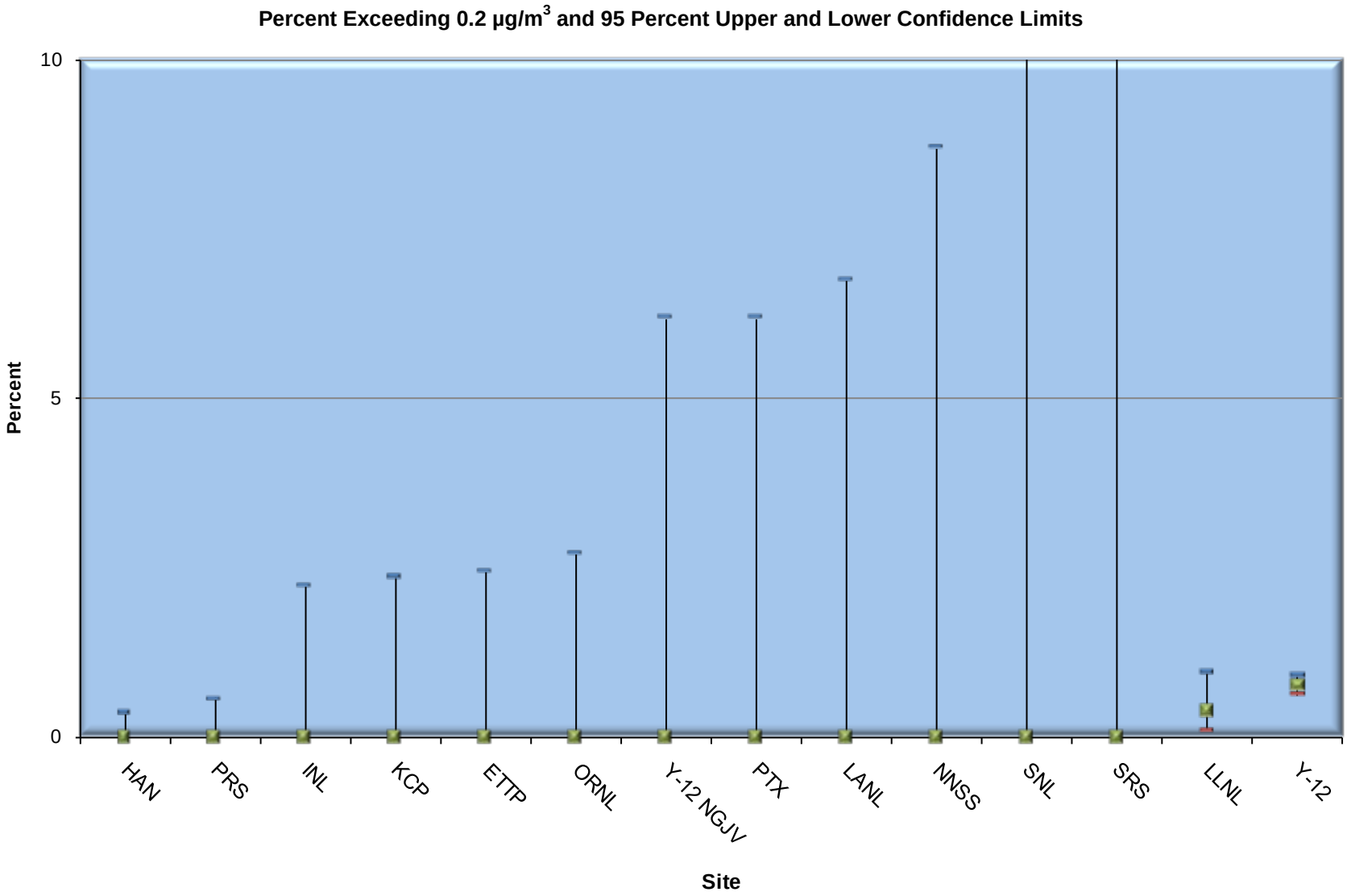
Table 14. Summary Statistics for 2010 8-Hour Time Weighted Average Exposure Monitoring Results by Site

Site	ETTP	HAN	INL	KCP	LANL	LLNL	NNSS	ORNL	PRS	PTX	SNL	SRS	Y-12	Y-12 NGJV	Units
Number of reported monitoring results	121	814	133	125	43	802	33	109	520	49	25	19	9,088	47	
Number of detected values	6	11	8	6	2	21	1	2	4	0	8	0	507	2	
Percent non-detects	95	98.6	94	95.2	95.3	97.4	97.0	98.2	99.2	100	68	100	94.4	95.7	%
Number of individuals monitored	42	295	41	18	26	65	12	42	66	30	16	17	422	8	
Arithmetic mean (EX)	0.005	0.001	0.007	0.010	NA	0.014	NA	NA	0.005	NA	0.0045	NA	0.030	NA	µg/m^3
Lower confidence limit of EX	0.005	0.000	0.006	0.008	NA	0.010	NA	NA	0.005	NA	0.0007	NA	0.013	NA	µg/m^3
Upper confidence limit of EX	0.006	0.001	0.009	0.011	NA	0.018	NA	NA	0.005	NA	0.0084	NA	0.047	NA	µg/m^3
Observed 95th percentile of data	0.006	0.000	0.023	0.009	<0.019	0.010	<0.062	<0.010	0.004	<0.011	0.0118	<0.007	0.011	<0.020	µg/m^3
95% upper tolerance limit of the 95th percentile	0.010	0.023	0.034	0.040	NA	0.02	NA	0.008	0.007	NA	NA	NA	0.0189	NA	µg/m^3
Largest value	0.010	0.062	0.056	0.071	0.052	1.530	0.009	0.016	0.019	<0.014	0.047	<0.007	79.330	0.024	µg/m^3
Percent exceeding 0.2 µg/m^3 (F)	0	0	0	0	0	0.4	0	0	0	0	0	0	0.7	0	%
Lower confidence limit for F	0	0	0	0	0	0.1	0	0	0	0	0	0	0.6	0	%
Upper confidence limit for F	2.4	0.4	2.2	2.4	6.7	1.0	8.7	2.7	0.6	6.2	11.3	14.6	0.9	6.2	%

See list of site abbreviations in table, "Sites and Organizations Submitting Data to BAWR."

American Recovery Act funding for beryllium decontamination and decommissioning work at the Y-12 National Security Complex led to extensive exposure monitoring in 2010.

Figure 12. Percent of Exposure Monitoring Results Exceeding the Action Level for 2010 by Site



See list of site abbreviations in table, "Sites and Organizations Submitting Data to BAWR."

Only LLNL and Y-12 reported results above the action level in 2010. The upper confidence limit is above 5 percent at sites that reported fewer than 59 sampling results in 2010.

Table 15. List of 2010 Exposure Monitoring Results Above the 0.2 µg/m^3 Action Level

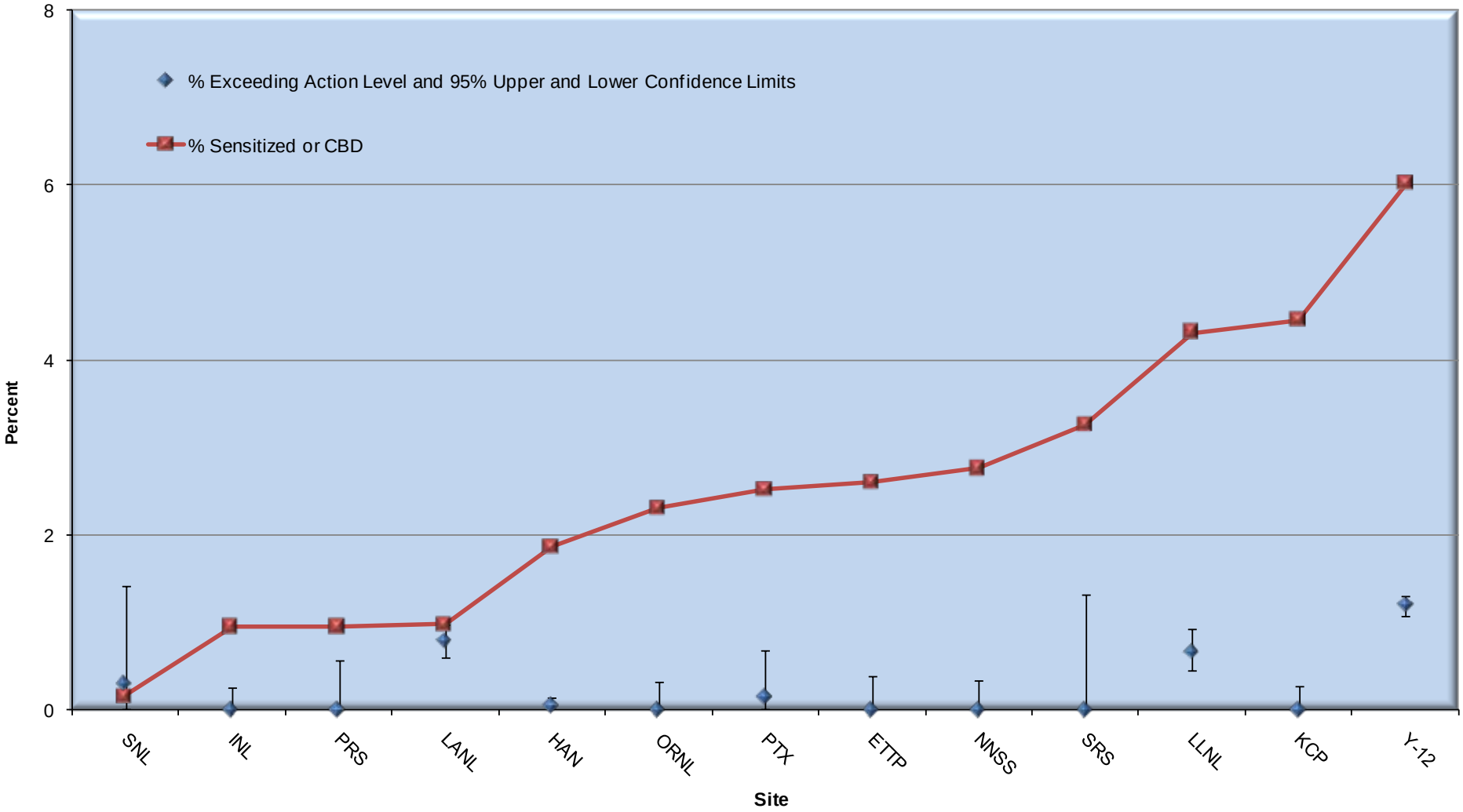
Site	Process Description	Job Title	8-Hour Time Weighted Average, µg/m^3	Respirator Assigned Protection Factor
Y-12	SUPPORT	Laborer	0.21	50
Y-12	SUPPORT	Laborer	0.21	100
LLNL		Laborer	0.22	1000
Y-12	SUPPORT	Laborer	0.23	100
Y-12	SUPPORT	Other Crafts	0.23	100
Y-12	SUPPORT	Millwrights	0.23	100
Y-12	PRODUCTION	Machinists	0.24	50
Y-12	SUPPORT	Laborer	0.24	50
Y-12	SUPPORT	Laborer	0.24	100
Y-12	SUPPORT	Other Crafts	0.25	100
Y-12	SUPPORT	Laborer	0.25	100
Y-12	SUPPORT	Laborer	0.25	100
Y-12	SUPPORT	Laborer	0.25	100
Y-12	SUPPORT	Other Crafts	0.25	100
Y-12	SUPPORT	Laborer	0.26	100
Y-12	SUPPORT	Millwrights	0.27	100
Y-12	SUPPORT	Laborer	0.27	50
Y-12	SUPPORT	Other Crafts	0.28	100
Y-12	PRODUCTION	Machinists	0.28	50
Y-12	SUPPORT	Laborer	0.29	50
Y-12	SUPPORT	Plumbers and Pipefitters	0.30	100
Y-12	SUPPORT	Other Crafts	0.31	100
Y-12	SUPPORT	Laborer	0.32	50
Y-12	SUPPORT	Other Crafts	0.32	100
Y-12	SUPPORT	Machinists	0.32	100
Y-12	SUPPORT	Laborer	0.35	100
Y-12	SUPPORT	Plumbers and Pipefitters	0.35	100
Y-12	SUPPORT	Electricians	0.36	100
Y-12	SUPPORT	Laborer	0.36	100
Y-12	PRODUCTION	Machinists	0.37	50
Y-12	PRODUCTION	Machinists	0.38	100
Y-12	SUPPORT	Laborer	0.39	100
Y-12	SUPPORT	Laborer	0.41	100
Y-12	SUPPORT	Laborer	0.41	50
Y-12	PRODUCTION	Machinists	0.42	100
Y-12	SUPPORT	Painters	0.42	100

Site ID	Process Description	Job Title	8-Hour Time Weighted Average, µg/m^3	Respirator Assigned Protection Factor
Y-12	SUPPORT	Millwrights	0.46	100
Y-12	PRODUCTION	Machinists	0.47	50
Y-12	SUPPORT	Painters	0.47	100
Y-12	SUPPORT	Laborer	0.50	100
Y-12	SUPPORT	Laborer	0.55	100
LLNL		Technologist Chem/Material	0.55	1000
Y-12	SUPPORT	Laborer	0.60	100
Y-12	SUPPORT	Laborer	0.72	100
Y-12	PRODUCTION	Machinists	0.74	100
Y-12	SUPPORT	Plumbers and Pipefitters	0.76	100
Y-12	SUPPORT	Chemical System Operators	0.76	50
Y-12	SUPPORT	Other Crafts	0.90	100
Y-12	SUPPORT	Laborer	0.95	50
Y-12	SUPPORT	Laborer	0.95	100
Y-12	SUPPORT	First Line Supervisors	1.03	100
Y-12	SUPPORT	Millwrights	1.09	50
Y-12	SUPPORT	Other Crafts	1.12	100
Y-12	SUPPORT	Laborer	1.17	100
Y-12	PRODUCTION	Machinists	1.26	100
Y-12	SUPPORT	Laborer	1.32	50
Y-12	SUPPORT	Other Crafts	1.39	100
LLNL		Fabrication Assistant	1.53	50
Y-12	SUPPORT	Painters	1.55	100
Y-12	PRODUCTION	Machinists	1.82	100
Y-12	SUPPORT	Chemical System Operators	2.00	100
Y-12	SUPPORT	Laborer	2.16	50
Y-12	SUPPORT	Laborer	2.18	50
Y-12	SUPPORT	Other Professional Administrative	2.22	100
Y-12	SUPPORT	Millwrights	2.42	100
Y-12	SUPPORT	Laborer	3.83	50
Y-12	SUPPORT	Laborer	5.36	50
Y-12	SUPPORT	Laborer	5.70	50
Y-12	SUPPORT	Millwrights	7.04	100
Y-12	PRODUCTION	Machinists	51.89	50
Y-12	SUPPORT	Laborer	79.33	100

See list of site abbreviations in table, "Sites and Organizations Submitting Data to BAWR."

Exceedances in 2010 were primarily associated with decontamination and decommissioning work. With 2 exceptions, work planning processes had identified the potential beryllium exposures and workers were wearing appropriate respiratory protection.

Figure 13. Cumulative Beryllium Sensitization and CBD Rates versus Exposure Levels 2002 – 2010



See list of site abbreviations in table, "Sites and Organizations Submitting Data to BAWR."

Medical monitoring results for beryllium sensitization and CBD and beryllium exposure monitoring results are weakly correlated (Pearson product moment correlation coefficient = 0.43). A likely explanation for this is that the sensitization and 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 and CBD rates can investigate cases to determine if the possibility of ongoing exposure can be ruled out.