Office of Independent Oversight
Office of Security and Safety Performance Assurance
U. S. Department of Energy

Independent Oversight Status Report

Implementation of 10 CFR Part 850, Chronic Beryllium Disease Prevention Program

February 2006

SSA

Office of Security and Safety Performance Assurance

OVERSIGHT

Table of Contents

Abbreviations Used in This Report

CBDPP	Chronic Beryllium Disease Prevention Program
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EFCOG	Energy Facility Contractors Group
EH	DOE Office of Environment, Safety and Health
ES&H	Environment, Safety, and Health
LANL	Los Alamos National Laboratory
NNSA	National Nuclear Security Administration
PPE	Personal Protective Equipment
Y-12	Y-12 National Security Complex

Executive Summary

The Office of Independent Oversight, within the Office of Security and Safety Performance Assurance, has responsibility for evaluating safeguards and security; cyber security; environment, safety, and health (ES&H); and emergency management programs across the U.S. Department of Energy (DOE) complex and reporting on their status to the Secretary of Energy, senior DOE management, and Congress. To facilitate improvements across the DOE complex, Independent Oversight selects focus areas—areas that warrant increased attention across the complex —based on a review of operating events and inspection results. Independent Oversight then evaluates those focus areas during its inspection of DOE sites for a period of time, typically one year, and reports on the status of the focus areas based on the results of its evaluations. This report provides the status of one of Independent Oversight's selected focus areas for 2005, specifically, implementation of the chronic beryllium disease prevention program (CBDPP).

DOE has established regulatory requirements for the CBDPP in 10 CFR Part 850, *Chronic Beryllium Disease Prevention Program.* This rule is intended to protect workers and prevent exposure to beryllium, establishes medical surveillance requirements to ensure early detection of chronic beryllium disease, provides for training to alert workers to the hazards associated with exposure to beryllium, and provides for reducing the number of workers currently exposed to beryllium in the workplace. DOE has also developed guidance (DOE Guide 440.1-7A) to assist line managers in meeting their CBDPP responsibilities.

During calendar year 2005, Independent Oversight evaluated CBDPPs at five DOE sites as part of its inspection program. At each of these sites, comprehensive programs that address the 10 CFR 850 requirements have been implemented, and Federal and contractor management roles and responsibilities for implementing the CBDPP program have been defined. Sites have devoted considerable resources to meeting the 10 CFR 850 requirements, including resources from the industrial hygiene, training, medical (for specific medical surveillance activities), and recordkeeping and reporting organizations, and have increased analytical laboratory support.

All of the evaluated sites have established formal programs and are in compliance with 10 CFR 850. In addition, very few breathing zone samples have been reported to contain elevated levels of beryllium, indicating that the program is effective in controlling airborne exposures. However, fully characterizing beryllium sources, identifying potential contamination sources, and ensuring that workers are protected from potential exposure are challenging tasks that require continued attention. DOE sites collect and analyze many surface samples, and new sources and locations of beryllium contamination are still being discovered. As a result, some workers continue to be inadvertently exposed to beryllium contamination from sources that have not yet been identified or controlled. In a few instances, beryllium contamination from DOE sites has migrated to offsite communities, either through offsite vendors and contractors that provide services to DOE sites, or through release of internally contaminated equipment.

This Independent Oversight report presents several opportunities for improvement that responsible site offices and contractor programs may apply to their CBDPP activities. Site contractors, DOE program offices, DOE field offices, and DOE Headquarters ES&H staff should review these opportunities for applicability and action.

This page intentionally left blank.

1.0 Introduction

During calendar year 2005, the Office of Independent Oversight, within the Office of Security and Safety Performance Assurance, evaluated the effectiveness of U.S. Department of Energy (DOE) chronic beryllium disease protection programs (CBDPPs) at five sites (shown in Table 1) as part of regularly scheduled inspections. These reviews focused on site programs for ensuring that workers are protected in accordance with the requirements of 10 CFR 850. This report summarizes the observations, insights, and lessons learned from these reviews and from the review of DOE requirements, guidance, and other supporting documents for these programs, including:

- Department of Energy, Chronic Beryllium Disease Prevention Program; Final Rule; 10 CFR 850 (December 8, 1999)

- Department of Energy, DOE Guide 440.1-7A, *Implementation Guide for use with 10 CFR Part 850, Chronic Beryllium Disease Prevention Program* (January 4, 2001).

Health hazards associated with the use of beryllium have been recognized and addressed by DOE safety professionals for many years. Beryllium contamination has been routinely sampled and analyzed at DOE sites since the early 1960s. In the intervening years, the health effects of exposure to beryllium, even at low concentrations, have become better understood. This increased awareness of the health effects of beryllium, combined with an increasing number of DOE workers who were identified as beryllium sensitized or having chronic beryllium disease, resulted in the development of formal requirements for controlling beryllium hazards at DOE sites. A DOE notice entitled *Interim Chronic Beryllium Disease Protection Program* was issued in 1997 to alert all DOE sites to the hazards associated with beryllium, and established basic requirements for identifying the presence of beryllium at DOE sites. It further established beryllium protection programs similar to what was later proposed in more detail in 10 CFR 850 (the "Beryllium Rule"). Following the 1997 notice, the formal CBDPP rule was developed in 1999, which specifically outlined requirements for the worker protection program and required formal program compliance by April 2000. In addition to the Beryllium Rule, beryllium program implementation guidance documents were developed by the DOE ES&H staff, with input from numerous experts throughout the beryllium industry and DOE contractors with previous beryllium work experience. During this period, DOE Headquarters also hosted multiple workshops to help define the requirements, share

Table 1. CBDPP Evaluation Sites

Safety Management Inspection Site	Headquarters Program Office
Pantex Plant	National Nuclear Security Administration (NNSA)
Argonne National Laboratory	Office of Science
Sandia National Laboratories	NNSA
Y-12 National Security Complex	NNSA
Los Alamos National Laboratory	NNSA

compliance techniques among contractor personnel, and provide lessons learned from all participants.

Although the level of manufacturing and tooling of beryllium components has declined since the early decades of the DOE weapons program, beryllium continues to be used throughout the DOE complex because of its favorable physical properties (strength, conductivity, and malleability). In addition to its use in weapons components, small amounts of beryllium are used by DOE sites in research instruments and as an alloy with copper and other metals in electronic circuit boards, capacitors, non-sparking tools, grinding wheels, welding rods, and metal alloys. Workers may be exposed to beryllium dust or oxides when handling, cutting, grinding, or polishing these components. In addition, in many DOE facilities, including machine shops, laboratories, and work spaces, some workers could be routinely exposed to low levels of legacy beryllium contamination.

2.0 Positive Attributes

The DOE Office of Environment, Safety and Health (EH) facilitates and supports enhanced compliance with 10 CFR 850 requirements. EH works with sites to better understand and solve problems related to 10 CFR 850 requirements and manage the beryllium registry. EH has also facilitated a longstanding beryllium working group to explore questions, suggest solutions, and provide guidance for the CBDPP. Updated information is provided by EH to the sites through publications, workshops, Energy Facility Contractors Group (EFCOG) conferences, the DOE worker ES&H response line (which is used to field questions on beryllium or other ES&H issues), and site visits. The Headquarters staff continues to support beryllium-related investigations, such as the investigation of a contaminated office building at the Nevada Test Site. EH also performs beryllium compliance assistance visits and has participated as beryllium subject matter experts on several site self-assessments. In addition, EH continues to keep current with beryllium research and issues through communication with other Federal agencies, beryllium industry officials, medical professionals, researchers, and analytical laboratories.

The DOE sites that were reviewed have established comprehensive and coordinated CBDPP policies, program plans, and procedures. Because 10 CFR 850 requires sites to establish a consolidated CBDPP, Federal staff and prime contractors need to coordinate their roles and responsibilities to ensure that all site workers are made aware of potential beryllium hazards and understand the appropriate protective measures for beryllium workers and the controls for all site workers. At all sites reviewed, Federal and contractor staff had coordinated their efforts effectively to establish and implement a CBDPP.

Contractor training staff, medical program staff, and analytical laboratory support staff interfaces with the CBDPP are generally effective at the sites that were reviewed. To be effective, a site's CBDPP needs support from a number of site programs. In general, training, medical, and analytical laboratory programs have been effectively integrated into the CBDPP at each of the sites that were visited. Training staff offer a variety of classroom options and techniques that provide the necessary awareness and safety training to protect workers. General employee training also provides relevant education for employees not working directly in beryllium areas. Medical personnel provide counseling, information, and support to beryllium workers; respect the voluntary requirements of the Federal code; and appropriately refer workers to external medical providers after suspected or confirmed illnesses. Analytical staff have processed thousands of samples and provided results to staff and workers in the ongoing attempts to identify and mitigate beryllium contamination incidents and suspected beryllium contamination areas.

The reduced need for beryllium operations and efforts to better contain the dispersion of beryllium dust and particles have reduced the number of workers at risk of exposure. At several sites, senior management decided to consolidate operations and support ongoing research in ways intended to contain dispersion of beryllium contamination. These efforts have been effective and continue to reduce the likelihood of exposure and the number of workers who could be exposed.

Site contractors continue to strive for improvements and innovations that will increase the effectiveness of the CBDPP. Several examples of effective practices observed by the Independent Oversight team are:

- The Y-12 National Security Complex (Y-12) has published site maps that graphically depict the location of current and legacy beryllium work and created beryllium buffer zones to alert employees to the presence of beryllium areas. Senior management has developed a process to justify and limit any increase in the number of beryllium workers needed at the site. Y-12 has also developed a facility fact sheet database to track the history and use of beryllium at all facilities.

- The Y-12 Site Office has used award fee incentive funding effectively to encourage the contractor to upgrade systems and clean up contaminated areas.

- The Los Alamos Site Office and Los Alamos National Laboratory (LANL) have established specific criteria for contractual performance measures that are tied directly to performance and keep the CBDPP visible and accountable through the laboratory's oversight process. LANL also has the first and only dedicated beryllium technology facility, which provides technical capabilities (e.g., nondestructive testing, analytical laboratories, a foundry, and other capabilities specifically designed to work with beryllium) to support defense programs and perform beryllium-related research and development.

- Pantex Plant senior management has accelerated legacy beryllium cleanup activities, reducing the cleanup schedule by several years, and has helped eliminate potential worker hazards. Management has also reduced the projected backlog of medical surveillance requests by several years so that all worker requests for beryllium-related medical surveillance are immediately processed.

- Sandia National Laboratories has initiated research to identify the sources of naturally occurring beryllium (versus operational sources of beryllium) that may collect on surfaces. The research should enable more effective allocation of funds for the most hazardous operational cleanup activities.

3.0 Weaknesses

Work control processes have not always adequately identified, analyzed, or controlled beryllium hazards in the workplace. Although beryllium controls are generally effective in addressing airborne beryllium hazards, the beryllium programs are not always sufficiently rigorous to address some other beryllium hazards, such as contamination. In addition, during the initial stages of beryllium program implementation, sites were required to characterize past and present beryllium usage and location. In some cases, the initial characterization was not comprehensive, and sites did not always adequately identify all potential sources of beryllium contamination. As a result, DOE sites are still encountering sources of beryllium contamination that are not sufficiently identified, analyzed, and controlled. For example, DOE sites occasionally identify legacy contamination that had not been recognized previously, or beryllium contamination that could spread when equipment or structures are moved, transferred, discarded, or destroyed. In some cases, sampling strategies have not been sufficient to identify beryllium contamination that has spread from nearby beryllium sources to areas that were assumed to be clean. A contributing factor is that ES&H professionals do not always adequately participate in hazards analyses, and line managers do not always recognize potential hazards before work starts. Another contributing factor is that lessons learned from these incidents often do not get communicated to line managers at other DOE sites. While EH has taken a number of actions to communicate beryllium information within the industrial hygiene community and to beryllium program managers (as discussed above), this information is not adequately communicated to facility-level managers at DOE sites, in part because sites have not sufficiently used the DOE lessons-learned process, which provides a mechanism to communicate information to a broad audience for review and development of actions as appropriate.

Research and development activities for beryllium work activities are insufficient to resolve worker safety and health issues in a timely manner. Numerous technical and medical research issues involving beryllium have been identified (e.g., the dispersal of beryllium contamination in work environments, beryllium sampling and analysis techniques, and diagnosis and treatment of beryllium disease); however, few of these research issues have been funded. Research funding to improve worker protection standards and methods has not been allocated by either Federal or beryllium industry officials. External reviews of research and analysis of beryllium data gathered from the beryllium registry have identified deficiencies in some areas, including incomplete data, late annual reports, and lack of reporting of data for the past two years.

Some workers continue to be stigmatized by participating in beryllium testing programs. Beryllium testing programs that lead to early detection of a worker's sensitivity to beryllium have many potential negative ramifications for employees in the areas of future employment, insurance considerations, compensation issues, and psychological stress. Many workers, especially those in the early stages of their careers, refuse beryllium lymphocyte proliferation testing because of these uncertainties and the fear of losing wages and insurance benefits. Compensation benefits may be difficult to obtain, and some states do not recognize a disease that has no specific symptoms or treatment, which may characterize early beryllium disease. Beryllium training programs adequately address a wide variety of health-related issues, including compensation following a positive diagnosis for sensitization or disease; however, most training does not clearly discuss an employee's decision to be initially tested.

Sites have not adequately addressed machinery and equipment that may have been contaminated with beryllium. At most sites that were reviewed, Independent Oversight identified equipment that had not been adequately sampled or characterized for potential beryllium contamination. In a number of cases, Independent Oversight found equipment, particularly machine shop equipment (lathes, mills, grinding/sanding machines), that may have been used for work with beryllium metal or beryllium-containing alloys. Such equipment can collect metal dust

and chips on its internal surfaces. This equipment is not routinely sampled but is frequently moved throughout the site facilities, possibly allowing sources of beryllium contamination to collect or sit for years without detection. Further, if the machine needs repair or becomes excess equipment, it could inadvertently spread this contamination to the community or some other external resource. In many cases, even when the sampling programs include the surface of equipment, there are no provisions for internal sampling, and therefore problems might occur when equipment is disassembled.

4.0 Overall Assessment

Overall, DOE and site contractors responsible for implementing site-level beryllium protection programs in accordance with 10 CFR 850 have been effective in identifying, analyzing, and controlling airborne beryllium hazards. Considerable resources and effort have been expended to document programs; characterize, inventory, and sample numerous locations; create training programs; arrange for medical surveillance; create recordkeeping and reporting systems; and provide analytical support. The CBDPP is an active and highly visible program at DOE Headquarters, the DOE site offices, and contractor organizations. To varying extents, the sites that were reviewed have established formal CBDPP policies and procedures that address the 40 elements of the Beryllium Rule. Protocols for creating the initial site characterization, inventory, worker rosters, training modules, and surveillance programs are generally in place and effective. Annual reviews of the CBDPP and the required performance feedback activities have been completed and include the monitoring and analysis of sampling results, incidents/accidents, medical surveillance outcomes, and the number of workers in the beryllium worker program. Typically, each site has collected and analyzed numerous beryllium samples, with some sites averaging 15 to 20 thousand beryllium samples each year (mostly surface samples). All of the sites that were reviewed have implemented strict beryllium worker protection procedures, such as mandatory personal protective equipment (PPE) for beryllium-controlled areas. One example of highly controlled and monitored work is the beryllium machining at LANL's Beryllium Technology Facility, where each worker is continuously monitored for airborne levels of beryllium dust.

Although the formal structure, documentation, and oversight of the CBDPP are in place at the sites that were reviewed, new sources of beryllium contamination at DOE sites continue to be found. In some cases, the new sources of beryllium are associated with production or research activities (e.g., beryllium in welding rods, or beryllium targets in research apparatus). Other new sources include beryllium contamination from former work sites that were not identified during the initial site beryllium characterization programs. This legacy beryllium contamination is a continual challenge because workers are exposed to low levels of surface beryllium contamination, some of which may inadvertently be released off site through laundry, equipment vendors, scrap, or excess property items. On several occasions, Independent Oversight identified beryllium contamination in areas that had not been suspected of being contaminated, such as in machine shop equipment that had been previously contaminated with beryllium. In one case, the lack of a robust sampling strategy failed to identify beryllium contamination on the external surfaces of a glovebox. In another case, workers who were not in the beryllium worker program entered potentially contaminated beryllium work areas. In addition, some workers were observed handling beryllium articles or beryllium-contaminated equipment without the appropriate PPE, or conducting destructive tests on beryllium components without sufficient confinement of the beryllium dust.

Site personnel recognize that providing beryllium worker protection is a complex and challenging task because of the physical size of DOE sites, the variety of beryllium applications (production and research), the widespread legacy sources of beryllium from former weapons operations at many sites, and the ongoing shifts in mission activities. The CBDPP programs are a high management priority and currently receive good management support. When weaknesses are identified, site management typically takes aggressive actions to address the deficient condition. However, addressing beryllium contamination is a complex challenge, particularly for legacy contamination (e.g., the history of beryllium usage is not always well documented, and contamination may have been spread through the past transfer of internally contaminated equipment from location to location over a period of many years). At each

site reviewed, Independent Oversight identified instances where sources of beryllium still have not been identified, where sampling strategies have not been effective, or where hazards have not been identified or adequately analyzed during work planning. In some cases, ES&H professionals could have helped identify and address such deficiencies had they been more involved during work planning efforts and/or when plant conditions changed (e.g., when equipment was moved or buildings were reconfigured). In addition, workers are not always sufficiently informed through training or counseling to make informed decisions about the benefits or risks associated with participating in medical testing programs that are aimed at early detection of beryllium sensitization or disease.

Continued improvements and management attention are needed in the implementation of site beryllium programs, DOE lessons-learned programs, cleanup of legacy contamination, and site-specific communication to more effectively identify legacy and new sources of beryllium. In addition, sites would benefit from more guidance and assistance from the research community in the areas of sampling strategies, analytical effectiveness, detection methods, and other guidance to reduce unnecessary surveillance.

5.0 Opportunities for Improvement

Site contractors, DOE program offices, DOE field offices, and Headquarters ES&H staff should review the following opportunities for applicability and action.

Office of Environment, Safety and Health

1. **Increase the opportunities and resources for research and development related to beryllium protection.** The DOE research agenda should consider including specific areas of study and analysis relevant to beryllium protection programs, such as:

   - A reliable national standard for beryllium oxide analysis/digestion that can be used by all analytical laboratories
   - The effects of beryllium surface contamination on workers, including particle size and the potential to absorb beryllium particles through the skin or other non-respiratory routes
   - The correlation between loose surface beryllium contamination levels and inhalation exposures
   - The effects of beryllium exposure from routine environmental sources and the frequency of chronic beryllium disease in a random population
   - Sampling strategy and detection of small quantities of beryllium contamination
   - The effectiveness of the lymphocyte proliferation testing, and research into new, more effective methods for determining sensitivity or disease in a host
   - The health effects of beryllium exposures and the correlation of exposure data to incidence of beryllium sensitization and/or beryllium disease.

2. **Increase emphasis on communication of lessons learned in publications and workshops to inform DOE and contractor site management.**

3. **Evaluate the factors that are causing employees to be stigmatized and to refuse initial testing, and determine whether changes to retention or compensation policies are needed.**

DOE/NNSA Line Organizations (Program Offices and Field Elements) and Site Contractors

1. **Improve communication of beryllium lessons learned.** Specific actions to consider include:

   - Establish and communicate management expectations to communicate information concerning beryllium-related weaknesses and issues throughout the DOE complex.
   - Routinely use the lessons-learned process and other sources of information exchange to share information about deficiencies and events, as well as innovative approaches and techniques that have proven successful, with other facilities and sites.
   - Incorporate lessons learned in EFCOG conferences, workshops, and publications.

2. **Increase rigor in the identification, analysis, and control of beryllium-contaminated legacy areas.** Specific actions to consider include:

- Establish processes for reviewing and sampling areas and equipment that could be internally contaminated, particularly machine shops and machine shop equipment.

  - Identify conditions that would trigger sampling of equipment that could be internally contaminated (e.g., before discarding surplus equipment and before using, moving, or disassembling equipment that may have been used for beryllium work in the past).

  - Include relevant information in the next revision of beryllium program guidance documents.

- Institute an accelerated cleanup schedule for areas of identified legacy beryllium contamination that could inadvertently expose employees, and identify and allocate needed resources for timely cleanup.

3. **Establish processes and thresholds for involvement of ES&H professionals in work planning and during the planning stages of activities that could involve new sources of beryllium or movement of beryllium-contaminated equipment (e.g., modifications to facilities or disposition of surplus equipment).**

4. **Ensure that managers responsible for CBDPPs monitor medical surveillance program data, training protocols, and critiques following potential beryllium exposures to determine whether sufficient information is provided to workers who need to make decisions about beryllium testing.** Although training programs provide quality information concerning beryllium health effects and compensation following a specific diagnosis, little information is provided to help employees decide whether beryllium testing should be considered.