HSS

Office of Health, Safety and Security

2008 Current Beryllium-Associated Worker Registry Summary

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Foreword

What is the Beryllium-Associated Worker Registry?

The U.S. Department of Energy (DOE) Beryllium-Associated Worker Registry 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 data are analyzed and summarized for use in managing CBD prevention programs. 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. Sites that determine employees are at risk due to ongoing or past work must implement CBD prevention programs that include reporting health and exposure data to the DOE Beryllium-Associated Worker Registry. Health data are collected through the operation of medical surveillance programs for current workers at 21 DOE sites. Exposure data are collected through the operation of industrial hygiene programs at 16 sites that have continuing beryllium operations.

Who is included in the Registry?

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 self-identify 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/.

Sites and organizations submitting data to the Registry include:

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)	Los Alamos National Laboratory (LANL)
Nevada Test Site (NTS)	Oak Ridge National Laboratory (ORNL)
Pantex Plant (PTX)	Sandia National Laboratories (SNL)
Savannah River Site (SRS)	Southwestern Power Administration (SWPA)
Stanford Linear Accelerator Center (SLAC)	Wackenhut Security Services Inc. for ETTP, ORNL, and Y-12 (WSI)
Y-12 National Security Complex (Y-12)	

What kinds of health and exposure data are used in the Registry?

CBD is diagnosed when clinical evaluations indicate both sensitization and characteristic changes to lung tissue have occurred. Evidence of characteristic changes include finding abnormal tissue called granulomas in biopsy samples or, if biopsy is not possible, findings from x-ray studies or pulmonary function studies that are consistent with CBD. CBD usually develops over several years or even decades and can be in a mild or severe form. Beryllium-related granulomas, i.e., non-cancerous tumors or growths due to inflammation, can make it difficult for the lungs to get oxygen to the bloodstream and body. Over time, scar tissue can develop causing permanent lung damage.

Workers potentially at risk for CBD are offered screening examinations. The beryllium lymphocyte proliferation test (BeLPT), symptoms questionnaires, and other tests recommended by the examining physician are used to screen for CBD. The 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 react strongly 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. An individual must have 2 abnormal blood tests to be considered beryllium sensitized (BeS). It is recommended that individuals with abnormal findings obtain a diagnostic evaluation to determine if they have CBD and whether medical treatment is indicated. Results from screening and diagnostic evaluations are reported to the Registry.

The exposure levels of workers potentially exposed to beryllium are assessed periodically through personal breathing zone sampling. Workers may come into contact with beryllium in a number of jobs. Machinists, welders, and operators may be exposed through direct handling of beryllium and beryllium compounds. Performing quality assurance analyses on beryllium materials, coming into contact with contaminated equipment, or working near a beryllium operation may expose other workers. Personal breathing zone monitoring results representative of workers' occupational exposure to beryllium are reported to the Registry.

What time period is included in this report?

The report summarizes cumulative health data through the end of 2006. Much of the data for 2006 were reported to or corrected in the Registry in 2007. The 10 CFR 850 rule required sites to begin reporting in January 2002. The Registry requested the health data for beryllium-associated workers include screening and diagnostic information from prior years. At some sites medical surveillance of current workers began in the early 1990s under research protocols but was not widely adopted until the 10 CFR 850 rule was issued in December 1999. Information reported by most sites includes results of medical evaluations before 2002 but the earliest dates vary from site to site.

The report summarizes exposure monitoring results for years 2002 through 2006, with a focus on 2006. Some data from years earlier than 2002 have been reported to the Registry but are not included in this summary. All 2006 data reported as of November 28, 2007 are included in this report. Data for 2007 were submitted in January and February 2008: omissions, entry errors, and logical inconsistencies have yet to be resolved. The analysis of DOE-wide time trend included exposure monitoring results from all sites reporting more than 1 result in 2006.

How are confidentiality and privacy protected?

The Privacy Act requires that DOE protect the confidentiality of medical and other personal information used in the Registry. This is achieved through the use of an encrypted identifier created and maintained at the site that reports data to the Registry. Names, social security numbers, and other identifying information are kept in confidential personnel medical records at the site. Information submitted to the Registry regarding a specific worker only includes his or her unique encrypted identification number.

Published reports using Registry information will generally contain only summary data. It is possible that descriptions of working conditions associated with a specific case will be published to share lessons with others. Such descriptions of specific cases will avoid containing enough unique information to allow readers to identify the individuals being described.

What happens to the information sent to the Registry?

Data are sent by each site to the Data Center maintained by the Oak Ridge Institute for Science and Education (ORISE). There the data are reviewed for completeness and accuracy. Registry staff members use a system of automated codes to determine missing data, data that are out of range (e.g. unusual or incorrect values), and other inconsistencies. The Data Center notifies each site data coordinator of errors or omissions so they can be corrected. Data processing and subsequent analyses are conducted by ORISE and DOE Office of Illness and Injury Prevention (HS-13) staff. Summary data and other results of analyses are published in periodic reports. Reports are reviewed internally by a Quality Review Board and approved reports are posted on the DOE web site. Participating sites will be notified of the availability of these reports and asked for comments and suggested improvements for future reports. Data analyses will also be presented at meetings of DOE and DOE contractor personnel.

Where do I get more information?

Reports, operating procedures, and other information are posted on the web at http://www.hss.energy.gov/HealthSafety/IIPP/hservices/bery_wr.html.

Questions about this program or related issues can be addressed to:

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At a Glance

This report summarizes health data from medical examinations reported for 12,645 current U.S. Department of Energy (DOE) workers who have had an association with beryllium work. These individuals received 1 or more DOE-provided screening examinations for chronic beryllium disease (CBD) between 1991 and 2006.

Among the 12,645 participants, 96 (0.8%) are known to have been diagnosed with CBD and another 198 (1.6%) have been found to be sensitized to beryllium (BeS). Sensitized individuals have been offered government-provided insurance coverage for medical monitoring to determine if they are advancing to CBD and for recommended medical care.

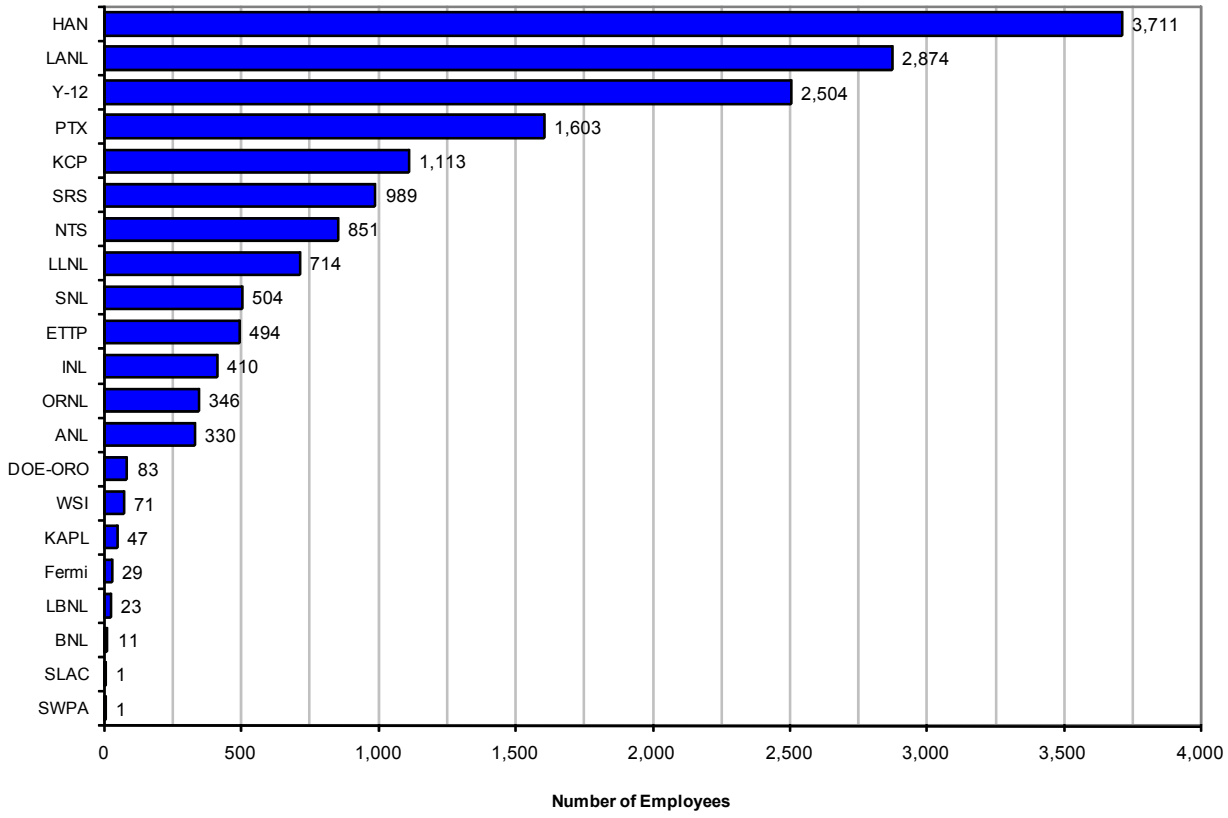
Differences in rates from site to site and among groups at the same site demonstrate that primary prevention through beryllium exposure control has the potential to reduce the incidence of sensitization and CBD.

Beryllium personal exposure monitoring data for 2006 from 9 DOE sites are summarized in this report. The data were required to be reported to the Beryllium-Associated Worker Registry beginning in 2002. Monitoring data prior to 2002 were reported for individuals in the Registry if available. The data indicate that controlling exposure to levels less than the DOE action level of 0.2 micrograms of beryllium per cubic meter of air ($\mu g/m^3$) has been feasible at most sites.

The Registry collects and analyzes existing information generated for other purposes. The quality and completeness of reporting of any particular data element varies depending on its accessibility to the site staff members who report the information.

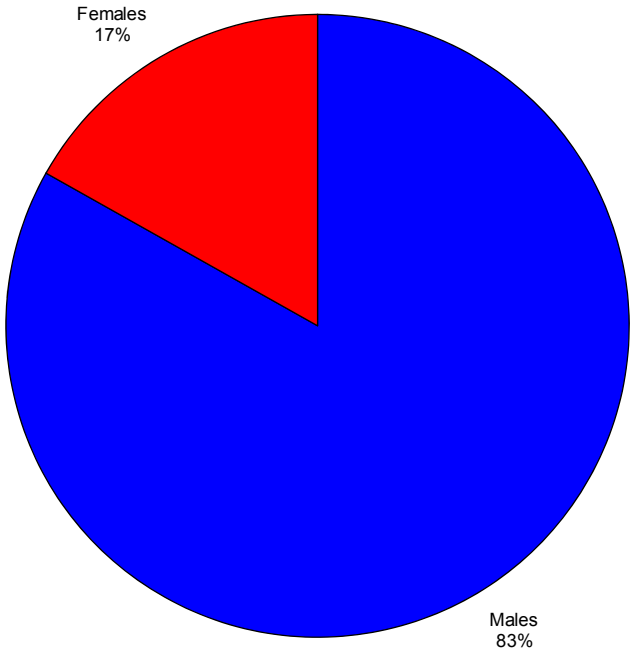
Figure 1 shows the cumulative number of beryllium-associated workers reported to the Registry since 2002. Included are individuals who were screened for chronic beryllium disease or monitored for beryllium exposure while employed at a DOE site. Most sites reported readily accessible records on individuals screened or monitored before 2002. Some of these individuals will have separated from employment since having been screened or monitored. There are a total of 16,709 individuals who have been included in rosters reported to the Registry. Rocky Flats Environmental Technology Site beryllium-associated workers included in previous reports have been dropped from this report because of closure of the site in 2005. The 3,998 Rocky Flats workers are now included in former worker medical surveillance programs.

Figure 1. Number of Employees Reported to the Be-Registry



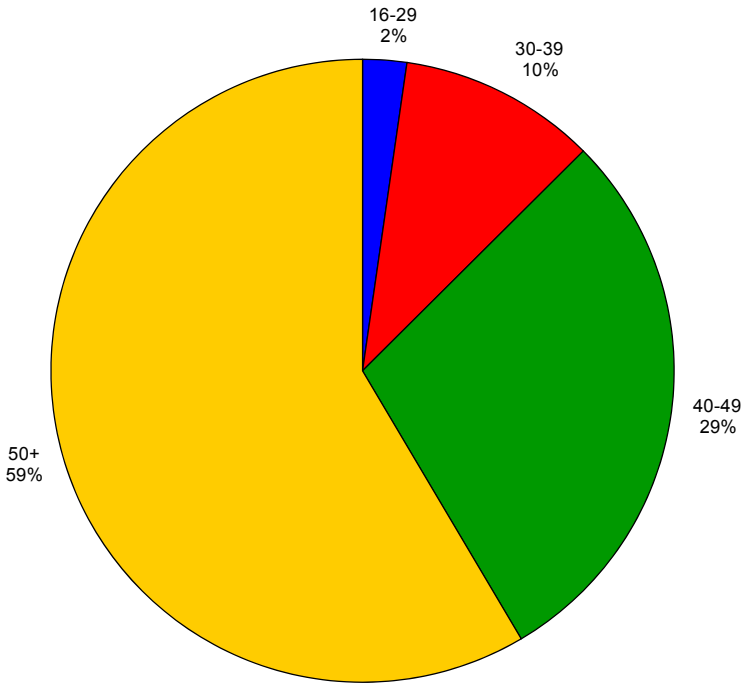
Beryllium-associated workers reported to the Registry are predominantly male. Reporting on gender was nearly complete with only 0.01% of the records failing to include information on gender.

Figure 2. Gender Breakdown of Employees Reported to the Be-Registry



The median age of beryllium-associated workers reported to the Registry exceeds 50 years. Reporting on age was nearly complete with only 0.02% of the records failing to include information on age.

Figure 3. Age Breakdown of Employees Reported to the Be-Registry



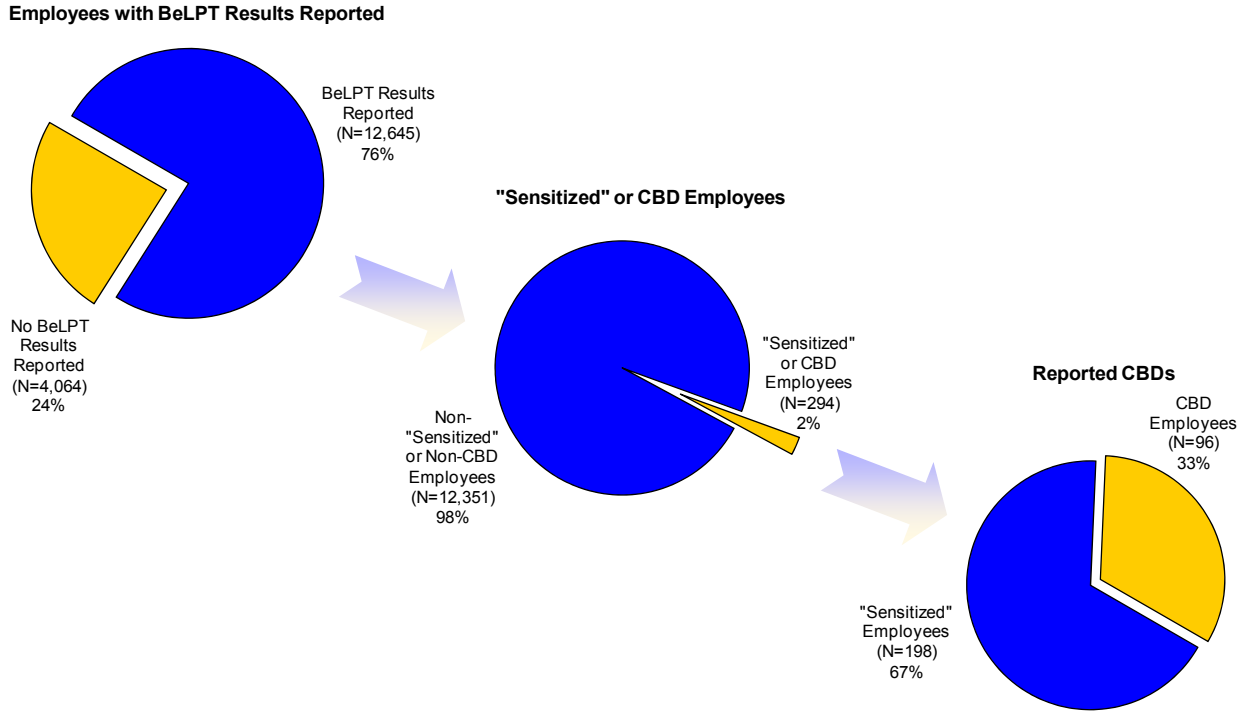
The age distribution of beryllium-associated workers is consistently skewed towards older workers at all sites.

Table 1. Age Breakdown of Employees Reported to the Be-Registry

Site	16-29	30-39	40-49	50+	Not Reported
ANL	3	18	94	215	0
BNL	0	0	3	8	0
DOE-ORO	0	6	29	48	0
ETTP	17	50	81	346	0
Fermi	0	2	7	19	1
HAN	81	443	1,222	1,965	0
INL	36	59	160	155	0
KAPL	0	10	22	15	0
KCP	11	20	279	803	0
LANL	83	438	933	1,420	0
LBNL	0	2	5	16	0
LLNL	9	63	224	418	0
NTS	37	90	219	505	0
ORNL	2	32	90	222	0
PTX	30	213	481	879	0
SLAC	0	0	0	1	0
SNL	27	55	133	287	2
SRS	12	72	360	545	0
SWPA	0	0	0	1	0
WSI	0	4	27	40	0
Y-12	33	136	469	1,866	0
Totals	**381**	**1,713**	**4,838**	**9,774**	**3**

Of the 16,709 individuals included in rosters of beryllium-associated workers, 12,645 have reported BeLPT results. Of those screened, 96 have been diagnosed as having CBD and another 198 are sensitized for a total of 294 (2%). "Sensitized" indicates the number of individuals found to have an immunologic response to their beryllium exposures by 2 or more peripheral blood BeLPTs or from a bronchoalveolar lavage BeLPT. “CBD” are individuals who have undergone clinical evaluations and diagnosed with CBD based on sensitization and lung pathology consistent with CBD. The difference in numbers from the individuals reported in rosters to those with BeLPT results are 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 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.

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. The total number of BeLPT results reported to the Registry is 30,191.

Figure 5. Number of BeLPT Results per Site

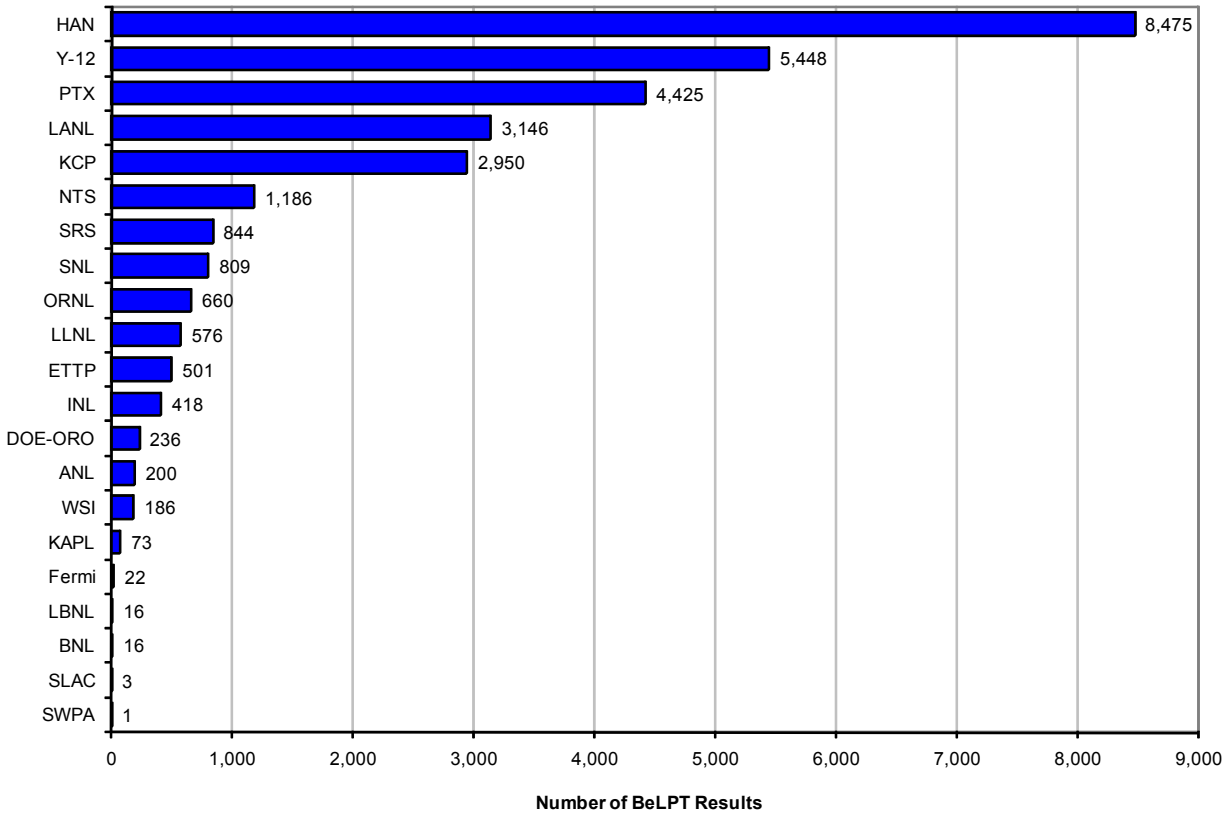


Table 2 shows the cumulative numbers of beryllium-associated workers reported to the Registry that have BeLPT test results, are "sensitized," or have been diagnosed with CBD.

CBD cases are individuals who have undergone a clinical evaluation and been diagnosed as having CBD while employed at a DOE site. This does not include individuals who were diagnosed after separating from employment. The cases of CBD at Y-12 are consistent with the opportunities for exposure that have been extensively monitored and characterized. The cases at Hanford, Pantex, and Kansas City are not as well understood since exposure monitoring in the past was limited and more recent monitoring has not identified the causes of exposures likely to be responsible for the number of cases being observed.

Table 2. Number of Employees BeLPT Tested, "Sensitized," and CBD

Site	Employees with BeLPT Results	"Sensitized" Employees	CBD Employees
HAN	3,488	50 (1.4%)	20 (0.6%)
Y-12	1,770	59 (3.3%)	42 (2.4%)
LANL	1,677	2 (0.1%)	3 (0.2%)
PTX	1,551	17 (1.1%)	15 (1.0%)
KCP	1,022	27 (2.6%)	12 (1.2%)
NTS	737	14 (1.9%)	0
SRS	491	12 (2.4%)	0
SNL	446	0	0
ETTP	365	5 (1.4%)	4 (1.1%)
LLNL	350	0	0
ORNL	266	5 (1.9%)	0
INL	178	0	0
ANL	90	3 (3.3%)	0
DOE-ORO	84	1 (1.2%)	0
WSI	63	1 (1.6%)	0
KAPL	22	0	0
Fermi	18	0	0
LBNL	14	0	0
BNL	11	1 (9.1%)	0
SLAC	1	1 (100.0%)	0
SWPA	1	0	0
Totals	**12,645**	**198 (1.6%)**	**96 (0.8%)**

"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.

Site occupational medicine clinics have reported 198 “sensitized” (BeS) and 96 CBD cases to the Registry. Table 3 shows beryllium-associated workers are overwhelmingly long-term workers and, as a result, both BeS and CBD cases occur primarily among individuals who have worked for many years. However, 11 BeS cases have occurred among individuals hired after the beryllium rule was issued in December 1999. New cases of BeS and CBD continue to be reported. Table 4 shows the distribution of initial positive screening results among cases who were eventually diagnosed as either BeS or CBD. Recent positive screening results among long-term workers could be due to false-negative results on initial tests, a latency period between exposure and the development of BeS, or as a result of recent exposure. The percentages shown in Tables 3 and 4 suggest a trend over time in the data. The trend could be due to improving working conditions. However, we may continue to see new cases of BeS or CBD due to the variable latency period between past exposure and the development of disease.

Table 3. Year of First Hire for Employees that Are "Sensitized" and CBD

Year of First Hire	Employees with BeLPT Results	"Sensitized" Employees	CBD Employees
<1961	48	0	0
1961-1965	90	2 (2.2%)	1 (1.1%)
1966-1970	562	19 (3.4%)	23 (4.1%)
1971-1975	624	9 (1.4%)	11 (1.8%)
1976-1980	1,763	44 (2.5%)	22 (1.2%)
1981-1985	1,322	27 (2.0%)	14 (1.1%)
1986-1990	1,077	11 (1.0%)	1 (0.1%)
1991-1995	1,020	17 (1.7%)	2 (0.2%)
1996-2000	855	8 (0.9%)	2 (0.2%)
2001-2006	1,355	11 (0.8%)	0
Not Reported	3,929	50 (1.3%)	20 (0.5%)
Totals	**12,645**	**198 (1.6%)**	**96 (0.8%)**

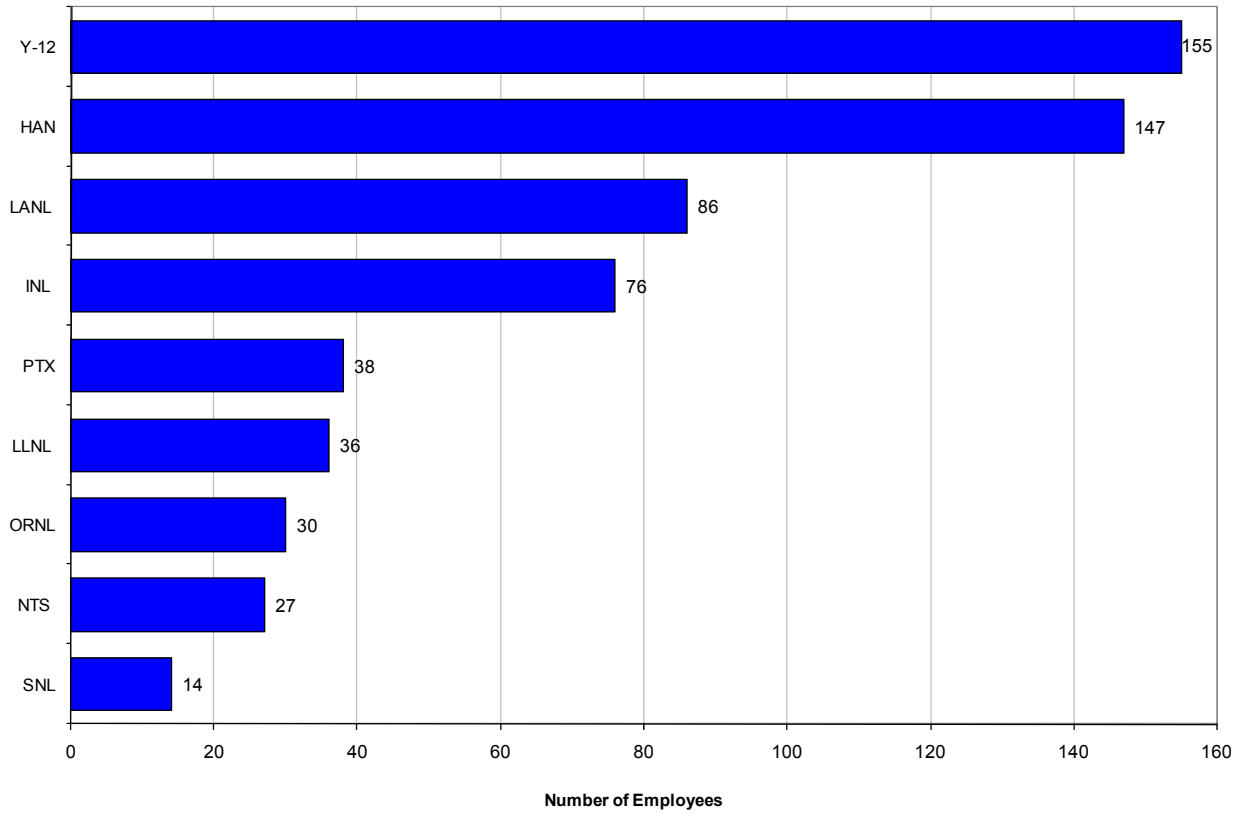
Table 4. Year of First Positive or Abnormal BeLPT for Employees that Are "Sensitized" and CBD

Year of BeLPT Result	Number of Employees Tested	"Sensitized" Employees	CBD Employees
<2000	636	31 (4.9%)	9 (1.4%)
2000	1,615	24 (1.5%)	16 (1.0%)
2001	3,196	34 (1.1%)	15 (0.5%)
2002	3,954	39 (1.0%)	7 (0.2%)
2003	3,931	9 (0.2%)	4 (0.1%)
2004	3,812	11 (0.3%)	2 (0.1%)
2005	5,105	24 (0.5%)	4 (0.1%)
2006	4,844	25 (0.5%)	1 (0.0%)
Not Reported	0	1	38
Totals	**27,093**	**198**	**96**

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.

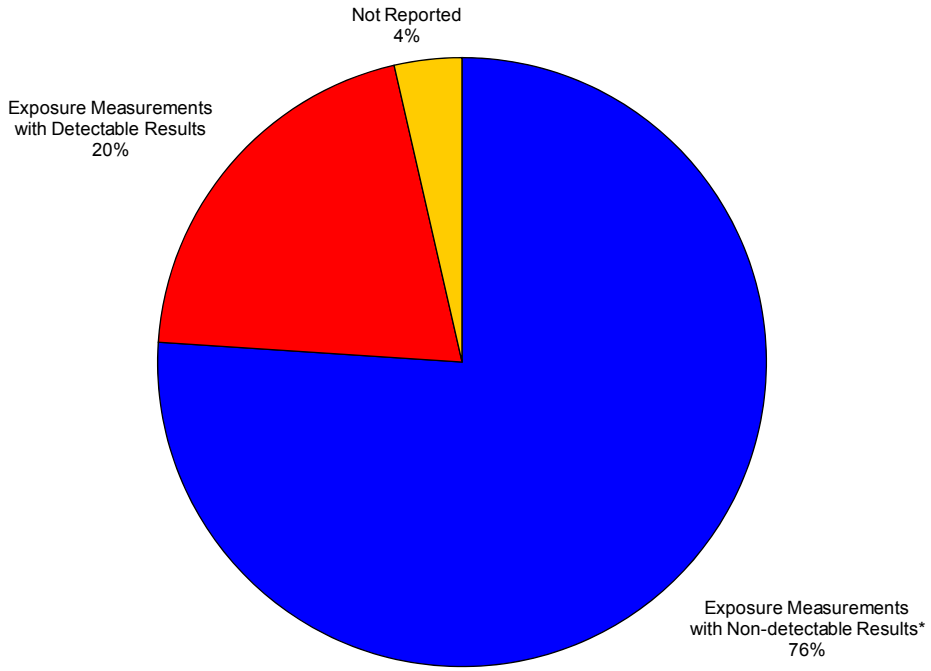
Figure 6 shows the number of individuals whose exposures were assessed by an industrial hygienist at least once in 2006 and indicates the level of recognized beryllium-related work activity at each site.

Figure 6. Number of Employees Monitored per Site in 2006



Participating sites have submitted 29,987 exposure monitoring records to the Registry. The majority of these results were "non-detectable," which indicates that sample analysis results were less than the laboratory's reporting limit. Accredited laboratories are required to establish reporting limits. Results that fail to achieve a specified level of accuracy are reported as less than the reporting limit and are commonly called "non-detects." 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 7. Reported Exposure Levels



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

Figure 8 shows estimates of the percentage of exposures exceeding the DOE action level of 0.2 µg/m^3 for the time period since the implementation date for 10 CFR 850. Monitoring demonstrating that fewer than 5% of exposures exceed the action level is considered convincing evidence of compliance. The 90% confidence interval is the distance between the upper and lower 95% confidence limits on the estimate of percent exceeding and is a function of the number of measurements used to make the estimate. For more information see "A Strategy for Assessing and Managing Occupational Exposures," Ignacio, JS and Bullock, WH (editors): Third Edition. American Industrial Hygiene Association, Fairfax, VA (2006).

Figure 8. Exposure Trend for 9 DOE Sites

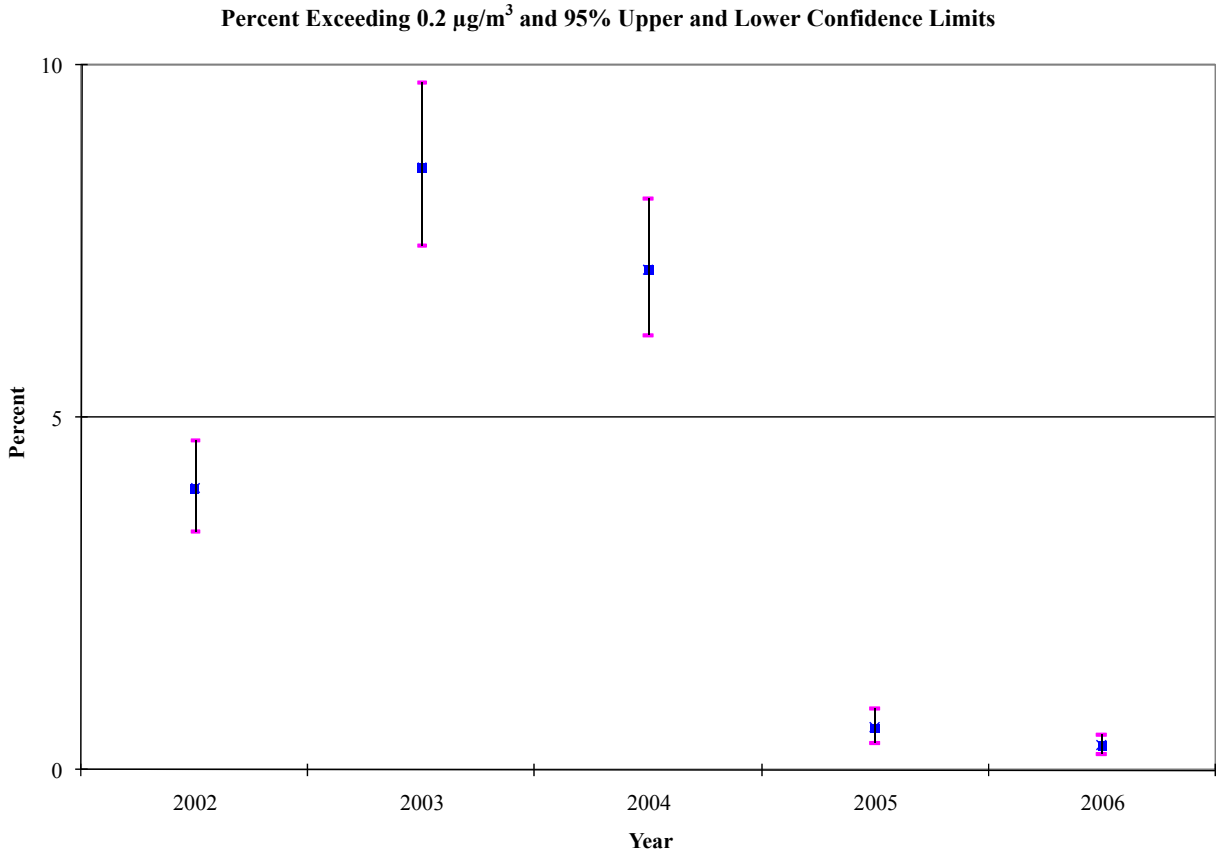
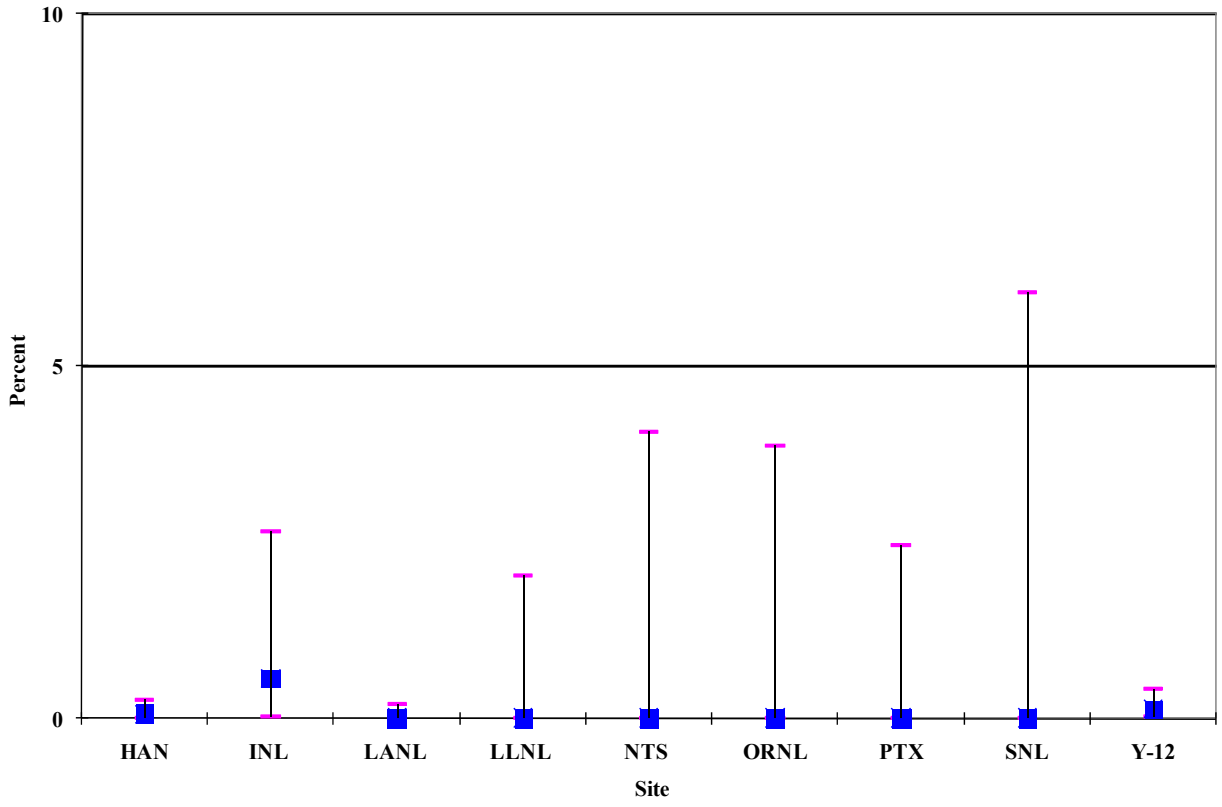


Figure 9 indicates the level of compliance with the DOE action level of 0.2 µg/m^3 achieved by site CBD prevention programs. When no values are above the action level both the central estimate and the lower 95% confidence limit of the percent exceeding the limit are zero. The upper 95% confidence limit is an indication of whether exposure monitoring was frequent enough to have confidence exposures that are in compliance.

Figure 9. Percent of Exposure Monitoring Results Exceeding the Action Level in 2006



The following table shows summary statistics estimated from exposure data submitted to the Registry. The majority of reported exposure monitoring results were "non-detects." When there are no detected results, estimates of mean levels are not possible. For more information on the statistical methods used see ORNL/TM-2005/52, "Statistical Methods and Software for the Analysis of Occupational Exposure Data with Non-Detectable Values" (June 2005), which is posted at http://www.hss.energy.gov/HealthSafety/IIPP/sand/index.html.

Table 5. Summary Exposure Monitoring Statistics

Metrics	HAN	INL	LANL	LLNL	NTS	ORNL	PTX	SNL	Y-12	Units
Kaplan-Meier(KM) Estimate of Arithmetic Mean (EX)	0.001	0.005	0.009	0.014	NA	NA	0.003	0.003	0.008	µg/m^3
KM Lower Confidence Limit (LCL) for EX	0.001	0.004	0.009	0.010	NA	NA	0.002	0.000	0.007	µg/m^3
KM Upper Confidence Limit (LCL) for EX	0.002	0.007	0.009	0.017	NA	NA	0.004	0.007	0.008	µg/m^3
Observed 95th Percentile of data	0.007	0.030	0.011	0.020	NA	NA	0.002	0.008	0.007	µg/m^3
Nonparmetric estimate of the Upper Tolerance Limit	**0.029**	**0.059**	**0.023**	**0.067**	**0.158**	**0.010**	**0.017**	**NA**	**0.010**	µg/m^3
Largest value in the data set	0.229	0.300	0.164	0.165	0.158	0.010	0.023	0.079	0.253	µg/m^3
The percent of values that are non-detects	94.3	80.2	97.9	94.5	100	100	97.5	79.2	98.7	
The number of observations in the data set	1800	177	1460	146	72	76	120	48	1506	
The number of detected values	103	35	31	8	0	0	3	10	20	
Number of individuals monitored	147	76	86	36	27	30	38	14	155	
Nonparmetric estimate of percent exceeding 0.2 µg/m^3	0.06	0.56	0	0	0	0	0	0	0.1328	%
Nonparmetric estimate of LCL for F	0.00	0.03	0	0	0	0	0	0	0.0236	%
Nonparmetric estimate of UCL for F	**0.26**	**2.65**	**0.20**	**2.03**	**4.08**	**3.87**	**2.47**	**6.05**	**0.42**	%

Discussion

In its audit report "Implementation of the Department of Energy's Beryllium-Associated Worker Registry," DOE/IG-0726, April 2006, the Inspector General described problems with the completeness and accuracy of data sent from DOE sites to the Registry. Reporting has steadily improved since 2002 as deficiencies and inefficiencies are identified and corrected. In 2007, SRS and ETTP were among the sites not reporting 2006 exposure monitoring data, indicating problems persist. In some cases, the coordinators at the sites do not have access to the information required by the Registry. In other cases, changes in database software have delayed reporting.

Data submitted by the sites to the central Data Center are run through computerized error-checking routines that identify missing fields, entry errors, duplicates, values outside of a logical range, and values that are logically inconsistent with others reported for the same individual or monitoring result. Errors may be minor and easily corrected or may point to systemic problems with corrective actions that require additional time and resources. Systemic problems can take several months to correct. As a result, the summary information in periodic reports is subject to change in subsequent reports as new and corrected information is added.

The goal of the Registry is to provide performance indicators that help the DOE manage its prevention efforts. Data in this report also suggest opportunities for further investigations that could more definitively characterize the working conditions associated with the development of CBD. At Pantex and Hanford, cases of CBD are occurring where personal monitoring has not detected significant exposure. These CBD cases could be due to exposures in the past; however, more extensive exposure monitoring is also indicated to rule out the chance that there are unrecognized sources of ongoing exposure.

Appendix – Site Descriptions for Sites with More than 100 Participants

Argonne National Laboratory

Site Description

The Argonne National Laboratory (ANL) covers 1,500 acres in DuPage County, Illinois. The site is 27 miles southwest of downtown Chicago. ANL was established in 1946 as a successor to the Manhattan Engineering District (MED) Chicago Metallurgical Laboratory, which developed the first nuclear reactor at the University of Chicago under the leadership of Enrico Fermi. It relocated to its current site in 1948 where most basic research is conducted and to an ANL-West site in Idaho where large scale testing of experimental reactors and fuel processing is conducted. The ANL-West site is now part of Idaho National Laboratory (INL). Initially, ANL was known for its expertise in nuclear reactor research, development, and testing. The first prototypes of naval pressurized water reactors, Savannah River production reactors, electric power generating boiling-water reactors, low cost research reactors, and passively safe liquid metal reactors were designed, developed, built, and tested by ANL. The Zero Gradient Synchrotron, completed in 1963, was the first of several ANL high energy physics research facilities designed, built, and managed as unique, shared National resources. In 1960, the ANL mission expanded to include radiation biology and nuclear medicine research.

Current ANL-East activities include research and development in: the basic physical, life, and environmental sciences; unique national facilities for materials science; advanced nuclear power technologies; efficient energy utilization in the transportation and industrial sectors; nuclear waste management; arms control and non-proliferation; reduced-enrichment fuel for research reactors; and enhanced science and mathematics education for students and teachers.

Beryllium Operations

Beryllium's ability to moderate and reflect neutrons led to its use in early experimental reactors designed, built, and tested at ANL. Similar to other laboratories, beryllium-containing components have been fabricated for use in instruments, tools, and other experimental apparatus. Beryllium-containing components, ranging in size from bench-top to very large reactor components, have been fabricated using machine tools, cutting, welding, and grinding equipment.

East Tennessee Technology Park

Site Description

The East Tennessee Technology Park (ETTP), formerly known as the K-25 Plant and the Oak Ridge Gaseous Diffusion Plant, is located on 4,689 acres in Roane County, Tennessee, 13 miles west of downtown Oak Ridge. The current site configuration is the product of past missions and programs, the most significant of which was the Oak Ridge Gaseous Diffusion Plant, which operated from the end of World War II until 1985. The primary mission of ETTP is decontamination and decommissioning of facilities and equipment, and environmental

restoration of the site. ETTP also operates a Toxic Substances Control Act (TSCA) incinerator, which handles radioactive, hazardous, and uranium-contaminated polychlorinated biphenyl (PCB) wastes. The long-term goal for ETTP is to convert the site into a private industrial park. The reuse of key site facilities through title transfer is part of the closure plan for the site.

Beryllium Operations

In addition to operation of the gaseous diffusion plant, shop areas at ETTP supported a variety of defense and energy research and development missions. Work for Others projects included fabrication of beryllium components. As a result, contaminated equipment and facilities are undergoing decontamination and decommissioning.

Hanford Site

Site Description

The Hanford Site (HAN) is located on 358,388 acres in southeastern Washington State, just north of Richland. It is bordered on the east by the Columbia River and on the south by the Yakima River and the city of Richland. The site was established in early 1943 to build the first full-size reactors to produce plutonium for nuclear warheads. A plutonium production complex with 9 nuclear reactors and associated processing facilities, Hanford played a pivotal role in the nation's defense for more than 40 years. In 1987, the last remaining defense production reactor was shut down. Today, Hanford is engaged in the world's largest environmental cleanup project, involving more than 1,700 waste sites and about 500 contaminated facilities. DOE has 2 federal offices at Hanford, the Richland Operations Office (RL) and the Office of River Protection (ORP), each of which oversees separate contracts held by private companies. The ORP is building and will operate a plant to treat the chemical and radioactive waste from past plutonium production. RL oversees cleanup of other Hanford Site facilities and wastes.

The Pacific Northwest National Laboratory (PNNL) operates laboratories on and adjacent to the Hanford Site. PNNL began in 1965 when Battelle was awarded a contract to perform research and development for the Hanford Site. The Laboratory's first projects included fabricating reactor fuel and designing reactors, including the Fast Flux Test Facility at Hanford. PNNL is a multi-program laboratory that performs energy, environmental, and national security research.

Beryllium Operations

The cladding for reactor fuel included beryllium alloy components. Brazing operations in fuel fabrication areas used beryllium-containing base and filler materials. In addition, nuclear research and development activities led to fabrication of beryllium-containing components for experimental apparatus. Contaminated equipment and facilities are undergoing decontamination and decommissioning through projects overseen by RL.

Idaho National Laboratory

Site Description

The Idaho National Laboratory (INL), located in Eastern Idaho, consists of an 890 square mile reservation on the Snake River Plain. Additional research facilities and office buildings are located 32 miles east in Idaho Falls, Idaho. INL was established in 1949 as the National Reactor Testing Station to provide an isolated location where various kinds of nuclear reactors and support facilities could be built and tested. From 1953 to 1992, the Idaho Chemical Processing Plant reprocessed spent naval reactor fuel to recover uranium-235. INL manages high-level and transuranic nuclear waste. In 2006, INL was named the DOE lead laboratory for nuclear reactor technology and is coordinating the Generation IV Nuclear Systems Initiative—an international effort to develop the next generation of nuclear power reactors. INL's Advanced Test Reactor produces isotopes for medical and aerospace applications. The new Space and Security Power Systems Facility at INL assembles radioisotope thermoelectric generators for NASA's space missions.

Beryllium Operations

Beryllium-containing components in experimental reactors have been assembled, disassembled, and maintained by INL workers. The radioactive waste managed at INL can also contain beryllium and other hazardous materials. Similar to other laboratories, beryllium-containing components have been fabricated for use in instruments, tools, and other experimental apparatus.

Kansas City Plant

Site Description

The Kansas City Plant (KCP) is situated on approximately 141 acres of the Bannister Federal Complex located 12 miles south of downtown Kansas City, Missouri. The facility was built by the Navy during World War II to assemble engines for U.S. Navy fighter planes. In 1949, the Atomic Energy Commission asked the Bendix Corporation to manage the facility and build non-nuclear electronic, electromechanical, mechanical, plastic, and metal components for nuclear weapons. Over the past 50 years, the products manufactured at the KCP have become smaller and much more complex. The facility has evolved into a research production facility that specializes in science-based manufacturing. The KCP operates 3 major factories involved in the development and production of non-nuclear weapons components, and produces more than 40 product lines for the nation's defense system.

Beryllium Operations

Small quantities of copper beryllium alloys are used for fabrication of electronic components. Exposure monitoring of these operations indicated very low potential for exposures that might exceed exposure limits, and no routine exposure monitoring programs were implemented. Subsequent to finding beryllium sensitization among KCP workers, the pattern of contamination detected by surface sampling indicated that beryllium oxide ceramic process equipment used in the production of engineered materials may have been a source of beryllium exposure.

Lawrence Livermore National Laboratory

Site Description

The Lawrence Livermore National Laboratory (LLNL) is 1 of 3 national laboratories that are part of the National Nuclear Security Administration (NNSA) within DOE. The laboratory was established in 1952 and is located on a 1 square mile site in Livermore, California on what was formerly the Livermore Naval Air Station. A 10 square mile remote explosive testing site is situated 18 miles to the east. As a NNSA laboratory, LLNL's ongoing responsibilities ensure that the nation's nuclear weapons remain safe, secure, and reliable through the application of advances in science and technology. The Laboratory is also responsible for countering the proliferation of weapons of mass destruction and strengthening homeland security against the terrorist use of such weapons. With the Laboratory's broad-based capabilities in science and technology, it continues to make key advances in major research programs in energy and environment, bioscience and biotechnology, and basic science and applied technology. Facilities include an explosives test site, a tritium facility, the NOVA laser, Inertial Confinement Fusion facilities, the National Ignition Facility, and the High Explosive Application Facility.

Beryllium Operations

The primary beryllium operations at LLNL include testing beryllium-containing components to support the nuclear weapons stockpile stewardship mission. It is 1 of the metals studied in non-nuclear experiments using high explosives, which require cleanup and recovery activities. Beryllium components have also been fabricated to support a wide range of energy and physics research and development unrelated to nuclear weapons. A long history of materials and component research, development, and testing created a legacy of contaminated facilities and equipment that require management and remediation.

Los Alamos National Laboratory

Site Description

The Los Alamos National Laboratory (LANL) is 1 of 3 national laboratories that are part of the National Nuclear Security Administration (NNSA) within DOE. LANL covers approximately 28,000 acres in north central New Mexico. The Los Alamos Laboratory was established in 1943 as a weapons research and development site for the Manhattan Project. When LANL was first established, scientists worked to achieve the laboratory's original mission—developing atomic weapons. Following World War II, although scientists continued to focus on nuclear defense research and development, they also branched out into other nuclear energy and technology projects. Today, LANL's mission is divided into 4 focus areas: national security, energy resources, environmental quality, and fundamental science. Under the national security mission, LANL monitors the safety and reliability of nuclear weapons stockpiles, and tracks the international use and spread of nuclear weapons, materials, and technologies. The energy resources mission covers research and development of energy resources, including renewable, fossil, and nuclear fuels. The environmental quality mission focuses on the treatment, storage, and disposal of DOE wastes (both chemical and radiological), as well as research and development of remedial technologies. As part of the science mission, LANL conducts

fundamental research in physics, materials science, chemistry, nuclear medicine, energy sciences, computational sciences, environmental sciences, and biological sciences.

Beryllium Operations

The primary beryllium operations at LANL support research and development, testing, and production activities. LANL fabricates beryllium metal nuclear weapon components to replace those consumed in the tests for stockpile stewardship. The processes include machining, welding, polishing, assembling, and testing of solid beryllium components. It is 1 of the metals studied in non-nuclear experiments using high explosives. Beryllium components have also been fabricated to support a wide range of energy and physics research and development unrelated to nuclear weapons.

Nevada Test Site

Site Description

The Nevada Test Site (NTS) is located on 864,000 acres with the southern entrance to the site approximately 65 miles north of Las Vegas. It is 1 of the largest secured areas in the United States. The NTS was established in 1951 as a nuclear weapons testing site. Since the nuclear weapons testing moratorium in 1992, the NTS has diversified into many program areas, such as subcritical experiments, hazardous chemical spill tests, emergency response training, conventional weapons testing, waste management, and environmental technology studies. The NTS conducts both non-destructive and destructive tests of nuclear weapons components in support of the nuclear weapons stockpile stewardship program.

The NTS is supported by laboratories and facilities in and near Las Vegas that develop specialized sensors and sensor systems, instrumentation and high-speed recording systems, and data analysis and data communication equipment. Employees in California, Maryland, Nevada, and New Mexico perform aerial radiation and environmental surveys of government sites, industrial nuclear power plants, and mining sites around the world to measure the levels of background and man-made radiation. They are part of the DOE nuclear emergency response program.

Beryllium Operations

The NTS has a legacy of beryllium use associated with nuclear weapons tests and tests of experimental reactors. Beryllium-containing materials were used in instruments fabricated and assembled to support the nuclear weapons testing mission. Beryllium components in experimental reactors were disassembled, inspected, declassified, and disposed of.

Oak Ridge National Laboratory

Site Description

The Oak Ridge National Laboratory's (ORNL's) primary site is approximately 4,250 acres located about 10 miles southwest of Oak Ridge, Tennessee. Originally known as Clinton Laboratories, ORNL was established in 1943 to carry out the pilot-scale production and separation of plutonium for the World War II Manhattan Project. Approximately 531 buildings and other major facilities, totaling about 3.1 million square feet, are located throughout the primary ORNL site. ORNL facilities are also located outside the primary site boundary for a total of about 4 million square feet in facilities. ORNL is a multi-program science and technology laboratory. Its mission today is to conduct basic and applied research and development to create scientific knowledge and technological solutions that strengthen the nation's leadership in key areas of science; to increase the availability of clean, abundant energy; to restore and protect the environment; and to contribute to national security. ORNL also performs other work for DOE, including isotope production, information management, and technical program management, and provides research and technical assistance to other organizations. The site continues to evolve to meet DOE's changing needs.

Beryllium Operations

Beryllium's ability to moderate and reflect neutrons led to its use in early experimental reactors designed, built, and tested at ORNL. Similar to other laboratories, beryllium-containing components have been fabricated for use in instruments, tools, and other experimental apparatus.

Pantex Plant

Site Description

The Pantex Plant (PTX), located on 16,000 acres in the Texas panhandle, 17 miles northeast of Amarillo, was constructed in 1942 to serve as a conventional bomb plant for the U.S. Army. The plant was deactivated when World War II ended and remained vacant until 1949 when Texas Technological University purchased the site for experimental cattle-feeding operations. The land was sold subject to recall under the National Security Clause, and the Atomic Energy Commission requested the Army to reclaim and reopen the site in 1951 to expand nuclear weapons assembly facilities. In 1975, the Pantex Plant became the only nuclear weapons assembly and disassembly plant in the United States. Currently, the site has 5 primary operational missions: weapons assembly, weapons disassembly, evaluation of weapons, high explosive research and development, and interim plutonium pit storage.

Beryllium Operations

At Pantex, beryllium and beryllium-containing alloys were used in the fabrication of weapons components and tools to make components. Pantex also performed destructive testing involving explosives and beryllium weapons components. Assembly and disassembly involve handling beryllium components manufactured at other sites. Currently, beryllium-containing components from weapons returned for dismantlement are demilitarized by crushing, shredding, or other means to make them unusable for military purposes and to ensure declassification. Firing Site

operations require energetic demilitarization (firing to disable) of components that contain small amounts of beryllium.

Sandia National Laboratories

The Sandia National Laboratories–Albuquerque (SNL) is located at the foot of the Manzano Mountains adjacent to the city of Albuquerque, New Mexico, and is essentially surrounded by Kirtland Air Force Base. A second smaller facility is located adjacent to LLNL in Livermore, California. Sandia has served as 1 of the major national defense research and development (R&D) laboratories since 1945. SNL scientists conduct large scale tests at the Tonopah Test Range and other areas of the Nevada Test Site. The site's nuclear weapons mission included design, development, and testing the command, control, and packaging components needed to make nuclear explosives useful weapons. The mission expanded to include support of the space program and work on other advanced military technologies, energy programs, arms verification, and control technology and applied research. Today, through science and technology, people, infrastructure, and partnerships, SNL's mission is to meet national needs in 4 key areas: nuclear weapons; nonproliferation and materials control; energy and critical infrastructure; and emerging threats.

Beryllium Operations

Beryllium components have also been fabricated to support a wide range of materials energy and physics research and development related and unrelated to nuclear weapons. A long history of materials and component research, development, and testing created a legacy of contaminated facilities and equipment that require management and remediation.

Savannah River Site

Site Description

The Savannah River Site (SRS) complex covers 198,344 acres (310 square miles) located approximately 25 miles southeast of Augusta, Georgia, in the state of South Carolina. It borders 27 miles of the Savannah River. SRS was built in the early 1950s to produce tritium and plutonium-239 nuclear materials. The original site had 5 nuclear reactors, 2 chemical-separation facilities, a heavy water extraction plant, a nuclear fuel and target fabrication plant, and support and waste management facilities. All reactors were shut down in 1991 when environmental remediation activities began. Currently, SRS is involved in nuclear materials stabilization, vitrification of nuclear waste, and radioactive operations at the Tritium Replacement Facility. DOE’s Savannah River Operations Office is responsible for oversight of the EM operations at SRS. Two other DOE offices, the Savannah River Site Office and the Office of Site Engineering and Construction Management oversee the missions supporting the DOE’s National Nuclear Security Administration (NNSA).

Beryllium Operations

Small quantities of copper beryllium alloys were used to fabricate electronic equipment and non-sparking tools to support SRS operations. Beryllium was also present in some materials irradiated in SRS production reactors.

Y-12 National Security Complex

Site Description

The Y-12 National Security Complex (Y-12) is located in Oak Ridge, Tennessee on 811 acres within the Oak Ridge Reservation. The site was established in 1943 to produce highly enriched uranium as part of the Manhattan Project. Enriched uranium production started in November 1943. At its peak during World War II, the plant employed approximately 22,000 workers. After World War II, the plant's focus changed to manufacturing components for nuclear weapons. For more than 50 years, the complex has been 1 of the manufacturing facilities in the DOE weapons complex. Every weapon in the stockpile has some components manufactured at Y-12.

Beryllium Operations

The primary beryllium operation at Y-12 has been the production of weapons components from beryllium oxide ceramics. Beryllium oxide powder is received, mixed with other materials, pressed into a shape, and fired in a kiln. The blank work piece is machined using diamond grinding tools. The operations are supported by quality assurance testing of the materials when they are received, and at various fabrication steps and by dimensional inspection of the finished products. Beryllium oxide ceramic components from retired weapons are returned to Y-12 for declassification and recycling of the materials. Y-12 also performs engineering research and development of new beryllium oxide ceramic manufacturing methods.

In the past, Y-12 operations produced beryllium metal components for nuclear weapons. The unique fabrication capabilities at Y-12 are used today to support energy and defense projects that include the use of beryllium metal, ceramics, and alloys. Remodeling, maintenance, and D&D projects on the site have required work on beryllium-contaminated facilities, utilities, and equipment.