# NOTICE OF PROPOSED RULEMAKING FOR

# 10 CFR PART 850

# CHRONIC BERYLLIUM DISEASE

# PREVENTION PROGRAM

# ECONOMIC ASSESSMENT

**OFFICE OF ENVIRONMENT, HEALTH, SAFETY AND SECURITY**
**OFFICE OF HEALTH AND SAFETY**
**OFFICE OF WORKER SAFETY AND HEALTH POLICY**

**JANUARY 2016**

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| | |
|---|---|
| ACGIH | American Conference of Industrial Hygienists |
| AEC | Atomic Energy Commission |
| ANL | Argonne National Laboratory |
| AU | Office of Environment, Health, Safety and Security |
| BAWs | Beryllium Associated Workers |
| BEA | Battelle Energy Alliance |
| BeLPT | Beryllium Lymphocyte Proliferation Test |
| BLS | Bureau of Labor Statistics |
| BeS | Beryllium Sensitization or Sensitivity |
| BNI | Bechtel National, Inc. |
| BNL | Brookhaven National Laboratory |
| BSA | Brookhaven Science Associates |
| BWCS | Babcock & Wilcox Conversion Services |
| BWs | Beryllium Workers |
| CBD | Chronic Beryllium Disease |
| CBDPP | Chronic Beryllium Disease Prevention Program |
| CHPRC | CH2M HILL Plateau Remediation Company |
| CPI | Consumer Price Index |
| CSC HOHS | Computer Sciences Corporation/ Hanford Occupational Health Services |
| D&D | Decommissioning and Decontaminating |
| DOE | Department of Energy |
| EAQ | Economic Assessment Questionnaire |
| EO | Executive Order |
| EPA | Environmental Protection Agency |
| FBP | Fluor-B&W Portsmouth |
| GDP | Gross Domestic Product |
| HSS | Office of Health, Safety and Security |
| IARC | International Agency for Research on Cancer |
| ICP | Idaho Cleanup Project |
| IH | Industrial Hygiene |
| INL | Idaho National Laboratory |
| IPF | Inhalable Particulate Fraction |
| ITG | Idaho Treatment Group |
| KAPL | Knolls Atomic Power Laboratory |
| KCP | Kansas City Plant |
| LANL | Los Alamos National Laboratory |
| LATA | Los Alamos Technical Associates |
| LBNL | Lawrence Berkeley National Laboratory |
| LLNL | Lawrence Livermore National Laboratory |
| MSA | Mission Support Alliance |
| NEV | Nevada Operations Office |
| NIOSH | National Institute for Occupational Safety and Health |
| NNSS | National Nuclear Security Site |

| | |
|---|---|
| NOPR | Notice of Proposed Rulemaking |
| NTP | National Toxicology Program |
| OMB | Office of Management and Budget |
| ORISE | Oak Ridge Institute for Science and Education |
| ORNL | Oak Ridge National Laboratory |
| OSHA | Occupational Safety and Health Administration |
| PEL | Permissible Exposure Limit |
| PNNL | Pacific Northwest National Laboratory |
| PPE | Personal Protective Equipment |
| R&D | Research and Development |
| RFA | Regulatory Flexibility Act |
| SBREFA | Small Business Regulatory Enforcement Act |
| SEC | Safety and Ecology Corporation |
| SLAC | Stanford Linear Accelerator Center |
| SNL | Sandia National Laboratory |
| SRS | Savannah River Site |
| SST | Swift & Staley |
| TA4 | Technical Area Four |
| TPF | Total Particulate Fraction |
| TWA | Time-Weighted Average |
| UCOR | URS/CH2M Oak Ridge |
| UTB | University of Tennessee-Battelle |
| WAI | Wastren Advantage, Inc. |
| WCH | Washington Closure Hanford |
| WEMS | Wastren EnergX Mission Support |
| WRPS | Washington River Protection Solutions |

# EXECUTIVE SUMMARY

Beryllium is a silver-gray metal that is characterized by high tensile strength, light weight, and high resistance to corrosion. Because of these properties, the U.S. Department of Energy (DOE, or the Department) and its contractors have used beryllium metal and ceramics in nuclear weapons, as nuclear reactor moderators or reflectors, and as nuclear reactor fuel element cladding. At DOE, beryllium operations have historically included foundry (melting and molding), grinding, and machine tooling of parts.

The use of beryllium is associated with potential health problems in workers exposed to beryllium dust. Specifically, inhalation of beryllium dust can lead to beryllium sensitization (BeS), which is an allergic reaction to beryllium in the blood that may progress to chronic beryllium disease (CBD), a chronic lung disease.

DOE Federal and DOE contractor employees at DOE sites who might be exposed or potentially exposed to beryllium include beryllium workers and beryllium associated workers. As defined in the proposed rule, beryllium workers are current workers exposed or potentially exposed to levels of beryllium at or above the action level in the course of the worker's employment in a DOE beryllium activity at a DOE site. Beryllium-associated workers are current workers who were previously exposed or potentially exposed to airborne concentrations of beryllium at a DOE site (based on either, their work history, signs and symptoms of beryllium exposure, or receipt of medical removal benefits due to beryllium exposure).

DOE's Former Worker Medical Screening Program provides ongoing medical screening examinations, to former DOE Federal, contractor, and subcontractor workers from all DOE sites, as well as former workers from its predecessor Agencies (DOE, 2014). This program covers occupational exposures to beryllium, as well as other occupational hazards (such as radiation,

asbestos, lasers, silica, lead, cadmium, chromium, solvents, noise, etc.) One of the tests included is a Beryllium Lymphocyte Proliferation Tests (BeLPT), a blood test for beryllium sensitization. In addition to an initial BeLPT screening, former workers are entitled to a re-screen three years after their initial medical screening and every three years thereafter (DOE, 2014). As of September 2014, the DOE Former Worker Medical Screening Program has provided initial BeLPTs to 64,645 current and former DOE and DOE contractor employees. Of those, 823 had one abnormal BeLPT during their initial screening exam; 620 had two abnormal BeLPTs during their initial screening exam; and 223 had one abnormal and one+ borderline BeLPT during their initial screening exam (DOE, 2014). Of the 64,645 former DOE and DOE contractor employees initially screened, 17,496 were also re-screened. Of those rescreened, 139 had one abnormal BeLPT, 163 had two abnormal BeLPTs, and 71 had one abnormal and one+ borderline BeLPT (DOE, 2014). Individuals with one abnormal BeLPT were encouraged to file a claim with the Department of Labor's Energy Employees Occupational Illness Compensation Program (Preamble).

The final rule, as issued in December 1999, established the Beryllium-Associated Worker Registry (the Beryllium Registry) to gather beryllium task, exposure, and health data for use in identifying trends that inform DOE in how to continuously improve the Department's Chronic Beryllium Disease Prevention Program (CBDPP). Unlike the Former Worker Medical Screening Program, which covers occupational exposures to multiple substances, the Beryllium Registry is limited to individuals potentially at risk for chronic beryllium disease (CBD) due to their work at DOE sites (DOE, 2013b). In 2002, employers began submitting data to the Registry. As of December 2013, a total of 29,869 current beryllium and beryllium-associated workers are listed in the Beryllium Registry. Of those beryllium and beryllium-associated workers, 21,921 (71%)

had been screened using BeLPT and 8,416 (28 percent) were not screened. Of the workers screened, 20,900 (97 percent) had normal results while 553 (3 percent) had abnormal results. Of the 553 workers with abnormal results, 407 (74 percent) had BeS and 146 (26 percent) had CBD (U.S. DOE, 2013b).

The current worker protection permissible exposure limit (PEL) of 2 $\mu g/m^3$, measured as an 8-hour, time-weighted average (TWA), was adopted by the Occupational Safety and Health Administration (OSHA) in 1971 and codified in 29 CFR 1910.1000, Tables Z-1 and Z-2, by reference to existing national consensus standards. One of DOE's predecessor agencies, the Atomic Energy Commission (AEC), had previously established the same 2 $\mu g/m^3$ limit at its sites in 1949, and that limit has remained in effect at DOE's sites up to the present. In 1977, the National Institute for Occupational Safety and Health (NIOSH) classified beryllium as a potential occupational carcinogen. Between the 1970s and 1984, there was a significant reduction in the incidence rate of CBD in the workplace. Because CBD has a long latency period, this led to the assumption that CBD was occurring only among workers who had been exposed to high levels of beryllium decades earlier. However, DOE medical screening programs are continuing to diagnose cases of CBD among workers employed at DOE sites where exposures to beryllium are complying with the existing OSHA PEL of 2 $\mu g/m^3$, as well as operating with an action level that triggers certain mandatory protection elements when exceeded (DOE, 2013).

In response to the apparent residual health risks to workers, DOE published 10 CFR 850 in December 1999 (64 FR 68854). 10 CFR 850 established the CBDPP for DOE sites and an action level of 0.2 $\mu g/m^3$ which triggered certain protective measures and controls designed to protect workers from exposures to beryllium. The CBDPP included regular reporting on

exposed and potentially exposed workers to the Beryllium Registry. Since 2002, the Beryllium Registry has compiled records for 29,869 DOE workers which have been reported by sites in accordance with 10 CFR 850 (U.S. DOE, 2014). The number of new cases of CBD has declined since the 1999 rule (with no new cases diagnosed in 2013 (DOE, 2013), but BeS continues. In response to nearly 15 years of data collected from its contractors and relevant research that has been published since 1999, DOE is proposing to amend 10 CFR 850.

The proposed rule continues to be designed to minimize the number of workers exposed to beryllium and further reduce worker exposures in the DOE complex. This report includes the economic assessment for the proposed rule, fulfilling four requirements:

- *Executive Order (EO) 12866 – EO 12866 requires federal agencies issuing rules to evaluate the costs, benefits, and economic impacts of the rule.*
- *EO 13563 – EO 13563 requires federal agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible.*
- *The Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Act (SBREFA) – Federal agencies are required to review rules for potentially significant impacts on small entities.*
- *The Unfunded Mandates Reform Act – Federal agencies are required to determine if rules will impose unfunded mandates on state and local governments.*

Before conducting these analyses, DOE profiled the sites and activities and estimated the number of workers that would be affected by the proposed CBDPP rule (Section 2). DOE estimates that 20,293 workers may have been or may be exposed or potentially exposed in the DOE complex. Based on exposure monitoring data submitted to the Beryllium Registry, DOE

estimates that 1,261 of these workers are potentially exposed above the proposed action level (0.05 $\mu g/m^3$) or PEL prescribed in the CBDPP rule.

DOE estimated the compliance costs of the proposed CBDPP rule (Section 3). These costs were estimated using data from the 1999 Economic Analysis, Beryllium Registry, and an Economic Assessment Questionnaire (EAQ), a questionnaire administered by DOE to the DOE sites potentially affected by this proposed rule in order to solicit the cost and other impacts of the rule. The proposed rule is estimated to cost from $13.6 million to $17.2 million (annualized first year costs plus annual costs in 2014 dollars, using a 7 percent discount rate and a 10 year period lifetime of investment). This includes first year costs of $41.4 million to $42.7 million, of which $7.8 million to $11.2 million are annually recurring costs. In addition, DOE expected sites would experience cost-savings attributable to minor changes and clarifications in the proposed CBDPP rule. These savings were not quantified due to the difficulty of communicating minor technical changes to the rule without providing the proposed regulatory text to the contractors, although the EA solicited qualitative information on whether they expected to experience cost-savings. DOE expects that other minor revisions not addressed in the EAQ may produce minor cost-savings to DOE, its contractors, and affected workers.

DOE recognizes that the proposed CBDPP rule will affect contractors at DOE sites rather than firms that compete in private markets. The contractor's contractual agreement with DOE means that the costs for complying with the proposed rule will ultimately be passed through to DOE in the form of higher costs of its contracts.

The proposed CBDPP rule would also result in substantial cost savings and benefits for DOE, DOE contractors, and workers. Although DOE has not conducted a quantitative analysis of the benefits of the revisions, DOE anticipates some areas where benefits are expected:

- *Reduced medical costs.*
- *Reduced mortality.*
- *Increased quality of life.*
- *Increased medical surveillance for workers at risk.*
- *Increased work-life for beryllium workers.*
- *Reduced confusion and dispute over the legal liability of DOE and DOE contractors.*
- *Reduced restrictions and costs for the release and transfer of equipment or areas with potential beryllium contamination.*
- *Reduced control of areas where contamination is a result of naturally high levels of beryllium in the soil or surrounding environment.*
- *Reduced turnaround time for sample analysis due to the use of portable laboratories.*
- *Reduced medical costs for periodic evaluations due to the Site Occupational Medicine Director's ability to judge that certain medical tests may be unnecessary for some workers.*

Because sufficient information on the dose-response relationship for beryllium is not available within the scientific community, DOE could not relate reduced levels of exposure to a specific reduction in CBD and beryllium sensitization.

Pursuant to the RFA and the SBREFA, DOE assessed the small business impacts of the proposed CBDPP rule (Section 6.1). Information collected indicates no small businesses performing beryllium-related work at the affected sites would be impacted by the proposed amendments. DOE also reviewed the proposed amendments for unfunded mandates that may be imposed on state and local government (Section 6.2). This review indicates that no unfunded mandates will be imposed on state or local governments.

## 1. INTRODUCTION

Beryllium is a light-weight, silver-gray metal characterized by high tensile strength and high resistance to corrosion. Because of these properties, DOE and its contractors have used beryllium metal and ceramics in nuclear weapons, as nuclear reactor moderators or reflectors, and as nuclear reactor fuel element cladding. At DOE installations, beryllium operations have included foundry (melting and molding), grinding, and machine tooling of parts.

Potential health problems are associated with workers' exposure to beryllium dust. Specifically, inhalation of beryllium dust can lead to BeS (an allergic reaction to beryllium in the blood) which may progress to CBD, a chronic lung disease. The current PEL of 2 $\mu g/m^3$, measured as an 8-hour TWA, was adopted by OSHA in 1971 and codified in 29 CFR 1910.1000, Tables Z-1 and Z-2 by reference to existing national consensus standards. One of DOE's predecessor agencies, the AEC, had previously established the same limit, 2 $\mu g/m^3$, for its facilities in 1949, and that limit remains in effect at DOE's facilities. In 1977, NIOSH classified beryllium as a potential occupational carcinogen. Between the 1970s and 1984, there was a significant reduction in the incidence rate of CBD in the workplace. Coupled with its long latency period, this led to the inference that CBD was occurring only among workers who had been exposed to high levels of beryllium decades earlier. However, DOE medical screening programs are continuing to discover cases of CBD among workers employed at DOE facilities that (presumably) have maintained worker exposures to beryllium below the OSHA PEL, as well as operating with an action level that triggers certain mandatory protection elements when exceeded.

Data have suggested that CBD can be associated with lower exposure levels and briefer periods of exposure than previously thought (Stange et al., 2001). The NTP, the IARC, and the ACGIH classify beryllium as a human carcinogen (NTP, 2011).

In response to the apparent residual health risks to workers, DOE published 10 CFR 850 in December 1999 (64 FR 68854). 10 CFR 850 established the CBDPP for DOE sites and an action level of 0.2 $\mu g/m^3$. The CBDPP included regular reporting on exposed and potentially exposed workers to the Beryllium Registry. Since 2002, the Beryllium Registry has compiled medical records for 21,453 DOE workers reported to them by sites in accordance with 10 CFR 850. The number of new cases of CBD has declined since the 1999 rule (with no new cases diagnosed in 2013 (DOE, 2013), but BeS continues. In response to over 12 years of data collected by DOE contractors and to relevant research published since 1999, the Department is proposing to amend 10 CFR 850.

### 1.1 HEALTH-RELATED JUSTIFICATION FOR THE PROPOSED CBDPP RULE

The Department is proposing to amend this rule to protect the health of workers involved in beryllium-related work or exposed to legacy contamination during non-beryllium related work in the DOE complex. Beryllium is a toxic chemical associated with a number of adverse health effects:

- *Acute Beryllium Disease – An acute, beryllium-induced, pulmonary disorder caused by exposure to high levels of soluble forms of beryllium.*
- *Beryllium sensitivity – An allergic reaction caused by exposure to insoluble forms of beryllium.*
- *Chronic Beryllium Disease (CBD) – A granulomatous lung disease caused by a delayed hypersensitivity response to beryllium in the lung.*

- *Lung cancer – A cancerous growth in the lungs caused by high levels of exposure to beryllium (e.g., above 100 µg/m$^3$).*

Of the five preceding adverse health effects, CBD currently poses the greatest risk to workers in the DOE complex (Kreiss et al., 1993a; Stange et al., 1996; Barnard et al., 1996). Acute Beryllium Disease and lung cancer are caused by high exposures which have become less common in industry since the implementation of the OSHA PEL in 1971. Also, Acute Beryllium Disease is caused by exposure to *soluble* forms of beryllium, which DOE believes are not commonly used at its sites. Skin lesions, while a legitimate health concern of beryllium exposure, are a less serious concern than others.[1] The majority of DOE sites are performing Decommissioning and Decontaminating (D&D) of facilities that historically contained beryllium-processing operations, as opposed to actively processing beryllium. Therefore, beryllium exposures at these sites are unlikely to reach levels that would put workers at risk for acute beryllium disease or lung cancer. CBD, therefore, is the greatest beryllium-related risk for workers in the DOE complex and is the focus of the following discussion.

Exposure to beryllium dust and fibers can occur in several activities in the DOE complex. Processing beryllium into useful products usually creates dust or particles that can be airborne and inhaled by workers. A number of DOE operations create beryllium dust:

- *Machining beryllium or beryllium objects.*
- *Manufacturing beryllium objects.*
- *Processing beryllium objects.*
- *Laboratory use of beryllium.*

[1] Nevertheless, the rule imposes requirements that protect against dermal exposure to reduce the incidence of skin lesions.

- *Industrial hygiene (IH) work related to beryllium monitoring (e.g., taking area samples or swipe samples in beryllium-contaminated areas).*
- *D&D of beryllium-contaminated workplaces.*
- *Maintenance or housekeeping in beryllium-contaminated areas.*

Workers involved in these operations are at risk of inhaling beryllium. Additionally, beryllium dust can settle on table surfaces, equipment, clothing, paper, ventilation filters, etc. If disturbed, these fibers can become re-entrained and potentially inhaled by workers or other exposed individuals.

Inhalation of beryllium dust and fibers can lead to the development of CBD. Before the onset of CBD, workers that have inhaled beryllium dust or fibers generally become sensitized to beryllium (Eisenbud and Lisson, 1983; Newman et al., 1992, 1996). Sensitization is characterized by an allergic reaction to beryllium in the worker's blood. While some research has shown that approximately 1 percent to 16 percent of workers exposed to beryllium become sensitized (Newman et al., 1996), most studies estimate the prevalence at 1 to 3 percent (ES&H, 1995; Eisenbud and Lisson, 1983; Kreiss et al., 1993a, b; Stange et al., 1996). Among workers exposed to beryllium, sensitized workers are at greater risk of developing CBD (Eisenbud and Lisson, 1983; Kreiss et al. 1993a, 1993b; Newman et al., 1992, 1996). Symptoms of CBD include:

- *Shortness of breath.*
- *Multiple lung scars visible on chest X-rays.*
- *Granulomatous scars found through lung biopsy.*
- *Abnormalities in pulmonary function tests.*
- *Abnormal lung sounds heard with a stethoscope.*

The time from first beryllium exposure to the development of CBD symptoms averages ten years, although reported exposure times among diagnosed patients range from a few months to nearly 40 years. There is no cure for CBD; symptomatic workers are typically treated with steroids. Some individuals with CBD may require oxygen support to sustain pulmonary function. Steenland and Ward (1991) report that 57 percent of workers with CBD die of beryllium-related diseases.

In 1987, the National Jewish Center and DOE began to screen workers for BeS with a new test: the beryllium-induced lymphocyte proliferation test (BeLPT). The BeLPT enables health professionals to make subclinical diagnoses of BeS, thereby increasing the accuracy and timeliness of that diagnosis (Newman et al., 1996; Rossman, 1996). The BeLPT can be performed on *in vitro* blood samples or on lung fluid samples obtained by bronchoalveolar lavage (BAL). Clinical trials have shown both methods to be accurate for diagnosing BeS (Rossman et al., 1988; Newman et al., 1989; Rossman, 1996), but the *in vitro* blood test is less intrusive and has therefore proven to be more acceptable as a screening tool (Kreiss et al., 1989; Mroz et al., 1991; Newman, 1996; Rossman, 1996). Individuals identified as BeS can then undergo more extensive clinical evaluation, including the BAL BeLPT to be tested for CBD. Thus, instead of waiting until workers develop CBD symptoms, the BeLPT enables health professionals to determine which workers are BeS and are therefore at greater risk of developing CBD.

The continued diagnosis of CBD and BeS among workers in the DOE complex in 2010 and 2011 has led DOE to consider the likelihood that the current standard is not protective enough and that amendments to the rule are necessary. Although DOE is continuing to de-emphasize the nuclear weapons program, DOE expects to continue using beryllium in some of its industrial,

aerospace, and research and development projects because of its unique combination of properties in these applications. DOE is also decontaminating and decommissioning an increasing number of facilities at DOE sites scheduled for demolition or conversion to other uses (U.S. DOE OEM, 1996, resulting in unanticipated beryllium exposures to the D&D workers account for much of the risk for BeS and CBD in the DOE complex. Thus, the continued use of beryllium in industrial and aerospace applications, combined with the volume of D&D work, has increased the number of operations potentially exposing workers to beryllium. Hence, beryllium continues to pose a significant health threat to DOE employees and contractors. More recently identified cases of CBD and BeS appear to have resulted from incidental exposures well below the current standard, and DOE believes that lower-level exposures present a significant health risk (Redlich and Welch, 2008; Rosenman et al., 2005; Chronic Beryllium Disease Prevention Program, 1999). Based on these observations, DOE is proposing to amend its current rule to prevent the occurrence of CBD among the Department's workforce through more aggressive exposure reduction efforts.

### 1.2 BERYLLIUM EXPOSURE AND MARKET FAILURE

The U.S. Office of Management and Budget (OMB) has stated that a federal agency action, such as a rulemaking, should be taken only in cases of a significant market failure (OMB, 1996). A market failure occurs when the results of the operation of a free market (in the present case, the working conditions at DOE sites) can be improved.[2] A market failure is *significant* when non-governmental mechanisms (e.g., negotiation among interested parties) cannot ameliorate the failure. OMB (1996) identified four types of market failures: externalities, natural monopolies,

[2] An improvement can occur if the result can be changed to make at least one market participant better off, while making no one else worse off. In economics, a market result is said to be *Pareto optimal* if no one can be made better off without making someone else worse off. Market failures result in situations that are not Pareto optimal.

excessive market power, and inadequate or asymmetric information. Beryllium exposure in the DOE workplace and the consequent risk of disease exemplify market failure due to inadequate information. The lack of information leads to an inefficient allocation of the risk associated with beryllium-related disease.

It should be noted that this is not a case of asymmetric information; if it were, one party (e.g., DOE and its contractors) would have the information while another party (e.g., workers) would not. As discussed below, however, the market fails to allocate compensation for beryllium-related risk because neither workers nor their employers have the necessary information. Thus, the absence of information creates a failure in the market for DOE workers exposed to beryllium. The remainder of this section elaborates on this point.

Workers exposed to beryllium risk developing CBD. If workers and their employers had complete and accurate information about (1) the risk of developing CBD and (2) each other's preferences, then wages would act as an efficient allocation mechanism. Given a wage rate and a risk of developing CBD, only the workers who are willing to accept the risk at the given wage rate would elect to perform beryllium-related work. Clearly, this places a strong informational requirement on the market. First, workers and employers must know with certainty the risk and costs of developing CBD. Second, workers and employers must be able to tell what the other is willing to accept in terms of wages and risk. Recent evidence suggests that the first informational requirement is very unlikely to be satisfied at present; the second requirement is also likely to remain unsatisfied.

Although the adverse health effects of beryllium have been recognized since the early 1940s (Eisenbud and Lisson, 1983), CBD is still not well understood by the medical community, and much less so by the average worker (Jameson, 1996). Several studies have been conducted on

the health effects of beryllium exposure, but a definitive dose-response relationship has not been established (Kreiss et al., 1993a, 1993b, 1996; Stange et al., 1996; Barnard et al., 1996). Furthermore, cases of CBD and BeS have occurred in workers believed to have been exposed at levels below the OSHA 8-hour TWA PEL (2µg/ $m^3$) (Rosenman et al., 2005). Finally, the effect of particle size on the risk of CBD is still being addressed in research; no definitive results have been reported. From a medical perspective, defining the health risk of performing a specific beryllium-related job or task is problematical.

For wages to act as an efficient allocation mechanism, it is necessary to define the set of workers incurring risk, i.e., all workers who risk developing CBD must know they face that risk. Given the cases of CBD and BeS among individuals thought to have had only incidental contact with beryllium (e.g., secretaries, clerical staff), meeting this condition is also problematical. Before these cases were identified, only workers who were directly involved in beryllium-related work were believed to risk developing CBD, and the risk was believed to be small. Cases of beryllium-related disease among workers having had only incidental exposure suggest that more workers are at risk than was originally perceived.

While wages are generally the preferred allocation mechanism in the labor market, other mechanisms can allocate the risk of CBD. The tort system is one such mechanism. Monetary losses stemming from lawsuits for worker exposure to beryllium can act as an incentive to provide a safe and healthful working environment. As with wages, however, the lack of perfect knowledge regarding the risk of developing CBD—along with the uncertainties inherent in the tort system itself—suggest that the tort system may not be an efficient allocation mechanism for beryllium-related risk.

Another theoretical allocation mechanism is the use of insurance to hedge against the possibility of developing CBD in the future.[3] Theoretically, workers would buy enough coverage so that if they contracted CBD, the compensation from the insurance provider would render them no worse off financially than if they had not contracted CBD.[4] However, this type of insurance is not available, and a market for CBD insurance is not likely to develop because of the uncertainties surrounding the risk of developing CBD and because accurately calculating the value of avoiding CBD (i.e., suitable payments to workers who develop CBD) is highly problematical.

Based on the preceding considerations, beryllium exposure at DOE sites can be considered a market failure. The failure occurs because both workers and employers lack information about the risk of developing CBD. This lack of information cannot be resolved through simple negotiation or other non-governmental allocation mechanisms. DOE believes these proposed rule would further alleviate this market failure by enhancing protection of workers exposed to beryllium at DOE sites.

### 1.3 Overview of the Economic Assessment

This report fulfills the requirements of a number of Executive Orders and public laws, including:

- *Executive Order (EO) 12866 and 13563, Regulatory Planning and Review.*
- *The Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Act (SBREFA).*
- *The Unfunded Mandates Reform Act.*

[3] This potential allocation mechanism may be more of a theoretical construction than a real-life possibility.
[4] Insurance of this type is different than health insurance that covers the medical costs of illness. This type of insurance would provide a payment to the worker to compensate him/her for contracting CBD.

The remainder of this section discusses the analyses required by each of the above orders and laws and how this report fulfills these requirements.

### 1.3.1 Executive Order 12866 and 13563

Executive Order 12866 requires federal agencies to conduct economic analyses of significant regulatory actions. DOE has determined that the proposed CBDPP rule constitutes a regulatory action that should be subject to review under EO 12866. EO 13563 requires federal agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. Pursuant to this, DOE conducted the following analyses:

- *Estimated the incremental compliance costs (Section 3).*
- *Evaluated the benefits of reducing beryllium exposure (Section 5).*

In Section 2, DOE provides a profile of the affected sites and activities.

### 1.3.2 Small Business Analysis

The purpose of the RFA and its subsequent amendment in SBREFA is to ensure that federal regulations do not unduly burden small entities, including small businesses, small governments, and small nonprofit organizations.[5] Federal departments or agencies issuing rules are required to assess the likely effect of the rule on small entities. If the rule is deemed to have a *significant* effect on a *substantial* number of small entities, then the department or agency must conduct further analyses to identify alternative, less costly approaches to the requirements of the rule. DOE conducted an analysis of the impacts that the proposed CBDPP rule would have on small businesses. This analysis is presented in Section 6.1.

[5] The proposed CBDPP rule potentially has an effect on small businesses but not small governments or small non-profit organizations.

### 1.3.3 Unfunded Mandates Analysis

The purpose of the Unfunded Mandates Reform Act is to reduce the incidence of federal agencies imposing unfunded requirements on state and local governments. To fulfill this law, DOE reviewed the proposed CBDPP rule to determine if any of the requirements would impose an unfunded mandate on state or local governments. This analysis is contained in Section 6.2.

In summary, DOE will performed three analyses in this report:

- *Review under EO 12866 and EO 13563 (Sections 2 to 5): DOE will profile the affected activities, estimate compliance costs, evaluate benefits, and consider the market impacts of the proposed revisions to the CBDPP rule.*
- *Small business analysis pursuant to the RFA, as amended by the SBREFA (Section 6.1): DOE will assess the impact of the proposed revisions to the CBDPP rule on small businesses.*
- *Unfunded mandates analysis pursuant to the Unfunded Mandates Reform Act (Section 6.2): DOE will determine if the proposed CBDPP rule would impose any unfunded mandates on state or local governments.*

## 1.4 REQUIREMENTS OF THE PROPOSED RULE THAT WOULD IMPOSE COSTS

The proposed rule requirements expected to have cost impacts for DOE sites and contractors in the economic assessment are summarized below in Table 1-1. Other impacts that were not quantifiable or possible to estimate were also excluded from the cost assessment. The cost savings provisions are summarized in Section 4.5 and Table 4-26.

## Table 1-1. Comparison of 1999 10 CFR 850 and Proposed Provisions Resulting in Cost Impacts

| Proposed Change | Preamble Text | Current CFR Text | Proposed CFR Text | Cost Implications |
|---|---|---|---|---|
| **850.23 Action Level** | | | | |
| Lower airborne action level | Proposed § 850.23(a) would continue to require employers to include in their CBDPPs an 8 hour time weighted average action level for beryllium and would change the action level from 0.2 μg/m$^3$ to 0.05 μg/m$^3$ (8-hour TWA of 0.05 microgram of beryllium, per cubic meter of air), as measured in the worker's breathing zone by personal monitoring. Due to the number of workers who have been identified as being sensitized to beryllium or having CBD, the Department feels that it is prudent to lower the action level. The 0.05 μg/m$^3$ action level was chosen based on the Department's review of epidemiological studies and the ACGIH® TLV®. Lowering the action level to 0.05 μg/m$^3$ would result in greater protection for the affected work force because it would lower the trigger that requires the use of controls and protective measures designed to prevent worker exposure to beryllium. | (a) The responsible employer must include in its CBDPP an action level that is no greater than 0.2 μg/m$^3$, calculated as an 8-hour TWA exposure, as measured in the worker's breathing zone by personal monitoring. | (a) Employers must include in their CBDPPs an action level that is no greater than 0.05 μg/m$^3$, calculated as an 8-hour time weighted average exposure, as measured in the worker's breathing zone by personal monitoring. | Costs to re-sample some areas and change to exposure monitoring methods that allow measurement of inhalable particulate fraction and have a sufficiently low limit of detection to demonstrate compliance or non-compliance with the proposed action level. Will impact requirements that are issued in:<br>- 850.24 (exposure monitoring)<br>- 850.25 (exposure reduction and minimization)<br>- 850.26 (regulated and controlled areas)<br>- 850.27 (hygiene facilities and practices)<br>- 850.28 (respiratory protection)<br>- 850.29 (protective clothing and equipment)<br>- 850.30 (housekeeping)<br>- 850.31 (release criteria)<br>- 850.38 (warning signs and labels) |

## Table 1-1. Comparison of 1999 10 CFR 850 and Proposed Provisions Resulting in Cost Impacts

| Proposed Change | Preamble Text | Current CFR Text | Proposed CFR Text | Cost Implications |
|---|---|---|---|---|
| **850.26 Beryllium Regulated Areas** | | | | |
| Restriction of non-beryllium workers from regulated areas | Proposed § 850.26(b)(2) would continue to require employers to limit access to beryllium regulated areas to authorized persons only. | (c) The responsible employer must limit access to regulated areas to authorized persons. | (b)(2) Limit access to beryllium regulated areas to authorized persons | Potential costs associated with establishing additional areas with the lower action level. |
| **850.34 Medical Surveillance** | | | | |
| Notifying beryllium-associated workers of right to participate in medical surveillance | To clarify the confusion, DOE would propose to add § 850.34(a)(6) to require employers to notify beryllium-associated workers yearly of their right to participate in the medical surveillance program. If the beryllium-associated worker declines at that time, he/she may elect to participate at any time during the year, but the worker is required to notify the employer in writing of the intent to participate in the program. | (a)(6) The responsible employer must provide the following information to the SOMD and the examining physician… | (6) Notify beryllium-associated workers on an annual basis of their right to participate in the medical surveillance program. If the beryllium-associated worker declines at that time, he/she may elect to participate at any time during the year, but must notify the employer in writing of his or her intent to participate. | Cost for notifying beryllium-associated workers annually. |
| Mandatory medical evaluations | Proposed § 850.34(b)(1)(i)(A) would require employers to make baseline medical evaluations mandatory rather than voluntary for beryllium workers. Proposed § 850.34(b)(1)(ii)(B) provides that baseline medical evaluations for beryllium-associated workers are voluntary. | a)(1) The responsible employer must establish and implement a medical surveillance program for beryllium-associated workers who voluntarily participate in the program.<br>(b) The responsible employer must provide, to beryllium-associated workers who voluntarily participate in the medical surveillance program, the medical evaluations and procedures required by this section at no cost and at a time and place that is reasonable and convenient to the worker. | (b)(1) (i) Employers must provide baseline medical evaluations that are:<br>(A) Mandatory for beryllium workers; and<br>(B) Voluntary for beryllium-associated workers. | Additional costs for additional medical exams for beryllium workers currently opting out. |

**Table 1-1. Comparison of 1999 10 CFR 850 and Proposed Provisions Resulting in Cost Impacts**

| Proposed Change | Preamble Text | Current CFR Text | Proposed CFR Text | Cost Implications |
|---|---|---|---|---|
| Mandatory periodic medical evaluations for beryllium workers | Specifically, proposed § 850.34(b)(2)(i) (A)-(B) would require employers to provide periodic medical evaluations annually to beryllium workers, and every three years to beryllium-associated workers who voluntarily participate in the program. Proposed § 850.34(b)(2)(i)(C) would require employers to provide a medical evaluation to beryllium workers, or beryllium-associated workers who voluntarily participate in the program, who exhibit signs and symptoms of BeS or CBD if the SOMD determines that an evaluation is warranted. | (b)(2)(i) The responsible employer must provide to beryllium workers a medical evaluation annually, and to other beryllium associated workers a medical evaluation every three years. | (b)(2) Periodic medical evaluations(i) Employers must provide:<br>(A) An annual medical evaluation to beryllium workers;<br>(B) A medical evaluation every three years to beryllium-associated workers who voluntarily participate in the program; and<br>(C) A medical evaluation to a beryllium worker or a beryllium-associated worker who voluntarily participates in the program, and when the worker exhibits signs and symptoms of beryllium sensitization or chronic beryllium diseases if the SOMD determines that an evaluation is warranted. | Additional costs for additional medical exams for beryllium workers currently opting out and Beryllium-associated workers. |
| Medical evaluations for beryllium associated workers showing signs and symptoms if the SOMD thinks it is warranted | Proposed § 850.34(b)(2)(i)(C) would require employers to provide a medical evaluation to beryllium workers, or beryllium-associated workers who voluntarily participates in the program, who exhibit signs and symptoms of BeS or CBD if the SOMD determines that an evaluation is warranted. | - | (b)(2(C) A medical evaluation to a beryllium worker or a beryllium-associated worker who voluntarily participates in the program, and when the worker exhibits signs and symptoms of beryllium sensitization or chronic beryllium diseases if the SOMD determines that an evaluation is warranted. | Potential additional costs for beryllium (and beryllium associated) workers in the medical surveillance program who are showing signs and symptoms but not due for a periodic evaluation in that year or already had their examination that year. However, the cost is offset somewhat by allowing the SOMD to determine whether it is necessary. |

**Table 1-1. Comparison of 1999 10 CFR 850 and Proposed Provisions Resulting in Cost Impacts**

| Proposed Change | Preamble Text | Current CFR Text | Proposed CFR Text | Cost Implications |
|---|---|---|---|---|
| Requirement for an exit medical evaluation | Proposed § 850.34(b)(4) is being added to require employers to provide an exit medical evaluation to a beryllium worker, or offer an exit medical evaluation to a beryllium-associated worker who voluntarily participates in the medical surveillance program, if a baseline or periodic evaluation had not been performed within the previous six months at the time of separation from employment. The purpose of the exit medical evaluation is to determine and document the worker's health status at the time of separation. | - | (b)(4)(i) If a baseline or periodic evaluation has not been performed within the previous six months, employers must:<br>(A) Provide an exit medical evaluation to beryllium workers at the time of the worker's separation from employment; and<br>(B) Offer an exit medical evaluation to beryllium-associated workers who voluntarily participate in the medical surveillance program at the time of the worker's separation from employment.<br>(ii) The exit medical evaluation must include... | Additional costs for exit medical evaluations. |
| **850.35 Medical Restriction** | | | | |
| Medical restriction requirements | Proposed § 850.35 would be added to establish the medical restriction provisions of the CBDPP… Proposed § 850.35(a) would require medical restrictions to be conducted in accordance with 10 CFR part 851, Appendix A, § 8(h). In such cases where medical restrictions appropriate, proposed § 850.35(b) would require employers to, within 15 working days after receiving the SOMD's written opinion pursuant to § 850.34(d)(2) that it is medically appropriate to restrict a worker, restrict the worker from a job that involves a beryllium activity at or above the action level. | - | (a) Medical restrictions must be conducted in accordance with 10 CFR part 851, Appendix A, § 8(h). | Potential cost implications for restricting workers from areas with beryllium activities. |

## Table 1-1. Comparison of 1999 10 CFR 850 and Proposed Provisions Resulting in Cost Impacts

| Proposed Change | Preamble Text | Current CFR Text | Proposed CFR Text | Cost Implications |
|---|---|---|---|---|
| **850.36 Medical Removal and Benefits** | | | | |
| Mandatory medical removal | Proposed § 850.36(c) would require an employer to remove a beryllium worker from a job that involves an activity where the airborne concentration of beryllium is at or above the action level within 15 working days after receiving the SOMD's written opinion pursuant to § 850.36(b)(2) stating that it is medically appropriate to remove the worker. Section 850.35(a) of the final rule, as issued in 1999, required the responsible employer to offer a beryllium-associated worker removal from exposure to beryllium if the SOMD determined in a written medical opinion that the worker should be removed from exposure to beryllium, but did not require the worker to be removed. | - | (c)(1) Within 15 working days after receiving the SOMD's written opinion pursuant to paragraph (b)(2) of this section stating that it is medically appropriate to remove the worker from jobs in the areas that are at or above the action level or may potentially be at or above an action level, the employer must remove a beryllium worker from such a job, regardless of whether, at the time of removal, a job is available into which the removed worker may be transferred. | Increased costs associated with removal of workers who previously would have opted out. |
| **850.37 Medical Consent** | | | | |
| Inform employees about mandatory testing | Proposed § 850.37(b) would require employers to inform beryllium workers that testing is mandatory to transfer into or remain in a job involving exposure to beryllium at or above the action level, and that a beryllium worker who decides not to consent to the medical evaluations that would be required in § 850.34 will be removed from a beryllium activity and will not receive medical removal benefits. | 850.36 (b) Responsible employers must also provide each beryllium-associated worker with information on the benefits and risks of the medical tests and examinations available to the worker at least one week prior to any such examination or test, and an opportunity to have the worker's questions answered. | (b) Employers must ensure all beryllium workers understand that testing is mandatory to transfer into or remain in a job involving beryllium activities at or above the action level. A beryllium worker, who decides not to consent to the testing, will be removed from the beryllium activity and will not receive any of the medical removal benefits. | Cost for notifying beryllium workers. |

**Table 1-1. Comparison of 1999 10 CFR 850 and Proposed Provisions Resulting in Cost Impacts**

| Proposed Change | Preamble Text | Current CFR Text | Proposed CFR Text | Cost Implications |
|---|---|---|---|---|
| **850.39 Warning Signs and Labels** | | | | |
| Changes to wording of signs | Proposed § 850.39(a) would continue to require the posting of warning signs demarcating beryllium regulated areas and these signs bear the following warning:<br>BERYLLIUM REGULATED AREA<br>DANGER<br>CANCER AND LUNG DISEASE HAZARD<br>AUTHORIZED PERSONNEL ONLY | BERYLLIUM CAN CAUSE LUNG DAMAGE<br>CANCER HAZARD<br>AUTHORIZED PERSONNEL ONLY | (a) Warning signs. The employer must post warning signs at each access point to a regulated area with the following information:<br>BERYLLIUM REGULATED AREA<br>DANGER<br>CANCER AND LUNG DISEASE HAZARD<br>AUTHORIZED PERSONNEL ONLY | Potential costs for additional signs and remaking signs where the wording must be changed. |

**Table 1-1. Comparison of 1999 10 CFR 850 and Proposed Provisions Resulting in Cost Impacts**

| Proposed Change | Preamble Text | Current CFR Text | Proposed CFR Text | Cost Implications |
|---|---|---|---|---|
| Requiring labels for equipment or items containing beryllium in inaccessible locations or hard-to-remove substances | Proposed § 850.39(b)(2) would add a new provision that would require employers to affix warning labels to equipment or items that contain sources of beryllium in typically inaccessible locations or embedded in hard-to-remove substances. This label is for less hazardous situations in which the beryllium is normally inaccessible but could be released with effort (e.g., by disassembling machine tools that were used for processing beryllium, or by removing paint that encapsulates beryllium particulates). This proposed section would require that labels bear the following information:<br>CAUTION<br>CONTAINS BERYLLIUM IN INACCESSIBLE LOCATIONS OR EMBEDDED IN HARD-TO-REMOVE SUBSTANCES<br>DO NOT RELEASE AIRBORNE BERYLLIUM DUST<br>CANCER AND LUNG DISEASE HAZARD | - | (2) The employer must affix warning labels to equipment or items that contain sources of beryllium in normally inaccessible locations or embedded in hard-to-remove substances. These warning labels must contain the following information:<br>CAUTION<br>CONTAINS BERYLLIUM IN INACCESSIBLE LOCATIONS OR EMBEDDED IN HARD-TO-REMOVE SUBSTANCES<br>DO NOT RELEASE AIRBORNE BERYLLIUM DUST<br>CANCER AND LUNG DISEASE HAZARD | Potential costs for additional labels. |

## 2. PROFILE OF AFFECTED DOE SITES AND ACTIVITIES

DOE's past and current uses of beryllium create the potential for harmful exposures to beryllium within the DOE complex. Past uses of beryllium include numerous manufacturing and research projects, most of which were associated with nuclear weapons production and maintenance. These past uses now create the potential for workers to be exposed to beryllium during environmental restoration projects at beryllium-contaminated sites. Beryllium is still used in manufacturing and research projects, but, in recognition of the health hazards associated with inhaling beryllium particles, current operations are performed under much more stringent controls than previously. Despite lower exposure levels, however, these operations continue to pose a health risk to workers in the DOE complex.

This section profiles DOE activities and facilities associated with the potential for worker exposure to beryllium. Section 2.1 explains the scope of the proposed rule; Section 2.2 discusses DOE activities that may result in worker exposure to beryllium; and Section 2.3 lists DOE site where these activities took place in 1999, where the activities currently take place, and presents estimates of the number of workers involved in the activities.

### 2.1 APPLICABILITY OF THE PROPOSED RULE

The proposed CBDPP rule would apply to DOE offices and contractors whose employees are exposed or potentially exposed to beryllium at or above the action level at DOE sites, and to the Site Occupational Medical Directors (SOMD) responsible for providing the overall direction and operation of the employer's beryllium medical surveillance program (§ 850.3).

The proposed rule would not apply to beryllium articles and DOE laboratory operations that are subject to the requirements of 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories" (the laboratory standard).

## 2.2 AFFECTED ACTIVITIES

Workers can be exposed to beryllium when beryllium particulate enters their breathing zone. A number of beryllium-related activities at DOE sites can involve such exposures. These activities are grouped into seven general categories:

- *Research and development (R&D) projects involving beryllium.*
- *Current production and maintenance of beryllium-containing products.*
- *D&D of beryllium-contaminated sites.*
- *Maintenance (e.g., janitorial work) in beryllium-contaminated sites.*
- *Detonating and dismantling of weapons with beryllium components.*
- *IH tasks associated with beryllium-related work.*
- *Non-beryllium work in areas where beryllium contamination has spread.*

This section profiles these activities at DOE sites, describing the nature of each activity and its potential for exposing workers to beryllium.

### 2.2.1 Research and Development Activities

DOE funds R&D projects that focus on a particular beryllium application (direct use), or that use beryllium or beryllium components to study another product or application (indirect use). Although the quantities of beryllium in R&D projects are substantially smaller than those in production operations, researchers may still experience harmful exposures. Projects that involve machining beryllium, or other processes that create beryllium dust or fumes, may expose researchers to airborne beryllium particulates.

Although R&D activities occur in facilities at DOE sites and involve the potential to expose workers to beryllium, they may not be covered by the proposed CBDPP rule. The proposed CBDPP rule continues to specify in Section 850.2(b)(2) that it excludes activities that are subject

to OSHA's laboratory standard (29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories"). DOE expects that most laboratory research involving beryllium will be subject to the laboratory standard.

### 2.2.2 Production Activities

Beryllium is an essential component in several DOE production applications, including nuclear weapons, nuclear reactor moderators and reflectors, and nuclear reactor fuel element cladding. With the end of the Cold War, DOE reduced its production of nuclear weapons, thereby also reducing the need for large-scale production of some beryllium-containing components. Nevertheless, some production operations involving beryllium continue at certain sites including Los Alamos National Laboratory (LANL) and Y-12 (U.S. DOE, 2013).

### 2.2.3 Decontamination and Decommissioning Activities

The reduced emphasis on nuclear weapons in the post-Cold War era has eliminated the need for a number of DOE facilities. Consequently, several DOE sites have undergone D&D, and additional sites are presently being decontaminated and decommissioned.

D&D activities are generally tailored to the facility, but D&D activities in beryllium-contaminated areas have several common aspects:

- *Cleaning—Most beryllium-contaminated sites contain equipment, machinery, and tools that can be reused in other applications.*[6] *For this equipment to be reused, the proposed rule continues to require beryllium surface contamination to be below 3 μg/100cm$^2$ (§ 850.30 (a)). The proposed rule also continues to require that beryllium dust be removed from surfaces and floors through HEPA vacuuming or wet cleaning.*

[6] One factor that may limit the use of beryllium-contaminated equipment in other applications is radiological contamination.

- *Removal and disposal—Contaminated equipment and building components that are not salvageable must be removed and disposed of properly. Beryllium-contaminated equipment that cannot be cleaned to less than the 3.0 µg/100cm$^2$ standard (850.31 (c)(5)) must be disposed of properly.*

- *Demolition—Buildings and other structures that are not being considered for future use may be slated for demolition. In such cases, D&D involves removing most of the beryllium contamination (through cleaning and disposing of contaminated equipment and areas) before demolition to avoid releasing beryllium dust into the ambient air.*

D&D of beryllium-contaminated sites may also involve site-specific activities that do not fall under the three preceding categories.

D&D activities pose significant challenges to protecting worker health and safety for at least three reasons. First, the nature of the activities (i.e., decontamination) requires direct contact with hazardous substances like beryllium (U.S. DOE, 1998). Second, records of the nature of the work performed at the facility and the extent of beryllium contamination in the facility may not correlate well with potential exposures during D&D activities (U.S. DOE, 1997). Third, records, if they are available, may not accurately reflect the nature of the work that was performed in the facility or the extent of beryllium contamination in the facility (U.S. DOE, 1997). The CBDPP rule addresses each of these points by requiring a baseline inventory and sampling (850.20) and hazard assessments (850.21) before D&D activities begin.

### 2.2.4 Maintenance Activities

Like the activities they support (such as production of beryllium-containing parts), several maintenance activities may result in harmful exposures to beryllium dust (Stange et al., 1996). Cleaning and replacing air filters in the exhaust ventilation system of beryllium processing areas

may pose the greatest risk for maintenance workers. The site characterization at LANL's beryllium processing facility found contamination levels of 5,156 μg/ 100 $cm^2$ in the exhaust ventilation system (LANL, 1996). Furthermore, the air filter itself contained significant amounts of beryllium removed from the air.

In addition to air filter cleaning and replacement, other maintenance jobs, such as housekeeping in beryllium production areas and laundering beryllium-contaminated protective clothing, may expose workers to beryllium dust. For example, contractors who are hired to fix building-related problems (e.g., heating, ventilating, and air conditioning malfunctions) may be exposed to beryllium.

### 2.2.5 Detonating and Dismantling Weapons

The de-emphasis of nuclear weapons production in the post-Cold War era was accompanied by a reduction in the stock of existing weapons, requiring DOE to dismantle and destroy nuclear weapons. Workers may be exposed to beryllium dust while disassembling and removing beryllium-containing parts and detonating (non-nuclear) explosive components of the weapons. During detonation, beryllium parts are often destroyed, and beryllium dust may become suspended in the air and create an inhalation hazard for workers.

The Pantex plant in North Central Texas engages in several activities of this nature that may expose worker to beryllium, including:

- *Weapon disassembly.*
- *Energetic demilitarization.*
- *Weapon materials management. (U.S. DOE, 2009)*

### 2.2.6 Industrial Hygiene Tasks

The hazardous nature of beryllium requires DOE to undertake a number of IH related tasks, such as:

- *Installing and maintaining air monitors and personal breathing zone samplers.*
- *Collecting swipe samples.*
- *Performing hazard analyses.*

Generally, any task that brings the industrial hygienist into beryllium-contaminated areas poses the potential for beryllium exposure. Therefore, industrial hygienists performing IH tasks in beryllium-contaminated areas should receive the same level of protection as workers in other job categories who have the same exposure.

### 2.2.7 Non-Beryllium Work Where Exposure is Possible

In addition to the beryllium-related work described in the previous six categories (Sections 2.2.1 to 2.2.6), other activities that are not directly associated with beryllium use may have the potential for exposure. The potential for exposure in these other activities results from the potential for contamination to spread from the beryllium areas to adjacent work areas. Therefore, diverse activities that do not involve beryllium, such as clerical, secretarial, janitorial, and production operations, may have indirect potential for exposure if they are near beryllium areas. While these activities are intended to be free of contamination, experience has shown that individuals performing them have been exposed at levels high enough to induce BeS and CBD (Kreiss et al., 1993a, 1996; Stange et al., 1996).

## 2.3 AFFECTED SITES AND WORKERS

This section lists the affected sites for the 1999 rule, as well as the affected sites for the proposed rule. Estimates of the number of workers that the proposed rule affects are provided.

### 2.3.1 Sites and Workers Affected by 1999 CDPP Final Rule

The 1999 rule affected 14 sites using beryllium across the DOE complex. These sites, their mission, and approximate total number of workers at the time of the 1999 rule, are listed in Table 2-1. Since 1999, some of these sites have closed, merged, or changed the type of activities they perform. Additionally, a number of new sites have come into existence. DOE's current sites are described in Section 2.3.2.

**Table 2-1. Sites Affected by the 1999 CDPP Final Rule**

| Site | Location | Mission | Approximate Total Number of Workers |
|---|---|---|---|
| Argonne East | Chicago, IL | Research and development to support development of energy-related technologies | 4,500 [a] |
| Argonne West | Idaho Falls, ID | Technology development for spent nuclear fuel and waste treatment, reactor and fuel cycle safety, and facility decommissioning | |
| ETTP (K-25) | Oak Ridge, TN | Environmental restoration, waste management, technology development and demonstration, education and training, and technology transfer | 6,200 |
| Hanford | Richland, WA | The site originally produced plutonium for U.S. nuclear weapons. The site is currently involved in environmental restoration. | 10,500 |
| Kansas City | Kansas City, MO | Manufacturing nonnuclear components for nuclear weapons | 3,300 |
| LANL | Los Alamos, NM | National security focus combined with several areas of high-tech research (e.g., space nuclear systems, controlled thermonuclear fission, lasers, biomedicine, environmental management) | 10,000 |
| LBL | Berkeley, CA | Energy-related reset activities | 3,400 |
| LLNL | Livermore, CA | Research, testing, and development that focus on national defense and security, energy, the environment, and biomedicine | 9,700 |
| Mound | Miamisburg, OH | Environmental restoration for conversion to commercial industrial site | 5,100 |
| ORNL | Oak Ridge, TN | Basic and applied research in numerous scientific fields | 5,000 |
| Pantex | Amarillo, TX | Fabricating high explosives for nuclear weapons, assembling and disassembling nuclear weapons | 2,400 |
| Stanford | Menlo Park, CA | High-energy accelerator research | 1,400 |
| Rocky Flats | Rocky Flats, CO | Cleanup and restoration | 4,000 |
| Y-12 | Oak Ridge, TN | Nuclear weapons processing technologies | 4,000 |

Source: U.S. DOE, 1999

[a] Includes workers at both the Argonne-East and Argonne-West site.

Table 2-2 shows the number of works estimated to be affected under the 1999 rule.[7] In total, the rule affected 8,113 workers.

**Table 2-2. Number of Affected Workers under the 1999 CDPP Final Rule**

| Site | BAWs [a] | BAWs Exposed Above the Action Level or PEL [b] | Total BAWs [c] |
|---|---|---|---|
| Argonne East | 4 | 4 | 419 |
| Argonne West | 34 | 0 | 283 |
| ETTP (K-25) | 12 | 0 | 350 |
| Hanford | 50 [d] | 0 | 205 |
| Kansas City | 50 | 0 | 40 |
| LANL | 200 | 200 | 3,000 |
| LBL | 17 [e] | 0 | 18 |
| LLNL | 20 [e] | 0 | 914 |
| Mound | 69 | 69 | 38 |
| ORNL | 26 | 0 | 85 |
| Pantex | 300 | 119 | 1,000 |
| Stanford | 8 | 0 | 17 |
| Rocky Flats | 228 | 228 | 500 |
| Y-12 | 616 | 616 | 1,244 |
| **Total** | **1,634** | **1,236** | **8,113** |

Source: U.S. DOE, 1999

[a] This was the number of workers exposed or potentially exposed to beryllium at the time of the 1999 rule.

[b] This number is a subset of the previous column, which only includes workers who were exposed or potentially exposed above the action level or PEL proposed in the 1999 rule.

[c] This was the total number of beryllium-associated workers under the 1999 rule. The rule defined beryllium-associated workers as any current (i.e., still employed at the site) worker that is or was exposed or potentially exposed to beryllium. The first column is a subset of this column.

### 2.3.2 Sites and Workers Affected by the Proposed Rule

Several sites currently use beryllium across the DOE complex and thus will be affected by the proposed amendments to the CBDPP rule. For this assessment, DOE has identified 22 potentially affected sites.[8] These sites, which appear in Table 2-3, were identified through the

[7] Note that under the 1999 rule, the definition of BAWs included BWs, whereas these would be mutually exclusive categories under the proposed rule. Table 2-2 thus only includes BAWs, while Table 2-4 includes both BAWs and BWs.

[8] Although this analysis identified 22 sites that will be affected by the proposed amendment to the CBDPP rule, two of the 22 sites provided combined responses. Information obtained from and analysis regarding the Office of River Protection and associated contractors have been incorporated with those of the greater Hanford site and thus on 21 sites are shown in the table.

Beryllium Registry, contact with DOE field offices and sites, and through the 2012 Office of Health, Safety, and Security (HSS) EAQ. Although the Beryllium Registry reports data from 27 sites and subcontractors, DOE has grouped some subcontractors by site, regardless of whether they have their own CBDPP. At the time of analysis, National Strategic Protective Services, LLC for ETTP and ORNL (NSPS) was not reporting to the Beryllium Registry, so it has not been included in the affected sites. Total employment in the 22 sites included in the assessment is estimated at 95,000.

**Table 2-3. Affected Sites and Total Employment**

| Site [a] | Location | Mission | Approximate Total Employees | Source |
|---|---|---|---|---|
| Ames | Ames, IA | Creates innovative materials, technologies and energy solutions. | 450 | Ames Laboratory, 2015 |
| Argonne National Laboratory (ANL) | Argonne, IL | Integrates world-class science, engineering, and user facilities to deliver innovative research and technologies. | 3,400 | ANL, 2015 |
| Brookhaven National Laboratory (BNL) | Upton, NY | Research in nuclear and particle physics, applying photon sciences and nanomaterials research, and performing cross-disciplinary research. | 3,000 | BNL, 2015 |
| Fermi National Accelerator Laboratory (Fermi) | Batavia, IL | Advances the understanding of the fundamental nature of matter and energy by providing leadership and resources for qualified researchers to conduct basic research at the frontiers of high energy physics and related disciplines. | 1,750 | U.S. DOE, 2015 |
| Hanford [b] | Richland, WA | The site originally produced plutonium for U.S. nuclear weapons. The site is currently involved in environmental restoration. | 8,000 | Hanford, 2015 |
| Idaho National Laboratory (INL) [c] | Idaho Falls, ID | Ensure the nation's energy security with safe, competitive, and sustainable energy systems and unique national and homeland security capabilities. | 3,500 | Grow Idaho Falls, Inc., 2014 |
| Kansas City Plant (KCP) | Kansas City, MO | Manufacturing nonnuclear components for nuclear weapons. | 2,500 | Honeywell, 2015 |
| Knolls Atomic Power Laboratory (KAPL) | Niskayuna, NY | Nuclear propulsion systems for U.S. Naval ships. | 2,600 | KAPL, 2015 |
| Lawrence Berkeley National Laboratory (LBNL) | Berkeley, CA | Conducts unclassified research across a wide range of scientific disciplines | 3,200 | LBNL, 2015 |
| Lawrence Livermore National Laboratory (LLNL) [d] | Livermore, CA | Development and application of world-class science and technology to enhance the nation’s defense; reduce the global threat from terrorism and weapons of mass destruction; and respond with vision, quality, integrity and technical excellence to scientific issues of national importance. | 6,300 | LLNL, 2015 |

**Table 2-3. Affected Sites and Total Employment**

| Site [a] | Location | Mission | Approximate Total Employees | Source |
|---|---|---|---|---|
| Los Alamos National Laboratory (LANL) | Los Alamos, NM | Develop and apply science and technology to ensure the safety, security, and reliability of the U.S. nuclear deterrent; reduce global threats; and solve other emerging national security and energy challenges. | 10,200 | LANL, 2015 |
| Nevada National Security Site (NNSS) | Las Vegas, NV | Supports the stewardship of the nuclear deterrent, providing emergency response capability and training, and contributing to key nonproliferation and arms control initiatives | 2,450 | NSTec LLC, 2015 |
| Oak Ridge Institute for Science and Education (ORISE) | Oak Ridge, TN | Assess and analyze environmental and health effects of radiation, beryllium and other hazardous materials; maintains medical and national security radiation emergency management and response capabilities; and manage education programs. | 450 | Wallace, 2012 |
| Oak Ridge National Laboratory (ORNL) [e] | Oak Ridge, TN | 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; increase the availability of clean, abundant energy; restore and protect the environment; and contribute to national security. | 4,400 | ORNL, 2015 |
| Pacific Northwest National Laboratory (PNNL) | Richland, WA | Transform the world through courageous discovery and innovation. | 4,300 | PNNL, 2015 |
| Pantex Plant (Pantex) | Amarillo, TX | Safely and securely maintain the nation’s nuclear weapons stockpile and dismantle weapons retired by the military | 3,300 | Babcock & Wilcox Enterprises, Inc., 2015 |
| Portsmouth Paducah Project Office (Portsmouth/ Paducah) [f] | Portsmouth, OH and Paducah, KY | Accomplish environmental remediation, waste management, depleted uranium hexafluoride (DUF6) conversion, decontamination and decommissioning. | 2,700 in Portsmouth, OH, and 1,800 in Paducah, KY | U.S. DOE, 2012 |
| Sandia National Laboratory (SNL) | Albuquerque, NM | Ensuring the U.S. nuclear arsenal is safe, secure, reliable, and can fully support our nation's deterrence policy. | 10,000 | Sandia, 2015 |

**Table 2-3. Affected Sites and Total Employment**

| Site [a] | Location | Mission | Approximate Total Employees | Source |
|---|---|---|---|---|
| Savannah River Site (SRS) | Aiken, SC | Safely and efficiently operate SRS to protect the public health and the environment while supporting the nation's nuclear deterrent and the transformation of the Site for future use. | 12,000 | SRS, 2012 |
| Stanford Linear Accelerator Center (SLAC) | Menlo Park, CA | Explore the ultimate structure and dynamics of matter and the properties of energy, space and time through robust scientific programs, excellent accelerator based user facilities and valuable partnerships. | 1,700 | Stanford University, 2013 |
| Y-12 | Oak Ridge, TN | Processing and storage of uranium and development of technologies associated with those activities. | 7,000 | U.S. DOE, 2013a |
| **Total** | | | **95,000** | |

[a] The Beryllium Registry currently indicates 27 sites and subcontractors are submitting data; however, DOE has grouped some subcontractors into the overall site.
[b] Includes both the Office of River Protection and Richland Operations Office.
[c] Includes Advanced Mixed Waste Treatment Project (AMWTP).
[d] Includes LLNL Clean Harbors Environmental Services (LLNL CHES).
[e] Includes East Tennessee Technology Park (ETTP)
[f] Includes LATA Environmental Services of Kentucky, LLC (PAD LATAKY).

Table 2-4 provides estimates of the number of workers affected by the proposed CBDPP rule. The table refers to the following categories of affected workers:[9]

- *Beryllium-associated workers: Current workers, who are or were exposed or potentially exposed to airborne concentrations of beryllium at a DOE site, including a current worker:*
    - Whose work history shows that the worker may have been exposed to airborne concentrations of beryllium at a DOE site;
    - Who exhibits signs or symptoms of beryllium exposure;
    - Who is receiving medical removal benefits.
- *Beryllium workers: Current workers who are regularly employed in a DOE beryllium activity, which means any activity, including the disturbance of legacy beryllium-containing dust, that can expose workers to levels of beryllium at or above the proposed action level.*
- *New Beryllium workers: Workers who will be newly defined as beryllium workers, i.e., those currently employed in a DOE activity that can expose them to levels of beryllium below the current action level but above the proposed action level*

Information gathered from the Beryllium Registry indicated as of 2013, 21,456 current workers are, or were, exposed or potentially exposed to beryllium at a DOE site (U.S. DOE, 2013b). In the EAQ, some DOE sites indicated the number of beryllium-associated workers at their site at the time the questionnaire was distributed. DOE prioritized these estimates over the 2013 Beryllium Registry reported numbers, but

[9] These definitions of beryllium worker and beryllium-associated worker under the proposed rule are a departure from the existing definitions, in which beryllium-associated workers included beryllium workers.

retained the 2013 Beryllium Registry numbers for sites that did not provide an estimate. Combining these two sources, DOE estimates 20,293 beryllium-associated employees within the DOE-complex.

Notably, the Beryllium Registry does not distinguish workers that are currently exposed from those who were once exposed but have since moved to work in other jobs in the DOE complex where they are no longer exposed. Also, the Beryllium Registry noted that sites may not report when a worker has left the DOE complex altogether. Therefore, the number of current beryllium-associated workers is unclear from the data reported by the Beryllium Registry. Nevertheless, to be conservative, in the absence of an estimate of active beryllium-associated workers from a site, DOE assumed that all workers listed by Beryllium Registry as current are active beryllium-associated workers. DOE estimates that 20,293 active workers are currently or previously exposed or potentially exposed to beryllium.

DOE also estimated the number of existing beryllium workers at each site based on responses to the EAQ. When information provided in responses was insufficient to estimate the number of existing beryllium workers, DOE estimated that one half of beryllium-associated workers were beryllium workers. DOE notes that in many cases, this is likely an overestimate. DOE also estimated the number of additional employees exposed or potentially exposed at or above the proposed action level (new beryllium workers). The estimated number of additional beryllium workers under the proposed action level was based on the percent of sampling results submitted to the Beryllium Registry that exceeded 0.05$\mu g/m^3$, which varied by site. DOE estimated a total of 9,373 active beryllium workers and 1,261 additional beryllium workers due to the lowered

action level. The number of existing beryllium workers at each site and the number of new beryllium workers due to the proposed action level are presented in Table 2-4.

**Table 2-4. Numbers of Affected Workers**

| Site | BAWs [a] | Existing BWs [b] | New BWs [c] |
|---|---|---|---|
| Ames (SC) | 34 | 17 | 0 |
| Argonne National Laboratory (SC) | 142 | 71 | 143 |
| Brookhaven National Laboratory (SC) | 18 | 9 | 0 |
| Fermi National Accelerator Laboratory (SC) | 20 | 0 | 336 |
| Hanford (EM) | 7480 | 3,017 | 24 |
| Idaho National Laboratory (EM & NE) | 355 | 178 | 4 |
| Kansas City Plant (NA) | 1208 | 604 | 0 |
| Knolls Atomic Power Laboratory (KAPL) [NA-30] | 20 | 10 | 0 |
| Lawrence Berkeley National Laboratory (SC) | 26 | 13 | 0 |
| Lawrence Livermore National Laboratory (LLNL) [NA] | 1400 | 800 | 32 |
| Los Alamos National Laboratory (LANL) [NA] | 2044 | 905 | 102 |
| National Nuclear Security Site (NA) | 1028 | 514 | 20 |
| Oak Ridge Institute for Science and Education (ORISE) [SC] | 0 | 0 | 0 |
| Oak Ridge National Laboratory (ORNL) [EM & SC] | 639 | 320 | 4 |
| Pacific Northwest National Laboratory (PNNL) [SC] | 0 | 0 | 0 |
| Pantex Plant (NA) | 1756 | 878 | 175 |
| Portsmouth Paducah Project Office (EM) | 112 | 56 | 0 |
| Sandia National Laboratory (NA) | 604 | 302 | 150 |
| Savannah River Site (EM & NA) | 669 | 335 | 132 |
| Stanford Linear Accelerator Center (SLAC) [SC] | 47 | 0 | 0 |
| Y-12 (NA) | 2691 | 1,346 | 140 |
| **Total** | **20,293** | **9,373** | **1,261** |

[a] These are BAWs currently or previously exposed or potentially exposed to beryllium. Notably, the Beryllium Registry indicated that these totals include all workers that have been, or are, exposed or potentially exposed to beryllium minus any workers no longer employed at the site. Nevertheless, Beryllium Registry expected that sites may not report the end of a worker's employment. Therefore, for sites that reported the number of BAWs in the EAQ, DOE used the site estimate instead of the Beryllium Registry reported number. Still, DOE anticipates that the total number of currently employed BAWs may be lower than the total presented here. Sources: U.S. DOE, 2013b and EAQ responses.

[b]These are estimated BWs exposed above the current action level. When no information regarding the number of active BWs at a site was provided in the EAQ, DOE estimated one half of BAWs were BWs. In many cases, this is an overestimate. Sources: U.S. DOE, 2013b and EAQ responses.

[c] These are estimated BWs exposed below the current action level but above the proposed action level. The percent of 2013 Beryllium Registry monitoring results above 0.05 $\mu g/m^3$ was treated as equal to the percent of current employees exposed above the current action level based on the assumption that the number of employees in the affected area is proportional to the number of samples taken to characterize that area. Source: U.S. DOE, 2013b.

[d] ORISE does not report to the Beryllium Registry as there are no workers currently exposed to beryllium employed at ORISE. ORISE's association with beryllium is based on a few workers who have transferred to ORISE from other sites where they were potentially exposed to beryllium (Wallace, 2012).

## 3. BASELINE COSTS

In order to estimate the baseline costs to the sites affected by this proposed rule (i.e., the costs currently incurred for their beryllium programs), DOE calculated the average cost per affected worker in the 1999 final CBDPP rule, inflated this cost to 2014 dollars, and multiplied by the current number of workers affected by the proposed rule.

First, DOE examined the costs of the 1999 CBDPP final rule, which established CBDPPs at DOE sites. That final rule's provisions included establishing an action level of 0.2 $\mu g/m^3$, developing a beryllium registry, developing a training program, medical evaluations, medical removal, removal benefits, and a number of other requirements. The 1999 final rule affected 8,113 workers, based on a survey of sites that was used to estimate the costs of the rule (see the "Total BAWs" column of Table 2-2). The economic analysis for the 1999 rule estimated that the rule imposed annually recurring costs of $30,124,316. These costs were collected and presented on a per-site basis, but because of the growth in the number of affected workers since that time, DOE judged that it would be more meaningful to extrapolate these baseline costs to the present regulated community on a per-worker basis. The $30,124,316 cost was thus divided by the number of workers affected by the 1999 rule (8,113) to yield an average of $3,713 per affected worker (in 1999 dollars).[10] Next, DOE converted this cost to 2014 dollars, resulting in total recurring costs of $40,743,547 and average costs of $5,022 per affected worker (in 2014 dollars).

[10] Note that the 1999 analysis also calculated initial costs which were borne between 1997 and 1999 and annualized over a 10 year period. As the amortization period for these costs has passed, these costs are not considered to be part of the current baseline.

The proposed rule is estimated to affect 20,293 workers (the sum of the "BAWs" columns in Table 2-4). Using the assumption that the same figure, $5,022, is also the average per affected worker cost for the 20,293 workers affected by the proposed rule, the estimated total baseline costs for all 20,293 affected workers combined is $101,911,597.

It should be noted that this is only a proxy estimate of baseline costs. In some cases, the workers affected by the 1999 economic analysis and the workers affected by this proposed rule are at new sites, conducting different beryllium activities, or working in different numbers of regulated areas, all of which might impact baseline costs.

## 4. INCREMENTAL COSTS OF THE PROPOSED RULE

The Department developed this cost analysis of the incremental costs of compliance with the proposed rule based primarily on information obtained from the EAQ, a questionnaire for contractors at all the DOE sites that would be affected by the proposed rule. The questionnaire solicited information on the number of workers affected and the incremental costs of compliance with the provisions of the proposed rule. This information was collected on a per site basis. The information was supplemented, where necessary, with data from the 1999 Economic Analysis and data from the Beryllium Registry. DOE initially developed the EAQ and hosted a video conference during which personnel at the 22 Beryllium sites could ask for clarification regarding the questions in the EAQ. The Beryllium sites then returned their responses to DOE. DOE analyzed each site's responses and distributed several rounds of clarification questions, as necessary. Some sites did not respond by the deadline for the final round of clarification questions; costs for those sites have been estimated where possible and

marked “Not Estimated” (NE) when the submitted information was inadequate to enable an estimate. Notably, DOE used the sites’ original responses wherever possible, and sites indicated that a high level of uncertainty surrounds their estimates.

The proposed rule is estimated to impose from $13.6 million to $17.2 million in total incremental costs (annualized first year plus annual costs) (in 2014 dollars, using a 7 percent discount rate and a 10 year period lifetime of investment). This includes incremental first year costs of $41.4 million to $42.7 million, of which $7.8 million to $11.1 million are annually recurring costs.

Although not quantified in this economic assessment, DOE expects that some revisions to 10 CFR 850 will result in ongoing cost savings.

### 4.1 PARAMETERS AND UNIT COSTS

All costs presented throughout this document have been updated to 2014 dollar amounts. The 1999 rule reported costs in 1999 dollars, and the responses to the EAQ were given in 2012 dollars. To convert all costs to current-dollar estimates, DOE used the U.S. Bureau of Economic Analysis’ (2014) gross domestic product (GDP) deflator to update all reported and estimated costs to 2014 dollars.

Through the EAQ, each contractor for each site reported various unit costs for sample collection and analysis (Table 4-1), prices and installation costs for signage (Table 4-2), wages for several types of employees (Table 4-3), and medical evaluations (Table 4-4). In some cases, if a contractor did not report a particular metric, the mean or median of the responses received for that metric was used to represent the missing response. In other cases, a contractor’s estimate may have been considered an outlier if it was much higher or lower than other contractors’ responses, without adequate

explanation. In such cases, the next lowest or highest estimate was used for that site. Unit costs reported in the EAQ were also updated to 2014 dollars. As mentioned above, in estimating the total annualized costs, DOE assumed a real discount rate of seven percent and a 10 year lifetime for any initial investments.

### 4.1.1 Sampling Unit Costs

In response to the EAQ, DOE contractors reported a range of sampling costs for Total Particulate Fraction (TPF) samples, Inhalable Particulate Fraction (IPF) samples, and TPF samples including wall deposits. Some contractors indicated that they would incur higher sampling costs than others due to radiological contamination. Notably, many respondents who reported unit costs for sampling did not incur any costs for additional exposure monitoring due to the proposed rule. Additional discussion of the variables having an impact on sample unit costs appears in Section 4.2.1..

## Table 4-1. Sampling Unit Costs by Contractor

| Site | Contractor | TPF | TPF with Wall Wiping | Additional Cost due to Radiological Contamination |
|---|---|---|---|---|
| Ames | Ames [a] | $154 | N/A | N/A |
| ANL | ANL [a] | $41 | $41 | N/A |
| BNL | BSA [a] | $237 | $299 | N/A |
| Fermi | Fermi lab [a] | $772 | N/A | N/A |
| Hanford | WRPS | $515 | N/A | N/A |
| Hanford | BNI | N/A | N/A | N/A |
| Hanford | MSA [a] | $942 | N/A | N/A |
| Hanford | CSC HOHS | N/A | N/A | N/A |
| Hanford | CHPRC [a] | $500 [b] | N/A | N/A |
| Hanford | WCH [a] | $218 | N/A | N/A |
| INL | ICP | $566 | $618 | N/A |
| INL | ITG [a] | $515 | $515 | N/A |
| INL | BEA [a] | $46 | N/A | $21 |
| KCP | KCP | $481 | N/A | N/A |
| KAPL | KAPL [a] | $101 | N/A | N/A |
| LBNL | LBNL | N/A | N/A | N/A |
| LLNL | LLNL | $57 | N/A | N/A |
| LANL | LANL [a] | $154 | N/A | N/A |
| NNSS | NEV | N/A | N/A | N/A |
| ORISE | ORISE [a] | $206 | N/A | N/A |
| ORNL | UTB [a] | $302 | $314 | N/A |
| ORNL | WAI [a] | $309 | $463 | N/A |
| ORNL | SEC | N/A | N/A | N/A |
| ORNL | UCOR [a] | $257 | N/A | N/A |
| PNNL | PNNL [a] | $499 | N/A | N/A |
| Pantex | Pantex | $292 | $303 | N/A |
| Portsmouth/Paducah | LATA of KY [a] | $566 | N/A | N/A |
| Portsmouth/Paducah | FBP [a] | N/A | $335 | N/A |
| Portsmouth/Paducah | BWCS | N/A | N/A | N/A |
| Portsmouth/Paducah | WEMS [a] | N/A | $335 | N/A |
| Portsmouth/Paducah | SST | N/A | N/A | N/A |
| SNL | SNL | $309 | $309 | N/A |
| SRS | SRS [a] | $835 | N/A | $160 |
| SLAC | SLAC [a] | $360 | N/A | N/A |
| Y-12 | Y-12 | $206 | N/A | N/A |

[a] This contractor provided an estimate of the unit cost for a sample, but did not anticipate incurring costs due to monitoring.
[b] CHPRC indicated airborne sample unit costs ranged from $400-$2,000 depending on the number of samples being collected at the same location; whether the industrial hygienist must be present the entire time the sample is being collected; and the radiological status of the location where the sample is being collected. DOE judged that cost effective numbers of samples would be used in complying with the proposed revisions to 10 CFR 850 and estimated an average sample cost closer to the lower end of the range.
Note: N/A indicates that the site did not provide an estimate for the cost of this type of sample or indicated that they do not collect that type of sample.

### 4.1.2 Sign Purchase and Installation Unit Costs

The EAQ requested contractors to estimate the incremental unit costs of purchasing and installing new signs for regulated areas and the cost of replacing existing signs to comply with the proposed requirements. Some respondents noted that if the language requirements for signage changed, they would purchase and install new signs rather than modify existing signs. The unit costs ranged from $10 to $309 per sign. Notably, signs are less expensive if ordered in bulk, which would contribute to unit cost variability. Most contractors reported modest printing or sign costs, while installation costs varied more widely. Some contractors would require two hours to install each sign, while others did not include installation costs at all, or estimated significantly less time to install each sign. Some respondents provided unit costs, but were not impacted by the revised signage requirements in the proposed rule. Thus, only some of those contractors listed in Table 4-2 incurred costs for replacing signs. Additional discussion of DOE's methodology for calculating signage costs is in Section 4.2.10.

**Table 4-2. Sign Unit Costs by Site**

| Site | Cost per Sign |
|---|---|
| BNL [a] | $118 |
| Hanford - CHPRC | $10 |
| INL | $103 - $309 |
| KCP | $31 |
| KAPL | $139 |
| LLNL | $15 - $21 |
| LANL [a] | $235 |
| ORNL [a] [b] | $43 |
| Pantex | $21 |
| Portsmouth/Paducah - FBP [a] | $51 |
| Portsmouth/Paducah - WEMS [a] | $51 |
| SNL | $51 |
| SRS | $31 |
| Y-12 | $67 |

[a] This site did not incur any signage costs as a result of the revised regulation.

[b] Cost does not include installation.

### 4.1.3 Wages

Respondents reported wage rates for various categories of employees who would incur additional work time in order for the facility to meet the proposed rule requirements. These wage rates were used to calculate labor costs for exposure monitoring, the development of training and sampling procedures, training costs, computer programming for computer training and reporting, and administrative or other support for medical removal. DOE did not increase wages for fringe benefits, because contractors included benefits in their estimates, as requested in the EAQ. Table 4-3 presents reported wage rates by worker-category and by contractor.

**Table 4-3. Wage Rates and Job Categories by Contractor**

| Site - Contractor | Job Title | Wage (per Hour, including Benefits) |
|---|---|---|
| **Industrial Hygienists** | | |
| Ames | Industrial Hygiene Specialist | $72.08 |
| ANL | Industrial Hygiene Professional | $118.57 |
| BNL | Industrial Hygiene Subject Matter Expert | $205.94 |
| Fermi | Industrial Hygienist | $205.94 |
| Hanford - CHPRC | Industrial Hygienist | $127.68 |
| Hanford - MSA | Industrial Hygienist | $77.23 |
| Hanford - WCH | Industrial Hygiene Technician | $51.48 |
| Hanford - WCH | Senior Industrial Hygienist | $154.45 |
| Hanford - WRPS | Industrial Hygienist | $77.23 |
| INL - BEA | Industrial Hygienist | $115.33 |
| INL - ITG | Industrial Hygienist | $66.93 |
| KCP | Health, Safety & Environment Engineer Senior | $91.53 |
| KAPL | Industrial Hygienist | $61.78 |
| LLNL [a] | Clinician | $223.96 |
| LLNL | Health & Safety Technician | $61.78 |
| LLNL | Industrial Hygienist | $159.60 |
| Paducah/Portsmouth - LATA | Industrial Hygienist | $102.97 |
| Paducah/Portsmouth - SST | Certified Industrial Hygienist | $102.97 |
| Paducah/Portsmouth - SST | Industrial Hygienist | $77.23 |
| Paducah/Portsmouth - SST | Laboratory Analyst | $66.93 |
| Pantex | Industrial Hygienist | $77.23 |
| SNL | Environment, Safety & Health Coordinator | $154.45 |
| SNL | Industrial Hygienist | $154.45 |
| Y-12 | Industrial Hygiene Technician | $101.69 |
| Y-12 | Industrial Hygienist | $101.69 |
| **Procedure Writing Staff** | | |
| ANL | Technical Staff | $102.97 |
| Hanford - CHPRC | Procedure Writer | $112.24 |
| Hanford - MSA | Technical Editor/Writer | $77.23 |
| Hanford - WCH | Administrative/Technical Writer | $82.38 |

## Table 4-3. Wage Rates and Job Categories by Contractor

| Site - Contractor | Job Title | Wage (per Hour, including Benefits) |
|---|---|---|
| Hanford - WRPS | Technical Editor/Writer | $77.23 |
| KAPL | Engineering | $61.78 |
| ORNL - UCOR | Technical Support | $102.97 |
| SNL | Document Coordinator | $154.45 |
| **Training and Computer Programming Staff** | | |
| Ames | Training Specialist | $51.48 |
| ANL | Training Developer | $102.97 |
| BNL | Web Computer Based Training Developer | $205.94 |
| BNL | Programmer | $205.94 |
| Hanford - MSA | Instructional Staff | $94.73 |
| Hanford - MSA | Training Coordinator | $71.05 |
| INL - BEA | Training Developer | $102.97 |
| INL - ITG | Training Specialist | $51.48 |
| LLNL [a] | Instructional Designer & Training Manager | $118.42 |
| LLNL | Programmer | $133.86 |
| LLNL [a] | Trainer | $115.84 |
| ORNL - UCOR | Technical Trainer | $77.23 |
| ORNL - UTB | Training Development Specialist | $137.98 |
| Paducah/Portsmouth - FBP | Training Specialist | $49.43 |
| Paducah/Portsmouth - LATA | Trainer | $77.23 |
| Paducah/Portsmouth - WEMS | Training Specialist | $49.43 |
| Pantex | Trainer | $77.23 |
| SNL | Training Coordinator | $102.97 |
| SRS | Training Subject Matter Expert | $117.39 |
| Y-12 | Trainer | $92.67 |
| **Worker Staff** | | |
| ANL | Waste Mechanic | $102.97 |
| BNL | Labor for sign hanging | $102.97 |
| LLNL [a] | Line Management | $154.45 |
| LLNL [a] | Worker | $123.56 |
| ORNL - UCOR | Program Manager | $102.97 |
| Paducah/Portsmouth - LATA | Supervisor | $80.32 |
| **Human Resources Staff** | | |
| LLNL [a] | Human Resource, Job Placement Coordinator | $123.56 |
| LLNL [a] | Return to Work Manager | $115.84 |
| **Scientific and Subject Matter Expert Staff** | | |
| ANL | Scientific Staff | $102.97 |
| Hanford - WCH | Manager/Subject Matter Expert | $154.45 |
| KCP | Principal Statistician (Staff Engineer) | $137.08 |
| LLNL | Outside Consultant | $92.67 |
| LLNL | Statistician | $133.86 |
| ORNL - UCOR | Subject Matter Expert | $102.97 |
| ORNL - UTB | Senior Technical Resource | $126.65 |
| Pantex | Statistical Subject Matter Expert | $77.23 |
| SRS | Beryllium Subject Matter Expert | $117.39 |

[a] Represents average of the wage range provided by the site.

### 4.1.4 Medical Evaluation Unit Costs

Respondents reported unit costs for medical evaluations. Unit costs for a full medical evaluation reported in the EAQ varied from $412 to $618, and the costs of a BeLPT ranged from $221to $412. Thus, BeLPTs account for a large portion of the cost of medical evaluations. Notably, some contractors indicated that beryllium workers were only opting out of the BeLPT portion of the medical surveillance program. DOE estimated the incremental cost of BeLPTs for those workers. DOE used specific estimates of the unit cost of medical evaluations or BeLPTs for each site that provided an estimate and used an average for the sites that did not provide an estimate.[11]

**Table 4-4. Medical Evaluation and BeLPT Exam Unit Costs**

| Site | Complete Medical Evaluation | BeLPT Only |
|---|---|---|
| INL | NA | $220.97 |
| LLNL | $618 | NA |
| LANL | $412 - $515 | NA |
| Pantex | $597 | $412 |
| SNL | $535 | NA |

## 4.2 COMPLIANCE COSTS BY PROVISION

Using the unit costs presented in Section 4.1, other results from the EAQ, and data from the Beryllium Registry and the 1999 Economic Analysis, DOE estimated incremental costs for each site due to the proposed rule. Notably, sites' estimates varied greatly as each site has unique features and several sites do not have ongoing beryllium operations. DOE attempted to use the sites' estimates as much as possible, only altering them when evidence from other responses to the EAQ or from peer-reviewed literature indicated that a response may have been inaccurate.

[11] $553.46, the average of $618, $463 (the midpoint of LANL's estimate), $597 and $535, was used for sites that did not provide a unit cost in the EAQ.

### 4.2.1 Costs for Revising the CBDPP

The first incremental cost item is not linked to any specific revision, but results from any revision to 10 CFR 850. Any changes to the rule would require sites to update their CBDPPs and to update documents and training sessions used to educate individuals about the rule. DOE estimated that revising the CBDPP would require 10 percent of the effort required for the initial submission. Although not specifically requested by the EAQ, one site reported the costs of revising its CBDPP. That site's reported cost was approximately 10 percent of the cost for their initial submission, consistent with DOE's estimate. After calculating 10 percent of the costs incurred for submission of the original CBDPP as estimated in the Economic Analysis of the 1999 Final Rule, DOE converted that figure from 1999 dollars to 2014 dollars.[12] For sites that were not included in the 1999 Economic Analysis, DOE used 10 percent of the average cost of submitting a CBDPP from 1999 (converted to 2014 dollars) using the Bureau of Economic Analysis GDP deflator as an approximation for the costs of revising the CBDPP. These costs are presented in Table 4-5 below.

**Table 4-5. Cost of Revising the CBDPP by Site**

| Site [a] | Cost to Submit CBDPP (1999 Dollars) [b] | Cost to Submit CBDPP (2012 Dollars) | Costs to Revise CBDPP |
|---|---|---|---|
| Ames | $92,560 | $127,164 | $12,716 |
| ANL | $16,827 | $23,117 | $2,312 |
| BNL | $92,560 | $127,164 | $12,716 |
| Fermi | $92,560 | $127,164 | $12,716 |
| Hanford | $55,724 | $76,556 | $7,656 |
| INL | $92,560 | $127,164 | $12,716 |
| KCP | $12,327 | $16,935 | $1,694 |
| KAPL | $92,560 | $127,164 | $12,716 |
| LBNL | $20,288 | $27,872 | $2,787 |
| LLNL | $112,353 | $154,357 | $15,436 |
| LANL | $169,306 | $232,603 | $23,260 |
| NNSS | $92,560 | $127,164 | $12,716 |
| ORISE | $92,560 | $127,164 | $12,716 |

[12] See the original submission costs in Table 3-2 "Estimated Cost of Submitting Initial CBDPP Plans Under DOE N 440.1." Chronic Beryllium Disease Prevention Program Final Rule: Economic Analysis, 1999.

**Table 4-5. Cost of Revising the CBDPP by Site**

| Site [a] | Cost to Submit CBDPP (1999 Dollars) [b] | Cost to Submit CBDPP (2012 Dollars) | Costs to Revise CBDPP |
|---|---|---|---|
| ORNL | $26,525 | $36,442 | $3,644 |
| PNNL | $92,560 | $127,164 | $12,716 |
| Pantex | $23,274 | $31,975 | $3,198 |
| Portsmouth/Paducah | $92,560 | $127,164 | $12,716 |
| SNL | $92,560 | $127,164 | $12,716 |
| SRS | $92,560 | $127,164 | $12,716 |
| SLAC | $92,560 | $127,164 | $12,716 |
| Y-12 | $524,448 | $720,516 | $72,052 |
| **Total** | **NA** | **$2,846,343** | **$284,634** |

[a] Non-respondent sites were not considered to have separate CBDPPs and thus were not expected to incur costs.
[b] An average of the costs to submit a CBDPP for all sites in the 1999 Economic Analysis was used to estimate the cost of submitting a CBDPP for sites that were not included in the 1999 Economic Analysis.

### 4.2.2 Permissible Exposure Limit

In the 1999 CBDPP NOPR preamble, DOE reviewed the scientific evidence suggesting that the then current OSHA 8-hour time weighted average (TWA) permissible exposure limit (PEL) did not sufficiently protect worker health. However, DOE also stated that, in its view, it was difficult to determine from the scientific evidence the exposure level necessary to eliminate the risk of contracting CBD. DOE therefore concluded that the best approach to providing improved worker protection is through the establishment of a conservative 8-hour TWA action level, coupled with aggressive exposure reduction and minimization efforts, and the collection of medical surveillance data to better understand the causes of CBD. Accordingly, DOE retained the OSHA 8-hour TWA PEL in section 850.22 of the final rule and retained the action level concept put forth in the proposed rule, although at a lower level.

In 2006 when the Department promulgated 10 CFR part 851, *Workers Safety and Health Program*, the Department adopted OSHA's PEL for beryllium in 29 CFR 1910.1000, *General Industry Standards*. This makes sense in light of OSHA's current regulation. That is, currently OSHA's only beryllium protection is a PEL, so compliance with 10 CFR 851 merely makes the PEL the relevant level for purposes of the CBDPP. However, OSHA's proposed regulation

would establish additional substantive protections beyond the PEL. As a result, DOE recognizes that 10 CFR § 851.23(a)(3) could be read to require its contractors to comply with all provisions in OSHA's proposal (if finalized), including the ancillary provisions. However, it is DOE's intent that its facilities, at which employees may be exposed to beryllium, are to comply solely with the CBDPP provisions in 10 CFR 850. Now that DOE has recognized the issue and the substantive differences that would result under OSHA's proposal (if finalized), the Department is taking action to clarify § 851.23 by explicitly removing OSHA's beryllium rule from the group of OSHA standards in 29 CFR part 1910 with which DOE sites must comply. 10 CFR part 851 also requires DOE contractors to comply with the requirements in 10 CFR part 850, *Chronic Beryllium Disease Prevention Program*.

Although OSHA is currently proposing a new comprehensive health standard for beryllium in 29 CFR 1910, *Subpart Z Toxic and Hazardous Substances,* which will include a new PEL and ancillary provisions, DOE's intent is to adopt only OSHA's permissible exposure limit for beryllium, and not require its contractors and their employees to comply with OSHA's ancillary provisions (i.e., exposure assessment, personal protective clothing and equipment, medical surveillance, medical removal, training, and regulated areas or access control) of the new rule. The Department expects its contractors and their employees to continue to implement the provisions of 10 CFR part 850 at DOE sites.

OSHA's current PEL is 2 $\mu g/m^3$. DOE beryllium sites currently maintain workers' exposure to beryllium below the current OSHA PEL of 2 $\mu g/m^3$ and implied action level of 1$\mu g/m^3$, because the current DOE rule specifies a lower action level of 0.2$\mu g/m^3$.

OSHA's proposed rule includes a PEL of 0.2 $\mu g/m^3$, as well as, two regulatory alternatives that include PELs of 0.5$\mu g/m^3$ or 0.1 $\mu g/m^3$. Associated with the proposed OSHA PELs are

action levels set at half the level of the PELs (i.e., 0.1 μg/m$^3$, with alternatives of 0.25μg/m$^3$ or 0.05 μg/m$^3$).

OSHA's proposed PEL of 0.2μg/m$^3$ and associated 0.1 μg/m$^3$ action level are less stringent than DOE's proposed action level. In order to estimate how the costs of complying with the OSHA proposed PEL and associated action level would compare to the cost of complying with DOE's proposed action level, DOE identified any responses to the EAQ that explicitly stated impacts at an action level of 0.1 μg/m$^3$. This resulted in removing LANL's sampling costs, changing the number of regulated areas to zero for Hanford-WRPS, Pantex, and SRS, and changing the number of additional areas for monitoring to zero for Pantex. Complying with the OSHA proposed PEL instead of the DOE proposed action level would cost approximately $7.9 to $11.4 million *less* annually.

OSHA's first proposed alternate PEL of 0.1 μg/m$^3$ and associated action level of 0.05 μg/m$^3$ will not impose any additional costs on DOE sites, as the OSHA alternative action level of 0.05 μg/m$^3$ is equivalent to the DOE proposed action level of 0.05 μg/m$^3$. (While the DOE proposed action level will itself impose costs, as discussed further in this economic assessment, these costs are attributable to the DOE proposed rule and not the proposed OSHA rule.)

OSHA's second alternative proposed PEL of 0.5 μg/m$^3$ is not anticipated to impose costs on DOE sites, as the associated action level of 0.25 μg/m$^3$ is greater than the current DOE action level of 0.2 μg/m$^3$. If DOE were to adopt this second of OSHA's proposed PELs, it would in fact cost $8.0 to $11.5 million less than the DOE proposed rule.

Table 4-6 offers a comparison of compliance costs of the DOE proposed rule (action level of 0.05 μg/m$^3$), the OSHA proposed PEL of 0.1 μg/m$^3$ (action level of 0.05 μg/m$^3$), and OSHA regulatory alternative PEL of 0.5 μg/m$^3$ (action level of 0.25 μg/m$^3$).

**Table 4-6. Comparative Cost Analysis for Different Action Levels**

| | 0.25 µg/m³ Action Level | | 0.1 µg/m³ Action Level | | 0.05 µg/m³ Action Level |
|---|---|---|---|---|---|
| **Requirements Triggered by the Action Level in the Final Rule:** | **Annual Cost** | **Difference from 0.05 µg/m³ Action Level** | **Annual Cost** | **Difference from 0.05 µg/m³ Action Level** | **Annual Cost** |
| Revising the CBDPP (Initial cost only) | $284,634 | $0 | $284,634 | $0 | $284,634 |
| Sampling and New Analysis Methods | $0 | -$3,584,552 | $3,541,305 | -$43,247 | $3,584,552 |
| Regulated Areas | $0 | -$1,803,958 | $1,784,030 | -$19,928 | $1,803,958 |
| Exposure Monitoring | $0 | -$11,697 | $0 | -$11,697 | $11,697 |
| Medical Surveillance | $0 | -$967,894 | $967,894 | $0 | $967,894 |
| Medical Restriction | $0 | -$395,384 | $395,384 | $0 | $395,384 |
| Medical Removal | $0 | $745,813 to $4,249,063 | $745,813 to $4,249,063 | $0 | $745,813 to $4,249,063 |
| Medical Consent | $0 | -$71,993 | $71,993 | $0 | $71,993 |
| Changing Existing Signs (Initial cost only) | $0 | -$194,530 | $194,530 | $0 | $194,530 |
| Reporting to the Registry in Compliance with DOE STD 1187-2007 | $2,057 | $0 | $2,057 | $0 | $2,057 |
| Total for all requirements [a] | $286,692 | -$8,012,929 to -$11,516,178 | $9,352,367 - $11,156,535 | -$74,872 | $8,299,620 to $11,802,870 |

[a] Total annual costs include initial costs associated with revising the CBDPP and changing existing signage.

### 4.2.3 Demonstrating Compliance with the Revised Action Level

DOE intends to propose an action level of 0.05 µg/m$^3$. Some contractors indicated that, due to the limits of their current sampling methods and the short duration of beryllium tasks in their facilities, it would be difficult to collect samples with a limit of detection sufficiently below the action level of 0.05 µg/ m$^3$. For these contractors, DOE requested that sites estimate the costs of switching to another sampling method, such as Environmental Protection Agency (EPA) Method 6020A (Inductively Coupled Plasma-Mass Spectrometry) or NIOSH method 7704 (Beryllium in Air by Field-Portable Fluorometry). Contractors' estimates varied significantly. Some indicated

that their annual analysis costs would increase; others anticipated only an initial investment in new equipment, followed by annual costs similar to their current budget. Hanford, Pantex, and SRS anticipated both initial and annual costs for transitioning to NIOSH method 7704. Annual materials costs for this method were estimated based on the individual airborne monitoring results reported to the Beryllium Registry from 2009-2011. Table 4-7 presents total incremental costs to each facility of demonstrating compliance with the revised action level.

**Table 4-7. Incremental Cost of Demonstrating Compliance with the Proposed Action Level**

| Site | Materials Costs | Re-Characterizing Areas | New Sampling Methods | | Total Costs | |
|---|---|---|---|---|---|---|
| | | | Initial | Annual | Initial | Annual |
| Hanford (EM) | NA | NA | $261,543 | $3,019,026 | $261,543 | $3,019,026 |
| Idaho National Laboratory (EM & NE) | NA | $152,910 | NA | NA | $152,910 | NA |
| Kansas City Plant (NA) | NA | $129,834 | NA | NA | $129,834 | NA |
| Lawrence Livermore National Laboratory (LLNL) [NA] | NA | NA | $514,848 | NA | $514,848 | NA |
| Los Alamos National Laboratory (LANL) [NA] | NA | NA | NA | $43,247 | $0 | $43,247 |
| Pantex Plant (NA) | NA | NA | $261,543 | $411,878 | $261,543 | $411,878 |
| Sandia National Laboratory (NA) | NA | NA | $9,267 | NA | $9,267 | NA |
| Savannah River Site (EM & NA) | $515 | NA | $261,543 | $110,400 | $262,058 | $110,400 |
| **Total** | **$515** | **$282,744** | **$1,308,744** | **$3,584,552** | **$1,592,003** | **$3,584,552** |

Note: NA indicates that no estimate was provided in the EAQ.

### 4.2.4 Regulated Areas

In the EAQ, contractors indicated the number of regulated areas they expected to establish due to the proposed action level and the incremental costs for establishing a regulated area. The

costs for establishing a regulated area were highly variable. Responses showed that the costs varied most based on: the adequacy of pre-existing hygiene facilities in the area; the feasibility of separating exposure generating processes from surrounding employees and areas; the number of employees that work in the area; and the frequency and duration of the exposure-generating activities. Other factors affected the variability of the costs, but less significantly.

Notably, Sandia National Laboratory (SNL) indicated that Technical Area Four (TA4) 983 High Bay (Z facility) Center Section would require significant facility modifications/renovations, including airlock separation, refrigerated air, and new hygiene facilities. SNL also anticipated a 25 percent to 75 percent decrease in worker productivity due to personal protective equipment (PPE) and a 50 percent reduction in their ability to meet customers' orders. DOE reviewed literature investigating reduced productivity associated with respirators and PPE and did not find evidence for impacts of that magnitude (Jaraiedi et al., 1994, Johnson et al., 1997). A quantitative estimate of the impact of SNL's reduced capacity to satisfy customers' orders on the mission of SNL was not available and is not included in the economic assessment.

Another site claiming high cost impacts was Kansas City Plant (KCP). KCP estimated costs of $0.5 million to $1.3 million per regulated area but indicated that very few airborne samples have had detectable results and that there are 10 beryllium processing areas currently at their facility. KCP also stated that processes at all 10 of these areas have the potential to exceed the proposed action level and estimated costs for establishing 10 new regulated areas.

Also, ORNL's prime contractor UT-Battelle (UTB) noted that it would have to establish temporary regulated areas for infrequent tasks such as removing laboratory hoods. Due to the infrequent and unique nature of possible areas, UTB was unable to estimate costs or the number

of such areas, but noted that regulated areas for such tasks would be established temporarily until the equipment was packaged for disposal.

The primary controls and activities for establishing regulated areas included costs to:

- *Demarcate regulated areas and control access and entry.*
- *Dress employees in appropriate PPE.*
- *Establish adequate hygiene facilities (changing rooms, showers, etc.).*
- *Modify and renovate the facility (negative air pressure, refrigerate air, air locks, etc.).*
- *Develop a training program for workers in new areas and implement training.*
- *Perform hazard analyses of individual jobs.*
- *Establish a system requiring employees to obtain permits for beryllium work in the area.*

The most costly items include facility modification and renovations, establishing adequate hygiene facilities, and outfitting workers with appropriate PPE. The total incremental costs for new regulated areas are displayed below in Table 4-8.

**Table 4-8. Incremental Compliance Costs for New Regulated Areas by Site**

| Site | New Regulated Areas | Minimum | | Maximum | | Average | |
|---|---|---|---|---|---|---|---|
| | | Initial | Annual | Initial | Annual | Initial | Annual |
| Hanford | 1 | $10,374 | $0 | $10,374 | $0 | $10,374 | $0 |
| INL | 3 | $623,996 | $139,009 | $1,890,522 | $154,454 | $1,257,259 | $146,732 |
| KCP | 10 | $5,072,969 | $0 | $12,898,658 | $0 | $8,985,813 | $0 |
| LLNL | 5 | $194,033 | $0 | $2,655,779 | $0 | $1,424,906 | $0 |
| LANL | 5 | $37,481 | $0 | $130,154 | $0 | $83,817 | $0 |
| Pantex | 2 | $15,802 | $13,556 | $20,157 | $22,593 | $17,980 | $18,074 |
| SNL | 1 | $12,959,135 | $541,126 | $32,797,050 | $1,091,478 | $22,878,093 | $816,302 |
| SRS | 2 | $14,498 | $618 | $16,558 | $3,089 | $15,528 | $1,853 |
| Y-12 | 71 | $2,352,362 | $820,997 | $2,581,849 | $820,997 | $2,467,106 | $820,997 |
| **Total** | **100** | **$21,280,650** | **$1,515,305** | **$53,001,101** | **$2,092,611** | **$37,140,875** | **$1,803,958** |

### 4.2.5 Exposure Monitoring in New Regulated Areas

In the EAQ, some contractors indicated that they would incur incremental exposure monitoring costs to comply with periodic monitoring requirements for the proposed new regulated areas. DOE noted that the number of quarterly samples per area varied widely, ranging from 13 to 138. Per sample unit costs also varied depending on whether sites had an on-site lab, the number of samples processed in one batch, and the labor required to collect the samples.[13] Due to the range of unit costs, DOE used contractor-specific estimates for the sample unit costs and the incremental number of samples needed for compliance. The incremental costs for exposure monitoring of the proposed new regulated areas are summarized in Table 4-9. The costs for re-characterizing existing areas to demonstrate current compliance and transitioning to new sample-analysis methodologies are accounted for in Section 4.2.20.

**Table 4-9. Incremental Exposure Monitoring Costs**

| Site | Contractor | Additional Areas | Samples per Area per Year | Cost per Sample | Total Cost (Annual) |
|---|---|---|---|---|---|
| Hanford | WRPS | 1 | 20 | $500 | $10,000 |
| INL | ICP | 3 | 90 | $550 | $148,500 |
| KCP | KCP | 1 | 30 | $467 | $14,010 |
| LLNL | LLNL | 5 | 126 | $55 | $34,571 |
| ORNL | UTB | 1 [a] | 138 | $293 | $40,288 |
| Pantex | Pantex | 2 | 20 | $284 | $11,360 |
| SNL | SNL | 2 | 80 | $300 | $48,000 |
| Y-12 | Y-12 | 5 | 52 | $370 | $96,200 |
| **Total** | | | | | **$402,929** |

[a] UTB has not responded to clarification questions. Thus, DOE assumed that one additional area would be established.

[13] See Table 3-1for the unit costs reported by all sites, including sites that did not incur costs for exposure monitoring.

### 4.2.6 Medical Surveillance

The proposed CBDPP rule in would modify the medical surveillance provisions (§ 850.34) for beryllium and beryllium-associated workers as follows:

1. Medical evaluations would be mandatory for beryllium workers (although still voluntary for beryllium-associated workers).
2. Periodic medical evaluations would be provided to any beryllium-associated worker who shows signs and symptoms of beryllium induced conditions, even if they have had a recent regular screening evaluation.
3. Exit medical evaluations would be provided to workers in the medical surveillance program.

The incremental cost impacts of each of these changes are discussed below and summarized in Table 4-10, Table 4-11, Table 4-12, and Table 4-13. The aggregate cost impacts for the proposed changes to the medical surveillance requirements are summarized in Table 4-14.

#### *4.2.6.1 Mandatory Medical Surveillance for Beryllium Workers*

The proposed CBDPP rule would make the medical surveillance requirements mandatory for beryllium workers (although it is voluntary for beryllium-associated workers) [§ 850.34(b)(1)(i)(A)]. Thus, DOE estimated the incremental costs of additional medical evaluations for beryllium workers currently opting out of the medical surveillance program who would be subject to mandatory screening under the proposed rule. Through the EAQ, contractors reported the number of beryllium workers that are currently opting out of the medical surveillance program. Notably, some contractors indicated that beryllium workers were only opting out of the BeLPT portion of the

medical surveillance program. DOE estimated the incremental cost of BeLPTs for those workers. DOE used specific estimates of the unit cost of medical evaluations or BeLPT exams for each site that provided an estimate and used the average of reported estimates for the sites that did not provide an estimate.

Table 4-10 shows the initial incremental costs of additional medical evaluations due to medical surveillance being mandatory.

**Table 4-10. Initial Incremental Costs for Additional Medical Evaluations for Beryllium Workers (BWs)**

| Site | BWs Declining Elements of Medical Evaluations | Unit Costs of Medical Evaluation Elements Declined by BWs | Total Costs of Additional Medical Evaluation Elements due to Mandate |
|---|---|---|---|
| Ames | 0 | NA | $0 |
| ANL | 45 | $553 | $24,629 |
| BNL | 3 | $553 | $1,660 |
| Fermi | 0 | $0 | $0 |
| Hanford | 0 | NA | $0 |
| INL | 1 | NA | $221 |
| KCP | 0 | NA | $0 |
| KAPL | 0 | NA | $0 |
| LBNL | 0 | $0 | $0 |
| LLNL | 12 | $618 | $7,414 |
| LANL | 425 | $463 | $196,929 |
| NNSS | 0 | $0 | $0 |
| ORISE | 0 | $0 | $0 |
| ORNL | 0 | NA | $0 |
| PNNL | 0 | NA | $0 |
| Pantex [a] | 89 | $412 | $36,657 |
| Portsmouth/Paducah | 0 | NA | $0 |
| SNL | 0 | $535 | $0 |
| SRS | 191 | $553 | $105,434 |
| SLAC | 0 | $0 | $0 |
| Y-12 | 0 | NA | $0 |
| **Total** | **765** | | **$372,945** |

[a] At this facility the costs would be incurred for a full medical evaluation, as opposed to only the BeLPT exam portion of the evaluation.

#### *4.2.6.2 Medical Exams for Beryllium-Associated Workers and Workers Showing Signs and Symptoms:*

The proposed CBDPP rule would require an employer to provide medical evaluations to workers who are showing signs and symptoms of a beryllium induced condition [§ 850.34(b)(2)(i)(C)]. In some cases, this evaluation might replace the worker's next scheduled periodic evaluation. However, in cases where the employer is not required to provide a regular periodic evaluation for the worker in the current year or where the worker started showing signs and symptoms after a recent evaluation, DOE expects the employer to provide an additional medical evaluation. The incremental cost impacts for evaluations for workers showing signs and symptoms are based on the profile of the DOE complex estimated in Section 2 and a DOE estimate of the share of workers showing signs and symptoms associated with beryllium conditions.

DOE combined two estimates—that 0.26 percent of workers would become BeS or have CBD (Chronic Beryllium Disease Prevention Program 1999) and that 0.86 percent of employees would have non-beryllium conditions causing them to show signs and symptoms associated with beryllium conditions (See Appendix B—Estimating the Share of Employees Showing Signs and Symptoms of Beryllium Induced Conditions) to estimate that 1.12 percent of beryllium-associated workers would show signs and symptoms each year.[14] While beryllium workers undergo an annual periodic exam,

[14] In DOE's 1999 Economic Analysis of 10 CFR 850, 0.2 percent of workers in the medical surveillance program were estimated to have beryllium-induced conditions on an annual basis. In this economic assessment the share of total tested workers diagnosed with beryllium sensitivity or CBD between 2002 and 2012 as reported by the Beryllium Registry was used to approximate the share of workers showing signs and symptoms of beryllium-induced conditions. Because the number of active workers participating in medical surveillance fluctuates and average participation is not available to DOE, DOE conservatively estimated the number of workers as a share of all workers eligible for medical surveillance (as opposed to all workers actively participating in the medical surveillance program).

beryllium-associated workers receive exams every third year. Thus, two-thirds of beryllium-associated workers would not be scheduled to have a medical evaluation in any given year and would need an additional evaluation before their next exam. The remaining third of beryllium-associated workers would be scheduled to have an evaluation in the current year. Nevertheless, DOE considered that some share of workers may have had their periodic evaluation earlier in the year before they begin to show signs and symptoms, and will also require an additional evaluation. DOE estimates that this will be the case for half of remaining workers. Thus, five-sixths of beryllium-associated workers showing signs and symptoms will require an additional medical evaluation, or 0.94 percent annually.[15] Using similar assumptions for beryllium workers, half of 1.06 percent of beryllium workers would require an additional exam, or 0.56 percent. Table 4-11 shows the estimated incremental costs of medical evaluations for worker showing signs and symptoms.

**Table 4-11. Incremental Annual Costs of Medical Evaluations for Workers Showing Signs and Symptoms**

| Site | BWs and BAWs Needing Additional Evaluations | Annual Costs of Additional Medical Evaluations |
|---|---|---|
| Ames (SC) | 1 | $553 |
| Argonne National Laboratory (SC) | 1 | $553 |
| Brookhaven National Laboratory (SC) | 1 | $553 |
| Fermi National Accelerator Laboratory (SC) | 1 | $0 |
| Hanford (EM) | 55 | $30,328 |
| Idaho National Laboratory (EM & NE) | 2 | $1,373 |
| Kansas City Plant (NA) | 8 | $4,672 |
| Knolls Atomic Power Laboratory (KAPL) [NA-30] | 1 | $553 |
| Lawrence Berkeley National Laboratory (SC) | 1 | $0 |
| Lawrence Livermore National Laboratory (LLNL) [NA] | 9 | $5,828 |
| Los Alamos National Laboratory (LANL) [NA] | 15 | $6,808 |
| National Nuclear Security Site (NA) | 7 | $0 |

[15] 5/6 is the result of adding 2/3 of beryllium-associated workers and 1/2 of the remaining 1/3 of beryllium-associated workers. [5/6 = 2/3 + 1/2 * 1/3]. 0.94 percent is the result of multiplying 1.12 percent by 5/6. [$0.0112 \times 0.833 = 0.00938$]

**Table 4-11. Incremental Annual Costs of Medical Evaluations for Workers Showing Signs and Symptoms**

| Site | BWs and BAWs Needing Additional Evaluations | Annual Costs of Additional Medical Evaluations |
|---|---|---|
| Oak Ridge Institute for Science and Education (ORISE) [SC] | 0 | $0 |
| Oak Ridge National Laboratory (ORNL) [EM & SC] | 4 | $2,471 |
| Pacific Northwest National Laboratory (PNNL) [SC] | 0 | $0 |
| Pantex Plant (NA) | 12 | $6,792 |
| Portsmouth Paducah Project Office (EM) | 1 | $553 |
| Sandia National Laboratory (NA) | 4 | $2,260 |
| Savannah River Site (EM & NA) | 5 | $2,587 |
| Stanford Linear Accelerator Center (SLAC) [SC] | 1 | $0 |
| Y-12 (NA) | 19 | $10,408 |
| **Total** | **149** | **$76,295** |

#### *4.2.6.3 Exit Medical Evaluations*

The proposed CBDPP rule would require employers to provide medical evaluations for workers in jobs with beryllium activities at the time of separation from employment if the employee has not had an evaluation within the previous six months [§ 850.34(b)(4)]. DOE estimated the proportion of beryllium workers leaving the DOE site based on the average separations rate for the manufacturing sector from the Job Openings and Labor Turnover Survey (JOLTS) (BLS, 2015), 21.4 percent, and assumed that one half of beryllium workers would have not received an evaluation within the previous six months.[16] Table 4-12 presents the estimated incremental costs of exit medical evaluations.

**Table 4-12. Incremental Annual Costs for Exit Medical Evaluations**

| Site | Workers Requiring Exit Evaluations | Exit Medical Evaluations |
|---|---|---|
| Ames (SC) | 2 | $1,007 |
| Argonne National Laboratory (SC) | 23 | $12,664 |
| Brookhaven National Laboratory (SC) | 1 | $533 |
| Fermi National Accelerator Laboratory (SC) | 0 | $0 |
| Hanford (EM) | 325 | $180,089 |

[16] JOLTS defines total separations as "all employees separated from the payroll." This includes: layoffs, quits, retirements, deaths, and disability separations.

**Table 4-12. Incremental Annual Costs for Exit Medical Evaluations**

| Site | Workers Requiring Exit Evaluations | Exit Medical Evaluations |
|---|---|---|
| Idaho National Laboratory (EM & NE) | 19 | $10,719 |
| Kansas City Plant (NA) | 65 | $35,769 |
| Knolls Atomic Power Laboratory (KAPL) [NA-30] | 1 | $592 |
| Lawrence Berkeley National Laboratory (SC) | 0 | $0 |
| Lawrence Livermore National Laboratory (LLNL) [NA] | 89 | $54,968 |
| Los Alamos National Laboratory (LANL) [NA] | 108 | $49,927 |
| National Nuclear Security Site (NA) | 0 | $0 |
| Oak Ridge Institute for Science and Education (ORISE) [SC] | 0 | $0 |
| Oak Ridge National Laboratory (ORNL) [EM & SC] | 35 | $19,182 |
| Pacific Northwest National Laboratory (PNNL) [SC] | 0 | $0 |
| Pantex Plant (NA) | 113 | $62,356 |
| Portsmouth Paducah Project Office (EM) | 6 | $3,316 |
| Sandia National Laboratory (NA) | 48 | $25,897 |
| Savannah River Site (EM & NA) | 50 | $27,627 |
| Stanford Linear Accelerator Center (SLAC) [SC] | 0 | $0 |
| Y-12 (NA) | 159 | $87,973 |
| **Total** | **1,043** | **$572,620** |

#### *4.2.6.4 Notifying Beryllium-associated Workers of Right to Participate*

The proposed CBDPP rule would require employers to notify beryllium-associated workers annually of their right to participate in the medical surveillance program § 850.34(a)(6)]. DOE estimates that this notification will require15 minutes of a human resources manager's time at a loaded wage of $123.56. Table 4-13 shows the incremental labor costs associated with this notification.

**Table 4-13. Incremental Costs for Notifying BAWs of their Right to Participate in Medical Surveillance**

| Site | BAWs Notified | Annual Cost |
|---|---|---|
| Ames (SC) | 17 | $525 |
| Argonne National Laboratory (SC) | 71 | $2,193 |
| Brookhaven National Laboratory (SC) | 9 | $278 |
| Fermi National Accelerator Laboratory (SC) | 20 | $0 |
| Hanford (EM) | 4,463 | $137,866 |
| Idaho National Laboratory (EM & NE) | 178 | $5,483 |
| Kansas City Plant (NA) | 604 | $18,658 |
| Knolls Atomic Power Laboratory (KAPL) [NA-30] | 10 | $309 |
| Lawrence Berkeley National Laboratory (SC) | 13 | $0 |
| Lawrence Livermore National Laboratory (LLNL) [NA] | 600 | $18,535 |
| Los Alamos National Laboratory (LANL) [NA] | 1,139 | $35,185 |
| National Nuclear Security Site (NA) | 514 | $0 |
| Oak Ridge Institute for Science and Education (ORISE) [SC] | 0 | $0 |
| Oak Ridge National Laboratory (ORNL) [EM & SC] | 320 | $9,870 |
| Pacific Northwest National Laboratory (PNNL) [SC] | 0 | $0 |
| Pantex Plant (NA) | 878 | $27,122 |
| Portsmouth Paducah Project Office (EM) | 56 | $1,730 |
| Sandia National Laboratory (NA) | 302 | $9,329 |
| Savannah River Site (EM & NA) | 335 | $10,333 |
| Stanford Linear Accelerator Center (SLAC) [SC] | 47 | $0 |
| Y-12 (NA) | 1,346 | $41,564 |
| **Total** | **10,920** | **$318,979** |

Table 4-14 presents the total incremental costs for all revisions to the medical surveillance provisions.

**Table 4-14. Total Incremental Costs for All Revisions to Medical Surveillance**

| Site | Medical Surveillance for BWs Currently Opting Out | Evaluations for BWs and BAWs Showing Signs and Symptoms between Periodic Medical Examination | Exit Evaluations | Notifying BAWs that Medical Surveillance is Optional | Total Annual Costs | Total Medical Surveillance Costs [a] |
|---|---|---|---|---|---|---|
| | Initial | Annual | Annual | Annual | Annual | Total |
| Ames (SC) | $0 | $553 | $1,007 | $525 | $2,085 | $2,085 |
| Argonne National Laboratory (SC) | $24,629 | $553 | $12,664 | $2,193 | $15,411 | $18,917 |
| Brookhaven National Laboratory (SC) | $1,660 | $553 | $533 | $278 | $1,364 | $1,601 |
| Fermi National Accelerator Laboratory (SC) | $0 | $0 | $0 | $0 | $0 | $0 |
| Hanford (EM) | $0 | $30,328 | $180,089 | $137,866 | $348,284 | $348,284 |
| Idaho National Laboratory (EM & NE) | $221 | $1,373 | $10,719 | $5,483 | $17,575 | $17,607 |
| Kansas City Plant (NA) | $0 | $4,672 | $35,769 | $18,658 | $59,099 | $59,099 |
| Knolls Atomic Power Laboratory (KAPL) [NA-30] | $0 | $553 | $592 | $309 | $1,455 | $1,455 |
| Lawrence Berkeley National Laboratory (SC) | $0 | $0 | $0 | $0 | $0 | $0 |
| Lawrence Livermore National Laboratory (LLNL) [NA] | $7,414 | $5,828 | $54,968 | $18,535 | $79,331 | $80,386 |
| Los Alamos National Laboratory (LANL) [NA] | $196,929 | $6,808 | $49,927 | $35,185 | $91,920 | $119,958 |
| National Nuclear Security Site (NA) | $0 | $0 | $0 | $0 | $0 | $0 |
| Oak Ridge Institute for Science and Education (ORISE) [SC] | $0 | $0 | $0 | $0 | $0 | $0 |
| Oak Ridge National Laboratory (ORNL) [EM & SC] | $0 | $2,471 | $19,182 | $9,870 | $31,523 | $31,523 |
| Pacific Northwest National Laboratory (PNNL) [SC] | $0 | $0 | $0 | $0 | $0 | $0 |
| Pantex Plant (NA) | $36,657 | $6,792 | $62,356 | $27,122 | $96,270 | $101,489 |
| Portsmouth Paducah Project Office (EM) | $0 | $553 | $3,316 | $1,730 | $5,600 | $5,600 |
| Sandia National Laboratory (NA) | $0 | $2,260 | $25,897 | $9,329 | $37,486 | $37,486 |
| Savannah River Site (EM & NA) | $105,434 | $2,587 | $27,627 | $10,333 | $40,547 | $55,559 |
| Stanford Linear Accelerator Center (SLAC) [SC] | $0 | $0 | $0 | $0 | $0 | $0 |
| Y-12 (NA) | $0 | $10,408 | $87,973 | $41,564 | $139,945 | $139,945 |
| **Total** | **$372,945** | **$76,295** | **$572,620** | **$318,979** | **$967,894** | **$1,020,993** |

[a] The total costs are the annualized initial costs plus the total annual costs.

### 4.2.7 Medical Restriction

DOE is proposing to add in § 850.35 a medical restriction requirement for workers with non-beryllium related conditions that may be aggravated by exposure to beryllium. While only beryllium workers with beryllium-induced medical conditions are eligible for medical removal and medical removal benefits, workers with non-beryllium related conditions may benefit from restriction from jobs with beryllium activities. For medically restricted workers, depending on the collective bargaining agreement, the contractor may adjust their salary and benefits to be consistent with a new job (if the employee is transferred). Thus, no wage differential was incorporated into the cost estimates for workers that are transferred to a new job because of medical restriction. The proposed regulatory text does not prohibit employers from terminating the workers' employment if they are restricted from their job, nevertheless, the compliance cost estimated here is based on DOE's assumption that employers will transfer employees to similar jobs or allow them to continue performing the activities they currently work in that do not involve beryllium exposures at or above the action level. The majority of the cost of medical restriction will occur when a worker is restricted from their current job and then retrained for another job. However, as a workers' jobs does not involve beryllium activities, no job transfer or retraining will be necessary. Even if no transfer is required the employer will have to record that the worker is restricted from certain areas and activities to prevent transfer to a restricted job, incurring some administrative costs. The SOMD will also be required to provide counseling to restricted workers. Thus, only beryllium workers who are eligible for medical restriction will require retraining, while

administrative labor and counseling will be performed for all medically restricted workers.[17]

Based on prevalence estimates in medical literature indicating the share of the population with non-beryllium related conditions that may be exacerbated due to exposure to beryllium (such as asthma, sarcoidosis, emphysema, COPD, etc.), DOE estimated that 0.86 percent of its workforce would be eligible for medical restriction.[18] DOE estimates the share of these cases that will occur among beryllium workers based on the share of overall employees at each site that are beryllium workers (U.S. DOE, 2012). For restricted workers who do not require retraining, DOE estimated costs for one hour of managerial labor per worker to adjust schedules and work plans to accommodate workers' restrictions from entering areas with beryllium exposures. The estimated cost of the counseling requirement includes an hour and a half of time for the SOMD (assuming a wage of $102.97 per hour) and the worker (assuming a wage of $77.23 per hour). For workers who will have to be transferred to a new job, DOE estimated incremental retraining costs of $6,178 per worker. The costs of these provisions are included in Table 4-15.

[17]The share of workers with exposures above the new action level was estimated based on an output of exposure monitoring results from the Beryllium Registry, 2012.
[18] See Appendix B—Estimating the Share of Employees Showing Signs and Symptoms of Beryllium Induced Conditions for methodology used to estimate the share of workers requiring medical restriction.

**Table 4-15. Incremental Medical Restriction Costs**

| Site | Workers Exposed above the AL with Beryllium Conditions Annually [a] | Workers Exposed above the AL with Non-Beryllium Conditions Annually [a] | Incremental Managerial Labor for All Workers | Cost of Counseling Restricted Worker | Total Cost of Medical Restriction |
|---|---|---|---|---|---|
| Ames | 1 | 4 | $514 | $1,349 | $1,863 |
| ANL | 6 | 30 | $3,696 | $9,703 | $13,399 |
| BNL | 6 | 26 | $3,295 | $8,648 | $11,943 |
| Fermi | 4 | 17 | $2,162 | $5,676 | $7,839 |
| Hanford | 20 | 95 | $11,689 | $30,684 | $42,374 |
| INL | 15 | 69 | $8,640 | $22,681 | $31,321 |
| KCP | 5 | 22 | $2,750 | $7,219 | $9,969 |
| KAPL | 5 | 22 | $2,780 | $7,297 | $10,076 |
| LBNL | 8 | 36 | $4,531 | $11,893 | $16,424 |
| LLNL | 12 | 55 | $6,857 | $18,001 | $24,858 |
| LANL | 20 | 95 | $11,791 | $30,952 | $42,743 |
| NNSS | 5 | 23 | $2,883 | $7,568 | $10,451 |
| ORISE [b] | 1 | 4 | $515 | $1,351 | $1,866 |
| ORNL | 8 | 38 | $4,720 | $12,391 | $17,111 |
| PNNL | 9 | 41 | $5,148 | $13,515 | $18,663 |
| Pantex | 6 | 29 | $3,551 | $9,322 | $12,873 |
| Portsmouth/Paducah | 8 | 40 | $4,940 | $12,967 | $17,907 |
| SNL | 16 | 75 | $9,348 | $24,537 | $33,885 |
| SRS | 22 | 104 | $12,951 | $33,996 | $46,947 |
| SLAC | 3 | 13 | $1,648 | $4,325 | $5,972 |
| Y-12 | 8 | 38 | $4,662 | $12,238 | $16,901 |
| **Total** | **188** | **876** | **$109,072** | **$286,313** | **$395,384** |

[a] The Beryllium Registry provided a customized set of exposure data from 2002-2011. DOE calculated the share of total samples above the proposed action level 0.05µg/m3. DOE multiplied this share by the number of workers at DOE sites to estimate total workers exposed above the action level. Finally, DOE multiplied this number of workers by the annual prevalence rate for beryllium-induced conditions.

[b] ORISE does not report to the Beryllium Registry as there are no workers currently exposed to beryllium employed at ORISE. ORISE's association with beryllium is based on a few workers who have transferred to ORISE from other sites where they were potentially exposed to beryllium. (Wallace, 2012)

### 4.2.8 Medical Removal

The proposed CBDPP rule would make medical removal mandatory for beryllium workers with CBD [§ 850.36]. This will cause sites to incur costs for any beryllium workers who are currently opting out of medical removal benefits. Also, due to the lower proposed action level, the number of beryllium workers will increase due to newly regulated areas, and the medical removal provision will apply to a larger pool of eligible workers. DOE considered that over time, the lower action level would reduce the number of employees requiring medical removal by reducing the incidence of CBD in the DOE complex. In the short run, however, more employees will qualify as beryllium workers, be covered by the medical surveillance program, and be eligible for medical removal benefits if they should be diagnosed with a beryllium induced condition due to past exposures. Thus, DOE estimated the costs of providing medical removal to workers who are currently opting out of medical removal and to the new beryllium workers under the proposed action level. DOE estimated the medical removal rate based on the share of workers reported by Beryllium Registry to have been diagnosed with CBD between 2002 and 2013. Notably, the proposed regulation allows sensitized workers to choose whether to accept medical removal or return to their job. Based on diagnoses recorded in the 2013 Beryllium Registry, DOE estimated 0.05 percent of beryllium-associated workers will require medical removal.[19]

[19] From 2002 to 2013, 146 of 21,453 workers were diagnosed with CBD, or about 0.7 percent of workers. Dividing this by 14 to convert it to an annual rate, 0.05 percent of beryllium-associated workers are judged to require medical removal on an annual basis. It should be noted, however, that the rate reported is for beryllium-associated workers under the current definition, which includes both beryllium-associated workers and beryllium workers, as the definitions are proposed. The rate under the rule for beryllium workers only may thus vary, but no data are currently available to estimate a BW-specific figure.

In the responses to the EAQ, three contractors, LLNL, Pantex, and SST, anticipated incremental costs associated with mandatory medical removal for beryllium workers who are currently opting out of removal. Pantex estimated that six active workers are opting out of medical removal and estimated the costs of medical removal at approximately $364,000 per worker (including medical removal benefits of approximately $92,673 per year per worker). The other two sites did not include medical removal benefits in their estimate. To account for this difference, DOE added $92,673 per year to those sites' estimates to estimate the maximum unit cost per employee. For sites that did not provide a specific estimate of the cost for medical removal, DOE used the average for the three unit costs provided: $194,901. DOE also noted that medical removal will not cost this much for workers that can be transferred to other jobs, as the cost of wages paid out to the worker will be offset by the value of the labor performed in the alternate job. Thus, DOE estimated a minimum unit cost per worker by subtracting $92,673 from the unit cost used for each site.[20] In this case, the average cost used for sites that did not provide a specific estimate in the EAQ was $102,228. Minimum and maximum incremental costs for the permanent removal benefits provision in proposed § 850.36 are displayed in Table 4-16.

[20] DOE subtracted $92,673 (the estimate provided in the Pantex response to the EAQ as the cost of paying a worker's wages when he or she was not working). In the case where an alternate job is available, the remaining costs of medical removal are expected to include: administrative costs, hiring a replacement, retraining the worker and the wage differential between the job into which the worker is transferred and their original job for 2,000 hours a year.

**Table 4-16. Incremental Cost of Permanent Medical Removal Benefits and Removal for Additional Workers**

| Site | Workers Needing Immediate Permanent Medical Removal [a] | Minimum Initial Cost of Permanent Medical Removal | Maximum Initial Cost of Permanent Medical Removal | Minimum Annual Number of Workers Needing Permanent Medical Removal [b, c] | Maximum Annual Number of Workers Needing Permanent Medical Removal [b, c] | Minimum Annual Cost of Permanent Medical Removal | Maximum Annual Cost of Permanent Medical Removal |
|---|---|---|---|---|---|---|---|
| Ames | 0 | $0 | $0 | 0.01 | 0.03 | $845 | $6,101 |
| ANL | 0 | $0 | $0 | 0.10 | 0.39 | $10,627 | $76,739 |
| BNL | 0 | $0 | $0 | 0.00 | 0.02 | $447 | $3,230 |
| Fermi | 0 | $0 | $0 | 0.00 | 0.00 | $0 | $0 |
| Hanford | 0 | $0 | $0 | 1.48 | 5.60 | $151,121 | $1,091,289 |
| INL | 0 | $0 | $0 | 0.09 | 0.33 | $8,995 | $64,954 |
| KCP | 0 | $0 | $0 | 0.29 | 1.11 | $30,015 | $216,750 |
| KAPL | 0 | $0 | $0 | 0.00 | 0.02 | $497 | $3,589 |
| LBNL | 0 | $0 | $0 | 0.00 | 0.00 | $0 | $0 |
| LLNL | 1 | $108,041 | $15,368 | 0.40 | 1.53 | $41,321 | $298,392 |
| LANL | 0 | $0 | $0 | 0.49 | 1.85 | $50,043 | $361,374 |
| NNSS | 0 | $0 | $0 | 0.00 | 0.00 | $0 | $0 |
| ORISE | 0 | $0 | $0 | 0.00 | 0.00 | $0 | $0 |
| ORNL | 0 | $0 | $0 | 0.16 | 0.60 | $16,096 | $376,354 |
| PNNL | 0 | $0 | $0 | 0.00 | 0.00 | $0 | $0 |
| Pantex | 6 | $2,180,383 | $1,624,347 | 0.51 | 1.94 | $52,326 | $377,861 |
| Portsmouth/ Paducah | 3 | $339,800 | $61,782 | 0.03 | 0.10 | $2,783 | $11,679 |
| SNL | 0 | $0 | $0 | 0.22 | 0.83 | $22,463 | $162,209 |
| SRS | 0 | $0 | $0 | 0.23 | 0.86 | $23,183 | $167,411 |
| SLAC | 0 | $0 | $0 | 0.00 | 0.00 | $0 | $0 |
| Y-12 | 5 | $511,141 | $511,141 | 0.72 | 2.74 | $73,822 | $533,091 |
| **Total** | **15** | **$3,139,365** | **$2,212,638** | **5** | **18** | **$484,583** | **$3,751,021** |

[a] Based on EAQ responses indicating the number of active beryllium workers currently opting out of medical removal

[b] Note that several sites will not have a beryllium worker requiring removal less frequently than on an annual basis. The difference

[c] The minimum number of workers is estimated based on the assumption that all sensitized workers will opt out of removal, while the maximum assumes that they will all accept removal. The unit cost for medical removal also varies between the minimum and maximum scenarios.

DOE also estimated costs for temporary medical removal benefits in cases where the final medical determination requires extra time. DOE estimated that 10 percent of final medical determinations might require additional time, and that employers would provide temporary medical removal benefits. DOE estimated that on average employees would receive three months of temporary removal benefits before the SOMD could issue a final medical determination. Three months of medical removal is estimated based on the cost for one year of medical removal: $16,242 per month in the maximum scenario ($194,900/12 months or $8,519 per month in the minimum scenario (($194,901-$92,673)/12 months). Total incremental costs for temporary medical removal are presented in Table 4-17.

**Table 4-17. Incremental Costs for Temporary Medical Removal**

| Site | Workers Needing Temporary Medical Removal (Over 10 Years) [a] | Minimum Annual Cost of Temporary Medical Removal | Maximum Annual Cost of Temporary Medical Removal |
|---|---|---|---|
| Ames | 0.2 | $455 | $868 |
| ANL | 2.2 | $5,729 | $10,922 |
| BNL | 0.1 | $241 | $460 |
| Fermi | 0.0 | $0 | $0 |
| Hanford | 31.9 | $81,466 | $155,318 |
| INL | 1.9 | $4,849 | $9,245 |
| KCP | 6.3 | $16,181 | $30,849 |
| KAPL | 0.1 | $268 | $511 |
| LBNL | 0.0 | $0 | $0 |
| LLNL | 8.7 | $22,275 | $42,469 |
| LANL | 10.6 | $26,977 | $51,433 |
| NNSS | 0.0 | $0 | $0 |
| ORISE | 0.0 | $0 | $0 |
| ORNL | 3.4 | $8,677 | $16,543 |
| PNNL | 0.0 | $0 | $0 |
| Pantex | 11.0 | $28,208 | $53,779 |
| Portsmouth/Paducah | 0.6 | $1,500 | $2,860 |
| SNL | 4.7 | $12,109 | $23,086 |
| SRS | 4.9 | $12,498 | $23,827 |
| SLAC | 0.0 | $0 | $0 |
| Y-12 | 15.6 | $39,796 | $75,872 |
| **Total** | **102** | **$261,230** | **$498,042** |

[a] Because fewer than one worker will require medical removal on an annual basis in most cases, the number of workers requiring removal every 10 years is presented here. Note that for several sites, the number requiring removal is less than one in 10 years.

The total incremental costs for the revised medical removal provisions combined are presented in Table 4-18.

**Table 4-18. Total Incremental Costs for Medical Removal**

| Site | Minimum Annual Cost of Mandatory Medical Removal | Maximum Annual Cost of Mandatory Medical Removal |
|---|---|---|
| Ames | $1,300 | $6,969 |
| ANL | $16,355 | $87,661 |
| BNL | $688 | $3,689 |
| Fermi | $0 | $0 |
| Hanford | $232,587 | $1,246,607 |
| INL | $13,844 | $74,198 |
| KCP | $46,196 | $247,599 |
| KAPL | $765 | $4,099 |
| LBNL | $0 | $0 |
| LLNL | $65,785 | $356,244 |
| LANL | $77,020 | $412,806 |
| NNSS | $0 | $0 |
| ORISE | $0 | $0 |
| ORNL | $24,773 | $392,897 |
| PNNL | $0 | $0 |
| Pantex | $311,804 | $742,077 |
| Portsmouth/Paducah | $13,079 | $62,919 |
| SNL | $34,572 | $185,296 |
| SRS | $35,681 | $191,238 |
| SLAC | $0 | $0 |
| Y-12 | $186,393 | $681,738 |
| **Total** | **$1,060,843** | **$4,696,038** |

Note: Minimum and maximum estimates represent the difference between the case where no alternative jobs are available for workers requiring permanent medical removal and the case when employers have jobs available for all workers requiring permanent removal.

### 4.2.9 Medical Consent

The proposed CBDPP rule in § 850.37(b) would require employers to ensure that beryllium workers understand that medical evaluations are mandatory. In order to ensure that all beryllium workers are notified, DOE estimates that all beryllium workers would be notified in the first year after the effective date of the rule, and new hires would be notified in subsequent years. The new hire rate is drawn from BLS' (2014) JOLTS survey, estimated to be 23.9 percent for the manufacturing sector. DOE estimates that this will require additional time and estimated that a human resources manager would spend 15 minutes per employee explaining the workers' options with

respect to medical evaluations. The incremental costs for this provision are displayed in Table 4-19.

**Table 4-19. Incremental Costs for Notifying Beryllium Workers that Medical Evaluations are Mandatory**

| Site | Initial Cost to Notify All BWs that Medical Surveillance is Mandatory | Cost of Notifying BWs that Medical Surveillance is Mandatory |
|---|---|---|
| Ames (SC) | $525 | $126 |
| Argonne National Laboratory (SC) | $6,606 | $1,579 |
| Brookhaven National Laboratory (SC) | $278 | $66 |
| Fermi National Accelerator Laboratory (SC) | $0 | $0 |
| Hanford (EM) | $93,939 | $22,451 |
| Idaho National Laboratory (EM & NE) | $5,591 | $1,336 |
| Kansas City Plant (NA) | $18,658 | $4,459 |
| Knolls Atomic Power Laboratory (KAPL) [NA-30] | $309 | $74 |
| Lawrence Berkeley National Laboratory (SC) | $0 | $0 |
| Lawrence Livermore National Laboratory (LLNL) [NA] | $25,686 | $6,139 |
| Los Alamos National Laboratory (LANL) [NA] | $31,107 | $7,435 |
| National Nuclear Security Site (NA) | $0 | $0 |
| Oak Ridge Institute for Science and Education (ORISE) [SC] | $0 | $0 |
| Oak Ridge National Laboratory (ORNL) [EM & SC] | $10,006 | $2,391 |
| Pacific Northwest National Laboratory (PNNL) [SC] | $0 | $0 |
| Pantex Plant (NA) | $32,527 | $7,774 |
| Portsmouth Paducah Project Office (EM) | $1,730 | $413 |
| Sandia National Laboratory (NA) | $13,963 | $3,337 |
| Savannah River Site (EM & NA) | $14,411 | $3,444 |
| Stanford Linear Accelerator Center (SLAC) [SC] | $0 | $0 |
| Y-12 (NA) | $45,889 | $10,967 |
| **Total** | **$301,225** | **$71,993** |

### 4.2.10 Sign Replacement

The purchase and installation of signs associated with the proposed new regulated areas are accounted for in Section 4.2.3. This section presents incremental costs only for the replacement of existing signs due to revised wording requirements in proposed § 850.38. As discussed in Section 3.1.2, sites purchasing fewer signs would have to pay a higher price per sign (although volume should not directly impact the labor costs of hanging signs). The material composition of the sign also affects the price. While it is reasonable for sign unit costs to vary, the two highest per sign costs of $309 and $139

(INL's contractor, Idaho Cleanup Project and KCP, respectively) were considered outliers. These two sites were assigned the next highest unit cost, which was $67. Similarly, two of Hanford's contractors estimated only $10 to purchase and install a sign. This was an exceptionally low estimate and may have excluded installation costs. Thus, it was replaced with the next lowest estimate provided, $19 per sign. Overall, sign replacement costs were relatively low, totaling less than $200,000. Incremental sign replacement and installation costs are displayed in Table 4-20.

**Table 4-20. Incremental Sign Replacement Costs**

| Site | Number of Signs to be Replaced | Cost per Sign | Total Costs |
|---|---|---|---|
| Hanford | 500 | $19 | $9,267 |
| INL - ICP | 90 | $67 | $6,024 |
| INL - BEA | 20 | $31 | $618 |
| KCP | 30 | $67 | $2,008 |
| KAPL | NE | NE | $18,020 |
| LLNL | 1,000 | $18 | $18,020 |
| Pantex | 99 | $21 | $2,039 |
| SNL | 150 | $51 | $7,723 |
| SRS | 40 | $31 | $1,236 |
| Y-12 | 1,936 | $67 | $129,577 |
| **Total** | **3,865** | | **$194,530** |

Note: NE indicates that the respondent indicated costs would be incurred, but did not provide a quantitative estimate of those costs. DOE followed up with that site and has not yet received sufficient clarification to estimate the cost.

### 4.2.11 Reporting to the Beryllium Registry

The proposed CBDPP rule would require contractors to submit data to the Beryllium Registry that is in compliance with its format [§ 850.40]. DOE's Technical Standard, DOE-STD-1187 provides formatting and content guidelines for reports submitted to the Beryllium Registry. Compliance with this standard was voluntary, and most contractors are already in compliance with the standard. The estimated costs of complying with the reporting standard total less than $1 million, a minor sum relative to the costs for regulated areas. Some contractors indicated that compliance with the format for the

Registry would require them to submit historical records for some employees and report new fields that they had not been including in their current reports to the Beryllium Registry. Other contractors indicated that they would incur computer programming costs, presumably to automate data systems to generate the required data. Notably, most contractors did not estimate annual costs for additional documentation or reporting. Rather, they estimated costs for changes associated with streamlining data reporting or tweaking the format of current reports. DOE assumes that contractors would continue to report only those fields that were relevant to their employees and operations. Thus, no new data collection would be necessary for sites in compliance with the format for the Registry. Although benefits were not quantified, DOE expects that more consistent data reported to the Beryllium Registry will result in improved reliability and increased utility of the Beryllium Registry in analyzing the effectiveness of CBDPPs at the sites, trends among DOE employees relating to beryllium sensitization and CBD, and exposure risk levels at the sites. The incremental reporting costs are presented by site in Table 4-21.

**Table 4-21. Incremental Cost of Compliance with DOE-STD-1187-2007**

| Site | Programming Costs | Documentation/ Reporting costs | | Total costs | |
|---|---|---|---|---|---|
| | | Initial | Annual | Initial | Annual |
| ANL | $1,236 | NE | NE | $1,236 | NE |
| BNL | NE | $238,117 | NE | $238,117 | NE |
| INL [a] | NE | $3,089 | NE | $3,089 | NE |
| LLNL | $133,860 | NE | NE | $133,860 | NE |
| LANL | $133,860 | $35,339 | $1,285 | $169,200 | $1,285 |
| PNNL | NE | $2,059 | NE | $2,059 | NE |
| SNL | $15,445 | NE | $772 | $15,445 | $772 |
| **Total** | **$284,402** | **$278,605** | **$2,057** | **$563,007** | **$2,057** |

[a] INL indicated 30 hours of labor would be required to comply with the standard, but the contractor did not provide a wage rate. A typical wage rate for INL of $103/hour was used for this cost estimate.
Note: NE indicates that respondent indicated costs would be incurred, but did not provide a quantitative estimate. DOE followed up with that site and has not yet received sufficient clarification to estimate the cost.

### 4.3 AGENCY COSTS

The proposed CBDPP rule will affect contractors at DOE sites rather than firms that compete in private markets. The contractor's contractual agreement with DOE means that the costs for complying with the proposed rule will ultimately be passed through to DOE in the form of higher costs of its contracts.

DOE employees who have occupational exposure to beryllium would also be covered under the proposed rule, but the present economic analysis does not explore the impact of DOE's proposed rule on DOE employees, because except at a few DOE-operated sites, DOE employees are not usually involved in production tasks or other activities in which they are exposed to airborne concentrations of beryllium. However, in performing management and oversight duties, DOE employees may enter a site where beryllium is handled. Federal Agencies are required to ensure the protection of Federal workers under the health and safety provisions of 29 CFR 1960, *Basic Program Elements for Federal Employees Occupational Safety and Health Programs and Related Matters*, and Executive Order 12196, *Occupational Safety and Health Programs for Federal Employees*.

DOE does not anticipate any incremental administrative costs as a result of the proposed rule, although it will continue to incur incremental costs for gathering and reporting beryllium registry data.

### 4.4 TOTAL COSTS

Table 4-22 and Table 4-23 present estimated incremental costs by proposed provision. Total costs are summarized in Table 4-24. The proposed rule is estimated to impose from $13.6 million to $17.2 million in total costs (in 2014 dollars, using a 7 percent discount rate and a 10 year period lifetime of investment). This includes first

year costs of $41.4 million to $42.7 million, of which $7.8 million to $11.2 million are annually recurring costs.

The incremental costs are dominated by the costs for establishing regulated areas, which are estimated to average $37.1 million in initial costs, or 84 to 87 percent of total initial costs. The initial costs for establishment of regulated areas are themselves dominated by the SNL's reported cost to convert TA4 to a regulated area($32.8 million in initial costs) and, to a lesser extent, KCP's reported cost for establishing 10 new regulated areas ($1.3 million in initial costs). These are substantially larger than the initial costs estimated by other sites, which ranged from $0 to $0.6 million per site.

Notably, only five sites will incur more than $1.0 million in total incremental costs, and only SNL and Hanford will incur costs greater than $4.0 million in annualized costs. DOE notes that some of these costs may be overestimated, as some sites provided costs for worst case scenarios.[21]

[21] KCP noted that they are transitioning into a new facility that is not designed for regulated areas and that they are unfamiliar with the new layout. Therefore, the uncertainty surrounding KCP's estimates was high.

| Table 4-22. Incremental Costs by Proposed Provision by Site (Part 1) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Site** | **Revising the CBDPP** | **Sampling and New Analysis Methods** | | **Regulated Areas** | | **Exposure Monitoring for New Regulated Areas** | **Mandatory Medical Surveillance** | |
| | **Initial** | **Initial** | **Annual** | **Initial** | **Annual** | **Annual** | **Initial** | **Annual** |
| Albuquerque | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Ames | $9,681 | $0 | $0 | $0 | $0 | $0 | $0 | $2,085 |
| ANL | $1,760 | $0 | $0 | $0 | $0 | $0 | $24,629 | $15,411 |
| BNL | $9,681 | $0 | $0 | $0 | $0 | $0 | $1,660 | $1,364 |
| Fermi | $9,681 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Hanford | $5,828 | $261,543 | $3,019,026 | $10,374 | $0 | $10,297 | $0 | $348,284 |
| Hanford Operations Office | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| INL | $9,681 | $152,910 | $0 | $1,257,259 | $146,732 | $152,910 | $221 | $17,575 |
| KCP | $1,289 | $129,834 | $0 | $8,985,813 | $0 | $14,426 | $0 | $59,099 |
| KAPL | $9,681 | $0 | $0 | $0 | $0 | $0 | $0 | $1,455 |
| LBNL | $2,122 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| LLNL | $11,752 | $514,848 | $0 | $1,424,906 | $0 | $35,598 | $7,414 | $79,331 |
| LANL | $17,709 | $0 | $43,247 | $83,817 | $0 | $0 | $196,929 | $91,920 |
| NNSS | $9,681 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| ORISE | $9,681 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| ORNL | $2,774 | $0 | $0 | $0 | $0 | $41,484 | $0 | $31,523 |
| Office of River Protection | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| PNNL | $9,681 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Pantex | $2,434 | $261,543 | $411,878 | $17,980 | $18,074 | $11,697 | $36,657 | $96,270 |
| Portsmouth/Paducah | $9,681 | $0 | $0 | $0 | $0 | $0 | $0 | $5,600 |
| SNL | $9,681 | $9,267 | $0 | $22,878,093 | $816,302 | $49,425 | $0 | $37,486 |
| SRS | $9,681 | $262,058 | $110,400 | $15,528 | $1,853 | $0 | $105,434 | $40,547 |
| SLAC | $9,681 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Y-12 | $54,854 | $0 | $0 | $2,467,106 | $820,997 | $99,057 | $0 | $139,945 |
| **Total** | **$216,698** | **$1,592,003** | **$3,584,552** | **$37,140,875** | **$1,803,958** | **$414,894** | **$372,945** | **$967,894** |

**Table 4-23. Incremental Costs by Proposed Provision by Site (Part 2)**

| Site | Medical Restriction | Medical Removal (Minimum) | | Medical Removal (Maximum) | | Medical Consent | | Changing Existing Signs | Reporting to the Registry in Compliance with DOE STD 1187-2007 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Annual | Initial | Annual | Initial | Annual | Initial | Annual | Initial | Initial | Annual |
| Albuquerque | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Ames | $1,863 | $0 | $1,300 | $0 | $6,969 | $525 | $126 | $0 | $0 | $0 |
| ANL | $13,399 | $0 | $16,355 | $0 | $87,661 | $6,606 | $1,579 | $0 | $1,236 | $0 |
| BNL | $11,943 | $0 | $688 | $0 | $3,689 | $278 | $66 | $0 | $238,117 | $0 |
| Fermi | $7,839 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Hanford | $42,374 | $0 | $232,587 | $0 | $1,246,607 | $93,939 | $22,451 | $9,267 | $0 | $0 |
| Hanford Operations Office | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| INL | $31,321 | $0 | $13,844 | $0 | $74,198 | $5,591 | $1,336 | $6,642 | $3,089 | $0 |
| KCP | $9,969 | $0 | $46,196 | $0 | $247,599 | $18,658 | $4,459 | $2,008 | $0 | $0 |
| KAPL | $10,076 | $0 | $765 | $0 | $4,099 | $309 | $74 | $18,020 | $0 | $0 |
| LBNL | $16,424 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| LLNL | $24,858 | $15,368 | $63,597 | $108,041 | $340,861 | $25,686 | $6,139 | $18,020 | $133,860 | $0 |
| LANL | $42,743 | $0 | $77,020 | $0 | $412,806 | $31,107 | $7,435 | $0 | $169,200 | $1,285 |
| NNSS | $10,451 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| ORISE | $1,866 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| ORNL | $17,111 | $0 | $24,773 | $0 | $392,897 | $10,006 | $2,391 | $0 | $0 | $0 |
| Office of River Protection | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| PNNL | $18,663 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $2,059 | $0 |
| Pantex | $12,873 | $1,624,347 | $80,534 | $2,180,383 | $431,640 | $32,527 | $7,774 | $2,039 | $0 | $0 |
| Portsmouth/Paducah | $17,907 | $61,782 | $4,283 | $339,800 | $14,539 | $1,730 | $413 | $0 | $0 | $0 |
| SNL | $33,885 | $0 | $34,572 | $0 | $185,296 | $13,963 | $3,337 | $7,723 | $15,445 | $772 |
| SRS | $46,947 | $0 | $35,681 | $0 | $191,238 | $14,411 | $3,444 | $1,236 | $0 | $0 |
| SLAC | $5,972 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Y-12 | $16,901 | $511,141 | $113,618 | $974,504 | $608,963 | $45,889 | $10,967 | $129,577 | $0 | $0 |
| **Total** | **$395,384** | **$2,212,638** | **$745,813** | **$3,602,728** | **$4,249,063** | **$301,225** | **$71,993** | **$194,530** | **$563,007** | **$2,057** |

**Table 4-24. Total Incremental Costs by Site**

| Site | Total Costs - Minimum | | | Total Costs - Maximum | | |
|---|---|---|---|---|---|---|
| | Initial | Annual | Total | Initial | Annual | Total |
| Albuquerque Operations Office | $0 | $0 | $0 | $0 | $0 | $0 |
| Ames (SC) | $10,206 | $5,374 | $6,827 | $10,206 | $11,043 | $12,496 |
| Argonne National Laboratory (SC) | $34,230 | $46,743 | $51,617 | $34,230 | $118,049 | $122,923 |
| Brookhaven National Laboratory (SC) | $249,737 | $14,062 | $49,619 | $249,737 | $17,063 | $52,620 |
| Fermi National Accelerator Laboratory (SC) | $9,681 | $7,839 | $9,217 | $9,681 | $7,839 | $9,217 |
| Hanford (EM) | $380,952 | $3,675,019 | $3,729,258 | $380,952 | $4,689,038 | $4,743,277 |
| Hanford Operations Office | $0 | $0 | $0 | $0 | $0 | $0 |
| Idaho National Laboratory (EM & NE) | $1,435,393 | $363,718 | $568,086 | $1,435,393 | $424,073 | $628,440 |
| Kansas City Plant (NA) | $9,137,603 | $134,149 | $1,435,138 | $9,137,603 | $335,553 | $1,636,542 |
| Knolls Atomic Power Laboratory (KAPL) [NA-30] | $28,010 | $12,370 | $16,358 | $28,010 | $15,704 | $19,692 |
| Lawrence Berkeley National Laboratory (SC) | $2,122 | $16,424 | $16,726 | $2,122 | $16,424 | $16,726 |
| Lawrence Livermore National Laboratory (LLNL) [NA] | $2,151,854 | $209,522 | $515,898 | $2,244,526 | $486,787 | $806,357 |
| Los Alamos National Laboratory (LANL) [NA] | $498,762 | $263,650 | $334,662 | $498,762 | $599,436 | $670,449 |
| National Nuclear Security Site (NA) | $9,681 | $10,451 | $11,830 | $9,681 | $10,451 | $11,830 |
| Oak Ridge Institute for Science and Education (ORISE) [SC] | $9,681 | $1,866 | $3,245 | $9,681 | $1,866 | $3,245 |
| Oak Ridge National Laboratory (ORNL) [EM & SC] | $12,780 | $117,282 | $119,102 | $12,780 | $485,406 | $487,225 |
| Office of River Protection (EM) | $0 | $0 | $0 | $0 | $0 | $0 |
| Pacific Northwest National Laboratory (PNNL) [SC] | $11,741 | $18,663 | $20,335 | $11,741 | $18,663 | $20,335 |
| Pantex Plant (NA) | $1,977,527 | $639,101 | $920,656 | $2,533,562 | $990,207 | $1,350,929 |
| Portsmouth Paducah Project Office (EM) | $73,193 | $28,203 | $38,624 | $351,211 | $38,459 | $88,463 |
| Sandia National Laboratory (NA) | $22,934,172 | $975,779 | $4,241,090 | $22,934,172 | $1,126,503 | $4,391,814 |
| Savannah River Site (EM & NA) | $408,348 | $238,873 | $297,012 | $408,348 | $394,430 | $452,570 |
| Stanford Linear Accelerator Center (SLAC) [SC] | $9,681 | $5,972 | $7,351 | $9,681 | $5,972 | $7,351 |
| Y-12 (NA) | $3,208,567 | $1,201,484 | $1,658,312 | $3,671,930 | $1,696,829 | $2,219,630 |
| **Total** | **$42,593,921** | **$7,986,546** | **$14,050,962** | **$43,984,011** | **$11,489,796** | **$17,752,129** |

### 4.5 COST SAVINGS

DOE considered that numerous provisions of the proposed rule would result in cost savings for DOE sites and contractors. These proposed provisions are summarized below in Table 4-26. DOE verified whether some of these would result in cost savings for sites through the EAQ. Results from the questionnaire pertaining to these items are discussed below.

One revision that DOE expected to save costs for sites was the proposed revisions to the definition of beryllium (see Table 4-26). At Hanford and ORNL, some contractors indicated that they might experience cost savings if allowed to remove controls from areas that are currently regulated due to forms of beryllium that are not covered by the proposed definition. Most sites that had a potential for cost savings in this area also lacked methods to distinguish the different forms of beryllium necessary for determining whether areas had to be controlled under the proposed definition. Only one Hanford contractor, WRPS made an estimate of potential cost savings ($5,148 annually). This cost savings would result from eliminating surface sampling in three currently monitored areas. DOE expects that similar cost savings will occur at more sites. Another Hanford contractor, WCH, estimated that the entire Hanford site could potentially save hundreds of millions if an adequate method of distinguishing natural and anthropogenic forms of beryllium were identified and natural forms were excluded from the definition. DOE expects that Hanford will experience significant cost savings from this proposed provision, as most beryllium at Hanford is suspected to come from volcanic coal ash.

Proposed § 850.23 would add a requirement that would require employers to implement housekeeping (§ 850.30) if the airborne level of beryllium is at or above 0.05 µg/ $m^3$, while the proposed housekeeping section notes an employer must conduct routine surface sampling where beryllium is present in operational areas at or above 0.05 µg/ $m^3$. Currently, sites do routine

surface sampling wherever beryllium is present, regardless of whether the level is at or above 0.05 µg/ $m^3$. DOE expects sites may be able to reduce costs as they would only need to conduct surface sampling when an operational area is at or above 0.05 µg/ $m^3$.

DOE also expected that sites might be able to reduce costs through the use of portable laboratories. Numerous contractors anticipated potential savings in turnaround time for exposure monitoring results as a result of using a portable laboratory. Conversely, some sites were skeptical of the qualifications of portable laboratories and were unaware of any existing American Industrial Hygiene Association (AIHA) accredited portable laboratories. Other sites did not anticipate any savings from a portable laboratory, as their onsite laboratory was sufficient for their needs. Table 4-25 summarizes the cost savings anticipated by contractors for this revision.

**Table 4-25. Savings from the Use of Portable Laboratories**

| Site | Contractor | Cost or Time Savings |
|---|---|---|
| Hanford | WRPS | 50 percent of analytical time per sample batch |
| INL | ICP | 2-3 days of shipping time per batch |
| INL | ITG | 18 hours |
| LANL | LANL | $33,980 - $127,682 and 320-960 days of turnaround time |
| PNNL | PNNL | Some turnaround time - no quantitative estimate |
| Portsmouth/Paducah | LATA | 3 days (per batch) |
| Portsmouth/Paducah | SST | One week of turnaround time |

In addition, several contractors indicated that they might experience cost savings due to relaxed requirements for transferring contaminated equipment to another area in which beryllium work is performed. DOE was aware that some sites were cleaning equipment below 3.0 µg/ $m^3$, sampling the equipment to demonstrate the effectiveness of that cleaning, and encapsulating or wrapping equipment before shipping. To relax these requirements, DOE would allow its sites to encapsulate or seal equipment, label it, and transfer it. Although cost savings appeared to be minor in most cases, and quantified estimates were not forthcoming, contractors from six sites

expected cost savings due to this change, including: BNL, Hanford, LLNL, LANL, Pantex, and Y-12.

DOE also expected that some of the proposed revisions to the medical requirements would allow sites to reduce costs and avoid confusion and disputes with employees over DOE's legal liability. Some sites had hired workers for jobs involving beryllium activities who already had a beryllium condition or historical exposure to beryllium. Unless these workers opted into the medical surveillance program, employers were unaware of their condition. Nevertheless, once employers became aware of their condition, medical removal benefits had to be provided. DOE expected sites might experience cost savings if required to screen all employees for jobs involving beryllium activities, thus protecting workers with existing conditions from additional exposure and medically removing those workers before their conditions progress to a level that interferes with continued work. Most sites did not anticipate any cost savings from the requirement to provide medical evaluations for beryllium workers. Sites instead, anticipated an additional cost due to providing a greater number of medical evaluations. DOE anticipates that the net costs of medical surveillance will increase due to this requirement, but that health benefits to employees and cost benefits to the employer will ultimately outweigh the increased costs. Increased medical surveillance might also ultimately reduce medical removal costs per employee if the disease can be caught before the employee is too sick to work at all.

DOE is proposing to delete the requirement for medical data analysis, because this function would now be performed by the Beryllium Registry. The cost savings might be estimated based on the costs estimated for medical data analysis in the 1999 Economic Analysis. DOE has not estimated cost savings for this amendment, because it is unclear whether sites will cease to perform the analysis even if the requirement is removed as eliminating this analysis might seem

like a relaxation of performance review. Nevertheless, DOE acknowledges that there are potential savings associated with removing this requirement.

Also in the proposed medical surveillance section (850.34), DOE anticipates cost savings due to the allowance for the SOMD to determine what exams and tests are necessary in a periodic evaluation. While it is problematic to quantify the savings that might result from this amendment, DOE expects that they may be significant, as the SOMD may use his or her judgment to select only the appropriate tests for each worker. This could substantially reduce the unit cost of a medical evaluation for workers who do not need to undergo some components of the medical evaluation annually.

DOE also is proposing to amend the language for medical removal benefits in order to clarify the eligibility of workers for benefits, how long those benefits would be provided, and other legal responsibilities that DOE has to workers under proposed § 850.36. DOE expects that these clarifications will reduce legal costs for sites that have been sued by workers based on the interpretation of the medical removal benefits section of the rule as promulgated in 1999. Although contractors could not quantify these cost savings, many indicated that they found this section of the rule confusing and welcomed clarification.

DOE has also proposed to amend the training requirements for beryllium-associated workers. The current training requirements for beryllium-associated workers were identical to the training requirements for beryllium workers and content was specified. The proposed provisions would, by contrast, specify that the training for beryllium-associated workers provide a general awareness about beryllium hazards and controls for other workers at a site where beryllium activities are conducted. This might result in cost savings if the time required for beryllium-associated workers training is now less extensive than the time previously required.

Table 4-26 below presents a side-by-side comparison of the rule as promulgated in 1999 and the proposed rule that DOE expects will result in potential cost savings.

## Table 4-26. Comparison of 1999 and Proposed Language for which Cost Savings are Anticipated

| Proposed Change | Proposed Preamble Text | Current CFR Text | Proposed CFR Text | Cost Implications |
|---|---|---|---|---|
| **850.3 Definitions** | | | | |
| Revise definition of beryllium | Beryllium is being revised to mean elemental beryllium, beryllium oxide, and alloys containing 0.1 percent or greater beryllium by weight. | Beryllium means elemental beryllium and any insoluble beryllium compound or alloy containing 0.1 percent beryllium or greater that may be released as an airborne particulate. | Beryllium means elemental beryllium, beryllium oxide, and any alloy containing 0.1% or greater of beryllium by weight. | - Potential cost savings associated with excluding mineral beryllium from the definition of beryllium and determining that some areas have legacy contamination.<br>-Potential costs associated with proving that contamination is due to legacy contamination. |
| **850.23 Action Level** | | | | |
| Inclusion of housekeeping | Proposed § 850.23(b) would continue to require employers to implement a number of protective measures designed to protect workers from beryllium exposures when the levels are at or above the action level, including:<br>• Periodic exposure monitoring (10 CFR 850.24(c));<br>• Additional exposure monitoring (10 CFR 850.24(d));<br>• Exposure reduction (10 CFR 850.25);<br>• Beryllium regulated areas (10 CFR 850.26);<br>• Hygiene facilities and practices (10 CFR 850.27);<br>• Respiratory protection (10 CFR 850.28);<br>• Protective clothing and equipment (10 CFR 850.29);<br>• Housekeeping (10 CFR 850.30); and<br>• Warning signs and labels (10 CFR 850.39). | (b) If an airborne concentration of beryllium is at or above the action level, the responsible employer must implement §§ 850.24(c) (periodic exposure monitoring), 850.25 (exposure reduction and minimization), 850.26 (regulated areas), 850.27 (hygiene facilities and practices), 850.28 (respiratory protection), 850.29 (protective clothing and equipment), and 850.38 (warning signs) of this part. | (b) If the airborne level of beryllium is at or above the level specified in paragraph (a) of this section, employers must implement §§ 850.24(c) (periodic exposure monitoring), 850.25 (exposure reduction), 850.26 (beryllium regulated areas), 850.27 (hygiene facilities and practices), 850.28 (respiratory protection), 850.29 (protective clothing and equipment),850.30 (housekeeping), and 850.39 (warning signs and labels) of this part. | - In conjunction with 850.30 (housekeeping), potential cost savings associated with only conducting surface sampling when an operational area is at or above 0.05 µg/ $m^3$. |

## Table 4-26. Comparison of 1999 and Proposed Language for which Cost Savings are Anticipated

| Proposed Change | Proposed Preamble Text | Current CFR Text | Proposed CFR Text | Cost Implications |
|---|---|---|---|---|
| **850.24 Exposure Monitoring** | | | | |
| Allowing portable laboratories | …proposed § 850.24(e)(2)(i) would permit employers to use a field or portable laboratory that is accredited in an AIHA or equivalent quality assurance program, to support increasing the speed with which exposure results are delivered so that employers can more quickly identify and control beryllium hazards. | | (e)(2) The employer may use:<br>(i) Field or portable laboratories that are accredited in an AIHA or equivalent quality assurance program that addresses field or portable laboratory analyses of beryllium samples; and<br>(ii) Air exposure results below laboratory reporting limits. | Potential cost savings by allowing for use of field and/or portable laboratory findings and results below reporting limits. |
| **850.31 Release and Transfer Criteria** | | | | |
| Modification of release criteria of formerly beryllium-contaminated equipment or areas without labeling if they do not contain beryllium in inaccessible locations or embedded in hard-to-remove substances, provided specified contamination levels are not exceeded. | Proposed § 850.31(a) would amend the requirements for releasing from beryllium regulated areas equipment, items, and areas contaminated at or below the levels specified in this subsection.<br>Proposed § 850.31(a)(1) would amend the existing regulation to require that, prior to the release or transfer of equipment and items, or areas, employers ensure that for formerly beryllium-contaminated equipment and items, or areas (except those that only contain beryllium in normally inaccessible locations or embedded in hard-to-remove substances), the removable contamination level of beryllium is at or below 0.2 µg/100 $cm^2$. | (a) The responsible employer must clean beryllium-contaminated equipment and other items to the lowest contamination level practicable, but not to exceed the levels established in paragraphs (b) and (c) of this section, and label the equipment or other items, before releasing them … | (a) *Release and transfer*. Except where the beryllium is in normally inaccessible locations or embedded in hard-to-remove substances, prior to the release or transfer of equipment, items, or areas to areas that are not beryllium regulated areas, the employer must ensure that for formerly beryllium-contaminated equipment, items or areas the removable contamination level does not exceed the following:<br>(1) Surface level of beryllium is at or below 0.2 µg/100 $cm^2$; or (2) Concentration of beryllium in bulk material on the surface is lower than the concentration in soil at the point of release; or<br>(3) Airborne levels of beryllium in an enclosure of the smallest practical size surrounding the equipment or item, or in an isolating enclosure of the area do not exceed 0.01µg/$m^3$ as determined under aggressive sampling conditions. | Potential cost savings due to the elimination of labels and thereby increased number of potential recipients. Costs may not be measurable (quantitative benefits i.e., donating and/or selling equipment or an area that was previously protected or labeled and would be rejected by recipients).<br>Potential cost savings when decontamination can be demonstrated through aggressive air sampling instead of through wipe samples. |

## Table 4-26. Comparison of 1999 and Proposed Language for which Cost Savings are Anticipated

| Proposed Change | Proposed Preamble Text | Current CFR Text | Proposed CFR Text | Cost Implications |
|---|---|---|---|---|
| Allowing release of equipment, items or areas that contain sources of beryllium in normally inaccessible locations or embedded in hard-to-remove substances. | Proposed § 850.31(b) would allow the release or transfer of equipment, items, or areas in which surface contamination is inaccessible or has been sealed with hard-to-remove substances (e.g., paint), and the requirements in paragraphs (a)(1) through (a)(3) of this section are met. In this case, the employer is being required to ensure that the labeling requirements in 850.39(b)(2) are met as specified in proposed § 850. 31 (b)(1). Proposed § 850.31(b)(2) would require the employer to condition the release of equipment, item, or area based on the recipients' commitment to implement controls to ensure that exposure does not occur. | - | (b) Release or transfer with inaccessible beryllium. For the release from a beryllium regulated area of equipment, items, or areas that contain sources of beryllium in normally inaccessible locations or embedded in hard-to-remove substances, the employer must comply with paragraphs (a)(1) through (3) of this section for accessible beryllium, and, the employer must ensure that:<br>(1) The equipment, item, or area is labeled in accordance with § 850.39(b)(2); and<br>(2) The release is conditioned on the recipient's commitment to implement controls that will prevent foreseeable beryllium exposure, considering the nature of the equipment or item or area and its future use. | Potential cost savings associated with the release of equipment that was previously protected. |

## Table 4-26. Comparison of 1999 and Proposed Language for which Cost Savings are Anticipated

| Proposed Change | Proposed Preamble Text | Current CFR Text | Proposed CFR Text | Cost Implications |
|---|---|---|---|---|
| Provisions for releasing equipment, items or areas with removable beryllium above 0.2 µg/100 $cm^2$ or that have beryllium in material on the surface at levels above the natural level in soil at the point of release. | Proposed § 850.31(c) is being amended to allow the release or transfer of equipment, items, or areas with levels that exceed 0.2 µg/100 $cm^2$. | (c) Before releasing beryllium-contaminated equipment or other items to another facility performing work with beryllium, the responsible employer must ensure that:<br>(1) The removable contamination level of equipment or item surfaces does not exceed 3 µg/100 cm2;<br>(2) The equipment or item is labeled in accordance with §850.38(b); and<br>(3) The equipment or item is enclosed or placed in sealed, impermeable bags or containers to prevent the release of beryllium dust during handling and transportation.. | (c) Release or transfer with levels that exceed 0.2 µg/100 cm2. For equipment, items, or areas that have removable beryllium above 0.2 µg/100 cm2; or that have beryllium in material on the surface at levels above the level in soil at the point of release, the employer must:<br>(1) Provide the recipient with a copy of this part;<br>(2) Condition the release on the recipient's commitment to control foreseeable beryllium exposures from the equipment, item, or area considering its future use;<br>(3) Label the equipment, item, or area in accordance with § 850.39(b)(1);<br>(4) Place the equipment or items in sealed, impermeable bags or containers, or have sealants applied that prevent the release of beryllium during handling and transportation; and<br>(5) Ensure that the beryllium that remains removable on the surfaces of areas is below 3.0 µg/100 cm2. | Potential cost savings associated with the release of equipment that was previously protected. |
| **850.34 Medical Surveillance** | | | | |
| Removal of requirement to establish routine and systematic analyses of medical, job and exposure data | DOE is proposing to delete § 850.34(h) in the final rule. This section required employers to establish routine and systematic analyses of medical, job and exposure data. The purpose of this requirement is to collect and analyze information so that the prevalence of disease can be accurately described and conclusions reached on causes or risk factors for disease. The Department will rely on the data collected from the DOE Beryllium Registry for this purpose. | (h)(1) The responsible employer must routinely and systematically analyze medical, job, and exposure data with the aim of identifying individuals or groups of individuals potentially at risk for CBD and working conditions that are contributing to that risk. (2) The responsible employer must use the results of these analyses to identify additional workers to whom the responsible employer must provide medical surveillance and to determine the need for additional exposure controls. | - | Potential cost savings as data analysis no longer needs to be conducted. |

## Table 4-26. Comparison of 1999 and Proposed Language for which Cost Savings are Anticipated

| Proposed Change | Proposed Preamble Text | Current CFR Text | Proposed CFR Text | Cost Implications |
|---|---|---|---|---|
| **850.38 Training and Counseling** | | | | |
| Training requirements for beryllium associated workers | Proposed § 850.38(a)(3) would establish the training requirements for beryllium-associated workers and other workers identified in paragraph (a)(1) of this section. The training for these individuals would continue to require general awareness about beryllium hazards and controls training for other workers at a site where beryllium activities are conducted. | 850.37(a) The responsible employer must develop and implement a beryllium training program and ensure participation for: (1) Beryllium-associated workers (2) All other individuals who work at a site where beryllium activities are conducted. (b) The training provided for workers identified in paragraph (a)(1) of this section, must: (1) Be in accordance with 29 CFR 1910.1200, Hazard Communication; (2) Include the contents of the CBDPP; and (3) Include potential health risks to beryllium worker family members and others who may come in contact with beryllium on beryllium workers or beryllium workers' personal clothing or other personal items as the result of a beryllium control failure at a DOE facility. | (a)(3) The training provided for beryllium-associated workers and other workers identified in paragraph (a)(1) of this section must consist of general awareness about beryllium hazards and controls. | Potential cost savings for reduced training requirements for beryllium-associated workers. |

## 5. BENEFITS

The goal of the proposed CBDPP rule is to further reduce worker exposure to beryllium and minimize the number of exposed workers at DOE facilities, thereby preventing the occurrence of beryllium sensitization and CBD in the DOE workforce. Sensitization and CBD cases continue to occur among workers in the DOE complex. DOE believes this is unacceptable, and is therefore, proposing to amend its CBDPP rule to reduce the action level which triggers certain control and protective measures designed to protect workers from exposure to beryllium. The lower action level would increase the number of workers who are considered at risk in the DOE complex and require sites and contractors to reduce exposures further. Pursuant to EO 12866, this section discusses the benefits that are attributable to the proposed CBDPP rule.

In contrast to the compliance cost section (Section 4), this section does not provide monetary estimates of the benefits of the proposed CBDPP rule. To provide quantitative estimates, four pieces of information would be necessary:

- *The number of workers affected by the proposed CBDPP rule.*
- *The reduction in exposure associated with the controls incorporated under the proposed rule (i.e., exposure reduction factors).*
- *A relationship between exposure and the incidence of disease (i.e., a dose-response relationship).*
- *The (monetary) value of reducing the incidence of CBD.*

While the first of these is available from the profile of affected activities and sites (see Section 2), information on the other three is lacking. Exposure reduction factors are generally only available for respirator use and may not be well-defined for other program requirements,

such as housekeeping.[22] As discussed in Section 1, no definitive dose-response relationship exists for beryllium. Finally, no studies have been conducted on the monetary benefits of reducing the incidence of beryllium sensitization and CBD.[23] Nevertheless, this section provides a qualitative discussion of the benefits of reducing the incidence of CBD, including relevant quantitative estimates where available.

Proposing to reduce the incidence of beryllium sensitization and CBD would benefit DOE, its contractors, and workers in a number of ways, including:

- *Reduced medical costs.*
- *Reduced mortality.*
- *Increased quality of life.*
- *Increased medical surveillance and medical removal for workers at risk.*
- *Increased work-life for beryllium workers.*
- *Increased productivity.*
- *Reduced legal liability for the Department and its contractors.*

Each of these categories of benefits is discussed in more detail in the subsequent sections.

### 5.1 Reduced Medical Costs

Workers who are sensitized to beryllium or who have CBD require medical attention and treatment. Reducing the incidence of beryllium sensitization and CBD will reduce the medical costs associated with treating and monitoring workers with these conditions. DOE expects the

[22] Housekeeping provisions reduce the accumulation of beryllium contamination in the workplace and thus play a role in reducing exposure levels. Developing quantitative estimates of these reduced exposure levels may not be straightforward, however.

[23] In the absence of information on the value of reducing the incidence of CBD, it would be possible to assess the cost effectiveness of the rule. This would be done by estimating the number of *avoided cases of CBD* and then comparing that to compliance costs to generate a *cost per case avoided* estimate. As noted, however, the number of avoided cases cannot be estimated because of the lack of a dose-response relationship. Thus, assessing the cost effectiveness of the rule is also not possible.

proposed rule to reduce two categories of medical costs: additional testing for workers with positive BeLPTs, and monitoring and treating cases of beryllium sensitization and CBD.

### 5.1.1 Costs for Additional Testing for Workers with Positive BeLPTs

The proposed CBDPP rule would continue to require DOE contractors to offer workers with positive BeLPTs further testing to determine if they are sensitized to beryllium or have contracted CBD. By reducing the incidence of BeS and CBD, the proposed CBDPP rule would reduce the number of positive BeLPTs. As a result, the number of referrals for further testing would be reduced and, consequently, their associated costs would be reduced.

The incremental benefits for this category would be calculated by multiplying the number of avoided beryllium-related medical referrals by the cost associated with each referral. The number of avoided referrals would be found by first determining the number of referrals that would occur in the absence of the proposed CBDPP rule (i.e., baseline referrals).[24] The number of avoided referrals is the reduction in the number of baseline referrals associated with the proposed CBDPP rule. Given the lack of a quantitative dose-response relationship, the number of avoided referrals cannot be calculated, and thus an estimate of the incremental benefits for this category is not possible.

### 5.1.2 Costs Associated with Monitoring and Treating Cases of BeS

Workers with BeS or CBD require both continued monitoring and treatment. Reducing the incidence of BeS and CBD will reduce the costs associated with both monitoring and treatment. The incremental benefits for this category can be calculated by multiplying the number of avoided cases by the costs of continued monitoring and treatment. As with the cost savings associated with reducing the number of referrals (Section 5.1.1), the number of avoided cases

[24] Baseline referrals would include the number of referrals that sites would make, plus the number of referrals that workers (i.e., self-referrals) and worker's personal physicians would make.

cannot be calculated because of the lack of a definitive dose-response relationship. Nevertheless, for each avoided case of BeS and CBD, the costs associated with continued monitoring and treatment will be avoided.

### 5.2 Reduced Mortality

Steenland and Ward (1991) report that 57 percent of workers with CBD die of beryllium-related diseases. By reducing the incidence of CBD, the proposed CBDPP rule would reduce the number of CBD-related deaths. The number of deaths that will be avoided cannot be estimated because of the lack of a quantitative dose-response relationship. Nevertheless, DOE expects the proposed provisions to reduce the number of CBD-related deaths, resulting in substantial benefits for each avoided death.

### 5.3 Increased Quality of Life

In addition to posing the risk of death, BeS and CBD may also reduce an affected worker's quality of life. BeS and CBD are often accompanied by a number of physical impairments, such as a reduction in lung function. These impairments will reduce a sensitized and diseased worker's quality of life. The proposed CBDPP rule is expected to reduce the incidence of both BeS and CBD, thereby reducing the number of workers that will suffer a reduction in their quality of life. Thus, reductions in potentially affected workers' quality of life will be avoided.

DOE has not quantified this benefit for a number of reasons. First, a quantitative dose-response relationship for beryllium has not been developed. This implies that the number of workers that become BeS or have CBD cannot be predicted. Second, there is no quantified relationship between the incidence of BeS or CBD and a reduction in the quality of life. Finally, studies relating monetary values to a reduction in quality of life associated with BeS and CBD do not exist.

## 5.4 INCREASED MEDICAL SURVEILLANCE AND MEDICAL REMOVAL FOR WORKERS AT RISK

The proposed CBDPP rule would make medical surveillance and medical removal mandatory for beryllium workers and workers transferring to a job that involves a beryllium activity. Contact with sites during this assessment indicated that a number of sites allow workers to opt out of medical surveillance (or the BeLPT) and medical removal. In addition, due to the proposed action level, medical surveillance requirements would apply to a broader range of workers as areas with lower exposures will be classified and controlled as regulated beryllium areas. DOE expects this increased level of medical surveillance for beryllium-related health effects will result in four benefits:

- *Improved timeliness in diagnosing cases of BeS and CBD.*
- *Improved accuracy in diagnosing cases of BeS and CBD.*
- *Improved timeliness in removing sensitized or diseased workers from beryllium-related work.*
- *Increased information regarding beryllium-related health effects.*

To improve the timeliness of beryllium sensitization and CBD case diagnosis, the proposed CBDPP rule requires DOE contractors to provide medical evaluations at initial assignment to beryllium areas; and annually to current workers who are exposed or potentially exposed to beryllium in their work assignments.

Because of the proposed action level, this requirement would increase the frequency of medical surveillance for workers in areas where exposures are between the current and proposed action levels, which allows BeS and CBD to be diagnosed sooner. More timely diagnosis of BeS and CBD will lead to more timely treatment of these conditions. Although BeS and CBD are not

curable conditions, a more timely response to these conditions may reduce the severity of the symptoms experienced by workers with these conditions (Newman, 1996).

To improve the accuracy of case diagnosis, the proposed CBDPP rule would make the BeLPT mandatory by making the medical surveillance mandatory for beryllium workers. DOE knows this test has improved the accuracy of medical evaluations that are conducted. Epidemiological research has shown the BeLPT to be more accurate than other methods of diagnosing BeS and CBD, such as chest radiographs and spirometry (Newman, 1996). These other methods will miss some cases, leaving some workers we are BeS or have CBD untreated. Thus, the proposed CBDPP rule would lead to more accurate diagnoses of BeS and CBD by mandating that all workers in beryllium regulated areas have a BeLPT as a part of a medical evaluation.

Early and accurate identification allows removal of at-risk workers from activities with beryllium exposure. Although there is no direct evidence that removal from exposure improves the prognosis of CBD patients, beryllium does clear from the lung over time. Reducing the level of beryllium in the lung should reduce the severity of the inflammation and the amount of lung damage (Preamble).

Finally, repeated (e.g., annual) and comprehensive medical surveillance would improve the information base for epidemiological research. The proposed rule would increase medical surveillance and exposure monitoring requirements which may lead to more understanding of beryllium-related health effects and possibly the derivation of a quantitative dose-response relationship. This increased information base may lead to improved treatment and diagnosis of the beryllium-related health effects, as well as improved methods of controlling exposure to beryllium to reduce the risk of disease.

## 5.5 INCREASED WORK-LIFE AND OPPORTUNITIES

BeS and CBD may shorten the work-life of workers with these conditions, reducing the time those workers may remain employed. Furthermore, BeS and CBD may reduce the opportunities workers would have in non-beryllium related occupations. Both of these factors will impose costs on affected workers by reducing their income earning opportunities. By reducing the incidence of these conditions, the proposed CBDPP rule would reduce these costs and result in a benefit to potentially affected workers.

### 5.5.1 Increased Work-Life

Severe cases of CBD may render afflicted workers unable to continue employment for medical reasons. These workers will lose income between the time they leave employment and the time they would have retired. Workers' compensation may partially offset some of this loss, but may not compensate the worker fully for two reasons. First, workers' compensation does not consider any raises workers would have received had they continued in their positions or occupations.[25] Second, some states place time limits on workers' compensation claims. Therefore, workers who develop CBD after the expiration of their state's time limit may be unable to collect worker's compensation. Given that the average time from exposure to onset of disease is 10 years (Newman et al., 1996), this scenario is a distinct possibility.

The proposed CBDPP rule will reduce the incidence of BeS and CBD, and therefore reduce the number of workers who would be required to retire early for beryllium-related medical reasons. The value of avoiding this income loss can be calculated by determining the number of lost work-years that would be avoided and then determining the income that would have been

[25] Although workman's compensation adjusts for inflation, workers may have been eligible for raises exceeding the inflation adjustment (e.g., performance-based raises).

lost during those years. The avoided lost income cannot be estimated because a number of key inputs are not available, including a quantitative dose-response relationship and a method for determining when workers can no longer work due to beryllium-related medical reasons. Nevertheless, reducing the number of workers who retire early for beryllium-related health effects would reduce the amount of lost wages.

### 5.5.2 Increased Opportunities

Medical conditions such as BeS and CBD may reduce a worker's opportunity for employment in non-beryllium work at a DOE site or in work outside the DOE complex. Employers may not be willing to hire workers with these conditions because of the increased insurance costs and the possibility that CBD may leave the workers unable to work. Reducing the number of workers with BeS or CBD implies that fewer workers would have diminished opportunities as a result of these conditions.

## 5.6 INCREASED PRODUCTIVITY

Reducing the incidence of BeS and CBD will increase productivity at DOE facilities by keeping more experienced workers on the job. The proposed CBDPP rule would require workers who become BeS or who contract CBD be removed from beryllium work. Reducing the incidence of BeS and CBD would reduce the number of workers who would be removed from beryllium work, thus keeping more experienced workers in beryllium-related work. Workers who replace more experienced workers must be trained for beryllium-related work. Assuming that more experienced workers are more productive, the proposed rule would increase productivity at DOE facilities.

The extent of the increased productivity, however, would depend on the number of workers who would have been removed in the absence of the CBDPP rule (i.e., avoided removals). The

number of avoided removals is the decrease in the number of baseline removals, where the number of baseline removals is defined as the number of removals that would occur in the absence of the proposed CBDPP rule. The increase in productivity can be calculated by subtracting the productivity of the replacement workers (i.e., those who replace workers removed for beryllium-related medical reasons) from the workers who would have been removed in the baseline scenario (i.e., in the absence of the amendments to the CBDPP rule). In addition to the increased productivity would be the value of not having to train replacement workers.

Increased productivity and the reduced training costs are not estimated because a quantitative dose-response relationship is not available. The dose-response relationship would determine the number of baseline removals, as well as the number of avoided removals. Although a quantitative estimate is not available, reducing the incidence of beryllium-related health effects would reduce the number of removals and consequently increase productivity and reduce the need for training new workers under the proposed CBDPP rule.

### 5.7 Reduced Legal Liability for DOE and DOE Contractors

As a result of continuing incidences of BeS and CBD, lawsuits and claims have been brought against DOE and its contractors. In some of these cases DOE or its contractors have been held legally liable, and awards have been paid out to employees. DOE expects that, in the absence of the proposed CBDPP rule, future cases of CBD and BeS would result in lawsuits and potential legal liability. The proposed CBDPP rule would reduce the potential for lawsuits against DOE and DOE contractors in the future for at least two reasons. First, the lower action level in the proposed rule would reduce the number of cases BeS and CBD. This, in turn, will reduce the number of future lawsuits that are brought against DOE and its contractors. Second, by taking action to further reduce beryllium exposure and remove at-risk workers from exposed areas,

DOE reduces the possibility that it or its contractors would be found negligent in any future lawsuits. Thus, the proposed CBDPP rule should further reduce DOE and its contractors' potential future liability.

### 5.8 SUMMARY

The proposed CBDPP rule would further minimize the number of exposed workers and reduce the exposure levels of workers who are currently performing beryllium-related work. It would therefore, reduce the incidence of BeS and CBD among the DOE workforce. Reducing the incidence of beryllium-related health effects would reap substantial benefits for DOE, DOE contractors, and affected workers. This section identified and discussed seven benefits of the proposed CBDPP rule:

- *Reduced medical costs.*
- *Reduced mortality.*
- *Increased quality of life.*
- *Increased medical surveillance workers at risk.*
- *Increased work-life for beryllium workers.*
- *Increased productivity.*
- *Reduced liability for DOE and DOE contractors.*

These benefits were primarily given a qualitative discussion due to the lack of information on dose-response relationship for beryllium. Table 5-1 summarizes the discussion provided in this section for each of the benefits listed above.

**Table 5-1. Summary of Benefits of the Proposed CBDPP Rule**

| Benefit | Description |
|---|---|
| Reduced medical costs | By reducing the incidence of BeS and CBD, the proposed CBDPP rule would reduce referral and treatment costs associated with beryllium-related health effects. |
| Reduced mortality | Steenland and Ward (1991) report that 57 percent of workers with CBD die of beryllium-related diseases. By reducing the incidence of CBD, the proposed CBDPP rule would reduce the number of deaths that are attributable to CBD. |
| Increased quality of life | BeS and CBD reduce sufferers' quality of life. By reducing the number of cases of BeS and CBD, the proposed CBDPP rule would increase the quality of life of workers that would have become sensitized or contracted CBD. |
| Increased and mandatory medical surveillance and removal | The proposed CBDPP rule broadens the range of workers who would be receiving medical surveillance and makes medical surveillance and medical removal mandatory for beryllium workers. These changes result in several benefits including improvements in the timeliness and accuracy in diagnosing cases of BeS and CBD, the capability of protecting at-risk workers from further exposure by removing them from at-risk jobs, and increasing the information base regarding beryllium-related health effects. |
| Increased work-life for beryllium workers | Beryllium-related health effects may reduce the work-life of affected workers (e.g., medically-related early retirement) and may also reduce other employment opportunities. By reducing the incidence of beryllium-related health effects, the proposed CBDPP rule would reduce the incidence of medically-related early retirement. Furthermore, workers who are not sensitized or diseased would not have diminished employment opportunities. |
| Increased productivity | Reducing the incidence of beryllium-related health effects would reduce the number of workers removed from work for beryllium-related health effects. Assuming that current beryllium workers are more productive than those who would replace them, reducing the number of beryllium-related removals would avoid reductions in productivity. |
| Reduced legal liability for DOE and DOE contractors | Reducing the incidence of beryllium-related health effects would reduce the potential future legal liability for and controversial law suits against DOE and its contractors. |

## 6. SMALL BUSINESS AND UNFUNDED MANDATES ANALYSIS

This section examines the potential small business and unfunded mandates impacts of the proposed CBDPP rule. These analyses are conducted to fulfill regulatory requirements for federal agencies issuing rules. The small business analysis fulfills the requirements of the RFA, as amended by the SBREFA. The unfunded mandates analysis fulfills the requirements of the Unfunded Mandates Reform Act. The OMB's guidance on performing economic analyses of federal regulations suggests that both the small business and unfunded mandates analysis should be incorporated in the economic analysis (OMB, 1996).

### 6.1 SMALL BUSINESS ANALYSIS

The purpose of the RFA and its subsequent amendment in SBREFA is to ensure that federal regulations do not place an undue burden on small entities, including small businesses, small governments, and small non-profit organizations.[26] Federal departments or agencies issuing rules are required to assess the likely effect of the rule on small entities. If the rule is deemed to have a *significant* effect on a *substantial* number of small entities, then the department or agency must conduct further analyses that identify alternative, less-costly approaches to the requirements of the rule. The analysis performed here is to determine the potential for the rule to impose such a burden, thus determining if further analysis is required.

In terms of the proposed CBDPP rule, small businesses that are involved in beryllium-related work will be required to comply with the requirements of the rule, and thus incur compliance costs. If the impact of the compliance costs on the small businesses is significant then further analysis may be required.[27]

[26] The CBDPP rule would only potentially have an effect on small businesses but not small governments or small non-profit organizations.
[27] The impact of compliance costs on a small business can be estimated by the ratio of compliance costs to current revenues.

DOE's first step in determining if the proposed CBDPP rule will impose a significant impact on small businesses was to determine the number of small businesses that are engaged in beryllium-related work at the affected sites. To do this, DOE obtained information regarding the number of small prime contractors that are involved in beryllium-related work at the 22 affected sites[28] covered in this analysis. [29]

[28] Only 21 sites are listed in the table, because the Office of River Protection site was grouped with the Hanford site.
[29] DOE collected this information through a combination of direct contact with the sites and DOE operations offices that oversee the sites, review of prime-contractor web-sites, and queries of Dun & Bradstreet's Million Dollar Database .

**Table 6-1. Estimated Number of Small Businesses Affected by the Proposed CBDPP Rule**

| Site | Estimated Number of Small Businesses Affected by the Proposed Rule | Workers Employed by Small Businesses | Source |
|---|---|---|---|
| Ames | 0 | 0 | Stricker, 2012 |
| ANL | 0 | 0 | Turnquest, 2012 |
| BNL | 0 | 0 | Seniuk, 2012 |
| Fermi | 0 | 0 | Baird, 2012 |
| Hanford | 0 | 0 | Dun & Bradstreet, 2012 |
| INL | 0 | 0 | Floreen, 2012 |
| KCP | 0 | 0 | Dun & Bradstreet, 2012 |
| KAPL | 0 | 0 | Dun & Bradstreet, 2012 |
| LBNL | 0 | 0 | Dun & Bradstreet, 2012 |
| LLNL | 0 | 0 | Dun & Bradstreet, 2012 |
| LANL | 0 | 0 | Dun & Bradstreet, 2012 |
| NNSS | 0 | 0 | Dun & Bradstreet, 2012 |
| ORISE | 0 | 0 | Dun & Bradstreet, 2012 |
| ORNL | 1 | 252 | Wastren Advantage Inc, 2011 |
| PNNL | 0 | 0 | Dun & Bradstreet, 2012 |
| Pantex | 0 | 0 | Dun & Bradstreet, 2012 |
| Portsmouth / Paducah | 3 | 340 | LATA, 2010; Swift & Staley Inc., 2012; Wastren EnergX Mission Support, 2010; Zimmerman, 2012 |
| SNL | 0 | 0 | Brady, 2012 |
| SRS | 0 | 0 | Singh, 2012 |
| SLAC | 0 | 0 | Wenholz, 2012 |
| Y-12 | 0 | 0 | Piatek, 2012 |
| **Totals** | **4** | **592** | |

Nevertheless, DOE expects that any potential impacts on small businesses will be minimal for two reasons. First, in contrast to firms that compete in private markets, work performed by small businesses at DOE facilities is conducted under contract with either DOE or the prime contractor at the site. This contractual arrangement implies that increased funding may be available for compliance with the rule. If so, then any impact of the rule would be offset by the increase in funding that will be provided to comply with the requirements of the proposed CBDPP rule.

Second, not all of the proposed requirements apply to all contractors on a site. A number of the proposed requirements apply only to the prime contractor at a site and thus, small subcontractors are not burdened with some of the requirements. For example, each site is required to submit *one* CBDPP plan. This will most likely be prepared by the prime or integrating prime-contractor at the site. Thus, not all of the compliance costs will be applicable to small businesses at DOE sites.

As a final consideration, DOE notes that some sites may employ small businesses to perform D&D work. DOE has determined that the proposed rule would not impose any *incremental* burden on small businesses that may be employed. First, contracts for this type of work have not been written or offered at many of the sites that perform D&D work. This implies that these contracts would include additional funding to cover the compliance costs of the proposed CBDPP rule.

### 6.2 UNFUNDED MANDATES ANALYSIS

The purpose of the Unfunded Mandates Reform Act is to reduce the incidence of Federal agencies imposing unfunded requirements on state and local governments. DOE reviewed the proposed CBDPP rule to determine if any of the requirements impose an unfunded mandate on state or local governments and has determined that no such mandates are imposed. The proposed CBDPP rule would only impose requirements on DOE contractors and do not require state or local governments to take any actions.

## 7. SUMMARY

The proposed CBDPP rule is intended to further reduce the worker exposures in the DOE complex. This document constitutes the Economic Analysis fulfilling four requirements:

- *EO 12866 – EO 12866 requires federal agencies issuing rules to evaluate the costs, benefits, and economic impacts of the rule.*
- *EO 13563 – EO 13563 requires federal agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible.*
- *The RFA, as amended by the SBREFA – Federal agencies are required to review rules for potentially significant impacts on small entities.*
- *The Unfunded Mandates Reform Act – Federal agencies are required to determine if rules will impose unfunded mandates on state and local governments.*

The remainder of this section summarizes the findings of each of these analyses.

Before conducting these analyses, DOE profiled the sites and activities that would be affected by the proposed CBDPP rule and estimated the number of workers that would be affected (Section 2). DOE estimates that 20,293 workers may be exposed or potentially exposed in the DOE complex. Furthermore, DOE estimates that 1,261 of these workers are potentially exposed above the action level.

Section 4 concluded that the proposed rule is estimated to impose from $13.6 million to $17.2 million in total costs (using a 7 percent discount rate and a 10 year period lifetime of investment). This includes first year costs of $41.4 million to $42.7 million, of which $7.8 million to $11.2 million are annually recurring costs.

As discussed in Section 4, it should be noted that estimates generated for facility modifications to SNL and KCP, which would include airlock separation, new hygiene facilities,

and refrigerated air, dominated the costs of controls and activities for establishing regulated areas. In turn, the costs for regulated areas dominated the total cost estimates. The medical provisions of the proposed CBDPP rule would also cause significant cost impacts especially for the Hanford site which has the highest number of beryllium-associated workers.[30]

As mentioned within Section 5, while this economic assessment did not quantify potential cost savings generated from clarifications and eliminated requirements that will decrease sites' costs without causing any additional risk for workers, DOE not only expects the net impacts of the proposed CBDPP rule to be less than estimated in this assessment, but also expects DOE sites, contractors and workers to experience the following benefits:

- *Reduced medical costs.*
- *Reduced mortality.*
- *Increased quality of life.*
- *Increased medical surveillance and medical removal of at-risk workers.*
- *Increased work life for beryllium workers.*
- *Increased productivity.*
- *Reduced legal liability for DOE and DOE contractors.*

Because sufficient information on the dose-response relationship is not available in the scientific community, DOE could not relate reduced exposures to a specific reduction in CBD or BeS. Although not quantified, DOE expects that the proposed CBDPP rule would result in substantial benefits to DOE, its contractors and employees.

[30]Note that in the EAQ, Hanford indicated that all workers at the site are considered beryllium-associated workers due to low levels of legacy contamination at the site. Hanford also indicated that they would experience significant cost savings if a feasible method for distinguishing natural and anthropogenic forms of beryllium were developed, and areas at Hanford with natural forms of beryllium no longer required control.

Section 6 assessed the potential small business and unfunded mandates impacts of the proposed CBDPP rule pursuant to the RFA, as amended by the SBREFA, and the Unfunded Mandates Reform Act. Information collected regarding all affected sites indicates that no small businesses performing beryllium-related work at the affected sites would be significantly impacted by amendments to the CBDPP rule. DOE also reviewed the proposed CBDPP rule for unfunded mandates that may be imposed on state and local government. This review indicated that no unfunded mandates will be imposed on state or local governments.

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## Appendix A—The Economic Assessment Questionnaire

DOE circulated the Economic Assessment Questionnaire (EAQ) in this Appendix to sites that have beryllium. DOE also reviewed the EAQ with sites in two Video Tele-Conferences (VTCs). Sites submitted their responses to the EAQ to DOE to be reviewed and used in estimating the costs. Several rounds of site-specific follow-up questions followed in which DOE refined the cost analysis with specific information for each site.

### Economic Assessment Questionnaire

The purpose of this questionnaire is to obtain information on the cost and other impacts of implementing proposed amendments to Title 10, Code of Federal Regulations, Part 850 (10 C.F.R. 850), *Chronic Beryllium Disease Prevention Program* (CBDPP). The Office of Health, Safety and Security (HSS) will use this information in assessing the impact and preparing the economic analysis for these proposed amendments.

Before the questionnaire begins, we have provided a number of tips on answering these questions. Please read the tips before answering the questions. If you need further assistance, please call Jacqueline D. Rogers at 202-586-4714 or Christiana Marsden, Eastern Research Group, Inc., at 781-674-7331.

### Tips on answering the questions

- *The purpose of these questions is to determine the costs and impacts attributable to the proposed amendments to 10 C.F.R. 850 (should they be finalized). These questions are attempting to determine the incremental cost of complying with the new proposed sections of the rule.*

- *Some questions may repeat what has been asked in previous questions. If you feel that you have already answered a particular question elsewhere, simply make a reference to your answer (e.g., "see question #").*
- *Although precise estimates are desirable, HSS recognizes that this may not always be possible. If you expect that your estimates may overstate or understate the true impacts, please indicate this.*
- *For some questions, it may not be possible to provide a precise estimate without doing further engineering or factorial analysis. If you cannot provide precise estimates, but are able to express costs in relative terms, this is acceptable. For example, you may not be sure how much X will cost, but you are sure it will cost half as much as Y. Thus, you could answer, "X will cost half as much as Y."*
- *Another acceptable method of dealing with uncertainty about your estimates is to provide a range. For example, you may not know exactly how much X will cost, but you are reasonably certain it will cost between $10,000 and $20,000.*
- *For some questions, we have provided examples of possible responses. These are designed to provide you with an indication of the type of information we are looking for but are not meant to limit your choice of answer. Please answer all questions as you see fit, but keep these sample responses in mind as they may help clarify the intended purpose of the question.*
- *Some questions ask for what may appear to be personal information about individuals at your facility (e.g., salary information). Please be assured that it is not the intention of this questionnaire to elicit any information about specific individuals. For example, when we ask about the salary of an individual who performs, or would perform, a certain task, we are looking*

*not for the salaries of specific individuals, but the typical salary of whomever it may be that would perform that task.*

- *If the space provided to answer any question is insufficient, please complete the question on a separate attached sheet. Clearly denote the question number that is being answered on the attached sheet. Alternatively, if you are answering this questionnaire electronically, feel free to add space, as needed, in the document*

*(e.g., by adding rows to tables, etc.).*

**Questions**

**Note:**

- *Skip Pattern Instructions: Italicized; Emphasis: <u>Italicized, underlined</u>.*
- *All airborne beryllium (Be) levels are µg/$m^3$ "<u>inhalable</u> particulate fraction" as opposed to "<u>total</u> particulate fraction."*
- *All surface Be levels are in µg/100$cm^2$ .*

**1. Definitions (The Definition of Be)**

1.1. Are there any areas at your site that are controlled due to Be found in the following forms—wind-blown dusts, clays, coal slag, or concrete? (Or, any forms <u>other than</u> those from Be processes or activities?)

- If so, would your site make any change in the labor and materials currently employed in controlling and monitoring these areas if the Department of Energy (DOE) did not require control of such areas?

1.2. Are there areas at your site, which are, or may be, controlled due to Be contamination that is a result of naturally occurring soil contamination? (That is, the levels of Be found in dusts, clays, etc… in the controlled area are lower than, or equal to, the levels of Be in the surrounding environment and not a result of processes/activities currently or previously conducted at the site.)

- If so, would your site make any change in the labor and materials currently employed in controlling and monitoring these areas if DOE did not require control of such areas?

## 2. Site Information

2.1. Does your site have multiple contractors?

*(If "Yes," continue; if "No," skip to Section 3: Action Levels)*

2.2. Are the roles, responsibilities, and procedures of various contractors to ensure health and safety of workers clear and distinct in your site's CBDPP?

2.3. Do contractors share relevant information to help each other improve individual CBDPPs?

## 3. Action Levels

Airborne:

3.1. Among areas in your site that are not currently regulated, which area has the highest 95$^{th}$ percent upper confidence level on the 95$^{th}$ percentile Be exposure level, and what is that level?
Area name _____
95$^{th}$ percent upper confidence level on the 95$^{th}$ percentile exposure level in that area_____

3.2. Indicate whether your site's contractors would incur additional costs if the airborne action level were lowered to any of the following:

- 0.05 µg/m$^3$
- 0.1 µg/m$^3$
- 0.15 µg/m$^3$

3.3. Indicate whether the following potential action levels are likely to be below the reporting limit of your current sampling procedures.

- 0.05 µg/m$^3$
- 0.1 µg/m$^3$
- 0.15 µg/m$^3$

Surface Action Level:

3.4. Do you currently monitor surface levels in areas of your site with the potential for Be contamination (i.e., areas identified in your hazard analysis as potentially contaminated)?

*(If "Yes," continue; if "No," skip to question 3.6)*

3.5. Do you have a level (or levels) which you currently keep surface levels below and, if so, what are those levels in respective areas?
For example, Area:

Areas off limits to employees with a diagnosed medical Be Condition level X.X µg/100cm$^2$

Area _____ level _____

Area _____ level _____

Area _____ level _____

3.6. Indicate whether your site would incur additional costs if the following surface action levels were established for the areas you identified in 3.5:

- 1.5 µg/100cm$^2$
- 2.0 µg/100cm$^2$
- 2.5 µg/100cm$^2$
- 3.0 µg/100cm$^2$
- No additional costs for any of the above

3.7. Indicate whether the following potential surface action levels are likely to be below the reporting limit of your current analytic procedures for surface samples.

- 1.5 µg/100cm$^2$
- 2.0 µg/100cm$^2$
- 2.5 µg/100cm$^2$
- 3.0 µg/100cm$^2$
- No additional costs for any of the above.

**4. Exposure Monitoring**

4.1. If the current airborne action level was lowered to the lowest airborne action level for which you indicated that your site would incur costs in 3.2:

4.1.1. Would your site have new areas for which periodic monitoring would be required?

4.1.2. If so, estimate approximately how many new areas you would have to monitor and, on average, how many samples you would have to process annually to monitor these new areas?
Number of new areas _____
Number of new samples per new area _____

4.1.3. Currently, do your site's samples measure "*total* particulate fraction" or "*inhalable*" particulate fraction?
Circle one: Total Inhalable Both Do Not Know

4.1.4. What is an estimate of the cost of a current airborne sample at your site (including laboratory fees, time for an industrial hygienist, and materials)?
Total _____
Inhalable _____
Inhalable if using Closed Face Cassette with wall wipings _____

4.2. If the lowest surface action level for which you indicated that your site would incur costs in 3.6 was established as an action level triggering periodic surface monitoring requirements:

4.2.1. Would your site have new areas for which periodic monitoring would be required?

4.2.2. If so, estimate approximately how many new areas you would have to monitor and, on average, how many samples you would have to process annually to monitor these new areas?

Number of new areas _____
Number of new samples per new area _____
*If you do not currently monitor any surface levels at your site, skip to question 4.3.*

4.2.3. What is the highest Limit of Detection among your current methods of collecting surface samples? _____

4.2.4. Currently, does your site use dry or wet surface wipes to determine surface levels?
Circle one: Dry Wet Both Do Not Know

4.2.5. What is an estimate of the cost of a current surface sample at your site (including laboratory fees, time for an industrial hygienist, and materials)?

Dry _____
Wet _____

4.3. Does your site's Hazard Analysis currently consider potential process and materials changes and their impacts on Be levels? *(If yes, skip to question 4.4)*

4.3.1. If not, what kinds of employees and how much of their time would be involved in considering such changes and noting these in your hazard analysis?

Type(s) of Employee _____ Wage + Benefit _____
Employee _____ Wage + Benefit _____
Employee _____ Wage + Benefit _____

4.4. Portable Laboratories

4.4.1. Would your site make use of a portable field laboratory for analyzing airborne and surface samples if it were available near your site and recognized by DOE?

4.4.2. Do you anticipate that using a portable field laboratory would save time? If so, please give an estimate of how much time _____

4.5. When you notify workers of results of airborne and/or surface sampling, do you notify:

- Only those workers who were sampled
- All the workers who perform jobs in the sampled area
- Some other group of workers, specify:
  _____

**5. Regulated Areas**

5.1. Estimate how many additional regulated areas would need to be established if the lowest airborne and surface action levels for which you indicated your site would incur costs in 3.2 and 3.6 were established?
- Due to the selected airborne action level _____
- Due to the selected surface action level _____

5.2. Currently, what is an approximate range of costs for setting up a regulated area, including training employees, putting up signs, investing in personal protective clothing and equipment, and any other costs? (Breakdown, if possible; otherwise, simply estimate the total cost):
- Limiting access to authorized persons: from _____ to _____
- Demarcating areas (signs etc…): from _____ to _____
- Personal Protective Clothing and equipment: from _____ to _____
- Keeping records of individuals who enter the areas (name, date, time in, time out, and work activity): from _____ to _____
- Other Costs (specify nature of costs) _____:
  from _____ to _____
- Total Cost: from _____ to _____

5.3. What would be a reasonable amount of labor hours required to update/develop training manuals for employees in newly regulated areas if the lowest airborne and surface action levels for which you indicated your site would incur costs in 3.2 and 3.6 were established, and what type(s) of employees would be involved in the updating process?

Type of Employee(s) _____ Wage/Salary (with benefits): _____
- Less than 4 hours
- Less than 8 hours
- 8 hours or more

Type of Employee(s) _____ Wage/Salary (with benefits): _____
- Less than 4 hours
- Less than 8 hours
- 8 hours or more

**6. Restricted Areas** (areas to which access is restricted for employees with a Be-induced medical condition)

6.1. If restricted areas were established wherever surface levels exceeded one-half of the lowest surface action level for which you indicated your site would incur costs in 3.6, approximately how many restricted areas would have to be established at your site?
_____

6.2. What would be an approximate range of costs for establishing and demarcating restricted areas wherever surface levels exceed one-half of the lowest surface action level for which you indicated your site would incur costs in 3.6?

- Demarcating areas (signs etc.): from _____ to _____
  Other costs associated with restricting such areas from access to workers with a Be-induced medical condition (specify other type of cost).
  _____
  from _____ to _____

6.3. Is there a surface action level that could cause all areas of your site to be restricted areas?

If so, what would that level be? _____µg/100cm$^2$

**7. Housekeeping**

7.1. Does your site currently control surface levels of Be in regulated areas during or in-between shifts in the same day?
*If "No" to question 7.1, skip to section 8: Release and Transfer Criteria.*

7.2. If so, how often do they clean this space? If they clean after every shift or during every shift, indicate how many shifts per week/month/year.

- Be Work Activity: _____
  Shift frequency_____
  Cleaning frequency per shift _____

- Be work activity: _____
  Shift frequency_____
  Cleaning frequency per shift _____

- Be work activity: _____
  Shift frequency_____
  Cleaning frequency per shift _____

7.3. What types of employees are involved in housekeeping and how much of their time?

Type of Employee(s) _____
Wage/Salary (with benefits): _____
Estimate of the number of employees of this type involved: _____
Indicate how much time each employee spends on housekeeping:

- Less than 15 minutes per day
- Less than 30 minutes per day
- Less than 1 hour per day
- 1 hour per day or more

Type of Employee(s) _____
Wage/Salary (with benefits): _____
Estimate of the number of employees of this type involved: _____
Indicate how much time each employee spends on housekeeping:

- Less than 15 minutes per day
- Less than 30 minutes per day
- Less than 1 hour per day
- 1 hour per day or more
-

**8. Release and Transfer Criteria**

8.1. Does your site have any areas or equipment that are unacceptable for release based on the requirements in the current rule?

*If "No" to question 8.1, skip to question 8.5.*

8.2. How many areas and pieces of equipment do you have that cannot be released?
Areas _____ Pieces of equipment _____

8.3. What are the reason(s) that these areas/pieces of equipment cannot be released? Circle all that apply:

a. No recipient could be found who would accept equipment labeled as currently required by DOE.

b. Be is embedded in usually inaccessible locations or hard to remove substances.

c. It was not cost effective to decontaminate the equipment in accordance with the current regulation.

d. It was not possible to decontaminate the equipment in accordance with the current regulation because the environment (windblown dust, clay, dirt, etc.) is the cause of the contamination.

e. Other (please specify) _____

8.4. Do you currently use wipe samples to demonstrate that a piece of equipment is decontaminated before release?

*If "No" to question 8.4, skip to question 8.5.*

8.4.1. How many wipe samples are generally required per area/piece of equipment to demonstrate decontamination? _____ /area _____ /piece

8.4.2. What is the cost per sample? _____

8.4.3. What would be the cost of encapsulating a piece of equipment and using aggressive air sampling in an enclosure surrounding the equipment to demonstrate decontamination? (Break down, if possible.)

- Training employees to encapsulate and sample equipment/areas
- Enclosing the encapsulated equipment/shutting off encapsulated area_____
- Aggressive air sampling labor _____
- Aggressive air sampling laboratory fees _____
- Other costs (specify) _____
- Total cost _____

8.4.4. Would your site find it more cost effective to continue to use wipe samples to decontaminate or to switch to encapsulating equipment and using aggressive air sampling within the enclosure?

_____ Wipe samples

_____ Encapsulation and aggressive air sampling in an enclosure or shut off area

8.4.5. Does your site have any equipment that you do not try to release (whether to a third party or to a different site or area in your site) under the current regulation, but would try to do so if allowed to demonstrate decontamination by encapsulation and aggressive air sampling in an enclosure surrounding the equipment?

8.5. Do you spend time demonstrating that a piece of equipment that will be shipped to another site/area in your site for use in a Be area is not contaminated before transporting it to that other site? If so, how much time?

## 9. Medical Surveillance

9.1. Are there currently any beryllium-associated workers or beryllium workers opting out of medical surveillance at your site?
If so, how many?

## 10. Medical Removal Benefits

10.1. Does your site currently hire workers before seeing the results of their medical evaluation (e.g., if they decline to accept a medical evaluation before hire)?
*If "No" to question 10.1, skip to question 10.3.*

10.2. At your site, have any of the workers described in 10.1 opted into the medical surveillance program after being hired and working at your facility for some time and

been shown to be sensitized or have Chronic Beryllium Disease, which they may, or may not, have had before their work at your site? How frequently has this occurred per year over the past 5 years?

- Rarely (less than annually)
- Sometimes (once or twice a year)
- Frequently (more than twice a year)

10.3. Are there currently any workers opting out of medical removal at your site? If so, how many?

10.4. Are there costs for your site associated with removing a worker from his/her job other than medical removal benefits?
If "*Yes*," specify: _____

10.5. Would your site incur additional costs if required to exclude workers with a diagnosed Be-induced medical condition from jobs performed in areas with one-half the lowest surface action level for which you indicated your site would incur costs in 3.6? If so, please comment on those costs; if not, circle "Already doing this."

- Incremental costs _____
  _____
- Already doing this

**11. Controversy about Be Benefits**

11.1. How frequently in the past 5 years has your site experienced any controversy (i.e., administrative issues or law suits) associated with whether workers who are diagnosed with a Be-induced medical condition but are currently ***not*** working in jobs with a Be activity will receive medical removal benefits?

- Never
- Rarely (less than annually)
- Sometimes (once or twice a year)
- Frequently (more than twice a year)

11.2. How frequently in the past 5 years has your site reduced the time period for medical removal benefits for a worker on permanent removal if they were already on temporary removal before they were placed on permanent removal?

- Never
- Rarely (less than annually)
- Sometimes (once or twice a year)
- Frequently (more than twice a year)

11.3. How frequently in the past 5 years has your site experienced confusion (i.e., administrative issues or law suits) associated with workers not understanding how long

they receive benefits because of this?

- Never
- Rarely (less than annually)
- Sometimes (once or twice a year)
- Frequently (more than twice a year)

**12. Training**

12.1. How many hours of training are currently provided to workers in jobs with Be activities?
Initially_____ Annually_____

12.2. How many hours of "general awareness training" are currently provided to all other workers?
Initially_____ Annually_____

12.3. Is Be-related training beyond general awareness training provided to a subset of the workers who are ***not*** in jobs with Be activities but have skills that may be called upon for use in a regulated area (i.e., maintenance, specific cleaning jobs, etc…)?
If "*Yes,*" specify type of training and number of hours:
_____

12.4. How many workers would require additional training if DOE required that your site develop a training program and provide more in-depth training than "general awareness training" for workers who have skills that may be called upon for use in a regulated area (even if their job typically does ***not*** involve entering regulated areas)?
_____

12.5. What kinds of workers at your site fall into the above category?
Employee _____ Number of employees _____ Wage+Benefit _____
Employee _____ Number of employees _____ Wage+Benefits _____
Employee _____ Number of employees _____ Wage+Benefits _____
Employee _____ Number of employees _____ Wage+Benefits _____

**13. Signage**

13.1. If the lowest action levels for which you indicated your site would incur costs in questions 3.2 and 3.6 applied, how much additional spending would be required to put up new signs demarcating new regulated and restricted areas? (Indicate number of signs and average sign cost.)
- Number of additional signs per new regulated/restricted area_____
- Average cost of a new sign_____

13.2. Also, what would be the cost of printing additional information on all the signs currently in your site? (Indicate number of signs and average sign cost.)

- Number of additional signs/current regulated or restricted area_____
- Average cost of a new sign_____

**14. Reporting Standard**

14.1. Would there be additional costs associated with submitting information in a format that is compliant with DOE Technical Standard DOE-STD-1187-2007? (Note: no additional information would need to be generated, although information that employers currently possess would be required to be reported in accordance with the standard.)

If "*Yes,*" specify number of additional paper work hours and the type of employee performing this labor: _____

## APPENDIX B—ESTIMATING THE SHARE OF EMPLOYEES SHOWING SIGNS AND SYMPTOMS OF BERYLLIUM INDUCED CONDITIONS

Medical restriction costs are based on the estimated share of workers that will be restricted from areas where beryllium is present due to non-beryllium conditions that cause signs and symptoms similar to beryllium induced conditions. Some of these symptoms include: shortness of breath, cough, fever, night sweats, and chest pain. Non-beryllium conditions that may cause these signs and symptoms enumerated in revised 10 CFR 850 include: dyspnea (shortness of breath) on exertion; sarcoidosis; asthma; emphysema; and chronic obstructive pulmonary disease (COPD). An aggregate estimate of the prevalence of these conditions was not available in medical literature. Thus, DOE aggregated prevalence estimates from various studies addressing each of these conditions to develop an estimate of share of workers eligible for medical restriction.

DOE estimated the lifetime prevalence of the dyspnea at 12.6 percent based on a low of 8.9 percent found in Currow et al. (2009), and a high of 16.2 percent as determined from Wilkins, III et al. (1999). Wilkins, III et al., (1999) also determined 9.4 percent to be a lifetime prevalence for chronic cough. Hunninghake et al. (1999) noted that medical literature has found lifetime prevalence estimates for sarcoidosis to range from less than 0.001 percent to 0.04 percent. The midpoint of these rates was averaged with the high prevalence rate of 0.048 percent found in Erdal et al. (2012), for an overall lifetime prevalence of 0.03 percent. The 2011 National Health Interview Survey (NHIS) conducted by the Centers for Disease Control and Prevention (CDC, 2011) determined the lifetime prevalence of asthma was 12.6 percent, while the lifetime prevalence of COPD was 4.3 percent. As COPD represents a group of lung diseases, including emphysema, the lifetime prevalence of emphysema was not considered separately.

These lifetime prevalence rates reflect the number of cases that have developed over a longer time frame. Based on these prevalence rates and an average working lifetime of 45 years, DOE has estimated an average of 0.86 percent of workers requiring medical restriction for non-beryllium conditions which may be exacerbated by exposure to beryllium on an annual basis.[31]

[31] To calculate the average annual prevalence, DOE summed the lifetime prevalence rates for all the considered conditions and divided them by the number of years in the average working lifetime (45 years).