Beryllium-Associated Worker Registry Summary

Through 2011

HSS
Office of Health, Safety and Security

Table of Contents

Beryllium-Associated Worker Registry Summary

Data Cumulative Through 2011

The U.S. Department of Energy (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 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—Specific Program Requirements, Section 850.39, requires that responsible employers must transmit all records generated as required by this rule, in a format that protects confidentiality of individuals, to the DOE Assistant Secretary for Environment, Safety and Health (now the DOE Assistant Secretary for Health, Safety and Security). To facilitate management of these data, a BAWR Data Center has been established at the Oak Ridge Institute for Science and Education, operated by 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, a 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.

HSS 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 2011 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 2011 data submitted or corrected by the end of October 2012. Health data were collected through the operation of current worker medical surveillance programs for all 28 sites and subcontractors submitting data. On page 14, the table showing *Number of Employees Exposure Monitored by Site and Year* reveals that there were no usable sampling data or no data submission at all for 5 sites. Exposure sampling data submitted by the 25 sites and subcontractors for 2002 through 2011 were analyzed in this summary.

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 a person 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 an individual must have 2 abnormal blood tests, 1 abnormal and 2 borderline blood tests, an 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; beryllium sensitized 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 but are not required to participate.

Individuals who have separated from employment at a DOE site are offered screening for CBD through programs operated by contract medical providers and cooperative agreement holders. The screening is performed at private clinics near the individual's current residence. These individuals are categorized as "former workers" and the results from these former worker programs are summarized in separate reports. For more information see http://www.hss.energy.gov/HealthSafety/FWSP/formerworkermed/.

The BAWR Summary Report for 2011 includes 2,480 more workers than the 2010 report and reflects 10,964 additional BeLPT test results. The tables and figures included in the report provide brief comments to direct the reader to noteworthy observations. Overall, the data suggest that the prevention programs implemented by DOE sites have been fairly consistent in providing a high level of compliance with the 10 CFR 850 action level of 0.2 $\mu g/m^3$ since 2004. In 2011, we noted 27 additional beryllium sensitizations and 6 additional CBD diagnoses. Among craft workers, HVAC mechanics show percentages reflecting beryllium exposures exceeding the 0.2 $\mu g/m^3$ action level when compared to the percentages of other craft workers. The exceedances observed in 2011 were primarily associated with craft and laborer groups at Y-12, although it should be noted that appropriate respiratory protection was in use. In the aggregate, the BAWR data suggest sites should do more monitoring of beryllium exposures, indicated by the broad width of the 95 percent confidence limits.

The data at hand provide a basic evaluation of worker protection in beryllium work, both historical and current. Analyses in this report may indicate areas of substantial success and provide information that could be of use in identifying areas in which further work may be of benefit in the prevention of CBD.

28 Sites and Subcontractors Currently Submitting Data to BAWR

Advanced Mixed Waste Treatment Project (AMWTP)	LLNL Boston University (LLNL BU)
Ames Laboratory (AMES)	LLNL Clean Harbors Environmental Services (LLNL CHES)
Argonne National Laboratory (ANL)	LLNL Envirocon, Inc. (LLNL ENVC)
Brookhaven National Laboratory (BNL)	Los Alamos National Laboratory (LANL)
DOE Oak Ridge Office (DOE-ORO)	Nevada National Security Site (NNSS)
East Tennessee Technology Park (ETTP)	Oak Ridge National Laboratory (ORNL)
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)	Wackenhut Security Services Inc. for ETTP, ORNL, and Y-12 (WSI)
LATA Environmental Services of Kentucky, LLC (PAD LATAKY)	Y-12 National Security Complex (Y-12)
Lawrence Berkeley National Laboratory (LBNL)	Y-12 Navarro Research and Engineering (Y-12 NRE)
Lawrence Livermore National Laboratory (LLNL)	Y-12 URS Corporation (Y-12 URS)

2 Inactive BAWR Sites

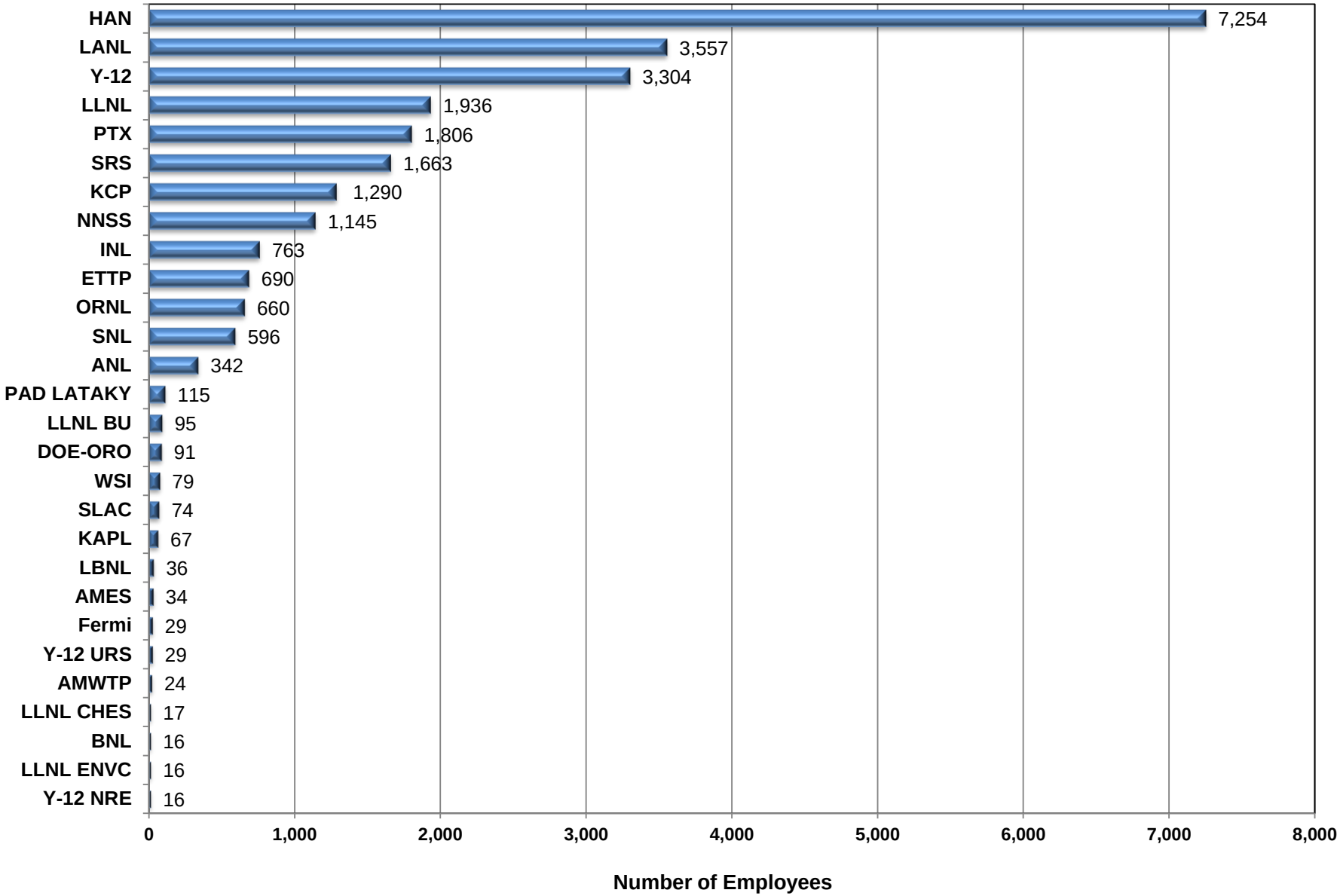
Rocky Flats Closure Project (RF)	Southwestern Power Administration (SWPA)

Most Recent Submission Dates to BAWR by Site

Site	Roster	BeLPT	Work History	Activities and Exposures
AMES	02/22/2012	02/22/2012	02/22/2012	02/22/2012
AMWTP	08/25/2011	01/25/2012	08/25/2011	01/25/2012
ANL	07/31/2012	07/31/2012	02/02/2009	02/02/2009
BNL	02/24/2011	12/09/2011	03/09/2011	03/20/2003
DOE-ORO	07/05/2012	07/05/2012	Not Reported	Not Reported
ETTP	08/03/2012	03/13/2012	03/13/2012	03/13/2012
Fermi	07/31/2012	01/30/2012	01/17/2007	07/31/2007
HAN	07/26/2012	07/26/2012	07/26/2012	07/26/2012
INL	07/31/2012	01/31/2012	07/31/2012	07/31/2012
KAPL	01/20/2012	01/20/2012	01/25/2011	01/20/2012
KCP	07/30/2012	01/26/2012	07/30/2012	01/26/2012
LANL	07/30/2012	01/23/2012	07/30/2012	07/30/2012
LBNL	07/26/2012	01/27/2012	08/16/2012	07/27/2012
LLNL	07/30/2012	07/30/2012	07/30/2012	04/16/2012
LLNL BU	05/03/2010	05/03/2010	05/03/2010	05/03/2010
LLNL CHES	06/18/2012	06/18/2012	06/18/2012	06/18/2012
LLNL ENVC	03/01/2012	01/31/2012	03/01/2012	01/31/2012
NNSS	08/22/2012	08/22/2012	08/06/2012	03/05/2012
ORNL	07/23/2012	01/31/2012	07/23/2012	01/31/2012
PAD LATAKY	06/28/2012	01/05/2012	06/28/2012	01/05/2012
PTX	07/27/2012	01/31/2012	09/12/2012	07/27/2012
SLAC	07/31/2012	07/31/2012	Not Reported	07/31/2012
SNL	07/31/2012	01/30/2012	01/30/2012	01/30/2012
SRS	07/31/2012	01/31/2012	07/31/2012	01/31/2012
WSI	02/24/2012	02/24/2012	Not Reported	Not Reported
Y-12	07/11/2012	07/11/2012	07/11/2012	03/01/2012
Y-12 NRE	05/05/2010	08/22/2012	05/05/2010	08/22/2012
Y-12 URS	07/06/2011	02/28/2012	07/06/2011	Not Reported

Total 25,744 Employees Reported to BAWR by Site

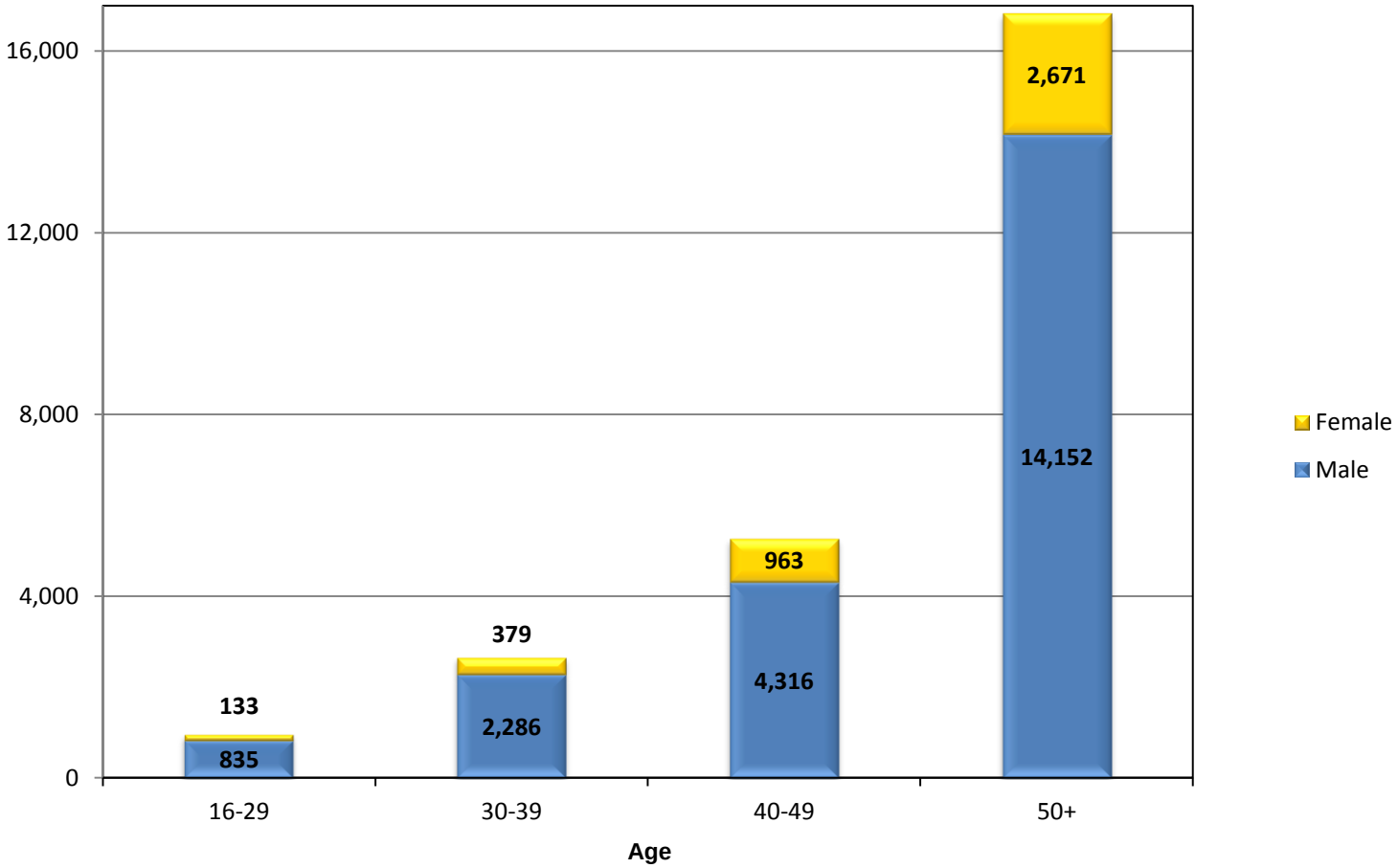
Data Cumulative Through 2011*



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

Gender and Age Distribution of Employees Reported to BAWR

Data Cumulative Through 2011*



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

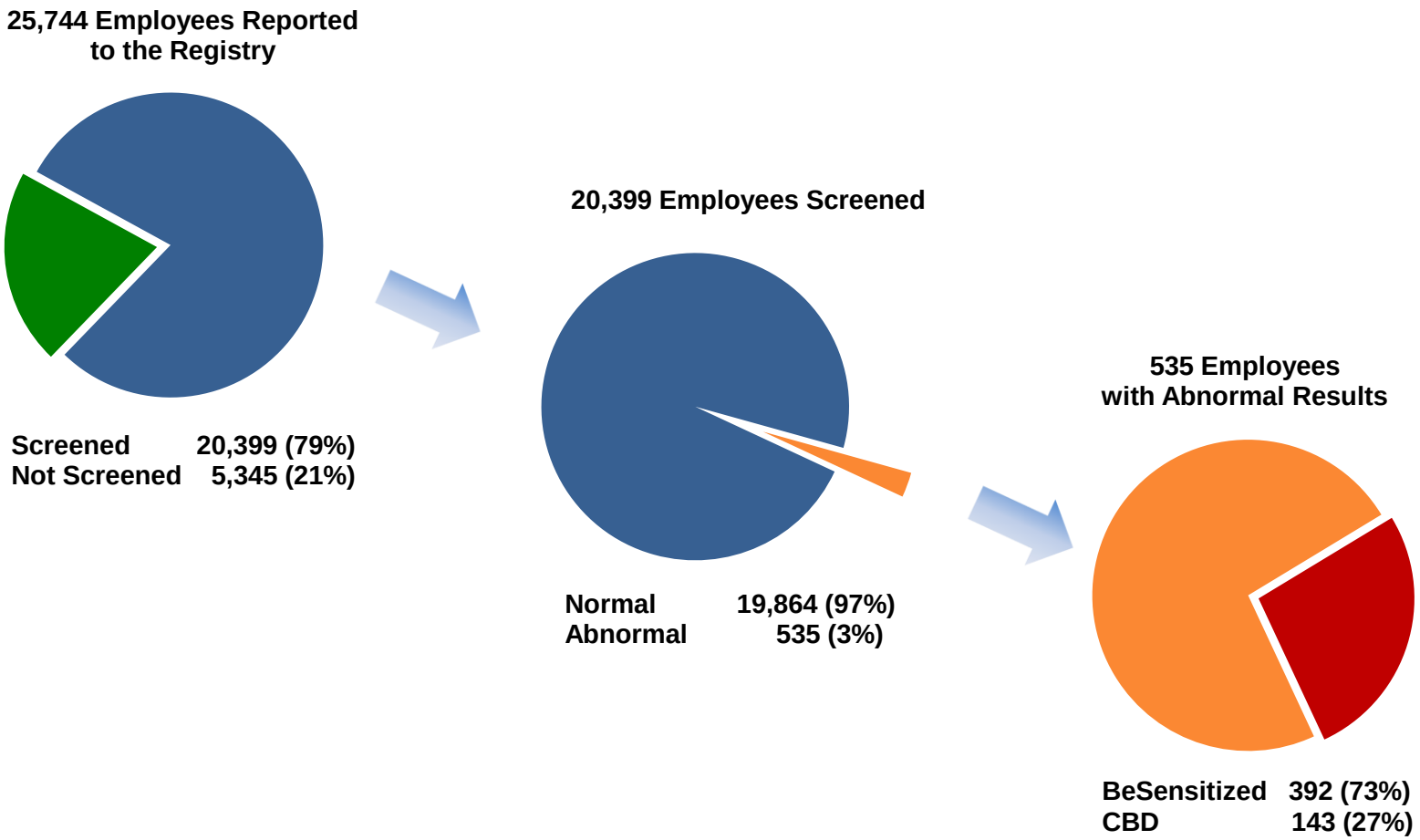
*Age and Gender by Site of 25,744 Employees Reported to BAWR Through 2011**

Site	16-29		30-39		40-49		50+		Not Reported
	M	F	M	F	M	F	M	F	
AMES	0	0	3	0	5	1	19	6	0
AMWTP	0	0	2	0	6	1	14	1	0
ANL	2	0	9	2	56	9	225	39	0
BNL	0	0	0	0	3	1	12	0	0
DOE-ORO	0	0	4	2	6	4	65	10	0
ETTP	24	5	63	10	112	19	413	44	0
Fermi	0	0	1	0	3	0	21	3	1
HAN	430	82	796	116	1,332	296	3,583	619	0
INL	37	7	118	16	189	41	310	45	0
KAPL	2	1	11	0	27	1	22	3	0
KCP	10	0	29	8	64	23	856	300	0
LANL	90	14	342	63	653	156	1,939	300	0
LBNL	0	1	0	0	7	1	25	2	0
LLNL	38	2	208	32	390	54	1,072	140	0
LLNL BU	1	0	10	1	22	1	46	11	3
LLNL CHES	8	0	1	1	2	0	4	1	0
LLNL ENVC	5	0	2	0	7	0	2	0	0
NNSS	16	4	89	33	141	56	556	250	0
ORNL	17	1	59	6	124	19	375	59	0
PAD LATAKY	6	3	16	5	34	6	42	3	0
PTX	18	4	123	28	298	79	1,011	245	0
SLAC	2	0	2	0	9	0	60	1	0
SNL	4	0	51	7	105	8	366	50	5
SRS	29	4	87	17	308	78	919	221	0
WSI	0	0	3	0	10	3	60	3	0
Y-12	96	5	240	32	389	105	2,123	314	0
Y-12 NRE	0	0	8	0	5	1	1	1	0
Y-12 URS	0	0	9	0	9	0	11	0	0
Totals	**835**	**133**	**2,286**	**379**	**4,316**	**963**	**14,152**	**2,671**	**9**

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

Progression from BeLPT Testing to "Sensitized" to CBD

Data Cumulative Through 2011*

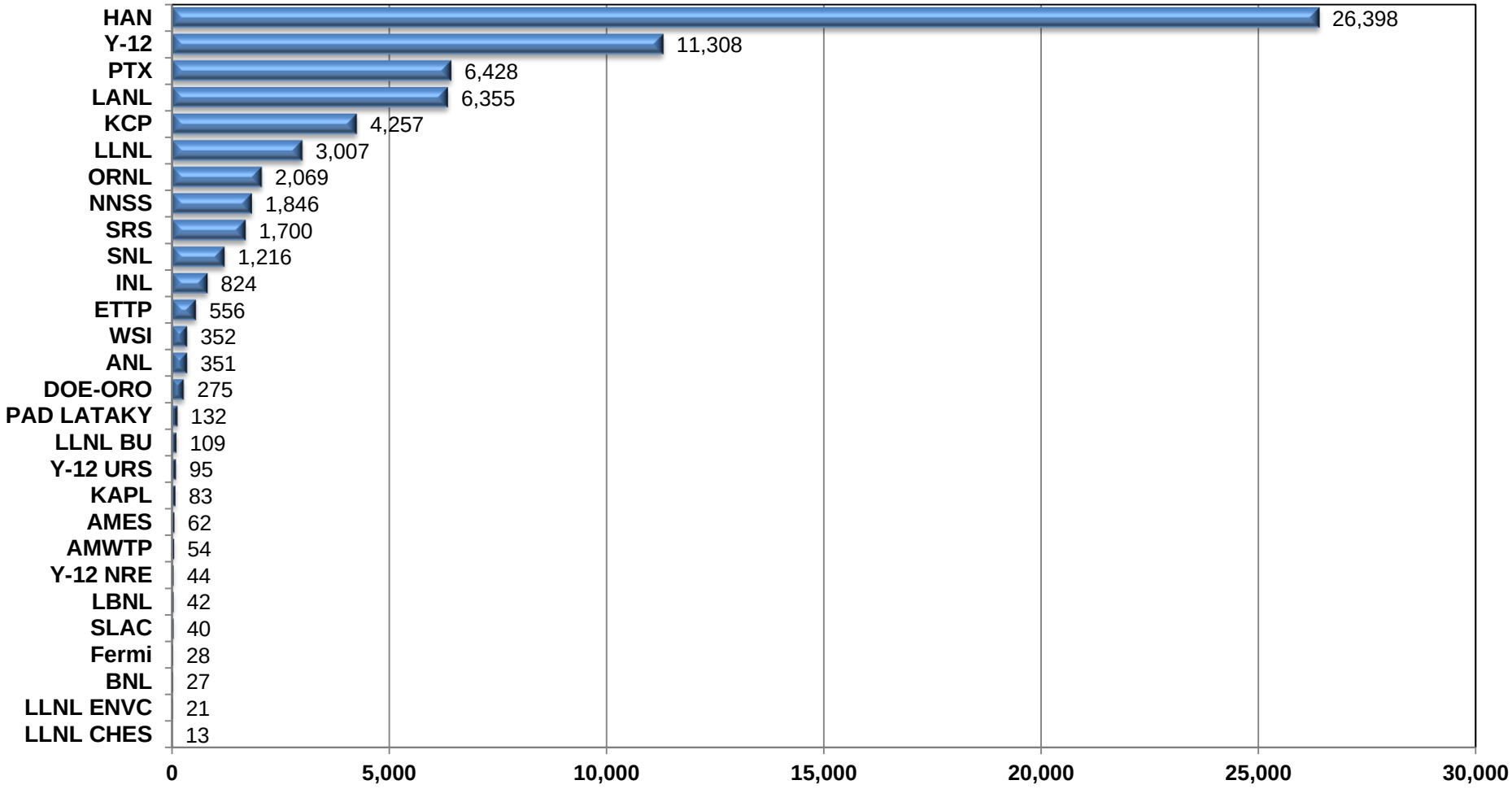


*Some sites provided data that predates the 2002 start date of the Registry.

From 2010 to 2011, sites reporting to the Registry identified 27 additional sensitized employees and 6 additional employees with CBD.

Total 67,692 BeLPT Results Reported to BAWR by Site

Data Cumulative Through 2011*



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

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

Data Cumulative Through 2011*

Site	Employees with BeLPT Results	"Sensitized" Employees	CBD Employees
HAN	7,008	83 (1.2 %)	34 (0.5 %)
Y-12	2,617	113 (4.3 %)	59 (2.3 %)
LANL	2,336	21 (0.9 %)	3 (0.1 %)
PTX	1,702	27 (1.6 %)	15 (0.9 %)
LLNL	1,251	38 (3.0 %)	3 (0.2 %)
KCP	1,195	39 (3.3 %)	14 (1.2 %)
NNSS	988	21 (2.1 %)	4 (0.4 %)
SRS	677	15 (2.2 %)	6 (0.9 %)
SNL	592	1 (0.2 %)	0
ORNL	575	12 (2.1 %)	0
ETTP	395	6 (1.5 %)	4 (1.0 %)
INL	327	3 (0.9 %)	0
ANL	139	3 (2.2 %)	0
LLNL BU	94	3 (3.2 %)	0
DOE-ORO	91	1 (1.1 %)	0
PAD LATAKY	91	1 (1.1 %)	0
WSI	74	1 (1.4 %)	0
AMES	34	2 (5.9 %)	0
SLAC	32	0	1 (3.1 %)
KAPL	29	0	0
Y-12 URS	28	0	0
LBNL	24	1 (4.2 %)	0
AMWTP	21	0	0
Fermi	19	0	0
LLNL ENVC	16	0	0
Y-12 NRE	16	0	0
BNL	15	1 (6.7 %)	0
LLNL CHES	13	0	0
Total	**20,399**	**392 (1.9 %)**	**143 (0.7 %)**

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

Number of Years Since Year of Hire for Employees that Are "Sensitized" or CBD

Number of Years Since Year of Hire	Employees in Roster	Employees with BeLPT Results	"Sensitized" Employees	CBD Employees
0-4	1,658	1,114	5	1
5-9	2,955	2,049	39	4
10-14	2,353	1,722	33	5
15-19	1,546	1,170	25	1
20-24	2,339	1,558	38	10
25-29	2,135	1,589	32	14
>=30	5,436	4,118	137	74
Not Reported	7,322	7,079	83	34
Totals	**25,744**	**20,399**	**392**	**143**

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

Year of BeLPT Result	Employees Tested	"Sensitized" Employees	CBD Employees
<2000	708	35	10
2000	1,630	28	17
2001	3,238	43	17
2002	3,986	40	15
2003	3,967	13	5
2004	3,837	13	3
2005	5,138	27	6
2006	4,906	43	8
2007	4,601	40	5
2008	5,203	27	6
2009	6,186	36	2
2010	6,928	25	1
2011	7,957	10	0
Not Reported	0	12	48

Work History Activity for Employees that Are "Sensitized" or CBD

Data Cumulative Through 2011*

Work History Activity	Employees with BeLPT Results	"Sensitized" Employees	CBD Employees
Management	1,436	29	10
Administrative Support	965	32	10
In-House Professionals	1,322	30	13
Field Professionals	1,885	40	7
Technical Support	2,782	51	12
Service	1,305	30	11
Security and Fire	1,376	18	7
Crafts	3,540	74	34
Line Operators	2,365	65	23
Guests	49	0	0
Unknown	730	12	11
Not Reported	2,644	11	5
Totals	**20,399**	**392**	**143**

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

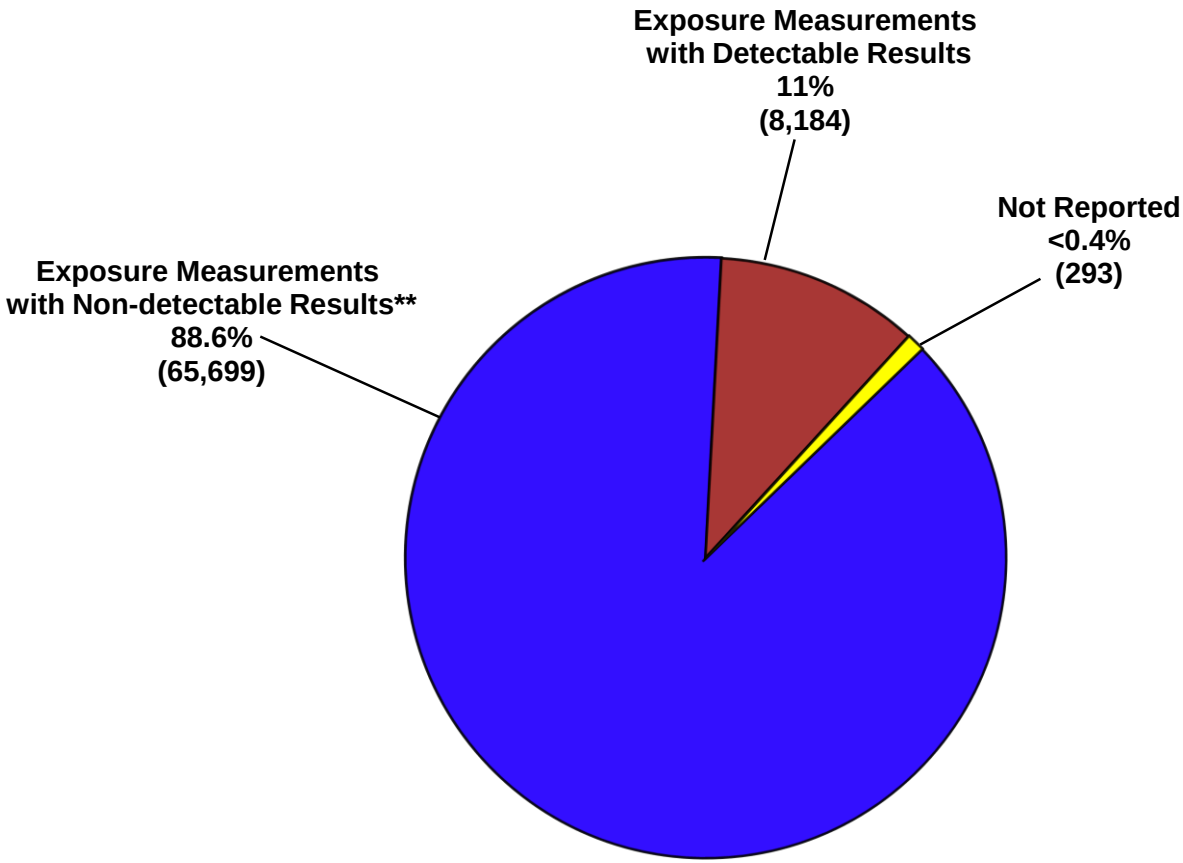
Number of Employees Exposure Monitored by Site and Year

Site	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
AMES								6	1	2
AMWTP			2	10	5	4	4	4	2	2
ANL	14				8	3	1			
BNL										
DOE-ORO										
ETTP	32	27	34	79	64	38		19	42	30
Fermi		2	2	2	1					
HAN	8	7	96	70	149	103	163	135	297	354
INL	3	4	3	53	76	81	49	57	44	39
KAPL	2	2		1		5	5	5	5	4
KCP	14	20	11	13	24	24	18	15	18	17
LANL	88	67	69	123	101	60	34	55	32	28
LBNL			1	1			1			2
LLNL	17	34	25	51	36	74	77	100	81	63
LLNL BU										
LLNL CHES										1
LLNL ENVC									10	13
NNSS	66	45	33	26	26	14	43	18	18	19
ORNL	22	21	50	38	59	53	46	47	44	39
PAD LATAKY								9	47	3
PTX	58	30	17	26	38	50	38	35	30	42
SLAC	1	5	6	3	2	1	8			1
SNL	7	5	38	21	17	7		5	16	19
SRS	22	13	34	35	6	18	34	28	19	2
WSI										
Y-12	124	129	85	101	160	223	215	304	426	354
Y-12 NRE						3	4	10	8	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. Twenty-one sites provided exposure monitoring results with monitoring dates in 2011. Site-specific totals for a given year may change from totals in previous annual reports due to late reporting and/or corrections.

Total 74,176 Reported Exposure Levels

Data Cumulative Through 2011*

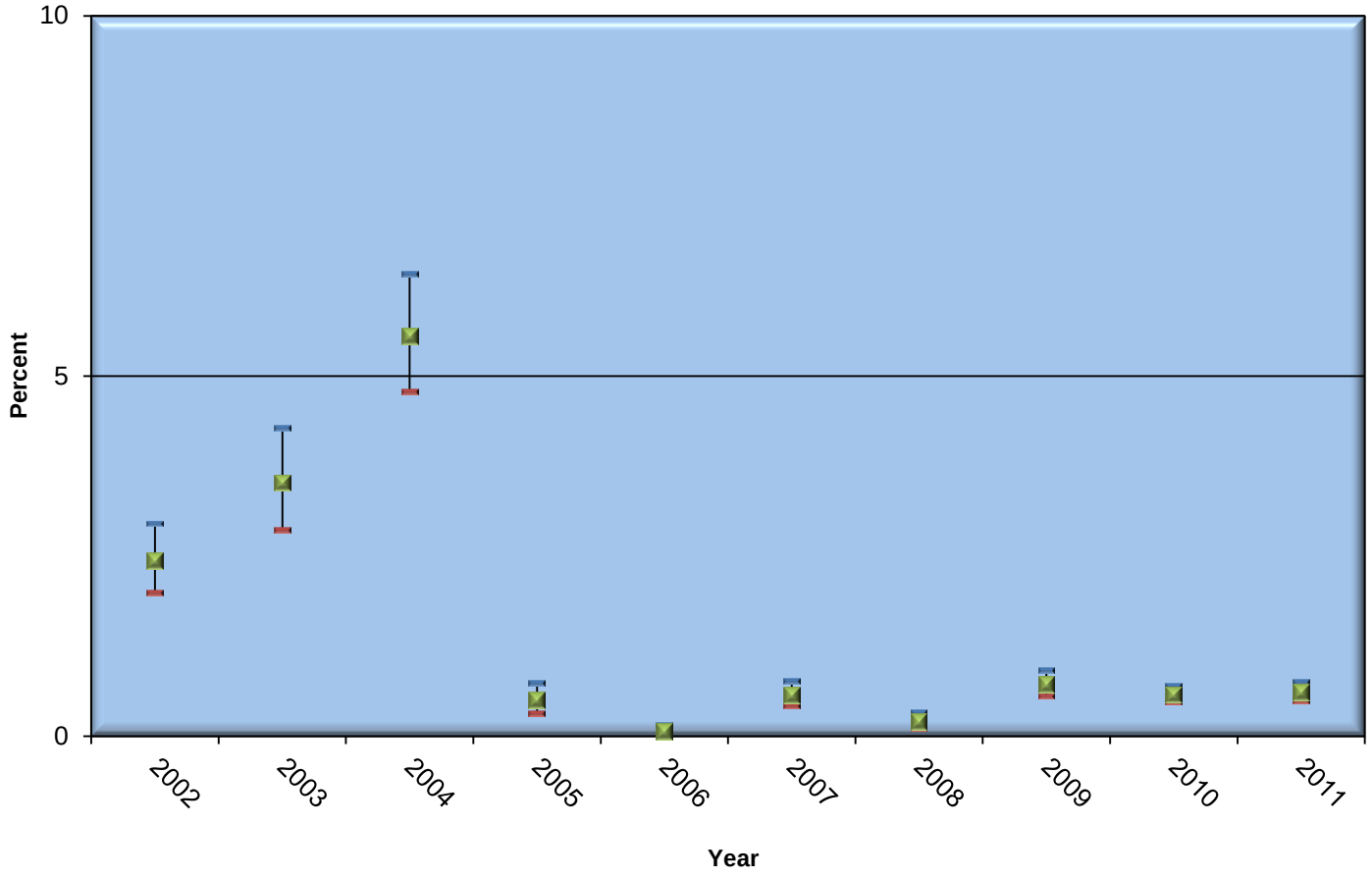


*Some sites provided data that predates the 2002 start date of the Registry.
**Non-detectable indicates that analysis results were reported as less than the laboratory's reporting limit.

Of the 74,176 exposure monitoring records submitted to the Registry, over 88 percent have “non-detectable” results, indicating 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 2002 – 2011

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



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

Summary Statistics for 2002 – 2011 8-Hour Time Weighted Average Exposure Monitoring Results

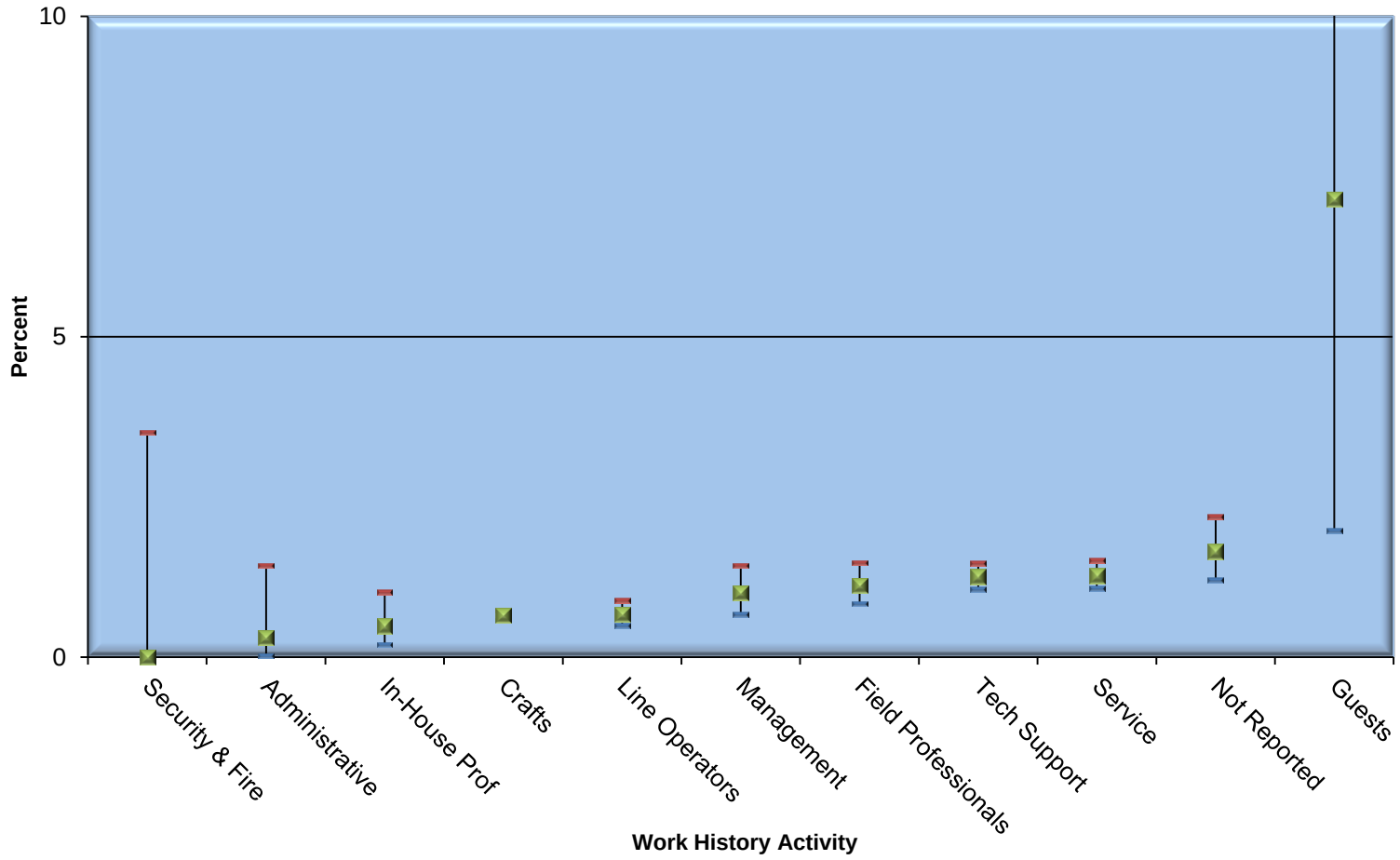
Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	All Years
Number of reported monitoring results	2,998	1,988	2,251	3,430	6,080	5,767	5,091	6,376	13,571	10,798	58,350
Number of detected values	1,180	405	558	132	232	318	148	244	623	485	4,325
Percent non-detects	60.6	79.6	75.2	96.2	96.2	94.5	97.1	96.2	95.4	95.5	92.6
Number of individuals monitored	465	402	498	618	760	759	728	851	1,138	1,037	4,048*
Arithmetic mean (EX) ($\mu g/m^3$)	0.036	0.028	0.058	0.008	0.002	0.010	0.003	0.008	0.018	0.013	0.014
Lower confidence limit of EX ($\mu g/m^3$)	0.028	0.024	0.046	0.004	0	0.006	0	0.005	0.006	0.008	0.011
Upper confidence limit of EX ($\mu g/m^3$)	0.044	0.033	0.070	0.011	0.002	0.014	0.003	0.012	0.030	0.017	0.017
Observed 95th percentile of data ($\mu g/m^3$)	0.096	0.133	0.228	0.009	0.007	0.011	0.000	0.001	0.008	0.006	0.018
95% upper tolerance limit of the 95th percentile ($\mu g/m^3$)	0.124	0.184	0.267	0.100	0.051	0.035	0.028	0.021	0.020	0.019	0.042
Largest value ($\mu g/m^3$)	7.423	3.041	8.420	5.133	0.310	12.513	1.774	11.762	79.330	18.023	79.330
Percent exceeding 0.2 $\mu g/m^3$ (F)	2.4	3.5	5.6	0.5	0.1	0.6	0.2	0.7	0.6	0.6	0.9
Lower confidence limit for F	2.0	2.9	4.8	0.3	0	0.4	0.1	0.6	0.5	0.5	0.8
Upper confidence limit for F	3.0	4.3	6.4	0.7	0.2	0.8	0.3	0.9	0.7	0.7	1.0

*Many individuals were monitored in more than 1 year. The total number of individuals measured at least once in the 10-year period from 2002 through 2011 is 4,048.

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.

Exposure by Work History Activity for 2002 – 2011 (Ranked by Percent Exceeding)

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

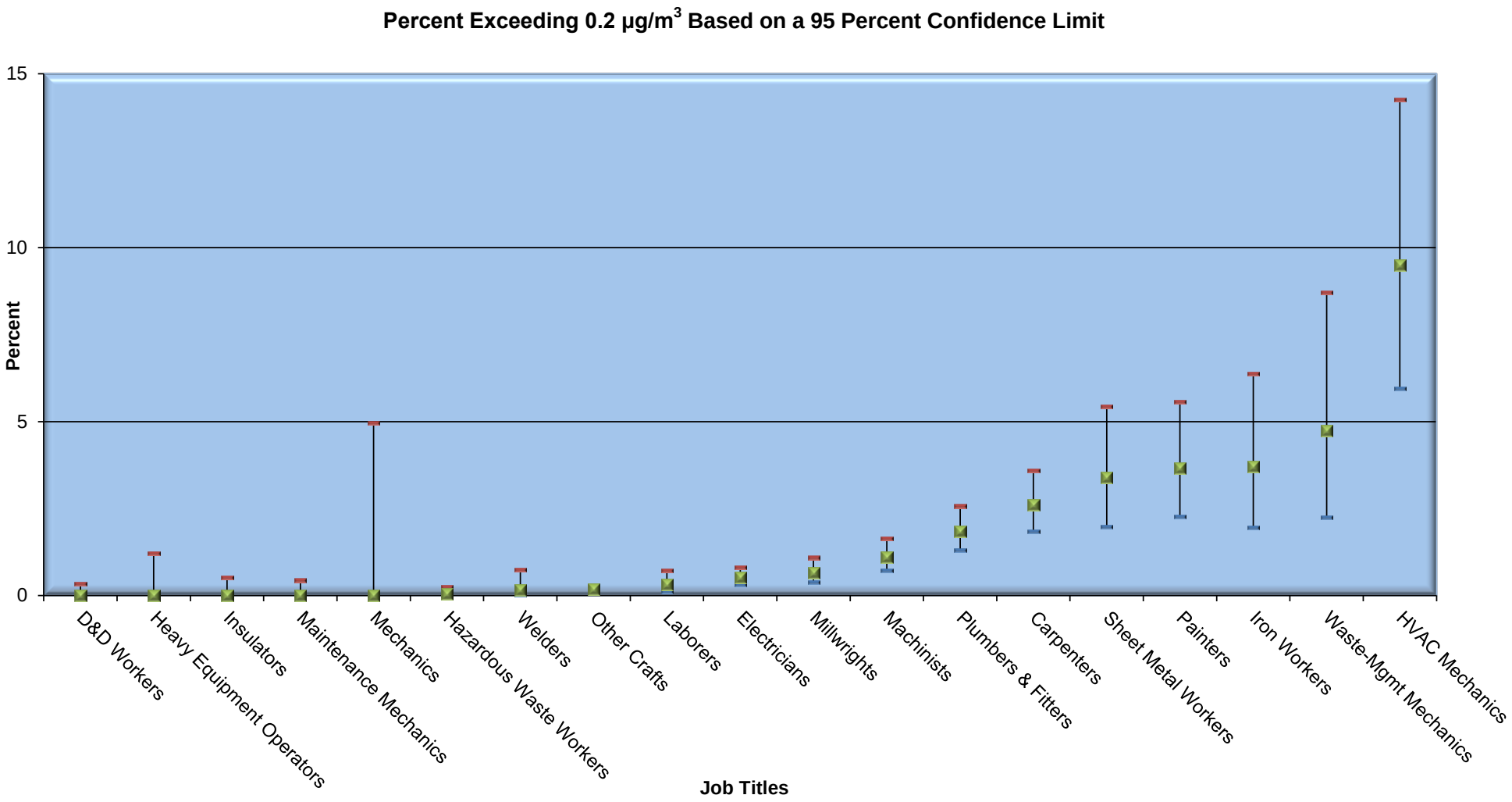


Shown above are exposure data grouped by work activity for years 2002 through 2011. Detailed data are presented on the following page. The work activities are the high level rollup of job functions used in table “Work History Activity for Employees that Are “Sensitized” or CBD.” Direct comparison with prior years’ reports may be problematic due to late reporting and/or corrections.

Summary Statistics for 2002 – 2011 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 & Fire	Service	Tech Support	Not Reported	All Combined
Number of reported monitoring results	330	27,674	3,307	42	1,031	5,260	2,110	84	7,862	8,639	2,011	58,350
Number of detected values	28	1126	454	27	54	357	194	1	681	864	539	4325
Percent non-detects	91.5	95.9	86.3	35.7	94.8	93.2	90.8	98.9	91.3	90	73.2	92.6
Number of individuals monitored	40	1,425	369	5	149	604	154	35	401	730	80	3,992
Observed 95th percentile of data (ug/m^3)	0	0.00669	0.05084	0.20621	0	0.01547	0.0189	0	0.02594	0.02472	0	0.018
95% upper tolerance limit of the 95th percentile (ug/m^3)	0.032	0.041	0.063	NA	0.026	0.042	0.031	0	0.043	0.05	0.099	0.042
Largest value (ug/m^3)	1.031	51.895	21.771	0.313	2.221	12.682	11.762	0.031	79.330	5.442	3.661	79.330
Percent exceeding 0.2 ug/m^3 (F)	0.3	0.6	1.1	7.1	0.5	0.7	1.0	0	1.3	1.3	1.6	0.9
Lower confidence limit for F	0.0	0.6	0.8	2.0	0.2	0.5	0.7	0	1.1	1.1	1.2	0.8
Upper confidence limit for F	1.4	0.7	1.5	17.4	1.0	0.9	1.4	3.5	1.5	1.5	2.2	1.0

Exposure by Job Title for Craft Workers for 2002 – 2011 (Ranked by Percent Exceeding)



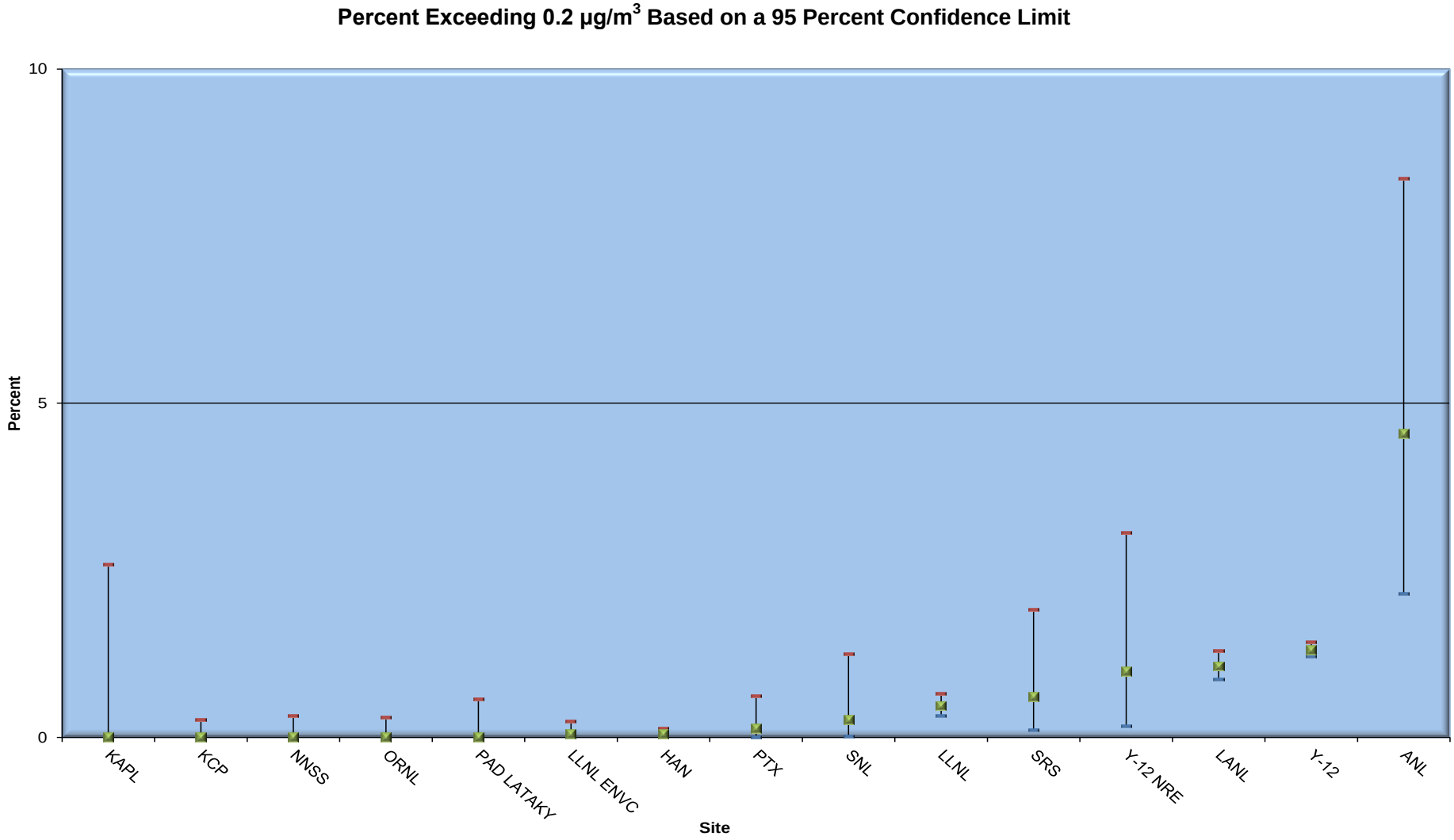
The figure above provides an indication of differences in exposure level for individuals with job titles that were grouped together in the Craft work activity category. Detailed data are presented on the following page. Machinists, Plumbers & Fitters, Sheet Metal Workers, Carpenters, Painters, Iron Workers, HVAC Mechanics, and Waste-Management Mechanics have exceedance rates significantly higher than all Crafts combined (0.6 µg/m^3, as shown in the table on page 21). Direct comparison with prior years' reports may be problematic due to late reporting and/or corrections.

Summary Statistics for 2002 – 2011 8-Hour Time Weighted Average Exposure Monitoring Results for Craft Job Titles (Ranked by Percent Exceeding)

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 confidenc limit for F
D&D Workers	913	40	95.6	99	0	0.037	0.095	0.0	0	0.3
Heavy Equipment Operators	247	7	97.2	53	0	0.052	0.140	0.0	0.0	1.2
Insulators	585	12	97.9	24	0	0.021	0.200	0.0	0.0	0.5
Maintenance Mechanics	693	11	98.4	64	0	0.053	0.200	0.0	0.0	0.4
Mechanics	59	9	84.7	24	0	0.091	0.091	0.0	0.0	5.0
Hazardous Waste Workers	1,966	22	98.9	24	0.003	0.009	0.432	0.1	0.0	0.2
Welders	637	25	96.1	27	0.000	0.030	0.356	0.2	0.0	0.7
Other Crafts	11,588	169	98.5	182	0	0.100	1.803	0.2	0.1	0.3
Laborers	1,284	30	97.7	208	0	0.041	0.653	0.3	0.1	0.7
Electricians	2,727	198	92.7	221	0.016	0.034	1.999	0.5	0.3	0.8
Millwrights	1,676	120	92.8	123	0	0.023	7.038	0.7	0.4	1.1
Machinists	1,629	87	94.7	41	0.012	0.020	51.895	1.1	0.7	1.6
Plumbers & Fitters	1,356	98	92.8	113	0.017	0.033	5.735	1.8	1.3	2.6
Carpenters	1,000	91	90.9	93	0.042	0.066	3.176	2.6	1.8	3.6
Sheet Metal Workers	354	35	90.1	30	0.049	0.301	4.872	3.4	2.0	5.4
Painters	411	63	84.7	39	0	0.215	7.423	3.6	2.3	5.6
Iron Workers	243	21	91.4	29	0.021	0.263	1.006	3.7	1.9	6.4
Waste-Mgmt Mechanics	148	17	88.5	16	0.092	1.290	2.390	4.7	2.2	8.7
HVAC Mechanics	158	71	55.1	15	0.340	0.844	6.329	9.5	5.9	14.2
All Combined	27,674	1,126	95.9	1,425	0.007	0.041	51.895	0.6	0.6	0.7

This table provides additional summary statistics for Craft job titles.

Percent of Exposure Monitoring Results Exceeding the Action Level by Site for 2002 – 2011 (Ranked by Percent Exceeding)



This figure summarizes 8-hour time weighted average exposure monitoring results by site. Detailed data are presented on the following page. Exceedance rates at ANL, LANL, and Y-12 were significantly higher than those for all sites combined.

Results from AMES, AMWTP, ETTP, Fermi, INL, LBNL, and LLNL CHES 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.

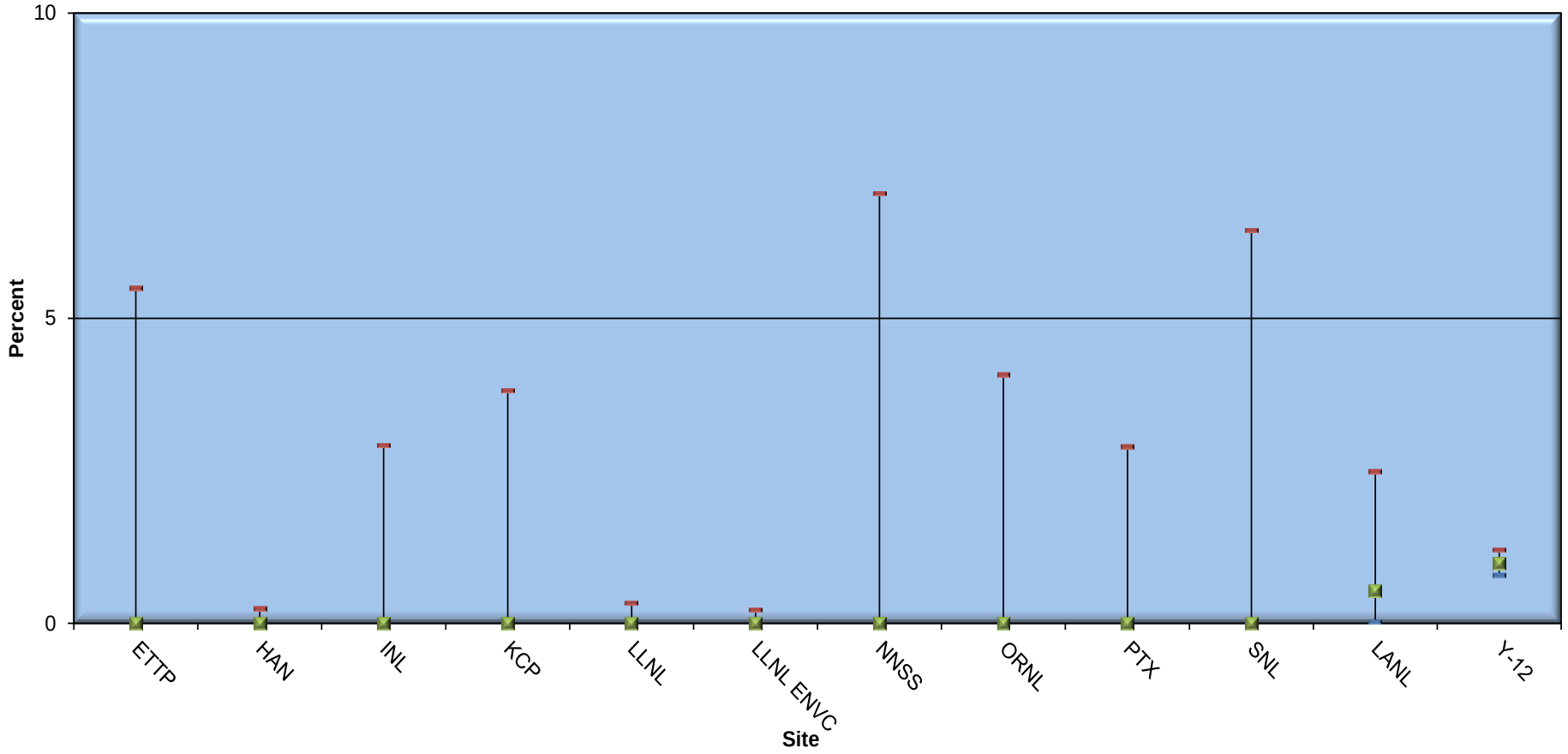
Summary Statistics for 2002 – 2011 8-Hour Time Weighted Average Exposure Monitoring Results by Site

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	0.000	0.028	0	0	6.2
AMWTP	53	2	96.2	13	0.00189	NA	0.036	0	0	5.5
ANL	154	17	89	22	0.0861	1.100	2.390	4.5	2.2	8.4
ETTP	839	27	96.8	254	0.00691	0.061	0.200	0	0	0.4
Fermi	12	4	66.7	4	0.274	NA	0.370	16.7	3.0	43.8
HAN	5,704	194	96.6	926	0.0036	0.026	12.513	0.1	0	0.1
INL	1,247	61	95.1	208	0.01421	0.041	0.200	0	0	0.2
KAPL	114	0	100	16	0	0.000	0.200	0	0	2.6
KCP	1,148	14	98.8	87	0.00176	0.152	0.196	0	0	0.3
LANL	7,031	996	85.8	346	0.019	0.032	11.762	1.1	0.9	1.3
LBNL	9	0	100	5	NA	NA	0.100	0	0	28.3
LLNL	5,290	186	96.5	247	0.01235	0.030	5.133	0.5	0	0.7
LLNL CHES	3	0	100	1	NA	NA	0.042	0	0	63.2
LLNL ENVC	1,923	17	99.1	15	0.00307	0.009	0.432	0	0	0.2
NNSS	931	35	96.2	240	0.00234	0.052	0.158	0	0	0.3
ORNL	1,003	4	99.6	212	0.002	0.011	0.157	0	0	0.3
PAD LATAKY	525	4	99.2	52	0.00441	0.007	0.019	0	0	0.6
PTX	760	24	96.8	217	0.00062	0.024	0.517	0.1	0	0.6
SNL	379	125	67	91	0.0282	0.061	2.800	0.3	0	1.2
SRS	327	16	95.1	182	0.01397	0.075	0.320	0.6	0.1	1.9
Y-12	30,648	2,539	91.7	890	0.02858	0.032	79.330	1.3	1.2	1.4
Y-12 NRE	203	13	93.6	14	0.0187	0.073	1.111	1.0	0.2	3.1
All Combined	58,350	4,278	92.7	4,048*	0.01799	0.042	79.330	0.9	0.8	1.0

*Many individuals were monitored in more than 1 year. The total number of individuals measured at least once in the 10-year period from 2002 through 2011 is 4,048.

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 2011 (Ranked by Percent Exceeding)



Y-12 reported the majority of results above the action level in 2011. Detailed data are presented on the following page. The upper confidence limit is above 5 percent at sites that reported fewer than 53 sampling results in 2011.

Results from AMES, AMWTP, KAPL, LLNL CHES, PAD LATAKY, SRS, and Y-12 NRE 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 2011

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	4	0	100	2	NA	NA	0.012	0	0	63.2
AMWTP	3	0	100	2	NA	NA	0.009	0	0	52.7
ETTP	53	7	86.8	30	0.010	NA	0.017	0	0	5.5
HAN	1,231	34	97.2	354	0.003	0.019	0.140	0	0	0.2
INL	101	2	98	39	0.009	0	0.024	0	0	2.9
KAPL	8	0	99.2	4	NA	NA	0.008	0	0	31.2
KCP	77	0	100	17	NA	NA	0.030	0	0	3.8
LANL	189	10	94.7	28	0.010	0.038	0.746	1	0	2.5
LBNL	2	0	100	2	NA	NA	0.013	0	0	77.6
LLNL	889	9	99	63	0.008	0.044	0.128	0	0	0.3
LLNL CHES	3	0	100	1	NA	NA	0.042	0	0	63.2
LLNL ENVC	1,332	9	99.3	13	0.003	0.009	0.077	0	0	0.2
NNSS	41	0	100	19	NA	NA	0.008	0	0	7.0
ORNL	72	0	100	39	NA	NA	0.017	0	0	4.1
PAD LATAKY	3	0	100	3	NA	NA	0.019	0	0	63.2
PTX	102	6	94.1	42	0.009	0.021	0.063	0	0	2.9
SNL	45	6	86.7	18	0.057	NA	0.136	0	0	6.4
SRS	2	0	100	2	NA	NA	0.000	0	0	77.6
Y-12	6,626	398	94	354	0.014	0.018	18.023	0.98	0.8	1.2
Y-12 NRE	15	0	100	5	NA	NA	0.009	0	0	18.1
All Combined	10,798	481	95.5	1,037	0.006	0.019	18.023	0.6	0.5	0.7

American Recovery Act funding for beryllium decontamination and decommissioning work at the Y-12 National Security Complex led to extensive exposure monitoring in 2011. Sites that did not report data for calendar 2011 are not included in this table.

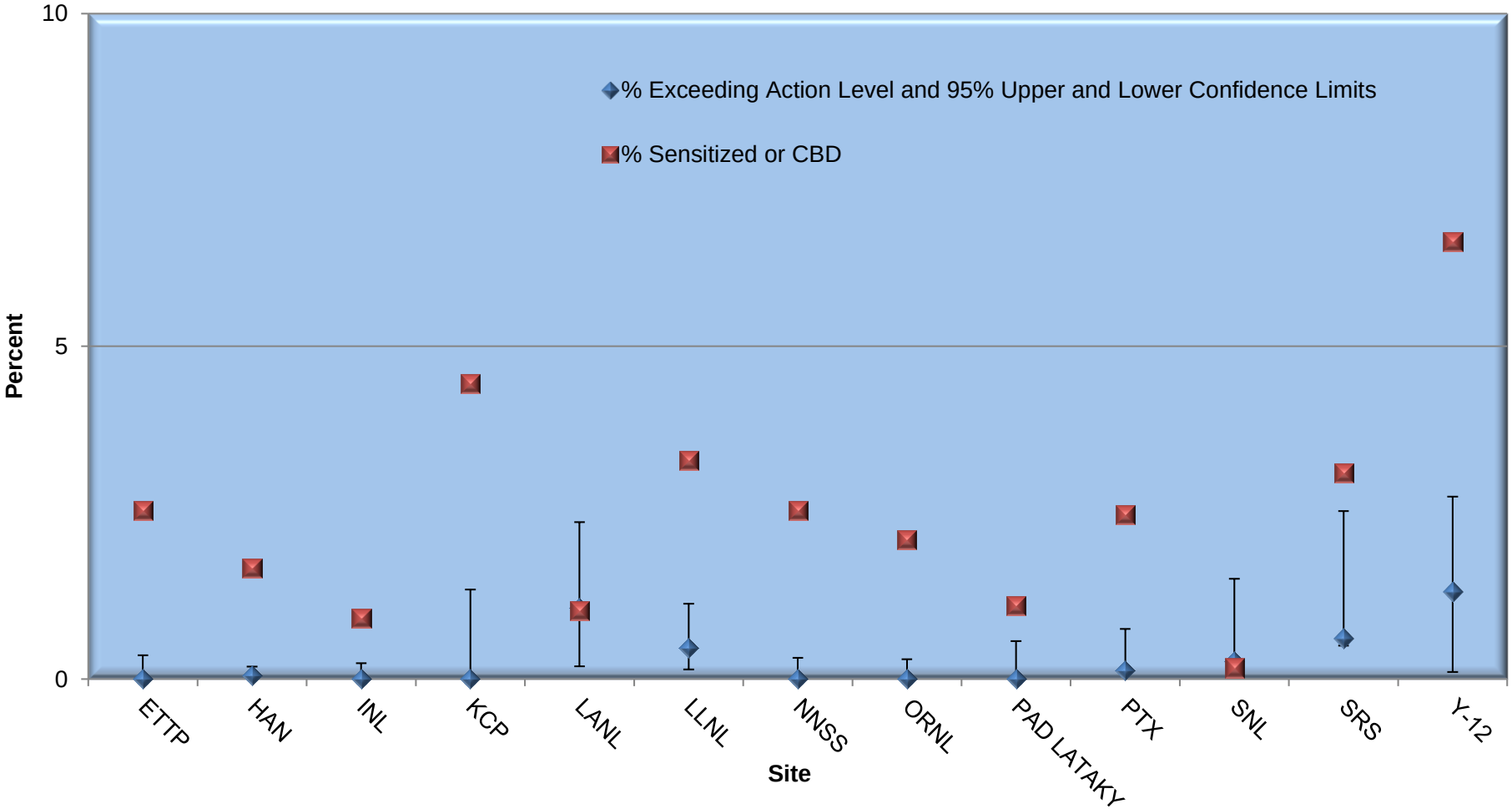
50 Largest Exposure Monitoring Results Above the 0.2 µg/m^3 Action Level for Calendar Year 2011

Site	Process Description	Job Title	8-Hour Time Weighted Average, ug/m^3	Respirator Assigned Protection Factor
Y12	SUPPORT	Other Laborers and General Services Workers	18.02	100
Y12	SUPPORT	Chemical System Operators	12.68	1000
Y12	SUPPORT	Machinists	12.61	1000
Y12	SUPPORT	Other Laborers and General Services Workers	12.25	1000
Y12	SUPPORT	Handlers, Helpers, and Laborers (General)	6.96	1000
Y12	SUPPORT	Handlers, Helpers, and Laborers (General)	4.59	1000
Y12	SUPPORT	Handlers, Helpers, and Laborers (General)	4.25	1000
Y12	SUPPORT	Machinists	3.94	1000
Y12	SUPPORT	Other Laborers and General Services Workers	3.66	1000
Y12	SUPPORT	Other Laborers and General Services Workers	3.25	1000
Y12	SUPPORT	Chemical System Operators	2.97	1000
Y12	SUPPORT	Millwrights	2.79	1000
Y12	SUPPORT	Other Laborers and General Services Workers	2.11	1000
Y12	SUPPORT	Handlers, Helpers, and Laborers (General)	2.11	1000
Y12	SUPPORT	Other Laborers and General Services Workers	1.91	100
Y12	SUPPORT	Other Laborers and General Services Workers	1.25	1000
Y12	SUPPORT	Handlers, Helpers, and Laborers (General)	1.13	1000
Y12	SUPPORT	Machinists	1.12	100
Y12	SUPPORT	Other Laborers and General Services Workers	1.11	1000
Y12	SUPPORT	Other Laborers and General Services Workers	0.97	1000
Y12	SUPPORT	Other Crafts	0.81	100
Y12	SUPPORT	Chemical System Operators	0.77	1000
Y12	SUPPORT	Other Laborers and General Services Workers	0.77	100
LANL	ENGINEERED SYS	EXPLOSIVES TEC	0.75	1000
Y12	SUPPORT	Other Laborers and General Services Workers	0.63	1000

Site	Process Description	Job Title	8-Hour Time Weighted Average, ug/m^3	Respirator Assigned Protection Factor
Y12	SUPPORT	Chemical System Operators	0.62	1000
Y12	SUPPORT	Other Laborers and General Services Workers	0.60	1000
Y12	SUPPORT	Light Vehicle Drivers	0.59	1000
Y12	SUPPORT	Handlers, Helpers, and Laborers (General)	0.58	1000
Y12	SUPPORT	Other Laborers and General Services Workers	0.54	1000
Y12	SUPPORT	Chemical System Operators	0.52	1000
Y12	SUPPORT	Other Laborers and General Services Workers	0.48	1000
Y12	PRODUCTION	First Line Supervisors	0.45	50
Y12	SUPPORT	Machinists	0.43	100
Y12	SUPPORT	Other Laborers and General Services Workers	0.43	100
Y12	SUPPORT	Other Laborers and General Services Workers	0.42	1000
Y12	SUPPORT	Handlers, Helpers, and Laborers (General)	0.41	1000
Y12	SUPPORT	Other Crafts	0.40	100
LLNL	D & D Operations	Sr. Technologist C/MS	0.40	1000
Y12	SUPPORT	Chemical System Operators	0.38	1000
Y12	SUPPORT	Machinists	0.37	1000
Y12	SUPPORT	Other Laborers and General Services Workers	0.37	100
Y12	SUPPORT	Other Laborers and General Services Workers	0.35	100
Y12	SUPPORT	Other Laborers and General Services Workers	0.35	100
Y12	SUPPORT	Machinists	0.34	1000
SNL	EQT MAINT	Technician	0.34	1
Y12	SUPPORT	Light Vehicle Drivers	0.34	1000
Y12	SUPPORT	Other Laborers and General Services Workers	0.33	100
Y12	PRODUCTION	Other Laborers and General Services Workers	0.33	1000
Y12	SUPPORT	Machinists	0.33	1000

Exceedances in 2011 were primarily associated with decontamination and decommissioning work at the Y-12 National Security Complex. Work planning processes had identified the potential beryllium exposures and workers were wearing appropriate respiratory protection.

Cumulative Rates of Beryllium Sensitization or CBD versus Exposure Levels for 2002 – 2011



*Some sites provided sensitization/CBD data that predates the 2002 start date of the Registry.

Medical monitoring results for beryllium sensitization or CBD and beryllium exposure monitoring results are weakly correlated (Pearson product moment correlation coefficient = 0.44). 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.