

**Independent Oversight
Inspection of the**



Hanford Site Chronic Beryllium Disease Prevention Program

June 2010

Office of Independent Oversight
Office of Health, Safety and Security



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Abbreviations Used in This Report

ACGIH	<i>American Conference of Governmental Industrial Hygienists</i>
AJHA	<i>Automated Job Hazard Analysis</i>
AMH	<i>AdvanceMed Hanford</i>
ATL	<i>Advanced Technologies and Laboratories International, Inc.</i>
BAG	<i>Beryllium Awareness Group</i>
BCA	<i>Beryllium-Controlled Area</i>
BCF	<i>Beryllium-Controlled Facility</i>
BEA	<i>Beryllium Exposure Assessment</i>
Be-Cu	<i>Beryllium-Copper</i>
BeLPT	<i>Beryllium Lymphocyte Proliferation Test</i>
BERPV	<i>Beryllium Exposure Profile – Previous Worker</i>
BRA	<i>Beryllium-Regulated Area</i>
BWP	<i>Beryllium Work Permit</i>
CBD	<i>Chronic Beryllium Disease</i>
CBDPP	<i>Chronic Beryllium Disease Prevention Program</i>
CFR	<i>Code of Federal Regulations</i>
CHPRC	<i>CH2M-Hill Plateau Remediation Company</i>
DOE	<i>U.S. Department of Energy</i>
ERDF	<i>Environmental Restoration Disposal Facility</i>
EJTA	<i>Employee Job Task Analysis</i>
EM	<i>DOE Office of Environmental Management</i>
ES&H	<i>Environment, Safety, and Health</i>
GET	<i>General Employee Training</i>
HAB	<i>Hanford Advisory Board</i>
HAMMER	<i>Hazardous Materials Management and Emergency Response</i>
HAMTC	<i>Hanford Atomic Metal Trades Council</i>
HSS	<i>DOE Office of Health, Safety and Security</i>
IH	<i>Industrial Hygiene</i>
IHT	<i>Industrial Hygiene Technician</i>
JHA	<i>Job Hazard Analysis</i>
LIBS	<i>Laser Induced Breakdown Spectroscopy</i>

Abbreviations, continued

MSA	<i>Mission Support Alliance</i>
NJH	<i>National Jewish Health</i>
ORP	<i>DOE Office of River Protection</i>
OSHA	<i>Occupational Safety and Health Administration</i>
PEL	<i>Permissible Exposure Limit</i>
PER	<i>Problem Evaluation Report</i>
PFP	<i>Plutonium Finishing Plant</i>
PNNL	<i>Pacific Northwest National Laboratory</i>
PPE	<i>Personal Protective Equipment</i>
RL	<i>DOE Richland Operations Office</i>
SOMD	<i>Site Occupational Medical Director</i>
TLV	<i>Threshold Limit Value</i>
TOC	<i>Tank Operating Contractor</i>
TWA	<i>Time-Weighted Average</i>
WCH	<i>Washington Closure Hanford</i>
WRPS	<i>Washington River Protection Solutions</i>
WSCF	<i>Waste Sampling and Characterization Facility</i>

Executive Summary

This independent inspection was conducted by the U.S. Department of Energy (DOE) Office of Health, Safety and Security (HSS) at the request of the Assistant Secretary for Environmental Management (EM) in response to concerns raised by external stakeholders regarding the adequacy of implementation of the Hanford Site chronic beryllium disease prevention program (CBDPP). This CBDPP was developed as the implementing document for the requirements of the beryllium rule – 10 CFR 850, *Chronic Beryllium Disease Prevention Program*.

This inspection focused on the current Hanford Site CBDPP, which covers the four EM operating contractors – CH2M-Hill Plateau Remediation Company (CHPRC), Mission Support Alliance (MSA), Washington Closure Hanford (WCH), and Washington River Protection Solutions (WRPS) – and the site medical contractor, AdvanceMed Hanford (AMH). The team evaluated the current practices for protecting workers against beryllium hazards at the Hanford Site and the beryllium medical surveillance programs for current workers. The inspection was conducted in a transparent manner that engaged representatives of various stakeholder groups, including the Hanford Advisory Board (HAB), the Beryllium Awareness Group (BAG), and the Hanford Atomic Metal Trades Council (HAMTC). Independent medical experts from outside DOE were included on the HSS team to further bolster independence and technical credibility.

Work with beryllium and beryllium-containing articles took place at the Hanford Site in the past but ceased over a decade ago. Most beryllium items have been dispositioned, although a few beryllium-alloy-containing tools and older equipment are still present. Currently, the potential for workers to be exposed to beryllium is primarily the result of legacy contamination from past work or past use of beryllium alloys in equipment and tools. Prevention of beryllium disease requires reliable and accurate information about the current location of the beryllium hazards and a conservative approach when areas cannot be verified to be free of beryllium contamination.

The development of the single Hanford Site CBDPP applicable to all EM contractors at the Hanford Site and the formation of a sitewide, multi-contractor CBDPP Committee are positive steps toward a fully effective program. The sitewide CBDPP provides an appropriate framework for standardization among the various contractors and clarity in expectations across the site and addresses most required elements. The positive features and benefits of the sitewide CBDPP and the CBDPP Committee include: (1) the single Hanford Site CBDPP provides consistent requirements that apply to AMH and the four applicable EM operating contractors and thus significantly enhances implementation and coordination of actions required by 10 CFR 850; (2) the unified approach provides a level of consistency and coordination that enhances the protection of Hanford workers from exposure to residual beryllium contamination, thereby reducing the potential for workers to become sensitized or develop chronic beryllium disease (CBD); (3) the CBDPP Committee provides a needed venue for evaluating and addressing beryllium issues at Hanford, developing consensus solutions, and driving continuous improvement; and (4) the CBDPP establishes a beryllium action level that is more conservative than the limit specified in the beryllium rule.

During the inspection, Hanford Site organizations were taking action to implement the Hanford Site CBDPP that was issued in May 2009. However, timely and effective implementation of the new

program has been hindered by inadequacies in the direction provided by the DOE Richland Operations Office (RL) and Office of River Protection (ORP) and the associated lack of clear plans for managing the implementation of the new CBDPP program, including identification of gaps (shortfalls in implementation), needed actions, and milestones.

Because the primary risk of worker exposure to beryllium is legacy contamination, a critical step in worker protection is the development of an accurate baseline inventory (a requirement of 10 CFR 850), based on reliable assessment and characterization activities. This inventory must identify the locations of potential beryllium contamination so that controls to protect workers can be established in those locations. Various Hanford Site organizations conducted baseline inventory, assessment, and characterization activities in the past and occasionally updated the results, but these past efforts were limited and incomplete. Therefore, the new CBDPP appropriately requires further actions to ensure that potential locations of legacy contamination are identified. Re-baselining, assessment, and characterization activities were under way at the time of the review; however, some aspects of the efforts were not sufficiently rigorous and comprehensive to provide a fully reliable basis for determining the need for controls to protect workers.

Recent, documented air samples indicate that airborne beryllium levels are very low, and personal protective equipment is typically used for work activities where the potential for airborne beryllium is anticipated. As a result, worker exposures have been well below current limits for activities where the potential for exposure is anticipated and controlled. However, there continue to be newly-diagnosed cases of beryllium sensitization and CBD among current and former Hanford workers. New cases of sensitization and CBD are not necessarily the result of deficiencies in the current program, because a newly-discovered case could be the result of a past exposure. Nevertheless, because of the weaknesses in the recent and current implementation of CBDPP controls (e.g., inadequate facility characterizations known areas of contamination that are not well controlled) and the ongoing discovery of new sources of beryllium, the possibility that new cases are resulting from recent exposures cannot be ruled out. Therefore, the analysis of these newly-discovered cases is critical to understanding exposure mechanisms, identifying currently unrecognized potential sources of contamination, and determining the need for implementation of additional actions to protect workers. Although required by the beryllium rule, AMH has not performed any analysis of newly-discovered cases for the past two years, and therefore has lost opportunities to gather information that might help determine whether these cases result from past or recent exposures and whether additional protective actions are needed.

Deficiencies were also identified in a number of other elements of the CBDPP that were implemented by the site operating contractors and medical contractor; these include training, work control, postings, counseling, and communications. To ensure that workers are protected in accordance with the requirements of the beryllium rule, the identified deficiencies need to be addressed in a timely and effective manner, with particular attention to establishing an effective baseline inventory and completing the needed hazards assessment and facility characterization efforts.

Members of the HAB, BAG, HAMTC, and several other former workers demonstrated a passionate interest in ensuring that the CBDPP is effective and that workers are protected, given accurate and complete information, and provided medical surveillance, diagnosis, and support. For example, HAMTC and BAG representatives were actively engaged in the development of the new program. Weaknesses in communications between site management (RL, ORP, and contractors) and the HAB, BAG, and site workers have hindered resolution of concerns, contributed to mistrust between site management and some former and current workers, and contributed to a perception among some workers that site management

does not support worker safety when it impacts contract objectives and, in a few instances, a perception that site management intimidates or retaliates against workers and managers who support safety.

Review of past concerns and corrective actions regarding implementation of the Hanford CBDPP revealed that most of the key deficiencies had been identified in the past at various times by several different internal and external evaluators and stakeholder groups. Although the identified deficiencies were often acknowledged by site management and corrective actions were often identified, the deficiencies were not always effectively resolved. For example, in 2009, the HAB identified several concerns and recommendations that were similar to the concerns and recommendations in a 2002 Hanford Joint Council report; many of these issues were not adequately addressed and were still evident during this HSS inspection.

Effective RL and ORP direction and oversight is essential at a site with five separate contractors implementing a program that requires consistency and integration across all organizations. Insufficient RL and ORP oversight contributed to unnecessary delays in implementing the new CBDPP, recurrence of past deficiencies, and poor communications. Improvements in RL and ORP direction and oversight are necessary to ensure the timely establishment of an effective program that protects workers from legacy beryllium hazards at the site and ensures that affected workers are provided appropriate care. Recognizing that the deficiencies at the site are of long standing, increased EM management attention and involvement are also warranted.

A contributing factor to the non-compliances and management weaknesses identified during this inspection is the perception of a number of individuals in key decision-making and program management roles that the recent cases of sensitization and CBD, while tragic, are primarily a reflection of exposures that occurred years ago from beryllium sources that are no longer present and/or are from exposures the individuals may have had during work at other sites. This perception may be founded on various factors, including: the current assessment and characterization results indicate that few buildings are contaminated; most air monitoring results indicate that airborne beryllium is not above the detection limit; and some personnel who were hired in recent years and determined to be sensitized since then had previously worked at other DOE or other defense facilities where beryllium sensitization could have occurred. While these factors are largely valid, they are not sufficient to conclude that Hanford workers are no longer being exposed and thus no longer at risk due to current exposures (e.g., the characterization and assessment processes used in the past and currently are not sufficient to ensure that facilities are in fact free of beryllium, and the risks of non-airborne exposures are not sufficiently considered). Additionally, new beryllium hazards with potential for worker exposure have been identified at Hanford in recent years, such as a recent discovery of beryllium contamination in an elevator switchgear panel.

Because of this perception and the priority placed on other significant legacy hazards at the site, the level of attention applied to beryllium has not been sufficient to ensure that all program elements are adequately implemented. In addition, the above perception is in sharp contrast to that of some stakeholder groups and some beryllium-affected workers, who view the lower attention and priority as an indicator that Hanford management does not place sufficient priority on the health and safety of Hanford workers. Further complicating interactions with stakeholders was a misperception by some stakeholders that RL, ORP, and site contractors must follow all stakeholder recommendations. In fact, RL, ORP, and site contractors should carefully consider all stakeholder input and evaluate the benefits, challenges, and risks in determining the most appropriate improvements to the protection program. Sustained management priority and attention, improved communications, and better feedback to stakeholders will be required to ensure implementation of an effective program and reestablish trust with these individuals and

stakeholder organizations. In addition, EM, RL, ORP, and contractor management attention is needed to ensure that the findings identified in this inspection are properly addressed in a timely manner and verified to be effective, and to ensure that an ongoing program of assessments and oversight of CBDPP implementation is put in place.

In addition, it is important that HSS organizations with responsibility for worker safety and health policy evaluate and address the issues and associated opportunities for improvement that warrant DOE Headquarters attention. These issues and opportunities include clarifying the apparently conflicting wording in 10 CFR 850 regarding medical surveillance notifications, improving communications with individuals contacting the HSS Regulatory and Policy Response Line, and accelerating efforts to consider newer information and evaluate changes to regulations that may further strengthen worker protection.

In a recent positive development, EM reacted promptly to address feedback obtained during the initial stages of this inspection by directing the implementation of a number of actions to address specific areas of concern. As the review progressed, RL and ORP reacted promptly to identify deficiencies and issued interim direction to their contractors to take a number of timely corrective or compensatory actions. While this prompt response is a positive step, some aspects of the direction warrant additional refinement. Increased and sustained DOE and contractor management attention will be needed to ensure that the interim measures and corrective actions are effectively implemented by the site contractors.

As summarized in Table 1, this report identifies findings that require corrective action to ensure compliance with the beryllium rule or other applicable requirements and opportunities for improving the overall management and implementation of the CBDPP by the various Hanford Site contractors and for improving program oversight by RL and ORP. Because of the importance of an effective CBDPP to worker protection and the multiple organizational interfaces, HSS believes that it is important for EM to take a lead role in evaluating the results of this inspection, including the cross-cutting opportunities for improvement (summarized in Table 1) and the specific opportunities for improvement identified in the appendices, and directing improvement actions as appropriate.

Table 1. Summary of Findings and Opportunities for Improvement

Summary of Findings That Require Corrective Action to Address Non-compliances	
Finding #1:	RL and ORP have not ensured that contractor baseline beryllium inventory and hazard assessments have been completed, as required by 10 CFR 850.20, 10 CFR 850.21, and the corresponding portions of the CBDPP.
Finding #2:	RL and ORP have not ensured that several categories of workers at the Hanford Site are receiving the minimum beryllium-related training, as required by 10 CFR 850.37 and 10 CFR 851.25.
Finding #3:	AMH has not always analyzed medical, job, and exposure data for employees diagnosed as sensitized or having CBD and thus is not collecting information needed to identify workers at risk for exposure, understand the beryllium health risks, and identify appropriate actions to improve the CBDPP, as required by the CBDPP, 10 CFR 850.39, and 10 CFR 850.34.
Finding #4:	WRPS, CHPRC, MSA, and WCH have not ensured that their work planning and control processes and their implementation of those processes in beryllium-controlled facilities and areas are sufficient to fully ensure protection of workers, co-located employees, and transient personnel, as required by 10 CFR 850.22 through 10 CFR 850.30, 10 CFR 850.38, and the corresponding portions of the CBDPP.
Summary of Cross-Cutting Opportunities for Improvement That Warrant EM Evaluation and Direction	
	<ol style="list-style-type: none"> 1. RL should promptly direct AMH to develop a comprehensive improvement plan that addresses the deficiencies and opportunities for improvement identified in this report. 2. RL and ORP should promptly direct operating contractors to identify and prioritize identified deficiencies (including those identified in this report and others identified by other assessments or gap analyses) and, where warranted, develop timely corrective actions and/or interim protective measures. 3. On a priority and risk basis, RL and ORP should require operating contractors to develop and implement comprehensive implementation plans for completing efforts to achieve full and effective implementation of the site CBDPP. 4. RL and ORP should consider ensuring that site contractors strengthen their processes for baseline beryllium inventories and hazards assessments. 5. RL, ORP, and contractor organizations should determine methods to strengthen assessment and issues management processes for beryllium processes and activities. 6. RL, ORP, and contractor organizations should identify appropriate timely actions to ensure that accurate information about beryllium is available. 7. To ensure the long-term effectiveness of the CBDPP, RL and ORP should consider further formalizing expectations and governance of the CBDPP (i.e., maintenance and implementation). 8. RL and ORP should identify actions to improve communications with stakeholder organizations and use their feedback and experience as a resource to improve the Hanford Site CBDPP. 9. RL should strengthen support mechanisms and communications with beryllium-affected workers. 10. RL, ORP, and contractor organizations should identify actions to raise site managers' and supervisors' awareness of the risks to workers associated with legacy beryllium contamination and to build trust among workers. 11. DOE line management should ensure that adequate assessments of the CBDPP are performed. 12. EM should closely monitor site progress in implementing and improving the CBDPP at the Hanford Site and take an active role in ensuring timely and effective implementation.

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1. Introduction

The U.S. Department of Energy (DOE) Office of Independent Oversight, within the Office of Health, Safety and Security (HSS), conducted an inspection of the beryllium program at the Hanford Site during March and April 2010. The inspection was performed by the Office of Independent Oversight's Office of Environment, Safety and Health Evaluations at the request of the DOE Headquarters Office of Environmental Management (EM) and focused on the Hanford Site's implementation of its recently developed sitewide chronic beryllium disease prevention program (CBDPP).

Purpose, Scope, and Approach of the Inspection

In requesting the inspection, EM recognized that the Hanford Advisory Board (HAB) and several Beryllium Awareness Group (BAG) members had expressed concerns about the adequacy of past efforts and several recent instances of newly-discovered beryllium-affected individuals. EM also recognized that the recently developed sitewide CBDPP was in the early stages of implementation. Consequently, EM asked HSS to perform a broad review of the beryllium program, while devoting particular attention to those areas of concern expressed by the HAB and BAG members.

EM and HSS recognized that it was critical that the inspection be independent and credible. Consequently, HSS determined the scope of the inspection based on its independent review of the status of the CBDPP and issues that were raised by the HAB and BAG members. Several individuals outside of DOE, particularly medical experts, were added to the team to enhance independence and credibility.

Based on the various inputs, HSS decided to perform a broad-based review focusing on the management and oversight of the implementation of the recently developed Hanford sitewide CBDPP, which was issued in May 2009, to determine its conformance to applicable requirements and the effectiveness of its implementation. The review examined a wide range of elements, including facility re-baseline assessments and characterization, work controls, training and qualification, medical surveillance, employee communications, contractor feedback and improvement activities, and DOE direction and oversight provided by the Richland Operations Office (RL) and the Office of River Protection (ORP). HSS also examined a number of issues related to beryllium that warranted management attention by the Hanford Site or other DOE organizations, including certain issues of interest to the HAB, BAG, or other stakeholders.

The scope of the review included all the major EM contractors that participate in or support the Hanford Site CBDPP. The four applicable Hanford operating contractors were evaluated:

- Washington River Protection Solutions (WRPS)
- CH2M-Hill Plateau Remediation Company (CHPRC)
- Mission Support Alliance (MSA)
- Washington Closure Hanford (WCH).

The HSS team also reviewed the medical surveillance program and activities of the medical contractor – AdvanceMed Hanford (AMH) – and elements of the analytical laboratory operations, which are performed

by Advanced Technologies and Laboratories International, Inc. (ATL) at the 222-S laboratories and by MSA at the Waste Sampling and Characterization Facility (WSCF) laboratory.

Two major contractors at the Hanford Site were not included in the scope of the inspection. Under contract to the Office of Science, Pacific Northwest National Laboratory implements a separate CBDPP. In addition, the Waste Treatment Plant, operated by Bechtel National, Inc., is a new construction site with no identified beryllium activities or legacy beryllium hazards.

Organization of the Report

Section 2 presents an overall assessment of the effectiveness of the management and oversight of the new Hanford sitewide CBDPP. Section 3 identifies the findings that require corrective action by site management. Section 4 provides the Independent Oversight team's overall conclusions and cross-cutting opportunities for improving the beryllium program at the Hanford Site.

Appendix A provides supplemental information, including team composition and additional information about the inspection activities. Appendix B presents background information for readers who are not familiar with the Hanford Site or beryllium programs. It identifies the DOE organizations and prime contractors at the Hanford Site, including those that have the potential to work with beryllium or in beryllium-contaminated facilities, and describes other organizations with a role in the efforts to protect workers from beryllium effects. It also briefly summarizes key information about beryllium and its health impacts.

Appendix C presents the results of the review of the beryllium medical surveillance program, which is managed by AMH. Appendices D through G provide the results of the review of implementation of the CBDPP by the four major Hanford Site contractors with operational responsibilities that were reviewed on this inspection (i.e., WRPS, CHPRC, MSA, and WCH). Appendix H discusses a number of issues related to the CBDPP that are cross-cutting (i.e., potentially relevant to multiple contractors) or that could have DOE-wide implications, including issues involving soil background levels for beryllium; the 2009 American Conference of Governmental Industrial Hygienists threshold limit value for beryllium; the status of research efforts for monitoring and sampling beryllium; and the use of the DOE Regulatory and Policy Response Line. The information in these appendices was used, along with management interviews and reviews of sitewide program documents, to develop the assessment of the management of the program in Section 2 and the findings listed in Section 3. Appendices C through H also include opportunities for improvement that apply to specific DOE and contractor organizations.

HSS inspections determine whether activities at DOE sites meet applicable safety and health requirements and are effectively implemented. Findings identify aspects of the program that do not comply with 10 CFR 850, *Chronic Beryllium Disease Prevention Program* (the beryllium rule), the Hanford Site CBDPP, or other applicable DOE requirements. The findings are listed in Section 3 and referenced in the applicable portions of Appendices C through H. The responsible DOE line management organizations – EM, RL, and ORP – must ensure that corrective action plans are developed to address the findings identified in Section 3 in accordance with site issues management processes and quality assurance requirements. As with all inspection results, DOE management and Hanford Site contractors should also consider the management weaknesses and opportunities for improvement identified in this report in accordance with their issues management processes. However, because of the importance of an effective CBDPP to worker protection and the multiple organizational interfaces, HSS believes that it is important for EM to take a lead role in evaluating the results of this inspection, ensuring that appropriate actions are taken by RL and ORP, and, as necessary, directing improvement actions as appropriate.

2. Management and Oversight

The HSS team evaluated the management and oversight of the Hanford Site CBDPP, with a focus on development and ongoing efforts to implement the CBDPP. The evaluation identified a number of positive attributes and weaknesses. This section details the results of these evaluations from a sitewide perspective, considering the information gathered about individual contractors' procedures and performance, as documented in Appendices C through H. It also incorporates insights from HSS's interviews with site personnel and reviews of the sitewide documents and CBDPP sitewide elements, such as medical programs and training. This section focuses on the HSS team's evaluation of CBDPP development and implementation, including aspects of the CBDPP that are managed on a sitewide basis, such as some aspects of training; it does not duplicate the detailed results in the appendices, which include contractor-specific positive aspects, deficiencies, and opportunities for improvement.

Historical Background

When the beryllium rule was issued in 1999, the Hanford Site contractors developed an initial sitewide baseline beryllium inventory to comply with the rule. Further characterization and sampling efforts were performed after the initial baseline, mostly in the 2003-2005 timeframe. However, these assessments and characterizations were limited. For example, only 25 of several hundred buildings were assessed and/or characterized, and the assessments that were performed were not always comprehensive. In addition, at the time the beryllium rule was issued in 1999, the criteria for performing the characterization and establishing beryllium-controlled areas were higher ($0.5 \mu\text{g}/100 \text{ cm}^2$) than the surface wipe criteria prescribed by the current program ($0.2 \mu\text{g}/100 \text{ cm}^2$).

In the mid to late 2000s, site activities were split among multiple contractors, and each contractor managed its own separate CBDPP. In addition to concerns about the limited characterizations, RL and ORP appropriately determined that there were various disadvantages to contractors having individual CBDPPs. RL and ORP, with input from various stakeholders, recognized that differences in approaches and protective measures (e.g., postings, training, and work practices) could be a particular problem at the Hanford Site, where it is not unusual for employees of one contractor to perform work at facilities managed by another contractor.

CBDPP Development

A working group of representatives from Hanford's primary operating contractors (i.e., currently MSA, CHPRC, WCH, and WRPS) and the medical support contractor (AMH) worked with RL, ORP, and various stakeholders to develop and issue a sitewide, multi-contractor CBDPP document. This program document describes site requirements and methods to be used by the Hanford Site EM contractors to implement the requirements of 10 CFR 850, *Chronic Beryllium Disease Prevention Program*. The document was signed by AMH and the EM contractors and issued in May 2009. DOE did not reject the document, and thus, in accordance with the rule provisions, the document was deemed approved by DOE 90 days after its submittal (i.e., August 2009).

The development of a sitewide CBDPP was a significant effort. Achieving consensus among the multiple contractors involved extensive discussions and sustained management attention. Further, the development of the single Hanford Site CBDPP applicable to all EM contractors at the Hanford Site

and the formation of a sitewide, multi-contractor CBDPP Committee are positive steps toward a fully effective program. The sitewide CBDPP provides an appropriate framework for standardization among the various contractors and clarity in expectations across the site, and it addresses most required elements. The positive features and benefits of the sitewide CBDPP and the CBDPP Committee include:

- The single Hanford Site CBDPP provides consistent requirements that apply to AMH and the four applicable EM operating contractors and thus significantly enhances implementation and coordination of actions required by 10 CFR 850.
- The unified approach provides a level of consistency and coordination that enhances the protection of Hanford workers from exposure to residual beryllium contamination, thereby reducing the potential for workers to become sensitized or develop chronic beryllium disease (CBD).
- The CBDPP Committee provides a needed venue for evaluating and addressing beryllium issues at Hanford, providing consensus solutions, and driving continuous improvement.
- The CBDPP establishes a beryllium action level that is more conservative than the limit specified in the beryllium rule.

Following issuance of the Hanford Site CBDPP, the working group transitioned into the CBDPP Committee. The CBDPP Committee has an adequate charter and is appropriately tasked with maintaining the Hanford Site CBDPP and providing consensus direction for consistent program administration and implementation.

Although the CBDPP is a positive step and includes many appropriate provisions, the HSS review indicates that some aspects of the CBDPP warrant additional clarification in the areas of sampling methods and worker protection controls, particularly as applied to beryllium-affected workers. Of particular importance, the CBDPP provisions do not fully address worker activities that could generate dust and other upset situations (e.g., deep cleaning, installing or removing utilities, facility maintenance in building interstices, and remodeling). For example, the CBDPP calls for sampling before such work activities to determine whether beryllium is present but not after, when additional beryllium contamination could be evident because of the disturbances. Appendix H discusses aspects of the CBDPP that warrant improvement and identifies or provides a set of specific opportunities for improvement.

RL and ORP have relied on the CBDPP Committee to coordinate contractors' efforts in implementing the CBDPP. The CBDPP Committee has been an effective mechanism for reaching consensus decisions on program development and maintenance, and it provides a useful mechanism for monitoring the status of implementation. However, the Committee's efforts have not always resulted in timely resolution of issues. For example, revisions in beryllium worker training involved much negotiation and required the use of a facilitator to achieve consensus. In addition, the CBDPP Committee's charter includes broad provisions for monitoring performance and ensuring that CBDPP implementation issues are resolved; however, in practice, the Committee serves as an advisory group, and RL, ORP, and contractor management do not expect the Committee to monitor implementation or provide direction to ensure that deficiencies are addressed.

Further, RL and ORP did not establish and enforce adequate and timely expectations for contractors to implement the new CDBPP. RL and ORP requested an implementation plan when the CDBPP was issued, but that effort was not completed. RL and ORP then issued letters of direction to MSA, CHPRC,

WCH, and WRPS in September-October 2009 (four to five months after the CBDPP was issued in May 2009), and the letters provided limited implementation criteria. For example, the RL direction letters to the contractors for implementation cited only three criteria: (1) make necessary procedure changes (without specifying the types of procedures required to be changed), (2) train beryllium workers and affected workers on the CBDPP, and (3) develop a schedule and methodology for characterization and interim control measures. The only deliverable required by RL was a response indicating development of a prioritization methodology and interim controls for characterization. ORP also issued a similar direction letter to WRPS identifying eight deliverables. In their letters, RL and ORP established a January 1, 2010, goal for implementation, although the beryllium rule states (in 10 CFR 850.10) that initial or updated CBDPPs are deemed to be approved 90 days after submission. As discussed later, even the inadequate criteria and milestones were not met, and the four operating contractors are still in various stages of performing the actions needed to declare full implementation of the CBDPP. (WCH was subsequently granted a four-month extension.)

In two instances, laboratory facilities may have been exempted from 10 CFR 850 and the CBDPP without sufficient evaluation and justification. Specifically, small quantities of beryllium are used or analyzed at the 222-S Laboratory, and there is historical information indicating that beryllium alloy tools were used, stored, and perhaps machined within the 222-S buildings. ATL (which operates the laboratory) determined that the 222-S Laboratory was an analytical laboratory, which is covered by a different standard (29 CFR 1910.1450), and that the operations were exempt from the beryllium rule (10 CFR 850). However, 222-S facility maintenance activities performed by WRPS are not exempt. ORP did not document its review or approval of ATL's determination that the exemption applied, and the exemption is questionable for a variety of reasons (i.e., some laboratory activities do not fall within the category of analytical laboratory operations). As a result, there is confusion among workers in the 222-S facility because of the two conflicting sets of regulations, and some workers who have been identified as being potentially exposed to beryllium are not afforded the same worker protections as others whose work is governed by the CBDPP. In addition, the WSCF laboratory, which performs a variety of laboratory activities that could involve beryllium, has also been determined to be exempt by MSA.

CBDPP Implementation to Date

Recognizing that the new CBDPP is in the implementation stage, the HSS team examined implementation to date. In addition to the results of the implementation reviews for AMH and the four primary EM contractors (as documented in Appendices C through G), HSS evaluated the efforts of the CBDPP Committee and aspects of the CBDPP that are managed on a sitewide basis.

The CBDPP Committee continues to be active during CBDPP implementation across the site. Members of the HAB, BAG, the Hanford Atomic Metal Trades Council (HAMTC), and several other former workers demonstrated an active interest in ensuring that the CBDPP is effective and that workers are protected, are given accurate and complete information, and are provided effective medical diagnosis, surveillance, and support. For example, HAMTC and BAG representatives, as well as other affected workers, were actively engaged in the development of the new program.

The HSS team identified two aspects of the CBDPP that are contributing most significantly to improvements in beryllium protection at Hanford or communications with affected workers:

- **The Beryllium Worker Training course presented by the Hazardous Materials Management and Emergency Response (HAMMER) training organization is comprehensive and well presented, and it contains the appropriate level of detail to address the training needs of**

beryllium workers at Hanford. Through the Committee, the Hanford contractors, HAMTC, and BAG have worked together to develop a sitewide training course for beryllium workers and are continuing to work together to refine and improve the course. The course has been recently updated to encompass the changes resulting from the new CBDPP, as well as incorporating some new and corrected information. The course includes practical exercises pertinent to beryllium workers, such as working through the planning of a beryllium work permit (BWP) for a hypothetical beryllium job. A small amount of erroneous or misleading information was discovered in the Beryllium Worker Training materials during this inspection; however, the HAMMER training organization was responsive to the comments, and further revisions are planned in the near future, including correction or clarification of the erroneous or misleading information and inclusion of a recent video from a previous Hanford worker with CBD, describing the effects of the disease.

- **Hanford management and beryllium-affected workers have multiple and diverse options for obtaining information and support.** While communication between the Hanford workforce and site line management (both DOE and contractors) has been a longstanding challenge and has contributed to a lack of trust on the part of both workers and managers, stakeholder organizations at Hanford serve as useful agents for communicating concerns and advice that promote balance and provide input to the resolution of beryllium issues. HAMTC safety representatives have gained the respect and trust of both workers and managers, and they are contributing to improved communications. The HAB and BAG are additional stakeholder groups that provide vehicles for monitoring the implementation of the CBDPP and for receiving and communicating concerns to DOE and the CBDPP Committee. In addition, BAG supports affected workers by sharing information based on members' experiences with newly affected workers. While input from these stakeholders sometimes results in challenging deliberations, the opportunity to identify the safety concerns of current and former workers for evaluation and implementation of needed corrective or preventive actions is essential to continuous improvement in protecting workers at Hanford from unnecessary and unintentional exposure to beryllium hazards. Affected workers also have other options for getting information and support, including AMH, National Jewish Hospital, contractor websites, and the DOE HSS beryllium website. While some interviewed individuals may have expressed opinions (satisfaction or dissatisfaction) about individual sources of information, the fact that there are many sources of information allows individuals to select the information sources that they trust the most or find most useful.

Although some implementation progress was evident, the efforts of RL, ORP, and site contractors have not been sufficient to achieve a fully compliant CBDPP at the Hanford Site in a timely manner. As discussed in Section 3, some aspects of program implementation do not meet applicable requirements of the beryllium rule, the CBDPP, or related DOE requirements. Specifically, significant program implementation non-compliances were identified in the facility assessment and characterization process, work planning and control, training of certain categories of workers, medical surveillance, and assessments. As a result of these deficiencies, some workers may not be provided the level of protection required by the rule.

Further, RL and ORP have not provided sufficient direction to ensure that contractors have effectively developed the requisite processes for implementing the program and have not performed sufficient oversight to ensure that contractor actions were adequate, timely, and effective. As a result, the expectations for contractors were not adequately defined, the few implementation criteria that were established were not met, and the site did not attain its goal of meeting the implementation criteria by

January 1, 2010. The four operating contractors are still in various stages of performing the actions needed to declare full implementation of the CBDPP and do not have adequate plans and procedures in place to ensure that program gaps are identified and addressed in a timely manner.

Based on the review of the sitewide and contractor-specific implementation of the program to date, HSS has identified the following management weaknesses that are contributing to the current non-compliances in CBDPP implementation:

- **DOE and contractor management has not been sufficiently proactive in setting goals, monitoring progress, and ensuring effective and timely implementation of the CBDPP across all organizations.** Along with the benefits of a single beryllium program that results in coordinated and consistent actions and processes by multiple contractors comes a need for leadership and guidance to ensure that program implementation remains on the right track to achieve fully-compliant implementation in a timely manner. RL and ORP have been not been sufficiently proactive or formal in directing and guiding contractor efforts or in holding contractors accountable for comprehensive, timely, and prioritized implementing actions. For example, during the months-long effort by the CBDPP working group to reach agreement on the content and scope of revisions to beryllium worker training, RL and ORP did not intervene and facilitate a timely resolution. In a number of instances, WRPS personnel did not attend committee meetings, citing other priorities. The RL direction letters to the contractors for implementation cited only three criteria for implementation and required only one deliverable – a response providing a prioritization methodology and interim controls for characterization. Contractor actions relative to those criteria were not always performed in accordance with established milestones, and there have been few actions to determine and address the causes of delays or to reestablish a definitive path forward. ORP and WRPS did not finalize an approach for implementing the CBDPP provisions until October 20, 2009 (five months after the CBDPP was issued), and the facility characterization and cleanup efforts are still not specifically defined. RL and ORP and their contractors have not addressed actions essential to effective implementation of the CBDPP, such as development of gap analyses and implementation plans, status reporting, reconstitution of beryllium facilities lists, and updating of General Employee Training (GET).
- **Hanford contractors have not applied proven project management tools to ensure timely and effective implementation of the Hanford Site CBDPP.** Although the Hanford Site CBDPP and many actions taken by Hanford contractors are positive steps toward full compliance with 10 CFR 850, contractors have not employed effective management tools for implementing the CBDPP. Only WCH performed a comprehensive gap analysis between the requirements of the Hanford Site CBDPP and existing conditions, practices, and procedures. Contractors have not managed the implementation with formal project management tools, such as implementation plans with detailed actions, assigned action owners, scheduled milestones, and management-monitored status. Contractors did not always have formal procedures governing CBDPP processes (e.g., re-baseline assessment and characterization), or their procedures had not been updated to comply with the Hanford Site CBDPP. Site management did not view the CBDPP Committee as a mechanism for providing direction for implementation of the CBDPP, and RL and ORP did not develop alternative approaches for performing some of the functions identified in the Committee charter. As a result of these shortfalls, many elements of the CBDPP are not fully or effectively implemented, including revising the work control processes to incorporate new beryllium signage, postings, and the use of the BWP; implementing specific requirements of the CBDPP, such as counseling beryllium-affected workers; carrying out systematic surveillance or studies to examine possible links between disease risk and job task, location, or work history; and effectively accomplishing other tasks as described in the program implementation weakness noted above and in the appendices.

- **A lack of clear requirements and guidance for collecting data for the ongoing re-baseline effort has adversely impacted contractors' efforts to develop an adequate baseline inventory.** Neither the CBDPP requirements for facility assessments nor the implementing procedures developed by contractors are specific enough to ensure adequate and consistent analysis of beryllium hazards across the site. Important sources of historical information were not used, people with knowledge of facility hazards were not contacted, characterization sampling was not always performed when needed, and records of analyses did not always support stated conclusions. For example:
 - RL has four binders of historical industrial hygiene reports related to beryllium activities in many Hanford facilities; however, some contractors were unaware of these binders and thus did not use this extensive information in their re-baselining and assessment efforts.
 - Over the years, dating back to the issuance of the beryllium rule in 1999 and before, several different contractors have performed “baseline” assessments of Hanford facilities for beryllium use and contamination, but the summary reports and characterization sampling reports from these efforts were not systematically collected and used. Also, some records were not archived so as to be readily retrievable for future efforts.
 - In the ongoing assessments, individuals with extensive corporate knowledge of past operations were not always sought out to ensure that the best available information was obtained and utilized to determine facility status.
 - Information from past interviews with personnel with knowledge of beryllium activities and movement of equipment in Hanford facilities and from interviews with personnel diagnosed with beryllium sensitivity or CBD have not been collected, maintained, or made accessible to persons performing re-baselining assessments.

In a related issue, the current CBDPP document does not ensure that information now being collected for the re-baseline effort will be maintained in a structured manner that supports ready retrieval for any needed future assessment efforts and for medical monitoring data analysis. The current facility re-baseline assessment is necessary, at least in part, because previous assessment efforts did not produce reliable information – largely as a result of the lack of requirements for archiving data in past versions of contractors' CBDPPs. This past deficiency has not been fully addressed by the new CBDPP document, which establishes some requirements for contractors to maintain records but leaves gaps (e.g., it does not define responsibility for maintaining previous baseline information and sitewide historical data, such as the four binders). Furthermore, the processes will result in multiple sets of records that are not compatible and thus will be difficult to use for data analysis.

- **Weaknesses in communication have hindered effective implementation of the CBDPP, satisfactory resolution of worker and stakeholder concerns, and efforts to build trust.** In many instances during the HSS inspection, Hanford workers, including support personnel (e.g., work planners and Human Resources personnel), demonstrated a lack of awareness or understanding of CBDPP requirements, contractor processes and procedures, information related to beryllium hazards and controls, and medical-related policies and processes. Stakeholder groups and individuals identified examples of inadequate feedback on reported concerns about the processes and performance in implementing 10 CFR 850, some of which were validated by the HSS team. Several beryllium-related websites contained erroneous and outdated information, including the site beryllium facility lists required by 10 CFR 850 and the CBDPP; these had not been maintained or updated since 2005.

Several work planners and planner supervisors were unaware that the posted lists were out of date and should not have been used as the only source of information about contaminated buildings during work planning. The list of suspect facilities on the AMH Beryllium Monitoring Program Hanford Site Beryllium Questionnaire did not include five facilities that were on the beryllium-contaminated facilities list on the Hanford website. In addition, weaknesses in communications with the HAB, BAG, and other workers have hindered resolution of concerns, contributed to mistrust between site management and some former and current workers, and contributed to a perception among some workers that site management does not support worker safety when it impacts mission. Further, some workers have a perception that site management intimidates or retaliates against workers and managers who raise safety concerns or support safety. RL and ORP have not established effective communications with the BAG or the HAB regarding beryllium issues.

- **In some cases, timely implementation of the CBDPP is contingent on pending funding decisions.** ORP and WRPS have agreed to implement the CBDPP and subsequent cleanup of beryllium-contaminated facilities at the Hanford waste tank farms through a sequential, three-phase process. However, at the present time, only the initial phase has been defined and funded; facility characterization, sampling, and cleanup are not yet specifically defined or funded. As a result, some requirements of the CBDPP, such as sampling of the work areas of WRPS beryllium-affected workers, were postponed to a later phase (i.e., the second phase) of the characterization process. Also, WCH submitted a request for additional funds to RL to implement the new sitewide CBDPP, delaying the start of implementation until the request was approved.
- **Inaccurate and incomplete perceptions about beryllium hazards among many site managers are an underlying factor in all of the observed non-compliances and management weaknesses. These perceptions contribute to non-conservative decisions or insufficient urgency in addressing gaps in the beryllium programs and concerns raised by workers.** The perception of a number of individuals in key decision-making and program management roles is that the recent cases of sensitization and CBD, while tragic, are primarily a reflection of exposures that occurred years ago from beryllium sources that are no longer present and/or are from exposures the individuals may have had during work at other sites. During the HSS inspection, various personnel expressed or implied that current beryllium risks are minimal and that persons recently diagnosed as sensitized or with CBD were exposed many years ago when more beryllium work was ongoing and beryllium materials were present. This perception is founded on various factors, including: the current assessment and characterization results indicate that few buildings are contaminated; most air monitoring indicates that airborne beryllium is not above the detection limit; and some personnel who were hired in recent years and determined to be sensitized since then had previously worked at DOE or other defense facilities where beryllium sensitization could have occurred. While these factors are largely valid, they are not sufficient to conclude that workers are no longer being exposed (e.g., the characterization and assessment processes used in the past and currently are not sufficient to ensure that facilities are in fact free of beryllium, and the risks of non-airborne exposures are not sufficiently considered). These perceptions have contributed to the non-conservative decisions discussed below. In addition, the perceptions expressed by some managers are in sharp contrast to those of some stakeholder groups and beryllium-affected workers, who view the lower attention and priority as an indicator that Hanford Site Federal and contractor management do not place sufficient priority on the health and safety of Hanford workers. Sustained management priority and attention will be required to ensure implementation of an effective program and reestablish trust with stakeholder organizations.

- **RL, ORP, and contractor processes for assessment, issues management, and application of lessons learned are not sufficient to identify and correct deficiencies in the processes and activities intended to protect workers from beryllium hazards.** Although Hanford contractors have performed various assessments of CBDPP processes and implementation since the beryllium rule was issued in 1999, many were insufficiently rigorous or were ineffective in addressing weaknesses and deficiencies in CBDPP processes and performance. Notwithstanding the differing levels of rigor and effectiveness of these assessment activities, many of the same issues identified by this inspection team were identified at various times by contractor assessments, by assessments and surveillances performed by RL, and in concerns raised by the Hanford Joint Council in 2002 addressing characterization, training, communication, outdated beryllium facility lists, and work restriction issues. WRPS and its predecessor conducted beryllium program reviews in 2007, 2008, and 2009 that identified issues related to training/employee job task analyses, building postings, failure to maintain the beryllium facility listing, and work control weaknesses in the recognition of beryllium hazards and potential exposures during maintenance and non-routine activities in beryllium facilities. However, the corrective actions from these reviews did not result in satisfactory resolution of the problems. In addition, some specific deficiencies in posting and other contamination controls identified by the HSS team were previously identified and documented on Problem Evaluation Reports (issue forms) by WRPS but were not effectively resolved. Weaknesses in the frequency, comprehensiveness, and rigor of assessment activities and insufficient rigor in addressing identified problems reflect missed opportunities to ensure effective and compliant implementation of the CBDPP. RL has performed only limited assessment activities related to beryllium since approval of the Hanford Site CBDPP in August 2009, and none of the few awareness activities have been directed at evaluating the quality of implementation. ORP has never performed a formal assessment of WRPS processes or performance related to controlling beryllium exposures, although several reactive operational awareness activities related to incidents were performed in 2009 and 2010. RL has performed one formal assessment of the medical services contractor's implementation of 10 CFR 850. Deficiencies in RL issues management processes were also evident in the October 2009 RL response to the HAB's concerns and recommendations (which were provided in two April 2009 letters to RL); the RL response did not adequately address some of the individual issues/recommendations and provided insufficient details on those that were addressed.

In summary, when viewed collectively, these management weaknesses have contributed to non-compliances, delays in identifying and addressing gaps in the CBDPP, and various non-conservative decisions. For example, there were instances where facilities were non-conservatively declared to be clean without adequate basis, as well as instances of inadequate delineation and control of areas where beryllium contamination was credible. There were also instances where workers or stakeholder groups identified credible issues (e.g., failure to interview workers about work histories) that were not sufficiently evaluated. During the inspection, interactions between individuals and groups with concerns related to beryllium and the personnel responsible for addressing those concerns often reflected the contentious nature of those interactions and the frustrations resulting from previous interactions involving personality conflicts, perceptions of unsupported allegations or concerns, and resolutions that were perceived as unsatisfactory.

Medical Surveillance Program

As the lead for the Hanford beryllium medical surveillance and worker restriction/removal process, AMH has adequately performed its responsibilities in many areas to ensure that workers receive the required medical services. Most requirements from 10 CFR 850 and the sitewide CBDPP are further captured in AMH procedures/protocols and, in most cases, are implemented by the AMH site occupational

medical director and staff. With regard to beryllium examinations, AMH has shown that it ensures workers are informed of the known beryllium hazards (although shortcomings in facility assessment and characterization efforts limit the reliability of the information), consent to examinations and complete work history and other forms, and receive prompt notification of test results. Overall, in the small number of cases examined by the HSS team, it appears that, with the exception of one case, AMH is appropriately issuing temporary work restrictions.

However, weaknesses were identified in some AMH protocols. The most significant weakness is the lack of formal data analysis over the last several years on workers diagnosed with beryllium sensitivity or CBD to determine potential vulnerabilities in controlling beryllium hazards and identifying additional populations at risk of sensitization or CBD, based on ongoing and/or past exposure to beryllium, so that these workers may be targeted for surveillance and education. Some deficiencies were noted in the workplace monitoring records (i.e., missing exposure data) that were provided by operating contractors to AMH for inclusion in worker medical records, along with some limitations in the adequacy of the worker occupational history form and the formal conditions/criteria to use temporary restrictions in the examination test protocols and/or algorithms.

There is insufficient clarity regarding the implementation and integration of some of the medical policies and protocols and methods for interfacing with the CBDPP. In addition, confusion arises because of insufficient clarity of definitions and inconsistent use of terminology (e.g., “work restrictions” versus “recommendations”). Currently, there are not enough experienced medical staff to provide oversight to the beryllium program due to the recent loss of the beryllium case manager and lack of staff depth in this area. There are also some apparent or perceived concerns raised by workers regarding the consistency of approach in the beryllium program with respect to test result follow-up, work restrictions, and integration of medical data. Clarifying these issues and ensuring consistency across protocols, exam profiles, the beryllium information booklet, and other such elements would improve the program. Because of some of these concerns, as well as concerns about confidentiality and a lack of confidence in AMH on the part of some workers, participation in the voluntary beryllium surveillance program has dropped. This reduced participation is a significant concern because it leaves some workers without the full benefits of the voluntary program (e.g., ongoing medical monitoring), and it warrants timely management attention and efforts to resolve the concerns that prompted individuals to drop out. Risk communication regarding beryllium health effects has not been optimal. Management attention is needed to address weaknesses in the Hanford beryllium medical surveillance and removal processes and to help ensure that these processes are applied consistently across the contractors and the workers’ jobs, with particular focus on the opportunities for improvement noted in Appendix C.

Other Worker Concerns

In addition to concerns about the CBDPP, a few individuals raised various concerns related to workers compensation. Some of these concerns centered around the differences between the Federal Department of Labor and the Washington State Department of Labor and Industries processes and the difficulties in navigating through the state worker compensation system. Although compensation issues are not within the scope of the HSS team’s review of the CBDPP and thus were not fully evaluated for validity, the HSS team identified some opportunities for AMH and other site organizations to better use existing resources (e.g., risk communicators and contractor patient advocates) to improve communications with and support for affected workers in dealing with compensation issues (see Appendix C).

A few individuals also raised concerns about two cases of personnel actions (i.e., employment terminations) involving medical professionals. These individuals indicated their perception that these

two cases were instances of management intimidation or retaliation against medical professionals who raised concerns about beryllium safety or related medical practices or who advocated for higher protection standards for workers. Although any allegations or perceptions of intimidation or retaliation are of significant concern, in these two instances HSS determined that the cases have been or are being investigated by an appropriate independent organization, as follows:

- The first case involved the termination of the AMH site occupational medical director in 2006. This case was investigated by the Department of Health and Human Services, which reported that they found no evidence of coercion. However, the independent investigation identified various problems involving miscommunications, insufficient procedures, and insufficient clarity of responsibilities and authorities, some of which were similar to the weaknesses identified during this HSS inspection.
- The second case involved the termination of the AMH nurse/beryllium case manager in March 2010; in this case, workers also expressed concern that the nurse/beryllium case manager's documents and notes were removed from the individual's office. The HSS team met with and advised this individual to file the papers that would preserve the right to appeal the AMH employment termination decision. HSS also advised RL to have an independent investigation of this case. RL indicated that an independent investigation had been performed and the results had been provided to RL for consideration.

Because these two cases have been investigated by an independent organization with expertise in employment issues, HSS did not investigate these cases further and did not draw conclusions about their validity. However, HSS interviews revealed that some workers have a perception that these two cases are part of a pattern of pressure, intimidation, or retaliation against individuals who raise concerns about beryllium safety or related medical practices. Such perceptions were expressed by a relatively small group of individuals, and they do not necessarily represent a widely held belief among the workforce as a whole. Nevertheless, in light of the weaknesses in management communications, management's perceptions about beryllium, and the mistrust of management by some workers, HSS has offered opportunities for improvement in these areas for consideration by RL, ORP, and contractor management (see Section 4).

Rule Interpretation and Refinement

The HSS inspection results indicate that CBDPP development and implementation at the Hanford Site could be enhanced by additional clarification of the provisions of 10 CFR 850 or by accelerated efforts to consider newer information in the regulation.

The preamble to 10 CFR 850 states in part that "The concept of authorized person is consistent with OSHA [Occupational Safety and Health Administration] standards and with contractor practice in many DOE facilities, and is intended to ensure that the population of potentially exposed individuals is reduced to the lowest possible number...." Paragraph 850.11(b)(3)(i) requires "minimizing the number of workers exposed or potentially exposed to beryllium." Section 6.3 of the Hanford Site CBDPP repeats this requirement and adds the words "through hazards assessment, work planning, and engineering controls." Under this provision, Hanford contractors have trained a large number of workers as beryllium-qualified workers. If effectively implemented, the approach defined in the Hanford CBDPP relies on controls to reduce or eliminate worker exposures, but it does not include provisions to minimize the absolute number of persons potentially exposed, as specified in the rule. A rule interpretation in this area may be useful to clarify the intent of the rule for Hanford and other DOE contractors.

In addition, 10 CFR 850 currently requires contractors to maintain “exposures to beryllium at or below the prescribed permissible exposure level.” It also requires contractors to “set specific exposure reduction and minimization goals that are appropriate for the beryllium activities covered by the CBDPP to further reduce exposure below the permissible exposure limit...” As discussed in Appendix H, some stakeholders have indicated that DOE should strengthen worker protection by adopting the 2009 American Conference of Governmental Industrial Hygienists’ threshold limit value as a mandatory standard. This value is lower than the action level in the DOE beryllium rule (but requires different sampling methods, so the values are not necessarily directly comparable). Further, results of studies by National Jewish Health and other organizations indicate that beryllium sensitization and CBD have occurred in workers who may have been bystanders or been exposed at levels far below the current regulatory standard. Also, although a matter of current debate among health professionals, some recent research results indicate that dermal exposures are more important than historically has been believed; some of the worker protection provisions of 10 CFR 850 are predicated on the control of airborne exposures, and less attention has been paid to dermal exposures.

Recognizing that newly-diagnosed cases of beryllium sensitization and CBD are evident at the Hanford Site and other DOE sites, timely evaluations of the adequacy of the protection measures in the current rule are warranted. HSS recognizes that changes in technology, improved understanding of health effects, and lessons learned from sites that have implemented beryllium programs may enhance the ability to minimize worker beryllium exposures. In an effort unrelated to this inspection, DOE has initiated the process for advance notice of proposed rulemaking to solicit stakeholder input for revising the current rule. Upon receipt of the necessary approvals, this notice will be published in the Federal Register.

3. Findings Requiring Corrective Action

HSS identified a number of CDBPP elements that do not currently ensure compliance with the beryllium rule, resulting in four findings. Two of those findings apply to more than one of the site contractors, and their resolution requires a coordinated and consistent response across the site for all EM contractors; consequently, these findings are directed to RL and ORP as the DOE organizations with responsibility for approving the CBDPP (10 CFR 850.10), ensuring that contractors comply with the beryllium rule and the approved CBDPP (10 CFR 850.4), and ensuring that tasks involving potential beryllium exposure are not performed unless approved by the responsible field element (10 CFR 850.3). For these two findings, RL and ORP need to develop interim protection measures, as appropriate, and corrective action plans that identify sitewide and contractor-specific actions needed to correct the non-compliances and prevent recurrences. The other two findings address various instances where the medical and operating contractors did not adequately implement the requirements of the beryllium rule and/or the provisions of the CBDPP. Responsible organizations need to address these findings in accordance with their management systems and develop and implement effective action plans that identify causes and actions to correct non-compliances and prevent recurrence. In addressing the findings, RL, ORP, and contractors need to perform appropriate extent of condition reviews and causal analyses. The causal analyses should consider management weaknesses (discussed in Section 2) as possible causal factors.

Findings Assigned to RL and ORP for Resolution

Finding #1: RL and ORP have not ensured that contractor baseline beryllium inventory and hazard assessments have been completed, as required by 10 CFR 850.20, 10 CFR 850.21, and the corresponding portions of the CBDPP.

As defined in the CBDPP, a beryllium-clean facility has been assessed to present no potential for beryllium exposure. Documentation and technical justification for recommendations and conclusions in re-baseline assessments of Hanford facilities for beryllium contamination were often insufficient. Some facilities in which beryllium activities were previously conducted, and some for which beryllium histories were not fully known, were declared to be beryllium-clean facilities without sampling or facility characterization. Also, the approved CBDPP directs contractors to use a methodology for attributing beryllium to background soil contamination, but that methodology lacks an adequate technical basis. Because the need for protective measures was contingent on these determinations, weaknesses in the assessment and characterization process increase the potential for worker exposure to beryllium. In addition, the lack of reliable information about areas where beryllium has been used in the past hinders the ability of AMH to ensure that affected workers are properly evaluated and protected.

Finding #2: RL and ORP have not ensured that several categories of workers at the Hanford Site are receiving the minimum beryllium-related training, as required by 10 CFR 850.37 and 10 CFR 851.25.

The beryllium rule requires contractors to ensure that all beryllium-associated workers receive specific training. However, the only beryllium-associated workers who routinely receive this required training are the current beryllium workers enrolled in the Beryllium Worker Training course. Other categories

of beryllium-associated workers that require but are not provided additional beryllium training include current workers whose work history indicates actual or potential beryllium exposure, current workers showing signs or symptoms of beryllium exposure (affected workers), and current workers receiving medical removal benefits (also affected workers). These categories of beryllium-associated workers may not need the extensive Beryllium Worker Training provided to the current beryllium workers, but they are required to receive more training than the GET beryllium awareness training, which is designed for non-associated workers. Although some contractors required their beryllium-affected workers to complete the web-based Gap Training developed for beryllium workers to address changes resulting from the new Hanford Site CBDPP, this training was not targeted to beryllium-affected workers and did not address the minimum regulatory requirements for these categories of beryllium-associated workers. No specific training course or other beryllium-related training requirements exist for beryllium-affected workers beyond GET. Further, 10 CFR 851.25, *Worker Safety and Health Program, Training and Information*, states that “contractors must provide training and information to workers who have worker safety and health program responsibilities that is necessary for them to carry out those responsibilities.” Several categories of workers have specific responsibilities in the Hanford beryllium program but are not specifically trained as required. Examples include personnel providing direction and information to beryllium workers, such as managers, supervisors, work control planners and Persons In Charge; environment, safety, and health personnel, such as industrial hygienists and industrial hygiene technicians; and Human Resources and employee concerns program personnel who deal specifically with personnel issues associated with beryllium. In addition, industrial hygienists and industrial hygiene technicians perform sampling activities in uncharacterized areas that could disturb surface contamination, causing it to become airborne; however, for some Hanford Site contractors, the workers’ training plans do not require Beryllium Worker Training, and in many cases, they are not current in Beryllium Worker Training. Other important categories of workers who may be missed are maintenance workers and repair personnel, some of whom are employees of subtier contractors. Such workers typically perform such activities as maintaining fire suppression, lighting, ventilation, elevators, or other equipment; these activities could generate dust in areas that are infrequently accessed, are not characterized or not well characterized, and/or have not been sampled. Recently, beryllium was discovered in a freight elevator mechanism at Pacific Northwest National Laboratory and appropriately reported as a lesson learned for consideration by other contractors. This discovery indicates that workers who perform maintenance on elevators across the Hanford Site could potentially be exposed to such previously uncharacterized hazards. Similar risks exist for other maintenance workers and crafts personnel.

Findings Assigned to Hanford Site Contractors for Resolution

Finding #3: AMH has not always analyzed medical, job, and exposure data for employees diagnosed as sensitized or having CBD and thus is not collecting information needed to identify workers at risk for exposure, understand the beryllium health risks, and identify appropriate actions to improve the CBDPP, as required by the CBDPP, 10 CFR 850.39, and 10 CFR 850.34.

Recent, documented air samples indicate that airborne contamination levels of beryllium are very low, and personal protective equipment is used for work activities where the potential for airborne beryllium is anticipated. As a result, worker exposures have been well below current limits for activities where the potential for exposure is anticipated and controlled. However, there continue to be newly-diagnosed cases of beryllium sensitivity and CBD among Hanford workers and former workers. Newly-diagnosed cases are not necessarily the result of deficiencies in the current program, because a newly-discovered

case could be the result of a past exposure. Nevertheless, because of the weaknesses in the recent and current implementation of CBDPP controls (e.g., inadequate facility characterizations known areas of contamination that are not well controlled) and the ongoing discovery of new sources of beryllium contamination, the possibility that new cases are resulting from recent exposures cannot be ruled out. The analysis of these newly-discovered cases is critical to understanding exposure mechanisms, identifying currently unrecognized potential sources of contamination, and determining the need for implementing additional actions to protect workers. Effective medical surveillance data analysis at the Hanford Site requires the coordinated efforts of AMH and all primary site contractors to achieve the objectives of identifying individuals or groups at risk, working conditions that contribute to the risk, and the need for additional exposure controls.

Although required by the beryllium rule, AMH has not performed any analysis of newly-discovered cases for the past two years, and therefore has lost opportunities to gather information that might help determine whether these cases result from past or recent exposures and whether additional protective actions are needed. According to the RL subject matter expert, analysis of medical surveillance data was discontinued over two years ago because it was considered to provide little value. However, cases of sensitization to beryllium and CBD continue to be diagnosed in site workers. Data analysis is a requirement of the rule and also an essential element in ensuring that the potential exposure mechanisms for these new cases are understood and that any actions to prevent or mitigate future exposures are implemented. This analysis is especially important for the Hanford Site, where past usage of beryllium-containing materials and controls for equipment are not always well documented, and potential exposure mechanisms are primarily from legacy contamination.

Finding #4: WRPS, CHPRC, MSA, and WCH have not ensured that their work planning and control processes and their implementation of those processes in beryllium-controlled facilities and areas are sufficient to fully ensure protection of workers, co-located employees, and transient personnel, as required by 10 CFR 850.22 through 10 CFR 850.30, 10 CFR 850.38, and the corresponding portions of the CBDPP.

Work planning and control deficiencies were evident at multiple facilities and for all four EM operating contractors, indicating a need for increased attention to the control of ongoing work involving the potential for exposure to beryllium. Deficiencies were identified in various aspects of procedures for hazard analysis regarding beryllium (e.g., job hazard analysis procedures that do not address beryllium hazards or controls). The interfaces between contractors were not sufficiently defined to address the responsibilities and processes for work planning and control for beryllium activities performed in facilities controlled by other contractors. Procedures and practices were insufficiently defined and implemented for establishing and maintaining the boundaries of beryllium-controlled areas and for downgrading beryllium-controlled areas after cessation of dust-producing activities, as well as implementing the BWP. As a result, BWPs sometimes contained insufficient details or inappropriate requirements, or otherwise did not comply with CBDPP requirements. For example, a standing BWP for “no dust producing activities” included “removal of ceiling tiles” as a covered activity, and another standing BWP did not identify any controls. In some cases, beryllium-controlled and interim-controlled facilities were not posted as required, and in other cases, postings did not conform to the CBDPP provisions. Appendices D through G identify the specific deficiencies applicable to the four EM operating contractors.

4. Conclusions and Cross-Cutting Opportunities for Improvement

Some beryllium-contaminated buildings have been removed from the site by decontamination and decommissioning, and thousands of beryllium samples in many facilities reflect contamination levels below action levels. Nevertheless, beryllium contamination remains in some Hanford facilities, and many facilities have not yet been adequately assessed or characterized. Further, workers are continuing to be diagnosed with beryllium sensitization and CBD, and the location, time, or means of exposure have not been, or cannot be, established.

If implemented effectively, the new Hanford Site CBDPP will improve worker protection from beryllium hazards at the Hanford Site. While aspects of program elements have improved (e.g., training course), much work remains nearly a year after the program was approved and four months after the intended completion date, and significant implementation deficiencies were identified. In addition, a number of management weaknesses are inhibiting the implementation of an effective CBDPP in such areas as project planning and management and feedback and improvement. Further, some managers still have a perception that current beryllium hazards at the site are controlled and unlikely to be causing new cases of beryllium sensitivity. This perception is not fully supported, and it is a significant impediment to full implementation of an effective CBDPP. Because of this perception, actions to identify remaining legacy contamination, analyze medical surveillance data, implement strict exposure control processes, and thoroughly respond to stakeholder concerns are not handled with the same sense of urgency as other competing issues. This situation results in delays in recognizing and addressing potential exposure issues and evaluating the potential for continuing exposures. Consequently, feedback on beryllium issues, exposures, and newly-discovered cases is not sufficient or timely, and the erroneous perception that there is only a limited need to improve CBDPP implementation is perpetuated.

After the onsite portion of the HSS team inspection, RL and ORP reacted promptly to many of the non-compliances and weaknesses identified during this inspection and issued direction to their contractors to take a number of corrective and interim actions to address identified deficiencies. The direction appropriately called for timely action, with many of the interim and corrective actions to be completed within 30 days; for the others, an implementation plan was to be completed within 30 days. In addition, the interim actions cover most of the areas of weakness identified during this inspection. While the direction is a positive step, some aspects warrant additional refinement, including additional focus on refining the characterization process to ensure its effectiveness before completing the outstanding assessments and improving certain controls (e.g., boundary barriers) in areas of known contamination.

Based on the results of this inspection, the HSS team developed the following cross-cutting opportunities for improvement to complement the specific opportunities for improvement identified in the appendices. As with all HSS inspections, the opportunities for improvement are not intended to be prescriptive or mandatory; however, they are for serious consideration and analysis by both the DOE contractor and line management. DOE line management has the responsibility and authority to review and evaluate the opportunities for improvement and accept, reject, or modify them as appropriate, in accordance with site-specific program objectives and priorities. However, because of the importance of an effective CBDPP to worker protection and the multiple organizational interfaces, HSS strongly believes that

it is important for EM to take a lead role in evaluating the results of this inspection and directing improvement actions as appropriate. In this role, it is important that EM ensure that RL, ORP, and other site organizations evaluate each of following cross-cutting opportunities for improvement and each of the specific opportunities for improvement in the appendices. EM should also evaluate the resulting corrective actions and/or improvement plans to ensure that they adequately address the specific deficiencies and underlying management weaknesses.

- 1. RL should promptly direct AMH to develop a comprehensive improvement plan that addresses the deficiencies and opportunities for improvement identified in this report.** The improvement plan should take into account appropriate topics, such as enhancing the volunteer medical monitoring program, ensuring that AMH has complete and accurate work place monitoring data, integrating the medical protocols, instituting risk communications, addressing aspects of the beryllium registry, ensuring industrial hygiene interfaces (including work histories for affected workers), obtaining comprehensive work history questionnaires, determining feedback and improvement mechanisms, and addressing staffing issues. RL and ORP should also determine the best methods for ensuring that site operating contractors work with AMH to address interfaces with the medical surveillance program, including processes for providing the data required for an effective medical surveillance program. RL should closely monitor AMH progress and evaluate the effectiveness of actions reported as complete, and RL and ORP should help identify and resolve barriers to timely and effective completion.
- 2. RL and ORP should promptly direct operating contractors to identify and prioritize identified deficiencies (including those identified in this report and others identified by other assessments or gap analyses) and, where warranted, develop timely corrective actions and/or interim protective measures.** The corrective actions and interim protective measures should recognize the current risks that result from the currently inadequate baseline beryllium inventory and hazards assessments. RL and ORP should consider placing priority attention on establishing controls that reduce the risk of worker exposure to beryllium contamination in facilities that were inaccurately designated as beryllium-clean facilities (e.g., accurate postings, clear boundaries, and conservative approaches to allowing access to areas that cannot be reliably verified to be free of beryllium contamination).
- 3. On a priority and risk basis, RL and ORP should require operating contractors to develop and implement comprehensive implementation plans for completing efforts to achieve full and effective implementation of the site CBDPP.** As an immediate measure, RL and ORP should coordinate with contractors to establish a comprehensive list of implementation expectations and promptly identify the current status and projected completion dates for each contractor. When developing plans, RL and ORP and contractors should consider the need for detailed gap analysis and needed actions, clear milestones, needed resources, and provisions for regular progress reports. The activities that pose the greatest potential health risk to workers should be prioritized. RL and ORP should closely monitor progress, evaluate the effectiveness of actions reported as complete, and help identify and resolve barriers to timely and effective completion.
- 4. RL and ORP should consider ensuring that site contractors strengthen their processes for baseline beryllium inventories and hazards assessments.** The processes should take into account such elements as effective documented procedures, adequate facility assessment forms, requirements for documented assessments that are adequate to support the identification of facilities as beryllium-

clean and beryllium-controlled, and provisions for considering and using all appropriate sources of information (process histories, records, interviews with workers and former workers, survey results, and analyses and references to supporting documentation). Where appropriate, facilities previously declared beryllium-clean should be reassessed to ensure that there is a sound basis for these declarations. Consideration should be given to establishing provisions for additional confirmatory sampling of facilities initially believed to be clean and where additional research determines that such sampling is warranted. For all contractors, common assessment and sampling criteria should be established related to types of equipment with a potential for beryllium contamination, such as electrical switchgear and crane components. Key information (e.g., past interviews with knowledgeable individuals and affected workers) needs to be systematically retained and organized for ready retrieval.

- 5. RL, ORP, and contractor organizations should determine methods to strengthen assessment and issues management processes for beryllium processes and activities.** Assessments should focus on work activities and objective evidence of adequate work controls to protect workers from beryllium exposure, and the results should be communicated to workers, line managers, planners, safety and health staff, the BAG, the HAB, and the CBDPP Committee as required by the Hanford CBDPP. Deficiencies and weaknesses identified by assessment and surveillance activities should be shared among site contractors to identify and apply lessons learned and support internal management assessment planning. A mechanism for performing a formal extent-of-condition review across contractor programs for identified deficiencies and weaknesses should be considered. RL, ORP, and site contractors should ensure rigorous development of corrective actions for deficiencies and weaknesses in the CBDPP and its implementation and verify the effectiveness of actions in correcting the specific problems and implementing effective recurrence controls. RL and ORP should ensure that effective issues management processes are applied to issues and recommendations provided by stakeholder groups and concerned individuals.
- 6. RL, ORP, and contractor organizations should identify appropriate timely actions to ensure that accurate information about beryllium is available.** As an immediate measure, site organizations should ensure that existing lists of beryllium facilities on the Hanford websites are not misused. Pending development of updated lists based on the re-baselining effort, the organizations should formally communicate to all persons involved in work planning that previous lists are not to be relied upon for work planning and should establish formal interim guidance and requirements for work planners and safety and health staff to identify current facility and area status. RL and ORP, working with the CBDPP Committee, should ensure that a formal process and expectations for prime contractors to support MSA are established, and should also ensure timely and accurate compilation and maintenance of the lists of beryllium facilities required by the CBDPP. RL and ORP should ensure that MSA, with the support of other contractors, establishes and implements a structured records management system that consolidates or links all re-baseline assessment and characterization-related records (including historical information, to the extent practical) and that supports ready identification and retrieval; the system should include mechanisms for allowing appropriate access by current and former workers.
- 7. To ensure the long-term effectiveness of the CBDPP, RL and ORP should consider further formalizing expectations and governance of the CBDPP (i.e., maintenance and implementation).** RL and ORP oversight and leadership should strengthen their role in ensuring that the CBDPP is implemented in a timely, compliant, and effective manner by all contractors. To preclude such

weaknesses as those observed during this inspection in establishing and meeting clear milestones, the mechanisms should include provisions for developing documented deliverables and formal implementation plans, establishing milestones for needed actions, monitoring progress, verifying completion, and performing appropriate effectiveness reviews where warranted. The mechanisms should also include provisions for justifying delays or changes in plans. For instance, to resolve disputes or differences among contractors in a timely manner, the mechanism for elevating issues to RL and ORP needs to be strengthened and effectively implemented, and provisions for raising issues to EM if necessary should be considered. RL, ORP, and contractors should consider revising the charter of the CBDPP Committee to reflect management expectations and should determine how to best provide direction to multiple contractors (e.g., via the Committee or another mechanism) for aspects of the CBDPP that need to be implemented consistently by the various contractors (e.g., postings).

- 8. RL and ORP should identify actions to improve communications with stakeholder organizations and use their feedback and experience as a resource to improve the Hanford Site CBDPP.** Effective resolution of concerns requires clear communication and impartial evaluations. All recent HAB recommendations regarding the beryllium program should be reevaluated and meaningful responses communicated to the HAB in writing and with opportunities for discussion. Site organizations and interactions need to better reflect the BAG members as valuable resources who are willing to contribute the overall effectiveness of the Hanford Site CBDPP. Opportunities to utilize BAG members to help with the program should be actively identified and acted upon. For example, the ongoing efforts with regard to counseling individuals with work restrictions and removals could benefit from the input of individuals who have recently experienced these processes. Building trust with stakeholders, especially with beryllium-affected workers, requires attention to detail, thorough analysis of concerns and recommendations, and effective communication of the results of analyses, the rationale for decisions, and any actions to be taken. RL and ORP should consider providing regular briefings to the HAB about the status of implementation efforts, and should also consider developing performance measures that can be used to monitor progress. RL and ORP should also consider regularly briefing stakeholders on the status of corrective actions developed in response to the findings in this HSS inspection report and the approaches to addressing the opportunities for improvement, including alternative approaches that line management may identify.
- 9. RL should strengthen support mechanisms and communications with beryllium-affected workers.** RL should ensure that specific personnel are assigned and that roles and responsibilities are defined for providing support to affected workers, including acting as a liaison between workers and non-contractor organizations involved with beryllium issues (e.g., Department of Labor for compensation issues). Responsibilities of these RL support personnel should include proactive engagement with affected workers and stakeholder groups, such as the BAG, and with interfacing organizations to ensure effective communication and to facilitate the resolution of problems. Affected workers should be formally informed of the identity of the designated support personnel and their contact information.
- 10. RL, ORP, and contractor organizations should identify actions to raise site managers' and supervisors' awareness of the risks to workers associated with legacy beryllium contamination and to build trust among workers.** Such actions are needed to address some managers' perceptions that do not have sufficient basis and that contribute to non-conservative decisions and insufficient

urgency in achieving full compliance with the beryllium rule. The program should address additional training for managers responsible for decisions about beryllium facilities and work activities and should specifically address factors that have contributed to some managers' perception that beryllium is no longer a significant hazard that could be leading to new cases of CBD. These factors include the limits on the ability to detect beryllium contamination, risks associated with transient beryllium disturbance conditions that would not be detected by airborne sampling, the potential for beryllium contamination via dermal exposure, and the fact that some genetic factors make some individuals very susceptible to beryllium health effects. Managers should be instructed on the importance of ensuring that all program elements are effectively implemented on a priority basis and that worker concerns are carefully considered and evaluated. In addition, management should strive to build trust with workers by better communicating expectations for medical surveillance programs and fully supporting data analysis efforts, including efforts to determine the work histories of affected workers and identify potential sources of exposures. Finally, management should attempt to evaluate perceptions of influence, intimidation, retaliation, and low priority for worker safety and address them by various mechanisms, including surveys and increased use of designated worker advocates.

11. DOE line management should ensure that adequate assessments of the CBDPP are performed.

RL and ORP should consider performing reviews of the implementation of the Hanford CBDPP to verify that key milestones and deliverables have been completed and are effectively supporting implementation of a program that protects workers from site beryllium hazards. Such reviews need to be performed with sufficient rigor and depth to identify and correct deficiencies and to reassure stakeholders who lack trust in the site's ability to establish an effective CBDPP. RL and ORP, with EM support, should also arrange for independent organizations (i.e., not RL, ORP, or site contractors) to perform targeted reviews of program effectiveness at appropriate points in CBDPP implementation. In addition, RL and ORP should consider performing assessments of their respective laboratory operations (the 222-S laboratories operated by WRPS with analytical and testing services provided by ATL under ORP, and WSCF managed by MSA under RL); the assessments should consider such issues as worker confusion due to the two conflicting sets of requirements at the same location (i.e., OSHA regulations and the beryllium rule), and the adequacy of the bases for the exemption and the implications for worker protection and medical surveillance (e.g., are affected workers at these laboratories provided the same protections under the beryllium rule as other Hanford site workers?).

12. EM should closely monitor site progress in implementing and improving the CBDPP at the Hanford Site and take an active role in ensuring timely and effective implementation.

EM should take an active role in monitoring progress and RL and ORP oversight. EM should consider such actions as participating in RL and ORP assessments and reviewing corrective action plans. EM should also ensure that all of the HSS inspection results are carefully considered by the site, that appropriate actions are taken to improve CBDPP implementation and worker protection, and that these actions are appropriately communicated to stakeholders. As appropriate, EM should direct actions to achieve the needed improvements in a timely manner. In addition, EM should determine whether other EM sites have similar issues and should communicate lessons learned from the experience at the Hanford Site to other DOE sites.

In addition to the above recommendations for EM and site organizations, HSS should continue and, where feasible, accelerate efforts to work with DOE line management to issue the advance notice of proposed rulemaking, with the goal of evaluating changes to regulations that may further strengthen worker protection. The evaluation should consider the more recent epidemiological studies, as well as the potential benefits and challenges of adopting the 2009 American Conference of Governmental Industrial Hygienists' threshold limit value on a DOE-wide basis. HSS should also identify the need for providing additional guidance or requesting the Office of General Counsel to provide regulatory interpretations of the intent of the provision for minimizing the number of personnel potentially exposed and other areas where 10 CFR 850 provisions have not been consistently understood (e.g., treatment of background soil contamination).

Appendix A

Supplemental Information

Dates of Review

Scoping Visit	February 22-26, 2010
Onsite Inspection Visit	March 22 - April 1, 2010
Followup Visit for Medical Discussions	April 13-15 and 20-22, 2010
Report Validation	May 18-20, 2010
Closeout Briefing	June 2, 2010

Management

Glenn S. Podonsky, Chief Health, Safety and Security Officer
William Eckroade, Deputy Chief for Operations, Office of Health, Safety and Security
John Boulden, Acting Director, Office of Independent Oversight and Office of Enforcement
Thomas Staker, Director, Office of Environment, Safety and Health Evaluations

Quality Review Board

William Eckroade	John Boulden	Thomas Staker
George Armstrong	Dean Hickman	Robert Nelson

Review Team

Thomas Staker, Team Leader

HSS Team Members

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Administrative Support

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Team Qualifications

Based on the scope of the review, the U.S. Department of Energy (DOE) Office of Health, Safety and Security (HSS) selected its core team members from within the HSS organization. The team was led by the Director of the HSS Office of Environment, Safety and Health Evaluations, and the core team included members with expertise in industrial hygiene, occupational medical programs, occupational safety, conduct of operations, integrated safety management, feedback and improvement processes, DOE facility operations and maintenance, and facility decommissioning and cleanup activities. Various other HSS personnel were also tasked to examine specific aspects of beryllium programs, such as current research into beryllium monitoring equipment and methods. To further demonstrate that the team was independent and credible, HSS arranged for independent experts from outside DOE to participate on the inspection team. Specifically, HSS arranged for one physician and one industrial hygienist from National Jewish Health (located in Denver, Colorado) and one physician from Simon Fraser University (located in Vancouver, Canada) to supplement the HSS team. All three individuals have extensive practical and research experience with occupational health and chronic beryllium disease. Input from Beryllium Awareness Group (BAG) members was considered in selecting these individuals to supplement the HSS team.

Conduct of the Inspection

HSS conducted the inspection in an open manner. Members of the Hanford Atomic Metal Trades Council (HAMTC), BAG, and the Hanford Advisory Board (HAB) regularly attended the team's daily meetings and expressed their views. These individuals were also instrumental in identifying relevant documents, identifying individuals who wanted to be interviewed by the HSS team, and identifying their areas of concern for the HSS team's consideration and follow-up. HAMTC safety representatives and the BAG chairman were instrumental in coordinating team members' observations of field work activities among the various contractors and were also observers during most of those activities.

The HSS inspection focused primarily on the effectiveness of the current programs and processes at the Hanford Site. To evaluate the current Hanford programs, the team:

- Interviewed Hanford Site personnel from the DOE Office of River Protection, the DOE Richland Operations Office, the operating contractors, and the support contractors to collect information about current practices related to beryllium work activities and controls. These included beryllium workers, operators, health physics technicians, quality assurance inspectors, electricians, machinists, iron workers, industrial hygienists and technicians, laboratory personnel, work planners, and managers at various levels.
- Toured numerous facilities, including those potentially contaminated with beryllium, facilities that were unoccupied and scheduled for demolition, and analytical laboratories.
- Observed ongoing work activities at beryllium-controlled facilities and in beryllium-controlled areas. The HSS team observed implementation of various controls, such as contamination controls, verification of training and qualification of workers, pre-job briefings, and surveys.

- Attended meetings with HAB, BAG, HAMTC safety representatives, and the Hanford Chronic Beryllium Disease Prevention Program (CBDPP) Committee, and attended a HAMTC safety meeting.
- Took the computer-based Hanford General Employee Training and audited the Beryllium Worker Training course.
- Reviewed numerous documents, including implementing procedures, website information and guidance, correspondence between DOE and contractors regarding CBDPP implementation, employee job task analysis forms, work packages and training records associated with beryllium work, training materials and lessons plans, beryllium sample results, facility assessment forms, characterization sampling plans and records, self-assessment and issues management reports, historical records of beryllium activities, medical policies and procedures, and medical records.
- Interviewed personnel, at their request, about medical issues. These interviews were performed primarily by the HSS team's independent medical and industrial hygiene consultants and covered a broad range of topics.

Although focusing primarily on the current program, the HSS team selectively examined historical data and past experience (e.g., past beryllium facility baseline assessments and characterization efforts and management of previously identified beryllium issues) to provide context for the current situation. In addition, HSS interviewed a number of current and former workers who were knowledgeable of the historical use of beryllium at the Hanford Site. HAMTC safety representatives and BAG members assisted in identifying these individuals, who volunteered to be interviewed. These individuals shared experiences concerning their work at Hanford; some of them also shared their perspectives and concerns about aspects of the beryllium program, medical support, and various related areas.

Appendix B

Background Information

This appendix provides background information for readers who are not familiar with the Hanford Site or beryllium programs. It identifies the U.S. Department of Energy (DOE) organizations and prime contractors at the Hanford Site, including those that have the potential to work with beryllium or in beryllium-contaminated facilities, and describes other organizations with a role in the efforts to protect workers from beryllium effects. It also briefly summarizes key information about beryllium and its health impacts.

B.1 Organizations with a Role in the Hanford Site Beryllium Program

Department of Energy. Within DOE, the Office of Environmental Management (EM) has line management responsibility for most activities at the Hanford Site. The Office of Science has responsibility for Pacific Northwest National Laboratory, which was not included in the scope of this inspection. At the site level, the DOE line management responsibilities fall under two DOE field elements:

- The Richland Operations Office (RL) has line management responsibility for overseeing site cleanup activities and the requisite site infrastructure support, such as utilities, security, fire protection, and medical.
- The Office of River Protection (ORP) has line management responsibility for overseeing operations at the high level waste tanks and associated laboratory activities, as well as construction of the Waste Treatment Plant, which will be used to transform the tank wastes into a stable glass form for disposition.

Contractors. The Hanford Site currently has several contractors. Historically, most Hanford Site facilities were managed under a single contract or through an integrating contractor approach. In the past five years, DOE has changed its approach and uses a number of different contractors to perform various aspects of the work.

Under ORP, two contractors perform work that involves beryllium or is conducted in potentially beryllium-contaminated facilities:

- **Washington River Protection Solutions (WRPS).** WRPS carries out the work associated with monitoring and managing the 177 underground storage tanks for high level waste at Hanford. Over the years, beryllium-copper (Be-Cu) alloy tools used for waste tank operations were modified, sharpened, and stored in various WRPS facilities, resulting in beryllium surface contamination and dusts.
- Advanced Technologies and Laboratories International, Inc. (ATL). WRPS operates the 222-S Laboratory complex, the primary onsite laboratory for analysis of highly radioactive samples in support of all Hanford projects. ATL performs the laboratory analytical services and testing in the 222-S lab. Bargaining unit chemical technologists, supported by analytical chemists, process low-activity level beryllium samples (including the use of pure beryllium calibration standards) and work

in facilities that used and/or stored Be-Cu tools. ATL is not under the sitewide chronic beryllium disease prevention program (CBDPP), based on their determination that they fall under a different regulation (i.e., 29 CFR 1910.1450) and are exempt from 10 CFR 850.

Under RL, three contractors perform work that involves beryllium or is conducted in potentially beryllium-contaminated facilities, and one contractor manages the Hanford Site occupational medical program:

- CH2M-Hill Plateau Remediation Company (CHPRC). CHPRC is tasked with environmental cleanup of the Central Plateau area of the Site and a number of projects to eliminate risks to the Columbia River. Some of the projects under the CHPRC scope include solid and liquid waste treatment and disposal; groundwater, soil, and facility remediation and disposition; and closure of the Plutonium Finishing Plant.
- Mission Support Alliance (MSA). MSA consists of several organizations responsible for many of the cross-cutting activities associated with Hanford cleanup. MSA oversees security, site infrastructure and utilities, information management (including web-based training), fire services, sitewide training at the Hazardous Materials Management and Emergency Response (HAMMER) facility, and business management. MSA also operates the Waste Sampling and Characterization Facility laboratory.
- Washington Closure Hanford (WCH). WCH is the prime contractor for environmental restoration of the Hanford Site, which includes cleaning up waste sites, decontaminating and decommissioning former plutonium reactors, and disposing of contaminated waste.
- AdvanceMed Hanford (AMH). AMH provides occupational medical services to DOE and the site contractors, including about 10,000 site personnel. Among other medical responsibilities, AMH is responsible for administering the beryllium medical monitoring program in accordance with 10 CFR 850 and acts as the Hanford Site Beryllium Registry Coordinator.

There have been a number of contractor transitions at the Hanford Site in recent years. Three of the current contractors have been in place for two years or less; CHPRC and WRPS were awarded contracts in 2008, and MSA in April 2009. The WCH contract has been in place since 2005. None of the current contractors had contracts at Hanford at the time the beryllium rule was issued in 1999.

In addition to those listed above, there are two other major contractors at Hanford. They do not operate under the site CBDPP and are not addressed in this report. Under ORP, Bechtel National, Inc. is coordinating the construction of Hanford's Waste Treatment Plant (also known as the Vitrification Plant). Bechtel National, Inc. is not covered by the Hanford CBDPP because ORP and Bechtel National, Inc. have determined that beryllium is not a credible hazard at the Waste Treatment Plant (which is a new construction effort that is not reusing potentially contaminated materials or equipment). In addition, under the Office of Science, Battelle Memorial Institute manages Pacific Northwest National Laboratory and has developed and implemented a separate CBDPP. It is therefore not under the sitewide CBDPP.

Other Site Organizations. In addition to the site contractors, there are other stakeholder organizations that have a role in the beryllium program at Hanford or that support workers or former workers who have been affected by beryllium. These include:

- The Hanford Atomic Metal Trades Council (HAMTC) represents bargaining union workers at the Hanford Site. HAMTC representatives were involved in the working group developing the most recent Hanford Site CBDPP and are members of the CBDPP committee responsible for maintenance of the CBDPP. It also has safety representatives at work sites and provides information to its members.
- The Hanford Advisory Board (HAB) is an independent, non-partisan, and broadly representative body consisting of a balanced mix of the diverse interests that are affected by Hanford cleanup issues to provide informed recommendations and advice to DOE on selected major policy issues related to the cleanup of the Hanford site. The HAB provided two advisory reports to DOE about beryllium concerns in 2009 and recently (February 2010) expressed concerns that the DOE responses to the 2009 recommendations were not sufficient.
- The Beryllium Awareness Group (BAG) at Hanford was chartered in the late 1990s to: 1) provide information and knowledge, orientation, and support to current and former beryllium-affected employees and their family members; 2) provide input on training and services; 3) be a resource to others on beryllium issues; and 4) provide feedback to contractor management and DOE. Only beryllium-affected individuals (including current or former employees) and their spouses are eligible to become BAG members. The BAG may be an advocate for the interests of beryllium-affected individuals and is supported by DOE, Hanford contractors, and HAMTC. A few BAG members also provided their concerns about the Hanford beryllium program to EM and the DOE Office of Health, Safety and Security (HSS).
- The HAMMER facility is a training center managed by MSA with the primary mission of providing a safe and high-quality training experience to Hanford workers engaged in environmental cleanup activities. Among other subjects, HAMMER provides beryllium worker training for Hanford Site personnel.

Independent Medical Providers and Beryllium Information Sources. Although not associated with DOE, various organizations and physicians specialize in treating individuals who are determined to be sensitized to beryllium or to have chronic beryllium disease (CBD). For example, National Jewish Health (NJH), in Denver, Colorado, has extensive experience with diagnosis and treatment of beryllium disease and performs research on CBD. Some of the Hanford workers with beryllium sensitivity or CBD have chosen NJH for diagnostic or treatment services.

Workers Compensation Administrator. The Hanford Site participates in a self-insured workers compensation program. The program is administered by a third party administrator – Penser North America, Inc.

Compensation Programs for Beryllium Workers. Workers with CBD may be eligible for compensation under the Energy Employees Occupational Illness Compensation Program Act, which is managed by the Department of Labor to provide compensation and medical benefits to workers who were employed in the nation’s atomic weapons programs during the Cold War and who may be suffering from illnesses caused by their work. Hanford workers or their survivors may be eligible for up to \$150,000 if the worker suffers from CBD.

B.2 Background Information on Beryllium and Beryllium Effects

Extensive information about beryllium and its health effects can be found in various sources, including websites maintained by DOE and NJH. These include:

- <http://www.hss.energy.gov/HealthSafety/WSHP/be/index.html> – a website maintained by HSS with extensive information about the DOE CBDPP.
- <http://www.hss.energy.gov/HealthSafety/berylliumaffectedworkers/> – a website maintained by HSS with information specifically targeted at beryllium-affected workers.
- <http://www.nationaljewish.org/healthinfo/conditions/beryllium-disease/index.aspx> – a website maintained by NJH with extensive information about CBD.
- <http://www.hanford.gov/safety/beryllium/> – a website maintained by the Hanford Site and the BAG with information about the beryllium at the Hanford Site.
- http://www.hanford.gov/amh/files.cfm/AMH_Beryllium_Hazards_Tri-Fold.pdf – AMH provides a brief fact sheet on beryllium for Hanford personnel.

Beryllium and Its Use at Hanford. Beryllium is a hard, lightweight metal that is very strong and easy to shape. Beryllium and beryllium compounds have many industrial uses. Beryllium parts for nuclear weapons, experimental reactors, and physics experiments have been manufactured and used at a number of DOE facilities since the 1950s.

At Hanford, a beryllium alloy was used to fabricate parts for reactors, including fuel rods for the N-Reactor during plutonium production. This use occurred from about 1960 until 1986, primarily in the 300 Area. However, beryllium may be present in some facilities from past usage, particularly in fume hoods, exhaust ducts, and similar spaces. During fabrication and research, the release of beryllium dust, fumes, and salts resulted in some workers being exposed. In buildings in which these activities took place, there is continued potential for beryllium contamination; in some cases, the presence of beryllium has been demonstrated by surface and/or air sampling. Beryllium contamination could also be spread to other facilities when items (e.g., tools or equipment) are moved from contaminated areas to other areas. In addition to past beryllium use for the reactors and research, beryllium alloys have been identified in non-sparking tools and certain installed hardware, including electrical switchgear and overhead crane components used at Hanford. Beryllium in such materials is normally contained but could be released by such activities as cutting, welding, and grinding of the tools or components; wear products due to friction; and arcing or wear of switchgear contacts. Such activities were particularly prevalent in the tank farms in the 1990s, when beryllium-containing non-sparking tools were extensively modified for use in potentially flammable and explosive environments in the waste tanks and associated valve pits. Many of the beryllium-containing tools and much of the older-model electrical switchgear have been removed from use at Hanford facilities but some remain, and beryllium contamination from past use may exist in some areas. Because research and production activities have ceased, the potential for exposure to beryllium at Hanford is primarily associated with legacy contamination from past usage.

Beryllium Health Impacts. Persons do not develop beryllium sensitization or beryllium disease unless they are exposed to beryllium, primarily through inhalation of beryllium particles. In a few people, even very small amounts of beryllium can pose a health problem. Small amounts of beryllium can cause some

people to become sensitive (called sensitization or sensitivity) to the metal. Beryllium sensitization is similar to an “allergy” to beryllium that can develop after a person is exposed to beryllium particles. More recently, some researchers believe beryllium sensitization might also occur when beryllium penetrates the skin through an open cut or from a beryllium splinter, or simply from dermal contact with fine particles. In individuals with beryllium sensitization, the immune system sees beryllium as a “foreign invader” and builds an “army” of cells in the bloodstream that are prepared to react to beryllium wherever they see it in the body. These cells can be found in the blood using a blood test called the beryllium lymphocyte proliferation test (BeLPT).

Not every individual who is exposed to beryllium will experience health effects. According to NJH, studies have shown that on average, 2 to 6 percent of exposed workers develop sensitivity, although the rates can be as high as 20 percent among workers with the highest exposures, such as beryllium machinists. Once exposed to beryllium, a person carries a lifelong risk of developing beryllium sensitization or CBD, even if the exposure amount was small and the exposures cease. The latency period (the time between exposure and indications of sensitivity or CBD) varies considerably and can be more than 30 years. According to NJH, individuals found to have beryllium sensitization have a significant risk of developing CBD in the future (although the latency period between becoming sensitized and progressing to CBD can be years or decades). Information from NJH indicates that such factors as particle size, type of beryllium used, amount and duration of exposure to beryllium, occupation, industry, and genetics may all play a role in determining why some people become sensitized or develop CBD and others do not.

There are two types of beryllium disease: acute and chronic. The acute disease results from relatively high levels of exposure to the more soluble forms of beryllium and is now rare because protective measures prevent such high exposures. Because acute beryllium disease is not an issue at DOE sites, the DOE beryllium program focuses on the chronic form.

The chronic form, CBD, is a lung condition that can develop after a person is exposed to beryllium dust or fumes, causing the immune system to react against beryllium as a person with beryllium sensitization similarly would. When an individual is diagnosed with CBD, it generally means that the resulting battle between the immune system and the beryllium particles has led to scarring (called granulomas) in the lungs. Information from NJH researchers and DOE websites indicates that practically all individuals with CBD also are sensitized, although there are cases of individuals who have been diagnosed with CBD without having a positive BeLPT. CBD can be mild or severe. For some, it can be a relatively minor condition, while for others it can become a very serious, disabling disease. As with many workplace hazards, higher exposures (doses) to beryllium cause more people to get sick and can result in more severe symptoms. CBD cannot be cured, but the symptoms can be treated with medications that reduce inflammation and the buildup of scar tissue.

When an individual is discovered to be sensitized or to have CBD, various factors can make it difficult to determine with certainty when or where he or she was exposed to beryllium. The long latency period (which can be 30 years) is one factor that makes it difficult to determine when or where an individual was exposed, particularly for individuals who have worked at the Hanford Site for a long period and who have worked in multiple facilities and different types of jobs.

Beryllium Testing. The BeLPT is a laboratory blood test that examines how a type of disease-fighting blood cells that are normally found in the body, called lymphocytes, reacts to beryllium. Uncertainties in medical testing also complicate efforts to identify beryllium-affected individuals and determine when and where they were exposed. As with any other screening test, the BeLPT sometimes provides inaccurate or uninterpretable results. The test results may appear abnormal when a person is not sensitized (false positives) or normal when a person is actually sensitized (false negatives). Individuals who have uninterpretable results may be asked to provide another blood sample so the test can be repeated. A repeat test also may be offered to confirm an abnormal test result or because the test was borderline. While concerns have been expressed over shortcomings of the blood BeLPT, DOE considers the test to be a reliable tool for screening individuals for beryllium sensitization based on published evaluations that found the BeLPT to positively identify cases of beryllium sensitization at a rate comparable to other widely accepted medical tests for other diseases. Testing for beryllium is offered to employees at regular intervals (e.g., annually for workers in areas with potential for beryllium exposure); however, testing is voluntary, and employees may refuse testing, for a variety of reasons (e.g., concern that they could be restricted from job opportunities). As a result, the testing for some individuals may be absent or sporadic. For a Hanford employee to work in a known beryllium-contaminated area, he/she must have been tested and must be enrolled in a beryllium medical surveillance program.

Beryllium Rule and Requirements for a CBDPP. The beryllium rule (10 CFR 850, *Chronic Beryllium Disease Prevention Program*) was initially issued in December 1999. It required contractors to develop a DOE-approved CBDPP and achieve full implementation by January 2002. The rule also states that contractors must conduct activities in compliance with their CBDPPs; therefore, failure to comply with the CBDPP constitutes a non-compliance with 10 CFR 850.

The ultimate purpose of the rule and associated site-specific CBDPP is to protect workers from exposure to beryllium and to prevent beryllium sensitization or CBD. The rule establishes a permissible exposure limit for beryllium and requires that contractor programs be designed to ensure that exposures are below that limit. The rule also establishes a lower action level at or above which the employer must implement certain controls and monitoring. To this end, the rule requires the CBDPP to establish processes and controls to minimize the number of people potentially exposed to beryllium, minimize the opportunities for workers to be exposed to beryllium, and minimize the worker disability and lost time due to sensitization, CBD, and associated medical care. The CBDPP must also describe how the site will comply with the rule provisions in various areas, such as developing a baseline beryllium inventory, performing hazards assessments, and establishing various controls (e.g., restricted areas, postings, contamination controls) to eliminate or reduce exposures.

Appendix C

AdvanceMed Hanford Beryllium Medical Support Program

C.1 Introduction

AdvanceMed Hanford (AMH) is the current occupational medical program contractor at the Hanford Site, working under contract to the Richland Operations Office (RL). AMH has clinics in Richland and the 200-West area of the Hanford Site and is responsible for the health and safety needs of more than 10,000 Hanford Site workers.

AMH provides occupational medical services to the U.S. Department of Energy (DOE) and Hanford Site contractor employees, including those working for the Office of River Protection (ORP) and RL contractors, as well as the Office of Science's Pacific Northwest National Laboratory; AMH's work scope does not include Bechtel National, Inc. employees, who are covered by another medical program.

The occupational medical services contract structure at the Hanford Site is different than at most DOE sites, where medical services are typically provided by a prime contractor (or subcontractor to a prime contractor) for its employees. At Hanford, a contractor reports directly to DOE but provides services covering employees of multiple site contractors. Although beneficial for other reasons (consistency across the site and, theoretically, independence from undue adverse influence from site contractors), the structure at the Hanford Site results in more complicated interactions among AMH, Hanford contractors, and the workers because AMH does not directly employ the workers and does not have authority to direct the actions of the site operating contractors.

AMH actively participated in the development of the sitewide Hanford chronic beryllium disease prevention program (CBDPP). The roles and responsibilities for the medical elements of the program are set out in the AMH Beryllium Medical Support Plan (Attachment 4 of the Hanford CBDPP). The sitewide Hanford CBDPP assigns lead responsibilities for medical surveillance and medical removal processes to the AMH Site Occupational Medical Director (SOMD).

The DOE Office of Health, Safety and Security (HSS) team, which included the support of two members from National Jewish Health (NJH) and one member from Simon Fraser University, reviewed the support plan and associated documents, including AMH procedures, protocols, and a small sample of patient health records. The team also conducted interviews with current and former workers, the AMH SOMD and medical staff, and RL management and staff responsible for the beryllium program. One HSS team member completed the beryllium worker physical exam and certification process. The team members from NJH and Simon Fraser University also participated in separate visits to Hanford to conduct interviews with workers, former employees of AMH, and RL personnel to obtain additional information.

C.2 Results

Medical Monitoring – Beryllium Worker Program. AMH provides two types of beryllium medical monitoring programs as required by the Hanford CBDPP and 10 CFR 850: the beryllium worker program (for those currently exposed) and the beryllium previous exposure program (discussed later).

The beryllium worker program provides medical monitoring for current beryllium workers identified in the Hanford site employee job task analysis (EJTA) database (further discussed below). Medical monitoring consists of a baseline examination followed by annual re-evaluations. With a few exceptions, AMH has established the necessary procedures and protocols to support the medical certification process as required by the sitewide CBDPP and 10 CFR 850. The HSS team reviewed many steps in the medical surveillance process, including informed medical consent, medical/occupational history, counseling/education, beryllium lymphocyte proliferation test (BeLPT) testing and work recommendations. These elements are discussed further in subsequent sections of this appendix.

Employee Job Task Analysis. AMH provides the training and infrastructure to manage the EJTA process. AMH maintains the computer-based training module and manages the EJTA infrastructure with input from the Hanford Occupational Health Process, which was established to provide a sitewide approach to risk reduction and includes a point of contact from each contractor organization at the Hanford site. The Hanford Occupational Health Process members discuss and vote on any changes to the EJTA process. Each contractor is responsible for maintaining the accuracy of its workers' EJTA's.

AMH uses the EJTA information to identify beryllium workers and to determine the required medical monitoring. During the review of a worker's EJTA at medical, the AMH industrial hygienist resolves, if necessary, any questions or inconsistencies with the worker's EJTA information. Some workers raised concerns that EJTA's were not always discussed with workers and some were based on poor building characterizations (e.g., if a building has not been well characterized, the EJTA may not reflect the exposures accurately). Although not verified with all contractors, some isolated examples of these concerns were noted by past reviews and interviews by the team. However, in principle, and for most jobs, the EJTA appears to be adequately supporting AMH's ability to determine the medical monitoring programs that are required for each worker. The EJTA also facilitates the ability of examiners to review current and past occupational histories, which can be accessed from the EJTA historical database.

Medical Monitoring – Beryllium Previous Exposure Program. The beryllium previous exposure program provides medical monitoring for current Hanford Site employees who may have been previously exposed to beryllium at the Hanford Site or at any other DOE facility. Enrollment is voluntary, and workers may elect to remain in the program for the duration of their Hanford employment. Workers who decide to discontinue their participation in the voluntary program may re-enroll at any time.

The examinations consist of a baseline initial examination followed by periodic examinations (every three years or as medically indicated). AMH uses its standard procedures and protocols for this program's examination process. As discussed later, the use of some of these procedures to address abnormal medical conditions is not well articulated. For example, for follow-up of abnormal symptoms or lung functions, there is no mention of a routine schedule in the beryllium exposure profile for previous workers (BERPV). Similarly, the BERPV indicates that other 12-month scheduling may be obtained to include a single or a split BeLPT, but it is not clear how or when these procedures would be obtained according to the BeLPT algorithm. The BeLPT algorithm suggests that split sampling may be obtained more frequently (i.e., more often than an annual basis) if a BeLPT test is anything but normal.

During interviews with workers, a concern was raised regarding a lack of understanding by AMH and local physicians of the relationship between a diagnosis of sarcoidosis and CBD. This relationship is addressed in Department of Labor Energy Employees Occupational Illness Compensation Act Circular

#08-07, dated September 4, 2008 (which establishes a presumption of CBD in situations with a diagnosis of sarcoidosis and a history of beryllium exposure). Also, a worker was concerned that the current procedures for submitting travel expenses for a confirming diagnosis could compromise the confidentiality of the individual's health status prior to the determination of a work-related illness.

Because the beryllium previous exposure program is a voluntary program, there have been many outreach attempts over the years to encourage participation by informing workers of this program's availability:

- A corrective action from the 2002 Joint Council Review identified a need for improvement in this area and suggested targeting outreach to specific groups of workers that were potentially exposed to beryllium based on their work history. An official DOE memorandum was sent to these workers providing the details of their beryllium exposure risk and encouraging participation in the program. However, this outreach method was not maintained and has not been reinitiated for several years.
- During the inspection, as a quick fix, RL and ORP sent an Operations Office Announcement to all Hanford employees to encourage increased participation in the voluntary medical monitoring program.
- General information about the beryllium previous exposure program is readily available. For example, the AMH website, the Federal DOE website, numerous types of printed materials located in the clinic, and other resources are readily available to employees seeking such information.
- As part of workers' retirement/termination process, employees are informed of the voluntary medical surveillance program that is offered under the DOE former worker program currently managed by the Department of Labor and local unions.

Although a wealth of general information is available on websites and in printed materials concerning all aspects of the beryllium programs at Hanford, workers still indicate that more information and education are needed to understand the issues associated with beryllium and the program. The ongoing challenge for AMH, site contractors, RL, and ORP is to further increase participation by using an array of different communication tools/methods and to foster worker confidence that their participation will not adversely affect their work conditions and opportunities.

In 2007, the participants in the previous worker program were informed of a change in the confidentiality of test results. As stated in the examination consent form (which is extracted from 10 CFR 850), only positive test results are provided to the employer, which was the process followed at Hanford until 2007. However, a 10 CFR 850 provision requires all test results to be reported to the employer; this requirement was implemented at Hanford in 2007. The change requested that all employees in the voluntary program sign a release that would allow AMH to notify each worker's employer that a beryllium examination was requested. If the release was not returned, the employee was eliminated from the voluntary beryllium program. This change in policy resulted in approximately 500 participants dropping from the program. Although AMH recently stated that a decision to stop employer notification had been implemented, the HSS review determined that contractors were still notified when an employee is notified of their examination appointment. The apparent conflict between the 10 CFR 850 text and the examination/informed consent form has not yet been resolved. If resolved, some improvements in participation should be attainable, but it will take considerable effort to restore confidence and assure confidentiality.

Medical Consent. AMH appropriately uses 10 CFR 850 Appendix A for its medical informed consent form, which is also contained in the Hanford Site CBDPP. The consent form requires that the patient be provided with a summary of the medical surveillance program at least one week before any procedure or examination takes place.

AMH has developed a beryllium information booklet that includes the information required by 10 CFR 850.36. The booklet is distributed to the workers by their employer and is also available on the AMH website. AMH also makes the booklet available to beryllium previous exposure patients by their request and also includes links to the booklet on appointment notices and reminders. Workers are required to review the beryllium information booklet prior to any examination or testing. The AMH beryllium protocols alert the examiner to obtain the consent form, and the counseling/education guide has the examiner ask for questions before any procedure or examination. The signed consent forms were properly retained in the medical records that were reviewed by the HSS team. The beryllium booklet was reviewed for its content and was found to contain the required information outlined in 10 CFR 850.36.

Medical History. In support of the beryllium examination process, patients are required to complete a medical/occupational history form. The forms are completed before the actual exam, and key questions related to beryllium are reviewed during the examination, including past history of beryllium work, major illnesses, chronic diseases, current medications (including any immunosuppressant medication), and any allergies and sensitivities. The beryllium examination guide and profile direct the examiner to review the patient history. A review of a sample of medical files showed that these forms are being adequately used in the evaluation process.

Occupational History. The employee's occupational history is a standard component of the workplace medical surveillance examination. It provides the examiner with additional information on any past exposures and job activities. The occupational history for a worker is mainly composed of previous general work history, previous work history with beryllium, and a documented review of the employee's EJTA, with specific emphasis on accuracy and present and future exposure to beryllium.

The contractors are responsible for providing beryllium medical information to AMH as appropriate for each worker. This required information includes the types of personal protective equipment (if used), current and planned work with beryllium, and any trends in exposure monitoring and actual exposure monitoring results. The HSS team determined that the medical information in some workers' files was not sufficient to create a comprehensive occupational history. A team member from NJH separately identified the same concern from previous experience in that medical records sent to NJH in support of beryllium follow-up examinations were noted to lack an adequate occupational history that included workplace monitoring data/documentation. In general, the SOMD and AMH staff did not address the lack of medical information, especially workplace monitoring records, with contractor management. AMH does not have a process/procedure to ensure that the information necessary to establish a comprehensive occupational history is collected.

In addition, the AMH form used to collect occupational history has some basic inadequacies. The facilities listed on the form are only identified by number and are not inclusive; maintaining the accuracy of the list is a challenge that has not been adequately met. Further information about these facilities is required to be maintained on a web page, but the information on the web page is currently inaccurate and has not

been updated since 2005 (although it is currently in the process of being updated). Further, at least five facilities known to be contaminated with beryllium and on the website list of beryllium-contaminated buildings are not on the AMH history form. The form requests the worker's job titles, but does not request information on what tasks/activities were performed that could cause potential beryllium exposure or the time spent in beryllium activities. Examples of activities not requested include: working in the ceiling above eight feet; working with beryllium alloy materials; machining beryllium tools; and using shop equipment to cut, grind, or polish beryllium components. Capturing this type of information is critical to perform the 10 CFR 850 mandated data analysis of potential beryllium exposure work activities. Further, AMH recently developed a revised draft of the occupational history form that combines work areas, instead of listing them separately. If this approach is implemented as defined in the current draft, less information would be obtained, which could contribute to misclassification of exposures if the data on the form is used in evaluation of risk factors for sensitization and CBD.

Counseling/Education. Counseling and education constitute an important element of 10 CFR 850 and the Hanford CBDPP medical monitoring program. Beryllium counseling and/or information is provided to workers before testing or examination, during the examination and testing process, and immediately following any referral recommendation or diagnosis.

Counseling for clinical examinations was integrated into the AMH medical monitoring process/protocols to ensure that the requirements in 10 CFR 850 and the Hanford Site CBDPP are addressed. The counseling and any consultation are documented on the Beryllium Information Checklist form, which is located in each worker's chart.

AMH has developed a beryllium information booklet (revised in March 2010), which contains information on the beryllium medical monitoring program, beryllium question and answers, and information about the Federal beryllium registry and 10 CFR 850. Before beryllium examination and testing, the patient is provided with this booklet in advance of the examination appointment so that the employee can be familiar with the beryllium program requirements. The patient is given the opportunity to ask any questions of the AMH staff about the risks of tests, the type of data collected, confidentiality, the risk of working with beryllium, and any other aspect of the beryllium program. The information provided is sufficiently detailed to adequately inform the patient of the health risks of beryllium. However, at least one definition in the booklet (i.e., beryllium assigned worker) is not clear and not consistent with the CBDPP and the exam guidelines protocols that are used to implement the program.

A pamphlet is also provided that outlines beryllium health hazards and identifies the Hanford Site beryllium buildings/facilities. This pamphlet is a good start but warrants review and revision to ensure that general CBDPP educational objectives are met, and to include a brief description of the CBDPP and the beryllium medical surveillance program at the Hanford Site. A flyer outlining workers' compensation options is also provided. However, it provides so much information on a single page that it may be confusing to workers, particularly at the early stage of testing. Consideration should be given to either expanding this flyer to a pamphlet or simplifying the information provided.

Although AMH was the author of the information booklet and pamphlet, the responsibility for distributing the information to employees now rests with the individual's employer/operating contractor. The change from an AMH responsibility to an employer responsibility was initiated last year to accommodate the increased number of new hire examinations processed by AMH as a result of the American Recovery

and Reinvestment Act hiring demands. This change has improved the process because AMH was having difficulty locating workers before testing. Contractors are motivated to distribute the information because the examination cannot be processed until the potential worker has reviewed the required information. A review of the medical records indicated that counseling and education is noted by examiners, and a formal checklist signed by the employee is maintained in each beryllium-associated worker's record.

AMH also provides counseling to workers when a confirmed diagnosis of sensitization or CBD is made or when medical removal is initiated. Details of the timing and content of the counseling are defined in the Hanford Site CBDPP. Some of the main topical areas discussed during the counseling session focus on: procedures that limit beryllium-affected workers' exposure to beryllium, medical treatment options, medical removal protection, multiple physician review process, arranging travel for further diagnosis, and worker compensation. The counseling is documented in progress notes located in each worker's chart and was adequately performed for the cases reviewed by the HSS team. The AMH beryllium medical support plan also provides for an employer interface to answer any questions or concerns about work assignments. Ongoing education is important to ensure that individuals understand the risks of beryllium exposure and the signs and symptoms to report to medical or their doctors once they leave the workplace. Ideally, beryllium counseling would also occur on separation or exit interviews from the site; such interviews would need to be coordinated by the contractors, with assistance from AMH.

Physical Examination. The completed baseline physical examination/visit establishes the current health status of an individual and determines whether a worker can be certified as a beryllium worker. AMH obtains information on past medical history, medications, family history, and occupational history, including other DOE/Department of Defense sites where beryllium exposure may have occurred (using the initial occupational medical history). The baseline examination focuses on the patient's respiratory system and skin for obvious signs of granulomas, BeLPT testing, pulmonary function testing (spirometry), and chest x-ray with interpretations from a certified B Reader who is skilled in detecting lung abnormalities. The AMH beryllium examination guides and profiles that describe the beryllium examination process are detailed and, in many areas, well written. While much of the required information is available, it could be better integrated and made more accessible to the medical providers. For example, the various documents do not cite the relevant parts of other chart documents for completeness, and there are occasional inconsistencies that would be identified and clarified with better integration.

The BeLPT is the best test currently available for detecting beryllium sensitization. It is more sensitive than the other medical evaluations that are part of the examination (i.e., spirometry, chest x-ray, and computer tomography [CT] scan). Although the test is not 100 percent effective (in some cases, it may be as low as about 70 percent effective), it is still the most effective, least invasive, and most cost-effective screening tool available for detecting beryllium sensitization among exposed individuals.

To improve the confidence in the accuracy of the BeLPT testing, RL initiated actions toward using a split BeLPT test instead of a single BeLPT for ongoing medical surveillance of beryllium-associated and beryllium workers. However, the use of a split test for all workers is not recommended, for a number of reasons. It is difficult to ascertain the precise rate of false negatives that result from using the BeLPT in any surveillance program. Rates determined from prior studies are not applicable to the Hanford program, where people are retested every one or three years. It cannot be assumed that false negatives will be caught using a split sample approach because research results do not support such an

assumption. The best method for addressing false-negative BeLPT test results and detecting workers who have BeLPT that are changing from a negative result to a positive (converting to sensitization) is to conduct single tests sequentially over time, as is done in the current examination schedule. When repeat testing is used over time (annually or bi-annually), it is likely that the ability to detect sensitization and CBD is enhanced compared with the use of one test (including a split test) in a workplace surveillance algorithm. Research studies show that split sample testing and a single test provide quite similar results and also support the serial testing approach. As a result, the few individuals who have false negatives will likely be discovered from the AMH comprehensive beryllium surveillance program, which includes a suite of tests, with yearly and/or every-three-year exams. In addition, increased testing will likely yield a greater number of false positive tests, which may prove problematic for the workers and for follow-up. Therefore, the NJH and Simon Fraser University team members do not recommend split samples for individuals who are in an ongoing medical surveillance program. However, split sampling is appropriately used in the BeLPT testing algorithm to address other-than-normal results from the initial single BeLPT test results (e.g., abnormal and borderline). It is also suggested that split sampling be performed as part of the last testing for a retiring worker on exit because follow-up tests might not occur regularly.

There are some circumstances where long-term medications could potentially affect the results of the BeLPT. Interviews with the SOMD indicated that the use of medications was identified as part of the initial and annual occupational medical history interview but not before taking repeat samples. Also, the potential effects are expected to be discussed with the patient according to the protocol, and the clinicians were taking these factors into consideration and following the protocols necessary to obtain a comprehensive diagnosis for the initial and annual examinations but not for repeat blood samples. Some of the workers interviewed by the HSS team raised questions about the effect of current medications on the BeLPT and indicated a concern that their medications could affect the blood tests and could result in a false negative result. Some of these workers also indicated a concern that their use of medications was not discussed or considered by the clinical staff (and the protocols do not call for such discussions for repeat blood samples). While the medical specialists on the HSS team indicate that there are limited circumstances in which medicines could impact a test result, the effects of medicine on test results has not always been sufficiently communicated to workers, and the protocols do not provide full assurance that medicine use is explicitly considered before all BeLPTs.

There are other ways that AMH could optimize the BeLPT algorithm to help clarify its use. Consideration should be given to returning individuals to routine surveillance or at most yearly testing after repeated testing at the end of the algorithm, instead of taking all workers who have had a non-repeatable abnormal or borderline test and evaluating them on a case-by-case basis. Also, individuals who have become beryllium-affected workers should not stay in routine medical surveillance to have additional BeLPT testing conducted once they have been diagnosed with sensitization or disease; additional BeLPT testing for these individuals may increase the rate of positive tests but does not help understand beryllium health effects at the facility. If AMH deems it prudent to follow them on a regular basis, there should be a separate protocol for beryllium affected workers; however, the additional testing for such individuals is not required by 10 CFR 850 and is not being recommended by the HSS team. Consideration could be given to providing a split sample for workers with an uninterpretable test, depending on the circumstances. The BeLPT algorithm should utilize one borderline and one abnormal as sufficient for referral for clinical evaluation. Inclusion of work recommendations in the BeLPT algorithm would be helpful to ensure that workers are being restricted temporarily and that these work restrictions are

either made permanent or removed as appropriate. The utility of other testing that is obtained as part of the beryllium exposure profile for current workers (BERCU) and BERPV examinations should be integrated and included in BeLPT testing. The beryllium algorithm does not indicate how an abnormal chest radiograph is included in the beryllium medical surveillance plan. While an algorithm for chest radiographs is provided in the beryllium examination guide, the recommended frequency of testing should be clarified in that guide. Finally, while it appears that spirometry is obtained as part of the beryllium medical surveillance program, there is no algorithm for the interpretation of spirometry, indications for its use and frequency of testing, or algorithm action if the spirometry is abnormal; in addition, there is no indication as to how these results integrate with the rest of the program or are further evaluated.

Based on the above testing, individuals are determined to have beryllium sensitization or CBD (via a referral to a licensed provider familiar with beryllium disease), or are sent for evaluation because of an abnormal chest radiograph. The definitions used for beryllium sensitization are not well defined in the beryllium examination guide and other materials, although these definitions should be consistent. The independent physicians on the HSS team recommend that sensitization be based on two abnormal BeLPTs or one abnormal and one borderline BeLPT. Additional “clinical” information will not differentiate the latter group from the former group because individuals with sensitization do not demonstrate clinical abnormalities besides the BeLPT. However, studies of large surveillance programs indicate that risk of CBD is similar in these two groups; thus the rationale for using one abnormal and one borderline as a criterion for sensitization. In addition, three borderline tests should be viewed as another indication for referral for evaluation of possible beryllium sensitization and CBD because this combination suggests that the immune system is reacting to beryllium and should be evaluated.

When testing is suggestive of sensitization, workers are offered the option to be sent for additional evaluation for CBD. In the past, Hanford paid for these evaluations directly. This practice is being changed and will be covered by the Department of Labor or workers compensation insurance. If this is the case, AMH will need to add a step to their beryllium exam protocol to indicate that they will request release of information from workers to obtain the results of these evaluations. This information is needed for determining work restrictions and reporting to the beryllium registry and is important to have when conducting an investigation of beryllium-affected workers.

Work Recommendations/Restrictions. The SOMD is required to provide a written medical opinion and recommendation for each medical evaluation performed on each beryllium-affected worker. The recommendations/restrictions can be temporary if tests are pending, or permanent if CBD or sensitization is present. The vehicle for that opinion and recommendation is the record of visit, which is provided to the employer via electronic mail and to the worker as hard copy.

Within the beryllium exam process, there was a lack of written protocols for actions to take when test results were other than normal. Overall, it is prudent to place a worker on temporary restriction when a test result is received that is other than normal or, at the least, withhold beryllium clearance. Although in practice, with one exception of an acknowledged error, the case management team issued temporary restrictions when test results were questioned. However, the protocols used by the case management team do not specifically outline when temporary restrictions should be implemented and removed. This situation is evident for both the BeLPT and beryllium chest x-ray algorithm. The Hanford Joint Council review in 2002 recommended that a temporary work restriction be initiated to reduce or eliminate further potential exposures to beryllium following one positive or borderline positive BeLPT blood test.

This change was not made to the BeLPT results algorithm and is not clearly outlined in the beryllium examination guide.

The optimal approach to the issue of work restriction continues to be a subject of considerable debate among Hanford workers, AMH, operating site contractors, and other affected organizations (e.g., the Hanford Atomic Metal Trades Council). Specifically, the beryllium level at which workers are restricted has been a point of discussion over the years. Some workers have raised concerns that the levels are too high to fully protect workers and that AMH has been pressured to not establish a lower level, which has been strongly denied by AMH. Conversely, other workers have raised concerns that establishment of too low a level would prevent them from working in jobs and locations that they prefer. Workers also cited instances where RL and contractor managers have communicated inaccurate information about the ability of beryllium-affected workers to work at Hanford. The worker concerns and perception about work restrictions should be one of the areas where management attention is focused on evaluation of worker concerns and improved communications with stakeholder groups and individual affected workers (see opportunities for improvement in Section 4).

Risk Communication. Risk communication refers to the process for accurately informing workers of health topics of concern and providing answers to workers' questions. Risk communication is an important tool that many groups at the Hanford Site could use to solicit and resolve worker health concerns and could provide a forum for ensuring that misinformation is limited. Improved risk communication could help address beryllium concerns and educate workers, managers, and supervisors about the CBDPP, the issues surrounding BeLPT testing (such as false negatives and false positives), work restrictions, and new information that is determined from analysis of the industrial hygiene data collected from each contractor. Following several weeks of meetings, interviews, and conversations with contractors, Federal staff, union personnel, stakeholders, and advisory groups, it is evident that each group has their own set of questions and concerns based on their individual roles and risks concerning the beryllium program. It was also evident that communication among the groups has, in many cases, not been effective or satisfactory in framing and resolving issues. Additional effort is needed to expand and strengthen the risk communication services provided by AMH and other stakeholder groups at the Hanford Site. Many of the questions and concerns identified by this review could be mitigated through better communication efforts from all stakeholders.

Beryllium Registry Support. AMH is responsible for coordinating the collection of beryllium registry data from all Hanford Site contractors and submitting the data into the beryllium registry database. 10 CFR 850 requires that employers include a listing of all beryllium-affected workers and other data to include medical screening test results. AMH also coordinates the resolution of questions or comments from DOE Headquarters; however, restraints on AMH prevent any major changes to the contractor data provided. The Hanford Site registry data has many examples of incomplete or incorrect data. Many data fields, such as "first hired to work on site date," personal protective equipment, employment end date, and information about work at other DOE sites, were not complete. Further, the work history data on 3000 workers has not been submitted. AMH has had difficulty in ensuring the quality of the submitted data; this issue has been forwarded to the Oak Ridge Institute for Science and Education and HSS for further discussion and resolution, and several recent improvements have been reported. AMH deficiencies in providing registry data in an accurate and timely manner should be addressed and resolved.

Medical Removal. The Hanford Site CBDPP (Sections 6.25 to 6.26) adequately incorporates the medical removal, multiple physician review, and compensation requirements from 10 CFR 850. The compensation process used to calculate the permanent removal benefit at Hanford provides for more compensation than the minimum 10 CFR 850 requirement. In accordance with 10 CFR 850, Hanford has authorized several employees to receive their medical removal benefits, including their two year standard salary, when they were deemed too sick to continue working. For the most part, this has been a positive program/position that encourages employees to continue working if they are symptom free, and it can contribute to their overall health status.

Based on interviews and a sampling of employee medical records, medical removal information was provided to the worker (hard copy) and the contractor point of contact as required. It was evident from the detailed notes in the medical charts that comprehensive evaluations were performed by the AMH case manager and the clinician to determine the need for work removal. The review also indicated that the appropriate work recommendations were made for the medical cases reviewed.

Currently, there is one case involving permanent removal that is open. Because no final decisions have been made, the HSS team did not review the open case. Also, some workers were concerned that implementation of the medical removal process is not uniform across contractors. This is another worker concern that warrants additional management attention and communication (See opportunities for improvement in Section 4).

Investigation of Beryllium-Sensitized or CBD Workers. AMH has the responsibility to work cooperatively with site contractors to analyze medical, job, and exposure data to identify workers or groups of workers potentially at risk for beryllium sensitization or CBD, and working conditions that may contribute to that risk. AMH has a database of beryllium-associated workers, including workers with previous exposure to beryllium, and current beryllium workers who are identified through their EJAs.

In the past, detailed occupational histories were obtained from beryllium affected workers; however, over the last two years, the collection of data and analysis of newly sensitized or CBD workers had not been conducted as required by 10 CFR 850.34. AMH has acknowledged this deficiency and is currently in the process of developing a revised study to accomplish this important task. This data analysis is critical to determine the most probable source of beryllium exposures for beryllium-affected workers and potential as a source of ongoing or future exposures. Correct building characterization and the historical EJAs, if available, are a resource to utilize in this endeavor. It is important to attempt to determine whether the beryllium sensitization/CBD cases were from legacy exposures, or from exposures occurring since implementation of new beryllium controls (around 2000). If the source of exposure is due to weaknesses in the current methods of protection, then these weaknesses would require careful review and initiation of corrective measures to prevent further exposures and potential cases of sensitization/CBD. The HSS team's review of the Hanford beryllium registry data shows that the causes of sensitization/CBD cases remain unexplained and that potential unrecognized and/or uncontrolled exposures may continue to exist at the Hanford Site. A timely investigation into the likely sources of these sensitization and CBD cases is necessary. (See Finding #3.)

AMH Certification, Oversight, and Process Improvement. AMH received a three-year certification from the Accreditation Association for Ambulatory Health Care in 2009. This certification process

thoroughly reviews the medical credentials of the staff, the adequacy of the administrative processes in place, and the quality assurance and improvement process. AMH was found to be compliant in all areas reviewed and was given a three-year accreditation by the association.

Federal Occupational Health, a division of the U.S. Public Health Service, has been retained by RL to conduct bi-annual assessments of the AMH medical program. The overall evaluation of these audits has shown AMH to have an effective medical program. Assessments that focus specifically on the beryllium program have not been part of any Federal Occupational Health or Accreditation Association for Ambulatory Health Care audit. AMH provided a self-assessment, required by the Accreditation Association for Ambulatory Health Care, that evaluated the beryllium support plan. However, this assessment was limited to a gap analysis to ensure that AMH documents were current with the requirements specified in a support plan approved in 2008. Another self-assessment related to beryllium was performed by AMH in 2009, but was limited to a listing of process improvements completed within the previous year. AMH has demonstrated that they have a process that could be utilized for quality improvement and assessment and should continue to use this process not only for issues that are determined from internal reviews but also from other processes and external sources/clients. In addition, it is not clear that problems that arise in the program are evaluated using this type of process. That is, AMH has developed a formal process for identifying weaknesses in their processes, evaluating and developing corrective actions, and tracking the corrective actions to closure (including review by the CBDPP committee and the AMH clinical services development committee); however, more work is needed to capture all issues. For example, some weaknesses were recently discovered in the chest x-ray algorithm by AMH staff, but this information was not developed into an action to correct the supporting protocol/procedure. AMH should continue to refine a process for improvement and evaluation of the beryllium program on a regular basis.

Customer satisfaction for AMH is also being reviewed by an independent group from Press Ganey Associates, Inc. Information on customer satisfaction is obtained from surveys, comment cards, and patient comments via e-mail or from a comment telephone line. The results of the surveys are generally positive, but are based on a limited number of completed surveys that do not specifically address the beryllium program. More survey results are needed to confirm the current customer satisfaction rating of satisfactory, and the survey should include some specific programmatic questions that address the beryllium program.

Recently, AMH received a letter of no confidence from the Beryllium Awareness Group that discussed their disappointment with AMH due to the recent (March 2010) termination of the beryllium case manager. The termination resulted in the individual filing an employee concern. The RL employee concerns manager requested an independent investigation by the U.S. Public Health Service/Federal Occupational Health; according to RL, the results of the investigation were provided to RL in May 2010 for their disposition.

Some workers and stakeholders have also voiced concern that AMH medical staff who advocate for workers' rights are terminated and/or forced to leave, providing additional lack of confidence in AMH. These workers and stakeholders have perceived that individuals at AMH have received pressure internally at AMH and externally from contractors and others to alter their opinions on the beryllium programs in AMH (AMH indicated their disagreement with these perceptions). To ensure that workers are willing

to utilize the programs and services mandated to be provided by AMH, and that the CBDPP can be implemented appropriately, it is important to evaluate the lack of confidence from the workers and to address these concerns as is appropriate.

In the area of counseling/education, stakeholders stated that AMH has not routinely solicited input from workers who completed the various counseling sessions. Experiences from previous workers who have gone through these counseling sessions, especially for permanent medical removal, may be able to provide suggestions on areas to improve and would be another way to ensure that AMH was able to better provide services.

Notwithstanding the surveys and accreditation reviews conducted by RL and AMH, the implementation of the Hanford Site CBDPP/medical requirements have not been specifically addressed. AMH has developed a process for identifying weaknesses in their procedures and/or performance and to manage identified issues (e.g., evaluate and develop corrective actions and track the corrective actions to closure). However, a recent failure to identify an inadequate issues management activity, which included the failure to formally address weaknesses discovered in the chest x-ray algorithm by AMH staff, indicate that more work is needed to improve this process.

C.3 Opportunities for Improvement

AdvanceMed Hanford

1. In an effort to improve participation in the volunteer beryllium medical monitoring program (or the BERPV program), RL, site operating contractors, and AMH should consider initiating and/or reinitiating various communication mechanisms directed at affected workers (both current and former) to ensure that correct and current information about this program is provided to these individuals. Consider the following actions:

- Work with stakeholders to obtain, evaluate, and address the areas where there are misunderstandings about the current program that are possibly preventing participation. Set appropriate goals to achieve and ensure that there is follow-up on these goals.
- Once HSS resolves the conflicting requirements in 10 CFR 850 (see opportunity for improvement for HSS, below), RL and AMH should communicate to all potential volunteer participants the interpretation on releasing test results to employers for volunteer participants.
- Ensure that the AMH information on the beryllium worker and the volunteer beryllium medical monitoring program is correct and that other resources providing this information are also correct. These resources include information on the AMH website, the DOE website, AMH printed materials, letters to affected workers, and informational e-mails from both contractors and DOE. This information and the implementation of the program should be reassessed on a periodic basis.
- Consider implementing additional targeted outreach tactics to these workers, with the goal of a specific increase in participation rates. Outreach should also be considered for quality improvement efforts in the near future.

2. AMH, RL, ORP, and the Hanford operating contractors should work together to implement the CBDPP and develop a process to ensure that the required beryllium workplace monitoring (exposure, personal protective equipment, work location, exposure monitoring, etc.) information and data from contractors is provided in a timely manner to AMH to be included in worker medical records so that clinicians can access the data during medical monitoring examinations as required by the Hanford CBDPP. Consider the following actions:

- Determine the information necessary to create a comprehensive occupational history and determine methods contractors can use to provide their portion of that data in an effective and efficient manner. Determine whether any creative changes to the EJTA can provide data for AMH to use in this manner and in their evaluation of beryllium-affected workers.
- Review each contractor’s process for sending beryllium workplace monitoring results to AMH and identify areas for improvement. Ensure that areas for improvement are addressed by AMH and the contractors.
- Provide feedback mechanisms from AMH to the Hanford contractors on the status of beryllium workplace monitoring submittals and/or the lack of submittals. As necessary, report longstanding deficiencies in this area to RL, ORP, the Hanford contractor(s) and/or the CBDPP Committee as appropriate.
- Consider using an audit process with RL and an external group to help with an annual evaluation of the beryllium program and to evaluate changes when deficiencies are noted.
- Provide milestones to be achieved for the CBDPP for AMH and contractors.

3. AMH should review and revise the beryllium exam test result protocols/algorithms to ensure that clear thresholds for temporary restrictions are included and that these processes may be easily followed by staff without specific expertise in beryllium. Consider the following actions:

- Revise the chart/ algorithm for the BeLPT and the chest x-ray test procedures to include temporary restrictions as outlined above. If spirometry is part of the medical surveillance testing, an algorithm for spirometry results, and action plans depending on results, should be developed.
- Ensure integration between the various protocols, including using standard language, so that the process for medical surveillance is clear to all providers, not just one. For example, ensure indications for exam types, definitions of sensitization, and determination of when a referral is necessary are clearly specified.
- Conduct training on the revised test procedures with the AMH staff on a regular basis, not just once. Ensure that there is sufficient trained staff to keep the program running if someone is on vacation, leaves employment, or is on sick leave.

4. RL and AMH should consider using the current risk communicator or a facilitator to establish and implement defined actions for solving beryllium-related questions and concerns from workers. Consider the following actions:

- AMH risk communicators and contractor patient advocates, with input from the Beryllium Awareness Group, should sponsor informational meetings by the Federal Department of Labor, Washington State Department of Labor and Industries (including the Office of Self-Insured Ombudsman), Penser North America, Inc., and/or Washington State Labor Council Project Help. Such meetings should be open to employees and their physicians. Fact sheets that clarify common errors in submitting documentation for claims and benefits should be provided.
- Engage risk communicators from experts and AMH who are already involved in the beryllium program at Hanford and could possibly be utilized more effectively to solve beryllium-related issues at Hanford.
- Integrate either an AMH risk communicator or facilitator to establish defined goals for solving beryllium-related questions and concerns. Site-specific data and topical expertise should be included by the AMH risk communicators in as many as possible beryllium hazards group discussions to help focus the discussion on solving issues and providing accurate information.
- Consider the benefits of standardizing risk communication across contractors, and having the contractors using the risk communicator at AMH for all workers. Information obtained from the site should be distributed to workers using risk communication.
- Ensure that RL, AMH, and experts continue to develop methods to reach out to and communicate with the local medical community to better understand the complexities, resources, and solutions to treating CBD patients (e.g., the relationship between sarcoidosis and CBD diagnoses).

5. RL and ORP should ensure that the responsibilities of AMH and the Hanford contractors for collecting, communicating, and entering data into the beryllium registry are formally established. Consider the following actions:

- Review and determine the root cause for Hanford contractors providing incomplete and inaccurate information to the registry database.
- Ensure that RL and ORP monitor and hold contractors accountable for sending complete and correct data to AMH to be entered into the beryllium registry and all medical records.
- Ensure that AMH considers providing training to the Hanford contractors or assistance to correct any defined deficiencies.

6. AMH and contractors should work to improve the requirements in the Hanford CBDPP concerning the interface between AMH and the contractor industrial hygiene staff regarding beryllium workplace monitoring information and in the data analysis of newly diagnosed sensitized or CBD workers. Consider the following actions:

- Ensure that contractor safety and health staff coordinate with AMH and are involved in helping workers provide accurate and complete information on work histories for inclusion in the beryllium data analysis process. The process should consist of questionnaires and interviews so that examples and suggestions from staff familiar with the work environment can provide assistance to the workers.

- Have the beryllium worker data analysis use an integrated epidemiologic approach that would include researching information on buildings, job tasks, classifications, year of first hire, EJTA data, and other such information that may have resulted in beryllium sensitization and CBD. It should include the integration of data/information derived from medical surveillance with industrial hygiene/workplace risk factors. This integrated review should also include reinstatement of a work history questionnaire and should be supported by interviews of affected workers to address relevant workplace risk factors. Consideration should be given to make this process ongoing, to be reevaluated on a regular basis (e.g., annually).
- Charter a separate/independent epidemiologic study by a qualified entity (e.g., a university) that can assemble the Hanford surveillance data in cohort design to clearly describe CBD risk in the workforce and help identify opportunities for prevention.
- Interview workers who have been sensitized or developed CBD and that are not long-term employees who worked at Hanford before the beryllium rule was issued (e.g., employed at Hanford less than 12 years) to obtain as much detail about work history details as possible to identify potential locations or sources of beryllium contamination.
- Use the beryllium registry data as an important risk management tool that can assist medical and contractor safety and health staff in focusing their efforts and soliciting issues related to the CBDPP.
- Re-review the information related to the beryllium medical surveillance program. This could be tracked and analyzed to identify the rates, times, and locations of Hanford workers' beryllium testing results, which may provide some trends or data to establish possible beryllium job tasks or locations of concern.
- Consider these improvement items when performing the current task to reinitiate and complete the data analysis that was deferred over the last few years.
- Ensure that the EJTA program is consistently applied by all contractor organizations to include participation between the manager, employee, and industrial hygiene and that workers are aware of and either formally agree or disagree with the final EJTA form sent to medical.

7. AMH should consider soliciting comments to improve the work history questionnaire from several sources including current beryllium workers, past beryllium workers, sensitized/CBD workers, Beryllium Awareness Group members, Hanford Advisory Board members, etc. Consider the following actions:

- Establish a new beryllium coordinator who is tasked with re-vitalizing the association between AMH and other stakeholders, such as the Beryllium Awareness Group; contractor advocates; contractor environment, safety, and health staff (including industrial hygiene staff); and other groups interested in beryllium issues.
- Ensure that sufficient AMH staff is provided to adequately support the beryllium program so that all of the requirements of 10 CFR 850 are met, including: worker exposures are included in worker records; beryllium-affected workers are properly protected from ongoing beryllium

exposures; newly sensitized workers are interviewed regarding their current and past beryllium exposures; and records and documents related to beryllium-associated workers are properly maintained.

8. AMH should establish formal feedback and improvement procedures and schedule periodic self-assessments of processes and implementation of the Hanford Site CBDPP. Specific actions to consider include:

- Develop formal procedures for self-assessment and management of issues.
- Ensure that assessments focus on evaluation of objective evidence and processes against requirements.
- Schedule a CBDPP assessment or series of assessments in the next year that comprehensively evaluate(s) the adequacy of AMH processes and performance in implementing the requirements of the CBDPP.
- Ensure that deficiencies and weaknesses identified as a result of the HSS inspection are formally evaluated for causes and extent of condition, with corrective actions and recurrence controls identified and implemented.

9. AMH should reinvigorate their efforts to ensure sufficient qualified staff to perform the required functions. Specific actions to consider include:

- Increase efforts to fill vacant Medical Doctor positions at AMH with individuals with beryllium experience. Identify and attempt to address the factors that are contributing to current difficulties in filling the positions (e.g., compensation, working conditions).
- Continue to use external expertise more effectively through various mechanisms (e.g., phone consultation or contracting for periodic clinics).
- Continue to use NJH as a resource to train/orient new-hire clinicians concerning the CBDPP protocols and processes.

Office of Health, Safety and Security

1. HSS should consider and initiate the best method to resolve the conflicting requirements in 10 CFR 850 relating to sharing of test results for volunteer participants in the beryllium medical monitoring program. The efforts should address the communication problem from a few years ago in which program participants were told that all tests results would be provided to contractors, which resulted in many participants (approximately 500) dropping from the program. The responsible HSS organizational element has indicated that resolution of this issue is under way.

Appendix D

CH2M-Hill Plateau Remediation Company

D.1 Introduction

CH2M Hill Plateau Remediation Company (CHPRC) was awarded a contract for environmental cleanup of the Central Plateau of the Hanford Site in 2008. The scope of the contract includes management and disposition of approximately 475 facilities, including cleanup and demolition of the Plutonium Finishing Plant (PFP), the U-Plant Canyon, and other facilities that are potentially contaminated with beryllium. CHPRC current employs about 4500 workers, 850 of whom are qualified as beryllium workers.

Minimal beryllium has been found in samples collected in CHPRC facilities to date. All air samples collected in these facilities since 2007 have been well below the Hanford action level of 0.1 micrograms per cubic meter, and no wipe samples have been above the Hanford control limit of 0.2 micrograms per 100 square centimeters. Only two of the approximately 1500 samples collected during this period contained beryllium above applicable limits. These were bulk samples of ash recently collected in the 200E Power House that were slightly above soil background levels.

Nonetheless, process histories indicate that beryllium was handled, stored, or processed in a number of CHPRC facilities, and characterization of these facilities is incomplete. Seven current CHPRC employees and one CHPRC subcontractor employee have been diagnosed with chronic beryllium disease (CBD), and 29 others are sensitive, or borderline-sensitive, to beryllium.

The U.S. Department of Energy (DOE) Office of Health, Safety and Security (HSS) team assessed the adequacy of the Hanford sitewide chronic beryllium disease prevention program (CBDPP) and the effectiveness of implementation of this program by CHPRC. The inspection focused on current procedures and practices for controlling worker exposures to beryllium. Activities conducted by the team during this inspection with respect to implementation of the beryllium program were as follows:

- Interviewed workers: Ten current and past workers, including operators, health physics technicians, quality assurance inspectors, electricians, machinists, and iron workers.
- Toured facilities and observed work: 11 facilities potentially contaminated with beryllium, including the PFP, T-Plant, U-Plant, Effluent Treatment Facility, East Power House, Groundwater Protection Warehouse, and seven additional facilities that were unoccupied and scheduled for demolition.
- Attended beryllium-related meetings: Hanford Advisory Board, Beryllium Awareness Group, Hanford Atomic Metal Trades Council safety meeting, and the Hanford CBDPP Committee.
- Attended training: General Employee Training and Beryllium Worker Training.
- Reviewed CHPRC documents: CHPRC CBDPP implementing procedures, correspondence between DOE and CHPRC regarding CBDPP implementation, work packages and training records associated with beryllium work, beryllium sample results, facility assessment forms, characterization sampling plans, and historical records of beryllium activities.

D.2 Results

Program Management. CHPRC has taken a number of important steps to implement the sitewide CBDPP. A gap analysis was performed to identify differences between the sitewide CBDPP and existing CHPRC procedures, and the CHPRC procedures were revised to achieve consistency. Letters from CHPRC management informed workers of changes that would be made to comply with the new CBDPP, and beryllium workers and beryllium-affected workers have been trained on the new CBDPP. Initial facility assessments were performed pursuant to the CBDPP, and a facility characterization schedule, including a prioritization methodology and interim protective measures, was developed and submitted to the DOE Richland Operations Office (RL). These steps have resulted in implementation of important elements of the CBDPP.

While significant progress has been made, some of the steps taken have not been fully effective, and some aspects of the CBDPP have not yet been fully implemented. CHPRC was aware of work that remained to be done, and they indicated that they have a target date of September 30, 2010, for complete implementation of the sitewide CBDPP. However, CHPRC does not have a comprehensive management plan that specifies the steps to be taken, assigned responsibilities, and due dates to ensure timely and effective implementation.

Inventory and Characterization. CHPRC has used a systematic process for assessing the beryllium status of each of its 475 facilities. An initial assessment of each facility was conducted in accordance with Section 6.6.1 of the Hanford CBDPP. Based on this assessment, CHPRC identified 29 facilities requiring characterization sampling using the facility characterization process specified by the CBDPP. This sampling was prioritized and scheduled based upon the potential for beryllium exposure. Occupied facilities were assigned the highest priority and were scheduled to be characterized by the end of April 2010. The lowest priority was assigned to unoccupied facilities that were scheduled for demolition. These facilities were scheduled for characterization by the end of 2011. Of the 475 facilities, 446 were classified as beryllium-clean based upon initial assessments, and 12 were classified as beryllium-controlled. The remaining 17 facilities were classified as interim-controlled in accordance with CHPRC procedure PRC-MD-SH-40277, *Interim Exposure Controls for Buildings Awaiting Beryllium Characterization*. In addition, the need for “validation sampling” was identified in 32 of the facilities that were classified as clean. The assessment results are recorded on CHPRC facility assessment forms.

However, the information recorded by CHPRC on facility assessment forms does not always provide sufficient bases for declaring facilities beryllium-clean. For example (see Finding #1):

- Some active facilities were classified as beryllium-clean without sampling, even though the beryllium facility assessment forms indicate that beryllium activities were performed in them. These facilities meet the CBDPP definition of a beryllium-controlled facility (i.e., there is some evidence that beryllium activity may have occurred in the past, and characterization sampling has not been completed). Many of these facilities are active and are occupied on a full-time or part-time basis.
- Many facilities were classified as beryllium-clean without sampling when facility histories are not fully known. To meet the CBDPP definition of a beryllium-clean facility, CHPRC must determine through characterization sampling and/or process knowledge that no potential for exposure to beryllium exists. The process histories that were used as bases for declaring these to be beryllium-clean facilities are described on many facility assessment forms as “Partially or Incompletely

Known.” In addition, statements on some facility assessment forms that facility historical usage is “Fully Known” are of questionable validity (e.g., the dates that the facilities were built are recorded as “Unknown” or are not specified).

- Facility assessment forms do not clearly specify the basis for declaring facilities to be beryllium-clean. The facility assessment form included as guidance in the CBDPP contains a field titled “Assessment Summary,” but this field is not on the form used by CHPRC, and assessments are not normally documented on the forms. In some cases, the basis for a “clean” declaration is not evident from the data recorded on the forms.
- The need for “Validation Sampling” is specified on assessment forms for some facilities that have been declared beryllium-clean facilities. There is no established protocol for “validation sampling,” and sampling locations and schedules are typically not specified. The facility assessment forms indicate past beryllium activities in at least six of the facilities for which “validation sampling” was specified. Similarly, other facilities with histories of beryllium activities were placed under interim controls while awaiting characterization sampling but were not classified as beryllium-controlled facilities. As discussed above, the CBDPP requires such facilities to be classified as beryllium-controlled.
- CHPRC performed initial beryllium assessments of its facilities without the benefit of beryllium facility historical records maintained by RL.

In summary, over 90 percent of CHPRC facilities have been declared beryllium-clean, based primarily upon process history, without performing characterization sampling. Many of the Hanford facilities are over 50 years old, their process histories are not fully known, and the bases for “clean” declarations are not always supported by information on facility assessment forms. Without additional characterization sampling, there is inadequate assurance that facilities classified as beryllium-clean meet the criteria specified by the CBDPP. Some facilities for which there is some evidence that beryllium activity may have occurred in the past, and for which characterization sampling has not been completed, were not classified as beryllium-controlled facilities as required by the sitewide CBDPP.

Work Controls. CHPRC has incorporated beryllium controls into its work control process and has included beryllium work permits (BWPs) and associated hazard analyses in work packages for activities to be performed in beryllium-controlled areas. Over 40 industrial hygienists provide good coverage of ongoing work involving potential exposure to beryllium. The industrial hygienists who were interviewed by the HSS team demonstrated a good understanding of the hazards and controls associated with beryllium work in their assigned facilities.

The HSS team observed pre-job briefings and work activities in beryllium-controlled areas at the PFP and discussed beryllium hazards and controls with project industrial hygienists and workers at the U-Plant Canyon Building (Building 221U), the Effluent Treatment Facility (Building 2025E), the East Power House (Building 248E), and the Groundwater Protection Warehouse (Building 1713H). Most beryllium hazards and controls associated with work observed during this inspection were adequately addressed in work packages. Work packages for activities in beryllium-controlled areas included BWPs and associated beryllium hazard assessments and work instructions. Project industrial hygienists were actively involved in job planning and in monitoring ongoing activities.

CHPRC applied appropriate beryllium exposure controls during preparation of the U-Plant Canyon Building (Building 221U) and East Power House (Building 248E) for demolition. Both facilities were appropriately classified as beryllium-controlled facilities. At the U-Plant, conservative personal protective equipment (PPE) was worn, appropriate beryllium warning signs were posted, access to potentially contaminated areas was properly controlled, air and surfaces were appropriately sampled for beryllium, and contamination was controlled by applying a fixative coating on all surfaces in the canyon. Appropriate PPE and postings were also observed at the Power House. The Power House work package included an automated job hazard analysis that identified beryllium work as a task and a beryllium hazard assessment that assessed the hazards associated with this task. The package also included a BWP and general work instructions. Project industrial hygienists were actively involved in planning the work and monitoring work activities at both facilities.

CHPRC has established interim controls pursuant to CHPRC procedure PRC-MD-SH-40277, *Interim Exposure Controls for Buildings Awaiting Beryllium Characterization*, for facilities for which there is evidence of past beryllium activities. The controls specified by this procedure include Industrial Hygiene review of work activities that have the potential to be intrusive and/or dust-generating, and communication of building status to the occupants of all buildings that are awaiting characterization. However, controls do not include posting the buildings as beryllium-controlled facilities while awaiting characterization, as required by the CBDPP. Except for this posting deficiency, the controls specified for interim facilities were appropriate. This procedure, PRC-MD-SH-40277, was also applied to facilities for which there was evidence of past beryllium activities, even though the stated purpose of the procedure is to establish controls for buildings “where there is no evidence of past beryllium activities but where characterization sampling is appropriate due to incomplete building history.” (See Finding #4.)

The HSS team assessed interim beryllium controls established by CHPRC for the CHPRC Effluent Treatment Facility (Building 2025E) and the Groundwater Protection Warehouse (Building 1713H). Both of these facilities were active and occupied, both had been classified as interim-controlled, and neither was posted with a beryllium-controlled facility sign as required. (See Finding #4.)

The Effluent Treatment Facility was classified as interim-controlled because previous sampling had identified beryllium in evaporator bottoms in the Thin Film Dryer Room. Most controls at the Effluent Treatment Facility were adequate. An industrial hygienist was assigned to the facility and was properly controlling activities in the Thin Film Drying Room. Beryllium activities were included on employee job task analyses (EJTAs) for employees assigned to the facility; respirators were worn (for radiological protection) by persons entering the room; and vacuum cleaners were equipped with high efficiency particulate air (HEPA) filters. However, controls at the Effluent Treatment Facility were not adequate to ensure that workers were informed of potential beryllium hazards. The facility was not posted as a beryllium-controlled facility as required by the CBDPP, one of two resident workers questioned was not aware of the potential beryllium hazard, and there was no process to ensure that visiting workers would be informed of this potential hazard. (See Finding #4.)

The second interim-controlled facility assessed was the Groundwater Protection Warehouse. The facility is more than 50 years old, its history was largely unknown to the individuals who assessed it, and the only sampling data available was one personal air sample result that was below the site action level. The history of items and materials stored in the facility was also not well known. CHPRC had appropriately classified this facility as an interim-controlled facility based on incomplete knowledge of

facility history. However, the facility health and safety plan did not address beryllium, and no beryllium controls had been established at this facility, apparently based on a non-conservative assumption that no beryllium was present. While the only individual assigned full-time to the warehouse was aware of the potential presence of beryllium and the CHPRC project industrial hygienist was aware of the status of the controls, the current practices are not conservative with respect to potential beryllium contamination. Items have been transferred in and out of the facility without a beryllium survey, and ongoing facility activities (e.g., routine sweeping of the floor) are likely to produce airborne dust. (See Finding #4.)

The team also visited seven additional interim-controlled buildings that were unoccupied and scheduled for demolition. Most had some evidence of past beryllium activities and/or incomplete histories. Each facility was locked to control access, but none were posted as beryllium-controlled facilities, as required. (See Finding #4.)

Beryllium exposure controls established by CHPRC for observed work at the PFP were adequate except as noted below. CHPRC conservatively and appropriately classified PFP facilities as beryllium-controlled, and had designated beryllium-controlled areas within these facilities based on the potential for beryllium inside glove boxes and laboratory spaces; however, at the time of this inspection, no beryllium had been detected. Beryllium-controlled facilities and beryllium-controlled areas were posted with warning signs, but the signs had not been updated to comply with the sitewide CBDPP. In several laboratories/rooms, the potential beryllium hazard was contained in glove boxes, so when work involved the potential for breaching a glove box, the laboratories/rooms were posted and controlled as beryllium-controlled areas, and appropriate respiratory protection requirements were applied. In general, these and other controls were adequately formalized in beryllium hazard assessments and BWPs that were included in work packages. Pre-job briefings were properly attended and, with one exception, included appropriate discussions of anticipated hazards and controls related to beryllium. For the one exception, the pre-job briefing, which was conducted without the participation of the project industrial hygienist, lacked adequate discussion of the BWP, the potential off-normal/upset events, and the actions to be taken if such events occurred. For work observed by the HSS team, appropriate PPE was worn and proper donning and doffing procedures were followed. Conservative controls were applied to limit the spread of beryllium contamination and to minimize the exposure of workers to beryllium. Engineered controls, including controlled ventilation and both existing and temporary glove boxes and vacuum cleaners equipped with high efficiency filters, were used to minimize exposures. Sampling for beryllium in work areas was generally adequate. Where beryllium and plutonium contamination existed in the same area, the correlation between the concentrations of these two contaminants was conservatively estimated, and continuous airborne radioactivity monitors were used to indicate the possible presence of beryllium. The BWP and radiation work permit controls were effectively integrated for work in the Standards Laboratory, and the permits provided clear and consistent direction to the workers for specific work tasks. However, some inconsistencies were noted in PPE requirements specified on radiation work permits and BWPs for work in other areas. (See Finding #4.)

A few additional weaknesses were identified in the implementation of beryllium exposure controls at the PFP. In some cases, standing BWPs were not sufficiently task-specific to identify such controls as sampling by industrial hygiene, specific ventilation controls, or steps to be taken if an off-normal event should occur. The need for more effective planning and improved worker performance following off-normal events was apparent following two recent spills that had the potential for beryllium contamination; in these cases, workers performed recovery operations without recovery plans and without following

the requirements in the approved PFP procedures and/or beryllium hazard assessments. Additionally, beryllium exposure assessments were not routinely documented and provided to AdvanceMed Hanford (AMH) following spills detected through radioactivity measurements. CHPRC has established a correlation between plutonium and beryllium concentrations at PFP, but this correlation is not routinely used to produce records of beryllium exposure, and separate beryllium samples are not always collected. (See Finding #4.)

Training and Qualifications. CHPRC has ensured that all beryllium workers and beryllium-affected workers have attended “gap training” on the new sitewide CBDPP and has assigned field work supervisors the responsibility for ensuring that beryllium training remains current. CHPRC work control process assigns field work supervisors with responsibility for determining worker qualifications to perform assigned tasks. A network database is available to assist supervisors in carrying out this responsibility. However, the verification process was not being adequately implemented at PFP. In some cases, field work supervisors verified training by asking those present at pre-job briefings if they were qualified as beryllium workers instead of referring to the electronic data base. (See Findings #2 and #4.)

The HSS team sampled ten beryllium workers and verified that all had received the applicable training. All other workers are required to take beryllium awareness training as part of computer-based Hanford General Employee Training. Workers demonstrated an awareness of beryllium hazards and an understanding of required controls.

Medical Surveillance and Counseling. Section 6.25 of the CBDPP requires contractors to identify beryllium workers through the EJTA system and requires AMH to provide medical surveillance to workers identified on EJTA. AMH notifies CHPRC and the worker of medical results. CHPRC then notifies the employee’s supervisor and posts medical qualifications in a network database that is available to supervisors. The HSS team confirmed implementation of this process by sampling six beryllium workers and verifying that they were properly trained and medically qualified to perform assigned tasks in beryllium-controlled areas. The medical and training status of beryllium workers was maintained in an electronic database that was available to supervisors. The CHPRC work control process requires field work supervisors to use “available tools” to verify training; supervisors understood their responsibility to confirm qualifications but did not always use the available tools for making this confirmation.

Section 6.27.2 of the CBDPP requires that contractors provide counseling to beryllium-affected workers within 10 working days, not to exceed 14 calendar days, after receiving notification from AMH that they have been diagnosed with beryllium sensitivity or CBD. AMH provides CHPRC electronic copies of records of visits for all cases involving work-related injuries and illnesses, including cases of beryllium sensitivity and disease. CHPRC has established a procedure for this counseling and has assigned counseling responsibility to a Human Resources staff member, but no counseling has been provided since December 2008. At least four CHPRC employees had been diagnosed with sensitivity or CBD since that time, and more than 14 calendar days elapsed before AMH reported each of these cases to CHPRC in records of visit. The person assigned responsibility for beryllium counseling received beryllium awareness training through the computer-based Hanford General Employee Training but had not been trained in the sitewide CBDPP, and no requirement has been established for such training. (See Findings #2 and #4.)

Section 6.25 of the CBDPP requires that copies of all personal monitoring data reports be transmitted to AMH for inclusion in workers' medical folders. The HSS team sampled data reports for ten CHPRC workers and verified that they were included in the medical folders.

Section 6.14 of the CBDPP states in part that "sampling shall be performed for each beryllium affected worker at the time the worker receives a diagnosis of beryllium sensitization and/or chronic beryllium disease. Periodic sampling shall also be performed." CHPRC has not established a procedure or process to ensure that this sampling is performed as required, and none of three CHPRC beryllium-affected workers questioned about this sampling recalled being sampled. (See Finding #4.)

Feedback and Improvement. CHPRC had identified the need to assess implementation of the CBDPP, and these assessments have begun. Assessments were scheduled in the CHPRC Integrated Assessment Plan in several of the areas where the HSS team identified deficiencies.

As discussed above, CHPRC has made significant progress in strengthening beryllium controls since assuming contract responsibilities at Hanford in 2008. However, some aspects of the sitewide CBDPP, which was issued in May 2009, have not yet been fully implemented.

D.3 Summary

CHPRC has recently trained its beryllium workers on the new Hanford CBDPP, revised its procedures to be more consistent with the new CBDPP, performed an initial assessment each of its facilities, and developed a prioritized schedule for additional characterization sampling. BWPs are used to control ongoing work in beryllium-controlled areas. While progress has been made, significant challenges remain in completing the characterization of CHPRC facilities and fully implementing the CBDPP. Over 90 percent of CHPRC facilities have been designated as beryllium-clean facilities, based primarily upon process history, without performing characterization sampling. Many of these facilities are over 50 years old, process histories are not fully known, and the bases for "clean" declarations are not always supported by information on facility assessment forms. Without additional characterization sampling, there is incomplete assurance that all facilities classified as beryllium-clean facilities meet the requirements of the CBDPP. Facilities for which there is evidence that beryllium activity may have occurred in the past, and for which characterization sampling has not been completed, have not been classified as beryllium-controlled facilities as required by the sitewide CBDPP. CHPRC has met the implementation criteria provided by RL, but several aspects of the program have not been fully implemented; these include resolving deficiencies in initial facility assessments, appropriate posting of beryllium-controlled facilities, and monitoring and counseling affected workers. CHPRC developed a gap analysis that identified inconsistencies between the sitewide CBDPP and the CHPRC procedure. Procedures were changed to eliminate inconsistencies. However, the gap analysis did not address implementation inconsistencies, and implementation deficiencies were not fully addressed.

D.4 Opportunities for Improvement

- 1. Develop and implement a comprehensive management plan for implementing the sitewide CBDPP that includes schedules, responsibility assignments, training, resources, and verification of implementation.**

2. Develop a more rigorous process for performing initial beryllium assessments of CHPRC facilities, and reassess facilities previously declared beryllium-clean facilities. Include items such as the following in the assessment process:

- Definitive criteria for determining whether a facility is a beryllium-controlled or beryllium-clean facility
- Training requirements for individuals who will be performing assessments
- Requirement to document information provided by contacted individuals
- Requirement to describe possible handling/storage/maintenance/usage of beryllium in the facility
- Requirements for assessment of older circuit breakers, switchgear, bus bars, and other items known to potentially contain beryllium
- Guidance and requirements for validation sampling specified on facility assessment forms, including schedule, responsibility, and locations to be sampled
- Guidance for classifying facility history as fully or partially known
- Clear responsibility assignments for completing assessment forms
- Requirement for a documented evaluation that provides a basis for conclusions
- Signatures and dates of those preparing and approving assessment forms.

3. Post facilities as beryllium-controlled facilities in accordance with the CBDPP when there is some evidence that beryllium activity may have occurred in the past and characterization sampling has not been completed. Include facilities under interim controls that are awaiting characterization.

4. Strengthen implementation of beryllium work controls. Specific actions to consider include:

- Establish a procedure for sampling of beryllium-affected workers in accordance with Section 6.14 of the CBDPP. Assign responsibilities and provide instructions for collecting samples and reporting results within specified time limits. Include a process for tracking the status of implementation.
- Establish a checklist for conducting pre-job briefings that includes a discussion of what can go wrong and steps to be taken if this should happen. Encourage the participation of project industrial hygienists in pre-job briefings for work involving potential exposures to beryllium.
- Reinforce the need to establish job-specific BWPs when job-specific controls are needed and when some controls specified on an applicable standing BWP are not applicable.

- Establish a process for assessing, documenting, and reporting beryllium exposures when beryllium is associated with radioactivity, and when radioactivity measurements indicate the presence of airborne radioactivity.
- 5. Improve counseling of beryllium-affected workers. Establish a tracking system to ensure timely counseling, and train counselors in the sitewide CBDPP.**

Appendix E

Mission Support Alliance

E.1 Introduction

In August of 2009, the Mission Support Alliance (MSA) team of Lockheed Martin, Jacobs Engineering Group, and Wackenhut Services, Incorporated, took over as the prime contractor for Hanford's Mission Support Contract. In this role, MSA manages and operates certain sitewide programs in such areas as safety, security, and environment; infrastructure and utilities; business management; information resources and content management; and portfolio management. MSA has been assigned certain cross-cutting responsibilities specific to the Hanford Site chronic beryllium disease prevention program (CBDPP), including coordinating the annual review and updating the program document, and maintaining the baseline inventories of beryllium-controlled facilities, decontaminated facilities, facilities that no longer exist but where beryllium activities occurred, and outdoor areas where beryllium contamination is identified. MSA is also responsible for operating the Volpentest Hazardous Materials Management and Emergency Response (HAMMER) Training Facility. HAMMER's primary mission is to provide a safe and high-quality training experience to Hanford workers engaged in environmental cleanup activities. HAMMER provides a four-hour Beryllium Worker Training course and the beryllium awareness portion of the sitewide computer-based General Employee Training (GET).

Other Hanford contractors – i.e., production and decontamination and decommissioning contractors – have responsibility for almost all facilities with a history of beryllium use. Many of the 241 facilities for which MSA is landlord are tanks, basins, training mockup facilities, relatively newly constructed office buildings, sheds, recently acquired mobile structures, and pump houses; MSA has been able to easily classify them as beryllium-clean facilities. However, as the support services contractor, MSA workers are frequently deployed or dispatched to facilities and areas throughout the Hanford Site where CH2M-Hill Plateau Remediation Company (CHPRC), Washington Closure Hanford (WCH), and Washington River Protection Solutions (WRPS) are landlords, including designated beryllium-controlled facilities and areas.

Activities conducted by the U.S. Department of Energy (DOE) Office of Health, Safety and Security (HSS) team during this inspection, with respect to the MSA beryllium program, were as follows:

- Interviewed workers: personnel responsible for various elements of the CBDPP, including program management, performance of the facility assessment and additional characterization, work planning and control, counseling and advocacy of beryllium-affected workers, employee concerns and issues management, and workers and Hanford Atomic Metal Trades Council safety representatives.
- Toured facilities: two facilities that had additional sampling performed, the Waste Sampling and Characterization Facility (WSCF) analytical laboratory, and a pumphouse where assessment forms specified that sampling of motor control cabinets for beryllium contamination would be conducted during future maintenance.
- Observed training: GET and Beryllium Worker Training.

- Reviewed MSA documents: CBDPP implementing procedures, correspondence between DOE and MSA regarding CBDPP implementation, work packages and training records associated with beryllium work, beryllium sample results, facility assessment forms and characterization sampling plans, self-assessments and surveillances, beryllium-related website information, and historical records of beryllium activities.
- Attended Meetings: CBDPP Committee and Beryllium Awareness Group (BAG).

E.2 Results

Program Management. While MSA continues to complete their establishment of governance documentation for implementing this contract, they have established several procedures and website sources of information related to their implementation of the Hanford Site CBDPP. In November 2009, MSA adopted intact the previous Project Hanford Management Contractor’s CBDPP description document acknowledging that it had not been updated to comply with the Hanford Site CBDPP. MSA has issued procedures and guidance for work management, job hazard analysis, occupational medical qualification and monitoring (including instructions for completing employee job task analyses or EJTA’s), managing the time and charges for supporting beryllium-related activities (including the support of the BAG), and medical testing and examination and workers compensation claims.

However, as described in the following paragraphs, MSA’s implementation of the Hanford Site CBDPP has not been managed in a sufficiently structured manner. As of the end of this HSS inspection, much work remains to complete CBDPP implementation. MSA did not conduct a formal gap analysis between the requirements of the Hanford Site CBDPP and existing conditions, and did not develop a formal implementation plan that provides actions, milestones, and responsible parties to manage and monitor the necessary activities.

Action to complete all necessary procedure revisions was not completed by January 1, 2010, as directed by the DOE Richland Operations Office (RL) and remains uncompleted. Procedures were not developed to detail the requirements for performing critical activities, such as the assessment and characterization of MSA-assigned facilities for potential beryllium contamination or interim controls for work in facilities and areas pending characterization sampling. Procedures and interfaces with other contractors for developing and maintaining the Hanford Site beryllium facilities lists were not established. MSA has not established technical instructions for industrial hygiene (IH) sampling, personal monitoring, or the counseling required by the CBDPP, Section 6.27.2.

In addition, many MSA procedures and websites and linkages were outdated, in that they referred to incorrect information and processes, provided details not in accordance with the Hanford Site CBDPP, and reflected weaknesses in past statements about the risk of beryllium exposure to workers at Hanford. For example, a document remaining on the Fluor Hanford website entitled “FH Practices and Procedures Limiting Beryllium Exposure” (no revision number, undated and unsigned) communicates erroneous information, such as “we do not have beryllium workers because we are not currently involved in operations involving working with beryllium materials or performing beryllium production work, we have created a worker classification designated ‘beryllium assigned workers’.” It further incorrectly states that the level of beryllium exposure for beryllium-assigned workers will also be very low because when work involving possible beryllium exposure is performed, it will generally be “short duration and performed on an infrequent basis.” As discussed below, work control and counseling procedures and

websites contained incorrect and misleading information. MSA has not fulfilled their responsibilities to maintain website lists of beryllium contaminated facilities, required by the rule and the CBDPP. The list of facilities for which Fluor Hanford (and now MSA) is the designated landlord was last updated in 2008, and the sitewide beryllium facilities list was last updated in 2005. Neither list is accurate. GET training has not been updated to reflect the new CBDPP, ten months after issuance of the sitewide CBDPP.

Facility Inventory and Characterization. As required by the Hanford Site CBDPP, during the summer and fall of 2009, an MSA subcontractor, a certified industrial hygienist, conducted the assessment and characterization of the 241 buildings for which MSA was the assigned landlord. The assessments were performed using a modified version of the assessment form provided as an option in the Hanford Site CBDPP, with supplementary reports prepared for a few facilities where additional characterization was performed. Facility reassessments and associated characterization sampling for all MSA facilities performed by a single industrial hygienist provided consistency and, with the exceptions and weaknesses discussed below, the evaluations, characterization sampling, and recommendations for further sampling were rational and conservative. For example, the examiner noted that older model (1940s to 1960s) high-voltage switchgear was known to have employed beryllium in electrical contacts that could have contaminated the interior of switchgear cabinets due to air arcing, wear, or previous maintenance activities. In response, MSA took swipe and bulk samples on the exterior of suspect switchgear cabinets in two facilities and six pumphouses that had similar switchgear; recommendations were noted on the assessment form to provide additional sampling and controls when these cabinets were opened for future replacement or maintenance. Additional sampling was also recommended above six feet (prior to any future maintenance activities above six feet) in the 105B facility (the B Reactor, where public tours are routinely conducted), although there was no known beryllium contamination and previous ground-level sampling results were negative for beryllium. Wipe samples were also taken on an old drill press in another building that lacked a documented history and on overhead crane rails in the same building, where certain crane equipment has been known to contain beryllium.

MSA provided two documents that reflected the results of assessment activities. A report entitled “MSA Facility Assessment for Beryllium Characterization,” dated December 21, 2009, identified that MSA facilities were prioritized for additional characterization based on a formula that includes factors for the probability of beryllium contamination and for consequences. This report reflected that additional characterization sampling was performed in eight facilities, all with negative results, and recommended that all 241 MSA facilities be classified as “clean” for beryllium contamination. Another document, entitled “Beryllium Issues with Electrical Switchgear,” described the sampling of switchgear in Buildings 2101 and 251W and various pumphouses, and provided recommendations for sampling and process controls for planned maintenance work on switchgear components in the river and reservoir pumphouses. However, neither of these documents had preparer or approval signatures.

Notwithstanding the generally conservative approach taken in the assessment of MSA facilities for beryllium contamination, there were several weaknesses in the processes and reporting of the re-assessments. Other than the assessment form and associated guidance for completing form fields, MSA did not establish any formal procedure, instruction, or plan on how to conduct and document the facility assessment and characterization. There are no form fields, requirements, or an expectation that persons performing the assessment sign the form and that management provide review or approval of assessment results that are the basis for protecting workers from exposure to beryllium. Neither the Hanford Site

CBDPP nor the CBDPP Committee provided any guidance or specific expectations or requirements for conducting or documenting the facility assessments. Further, the guidance for completing the assessment form fields provides insufficient specifications for the approach, resources, and required level of detail and documentation, specifically for essential information related to personnel contacted and facility historical usage. The guidance does not specify why personnel are contacted or who should be contacted, and it does not require documentation of what information or input was provided by those who were contacted. Completed MSA assessment forms listed persons contacted but did not identify their input to the assessment. Similarly, for evaluating historical usage, the guidance does not specify potential or required sources or level of effort expected for researching the potential presence of beryllium contamination. Completed MSA assessment forms did not indicate the source(s) or level of effort for the “yes/no” fields regarding past use, storage, and maintenance of beryllium materials.

Although the assessments were completed in late 2009, they had not been finalized or approved by MSA personnel/management as of April 2, 2010, over ten months after issuance of the Hanford Site CBDPP and over six months after MSA assumed responsibility for operations.

In several cases, the recommendations for additional sampling specified on the completed assessment forms had not been performed or did not have mechanisms in place to ensure they were performed, although the facilities were considered by MSA to be “clean.” For example, the recommendation for the B Reactor facility was to retain it as a beryllium-clean facility, but the recommendation to perform additional sampling above six feet had not been performed and there was no established mechanism to ensure this pre-work sampling was performed. For the recommendations on performing sampling and specific controls on maintenance processes for electrical switchgear in the pumphouses, no mechanism was in place to communicate these recommendations to work planners or health and safety professionals, and the cabinets were not posted as potentially contaminated with beryllium. (See Finding #1.)

Consequently, work planning would not have identified beryllium as a potential hazard to be evaluated and controlled in a facility that was classified as clean but lacked sampling in some areas/equipment. As discussed below, MSA work planners considered that the existing lists of beryllium facilities were accurate (they were unaware that these lists had not been maintained and were incorrect), and that the hazard analysis performed by the organizations/facilities “hosting” MSA workers would drive beryllium hazard analysis and controls. Neither of these potential control points would ensure that concerns related to switchgear contamination would be addressed. Cabinets were not posted as potentially contaminated, thus missing a safety barrier for craft workers or planners to identify and evaluate this potential hazard in the future. Further, assessment recommendations related to sampling of switchgear in other facilities were inconsistent with those in the pumphouses. For example, for Building 2102M, the assessment form documents that old switchgear in Room 203 may have contained beryllium alloys but does not recommend sampling prior to future maintenance activities in these cabinets. The “Beryllium Issues with Electrical Switchgear” paper also specifically discusses this room, indicating that some old switchgear had been replaced but that “Continental Electric Co Motor Controller cabinets” apparently contained old, 1950s-era switchgear. This document indicated that the exteriors of these cabinets were wipe-sampled during the current re-assessment (the pumphouse cabinets and switchgear located adjacent to the pumphouse cabinets were not) and were found not to be externally contaminated, but it does not recommend any future sampling or controls during future maintenance (as was performed for the switchgear in the pumphouses). The rationale for the differences in process and recommendations was not documented. These cabinets also were not posted as potentially contaminated. Similarly, the

report and assessment forms for the Hanford primary switching station built in 1944 (251W) stated that although older switchgear was no longer in use in the building (without citing the basis or evidence), the cabinets had originally contained such equipment. Wipe and bulk samples were taken in the room and on the top of switchgear cabinets, and all were less than 0.2µg/100cm² or 2 ppm beryllium. The assessor recommended the facility to be maintained as a “clean” facility, with no recommendations for further sampling or controls when the cabinets were opened. (See Finding #1.)

Building 2102M, which contains shops and offices, is currently occupied by approximately 100 people. This large warehouse, built in the 1950s, contains a very large amount of material and equipment moved from all over Hanford during the past 50 years. Based on information provided by an individual in the warehouse, MSA appropriately performed beryllium wipe samples of a few boxes and pieces of equipment that had been moved from Building 328, a known beryllium-contaminated building. However, no sampling was performed on other material and equipment of indeterminate origin, and the assessment form did not describe any evaluation of the quantity, type, and history of materials relocated to this facility or the rationale and justification for limiting sampling to this one area. (See Finding #1.)

MSA considers the WSCF analytical laboratory to be exempt from 10 CFR 850 and to be governed by the Occupational Safety and Health Administration Analytical Laboratory Standard, 29 CFR 1910.1450. This laboratory processes wipe and bulk beryllium samples for Hanford contractors. Several deficiencies and weaknesses in the laboratory’s processes related to beryllium work were identified by the HSS team as follows:

- Contractors that implement a comprehensive IH program according to 10 CFR 851, Appendix A, are required to perform an initial or baseline survey and periodic resurvey of work areas to evaluate potential worker health risks. MSC-PRO-17916, *Industrial Hygiene Baseline Hazard Assessments*, identifies that chemical products designated as an occupational carcinogen are to be included in the facility baseline. An examination of the IH Baseline Hazard Assessment, dated July 14, 2008, for WSCF Laboratory (Building 6266) rooms N12, N15, and N16, where beryllium standards (10,000 ppm) and samples are handled and prepared for analysis, did not identify beryllium as a potential hazard. Because the beryllium standards would be classified as a carcinogen, per the definition contained in MSC-RD-10994, *Occupational Carcinogen Control*, and 29 CFR 1910.1450, beryllium should be included in the hazard baseline.
- Contractors are required per 10 CFR 851.21 to identify and assess potential workplace hazards and, according to 10 CFR 851.21, Appendix A, and 29 CFR 1910.1450(g)(3), to provide this information for each employee to the occupational medicine provider. MSA implements these requirements using the EJTA process. The EJTA’s for the four employees who routinely prepare and analyze beryllium samples inappropriately did not identify the potential beryllium hazard. Laboratory personnel indicated that because chemical fume hoods and personal protective equipment are used during sample handling and analysis, exposures are controlled, and therefore beryllium would not be required to be identified on the EJTA; however, this perspective is incorrect because integrated safety management dictates that all potential hazards and necessary controls need to be identified. The adequacy of existing controls could then be evaluated for sufficiency.

Work Planning and Control. MSA has determined that all of the facilities for which they are designated as landlord are beryllium “clean” facilities and has formal memoranda of agreement with WCH,

CHPRC, and WRPS that address the expectations for work authorization; integration of environment, safety, and health (ES&H) requirements into work planning and execution; and the supervision of the performance of work. These memoranda of agreement specify that formal statements of work detail responsibilities for the day-to-day supervision of the work (MSA or the host contractor) and task-specific ES&H requirements, and that work will be authorized (released) by the facility where the work is to be performed. However, these interfaces and expectations have not been formally defined or detailed in MSA procedures. In practice, most MSA work in other facilities is managed/supervised by the hosting contractor personnel and processes (e.g., beryllium work permits.) Thus, at the time of this inspection, MSA had performed no work planning that identified beryllium as a hazard, but MSA employees have performed work in beryllium-controlled facilities and areas with host contractor-specified controls.

MSA work control processes, as detailed in MSA-PRO-12115, *Work Management*, and MSA-PRO-079, *Job Hazard Analysis*, provide for identification of beryllium hazards and controls in MSA-developed work documents. Work control for activities in MSA-controlled facilities, called “Managed Tasks,” involves various planning elements, including skill-based “Minor Work Tickets” or “No Planning Required” packages or planned work documents (for which an automated job hazard analysis, or AJHA, is completed). However, the linkage to identifying beryllium as a hazard is not always clear, as reflected by the lack of formal information related to the potential beryllium contamination of electrical breakers or crane rail and brake surfaces.

Five MSA organizations that provide services to other contractors (facilities maintenance, electrical utilities, security maintenance, Hanford Fire Department test and maintenance, and Lockheed Martin Information Technology computer field services) each have their own planning staff and work with pre-approved work documents, such as preventive maintenance instructions, or develop case-specific procedures. In addition, some MSA personnel, called “loaned labor” (e.g., truck drivers) support other contractors without MSA-prepared work documents. The process used for communicating with the hosting contractor is different for each of the above listed five groups and is not defined in MSA procedures or contractor interface agreements/documents. During interviews, planning personnel in several of these groups referenced the use of the lists of beryllium-contaminated or potentially contaminated buildings provided on the Hanford website as the source of information regarding beryllium exposure. As previously detailed, these lists are outdated and incorrect. Hanford Fire Department personnel do not have access to individual contractor facility beryllium inventories but rely on the inventory listed on the Hanford website to determine the status of the facility. In addition, Hanford Fire Department personnel, who would be required to respond in an emergency, were not aware of the CHPRC facility posting requirements for buildings designated as interim status. In all cases, the final barrier to ensuring that work is adequately controlled is the formal work release by the host organization.

Although MSA is almost entirely dependent on other contractors to ensure that their workers are protected from beryllium exposure through planning, work release, or proper posting (a final barrier that a worker can use to avoid errors), the HSS team did not identify any significant vulnerabilities as long as the host contractor processes are adequately defined and implemented. However, MSA’s oversight and monitoring of these processes is somewhat problematic because they perform this work for others. MSA was unable to identify work packages, developed internally, that addressed beryllium as a hazard to MSA workers. The team identified one example of a work package from 2008 for deactivating fire alarm systems in Building 324, a building with known beryllium contamination. This work package contained no AJHA and made no reference to beryllium as a hazard for this work. The lack of awareness

of current beryllium information, the inconsistent and informal processes, and the reliance on host organizations to identify potential beryllium exposures represent a vulnerability for MSA workers for inadvertent, uncontrolled exposure to beryllium. (See Finding #4.)

The MSA work control procedures contain out-of-date, incorrect, and misleading information that presents vulnerabilities to work planning involving beryllium. Appendix J, “Beryllium Suspect Buildings” of the Work Management procedure (issued in December 2009) does not adequately reflect the requirements of the Hanford Site CBDPP issued seven months earlier, and it provides links to incorrect information regarding beryllium-contaminated buildings. This procedure references the outdated CBDPP adopted by MSA (MSC-PRO-6155) instead of the current Hanford Site CBDPP, and also references developing beryllium exposure assessments (BEAs) instead of beryllium work permits and allows use of a “standing AJHA” in lieu of the BEA if working conditions have not changed. This procedure also provides a link to a list of MSA-controlled “facilities where beryllium may still be present,” which is the old, incorrect/outdated list of Fluor Hanford beryllium facilities. Similarly, a link is provided to a list of facilities where beryllium may be present for buildings not under MSA authority, which is also incorrect and outdated.

Furthermore, the recently revised guidance information in the AJHA tool, used by both MSA and CHPRC, contains several substantial errors related to beryllium hazards for “potential disturbance of beryllium containing dust or movement of beryllium containing equipment/component.” The Hazard Mini Help screen for this hazard provides three tables of facilities that have known or probable contamination, beryllium storage only, and “Exposure unlikely except for invasive work, Decontamination and Decommissioning, Bldg modification, etc.” These tables are inaccurate and incomplete. For example, seven buildings CHPRC has currently classified as beryllium-controlled facilities are not in the tables, and 21 buildings classified by CHPRC as “interim” buildings needing further characterization are not in the tables. The source of the data is not specified, and no method for keeping it current has been established. Another AJHA help screen incorrectly states that “beryllium contaminated areas are posted with ‘beryllium Caution Signs’ when the building is a beryllium Controlled Facility.” Contaminated areas would be posted with Warning Signs per the Hanford Site CBDPP. This last screen also incorrectly states that a beryllium work permit “must be completed, approved, and available prior to performing any work at the facility.” The work permit would only be required for work in the beryllium-controlled area, per the Hanford Site CBDPP. (See Finding #4.)

Medical Surveillance and Counseling. The Hanford Site CBDPP, Section 6.27.2, and 10 CFR 850 require contractors to provide counseling for beryllium-affected workers. MSA has assigned an individual in the Human Resources organization to be responsible for the required counseling and has established a number of online and handout materials that address the various specified elements of counseling. The person delegated to provide this counseling has prepared packages of important information to discuss and give to referred personnel and is experienced in workers compensation rules and case management. No MSA workers have been diagnosed with beryllium sensitivity or chronic beryllium disease (CBD) since June 2009, so this process has not yet been applied.

Although the medical surveillance and counseling element of the CBDPP has not been applied to date by MSA, there are several weaknesses and discrepancies in this area of MSA’s implementation of the CBDPP. The designated counselor was not aware that a sitewide CBDPP had been issued. The counselor had taken the beryllium worker course in the past but had not taken the computer-based “gap” training

that addresses the new CBDPP. Several incorrect and outdated documents and information were listed on MSA beryllium counseling websites and resource links, and in the information package. The MSA website links to the outdated Fluor Hanford policy on minimizing beryllium exposures, which still refers to beryllium “assigned workers,” incorrectly states that there are no beryllium workers because beryllium metals are not being worked with, refers to exposure assessments rather than beryllium work permits, and states that exposure is low because of short duration or infrequent exposure (when, in fact, sensitization or CBD could result from one, instantaneous exposure). The outdated Fluor Hanford/MSA CBDPP is also referenced on the website, in the handout material, and on the counseling checklist instead of the Hanford Site CBDPP. A boilerplate letter offering counseling makes reference to “assigned workers” and a beryllium sampling program that was being performed in 2008.

MSA has also designated an individual as a beryllium employee advocate to provide a resource for information and assistance in dealing with concerns and issues related to beryllium exposure and health issues – a role established in agreement with the BAG many years ago. This individual, who has been performing in this function since the contract change in August 2009, considers the position’s primary duty as helping MSA workers with any problems related to beryllium, specifically mentioning compensation, travel, and workers compensation issues. The advocate indicated that he/she had participated in the CBDPP “pilot” HAMMER Beryllium Worker Training, regularly attended CBDPP meetings and BAG meetings, and strived to project a caring and interested attitude about helping MSA employees with beryllium-related problems. However, the advocate was unaware of the specific roles and responsibilities for the employee advocate and unaware that those roles and responsibilities were listed on the Hanford beryllium website. Although the MSA advocate has had only limited interaction with company workers in this role, MSA has provided little advertising of this resource – only a name, title, and phone number on several websites and listing as a contact person in a recent special safety bulletin.

Training and Qualification. Section 6.27 of the Hanford CBDPP requires that all employees receive the appropriate level of training on the hazards of beryllium based on the worker’s current and past beryllium activities. As of April 2, 2010, all MSA designated beryllium workers and all MSA affected workers had completed the computer-based gap training.

However, beryllium sampling at MSA facilities is performed by industrial hygienists, and only three of the nine industrial hygienists on the MSA staff had completed beryllium training on CBDPP as beryllium workers. In addition, the subcontractor industrial hygienist, who performed the re-baseline facility assessments and all characterization wipe and bulk sample surveys for MSA, had not attended beryllium training and was not considered a Hanford beryllium worker as required by the CBDPP. (See Finding #2.)

Work Management procedure MSA-PRO-12115 specifies that, as part of the pre-job briefing, the field work supervisor or “Person In Charge” is to confirm worker training and qualification “using available tools” or verify that this was already confirmed by support staff. However, the available tools are not identified for Computerized Maintenance Management System planned work, and the methods for verifying medical qualification status are not defined and communicated.

The Beryllium Worker Training course provided by MSA at HAMMER is comprehensive and well presented, and contains the appropriate level of detail to address the training needs of beryllium workers

at Hanford. The course has been recently updated to encompass the changes resulting from the new CBDPP and to incorporate some new and corrected information. Further revisions are planned in the near future, including correction or clarification of some erroneous or misleading information and inclusion of a recent video from a previous Hanford worker with CBD, describing the effects of the disease. The course includes practical exercises pertinent to beryllium workers, such as working through the planning of a beryllium work permit for a hypothetical beryllium job. As mentioned above, a small amount of erroneous or misleading information was discovered in the Beryllium Worker Training materials during this inspection. However, the HAMMER training organization was responsive to the comments, and the review of Beryllium Worker Training content by the CBDPP Committee should further ensure the factual accuracy of the course.

The beryllium awareness training in the web-based GET provides an appropriate level of general awareness about beryllium hazards and controls. Since all site workers are required to take GET, this information is widely disseminated to the workforce. Although the current content of GET has not yet been updated to reflect controls in the sitewide CBDPP, revisions to reflect these changes are scheduled to be completed by the end of June 2010, and the existing content meets the intent of training material for non-associated beryllium workers at the Hanford Site.

Although no major deficiencies were noted in the course content and presentation currently provided by HAMMER, several deficiencies existed in that several categories of personnel are required to receive training tailored to their needs, but this training has not been provided as further described below.

Contractors are required to ensure that all beryllium-associated workers receive specific training specified by 10 CFR 850. However, the only course containing the specified training is the beryllium worker course. Other categories of workers not receiving the required training include current workers whose work history indicates actual or potential beryllium exposure, current workers showing signs or symptoms of beryllium exposure (affected workers), and current workers receiving medical removal benefits (also affected workers). These categories of workers may not need the extensive beryllium worker training, but they are required to receive more training than that provided in GET for non-associated workers. (See Finding #2.)

In some cases, workers with beryllium program responsibilities are not provided with the training they need in order to carry out those responsibilities as required by 10 CFR 851.25, *Worker Safety and Health Program, Training and Information*. Title 10 CFR 851 states that “contractors must provide training and information to workers who have worker safety and health program responsibilities that is necessary for them to carry out those responsibilities.” Several categories of workers have specific responsibilities in the Hanford beryllium program, but are not specifically trained. Examples include personnel providing direction and information to beryllium workers, such as managers; supervisors; work control planners and Persons In Charge; ES&H personnel, such as industrial hygienists and industrial hygiene technicians (IHTs); and Human Resources and employee concerns program personnel who deal specifically with personnel issues associated with beryllium. In addition, industrial hygienists and IHTs perform sampling activities in uncharacterized areas, which could potentially disturb surface contamination, causing it to become airborne; however, for some Hanford Site contractors, their training plans do not require Beryllium Worker Training, and in many cases, they are not current in such training. (See Finding #2.)

Finally, although HAMMER receives feedback on training programs through many avenues and maintains an internal tracking system, they do not have a mechanism to track the feedback provided by class attendees or other external reviewers, and to formally respond with disposition of comments. This lack of communication tends to foster misunderstanding and mistrust. For example, many comments have been provided by the BAG and addressed by the HAMMER training department; however, the BAG members were not aware of whether or when their comments were addressed.

Feedback and Improvement. The HSS team conducted a focused review of: assessment activities performed by MSA and its predecessor, Fluor Hanford; employee concerns reported by Fluor Hanford or MSA workers; and the management of issues occurring during the past seven years relating to the beryllium program and its implementation. The HSS review focused solely on identifying and characterizing the types of beryllium-related issues that had been previously identified for comparison to current conditions, and identifying the level of oversight effort; it was not a comprehensive evaluation of the adequacy of the MSA feedback and improvement programs.

The previous contractor conducted about one assessment or surveillance activity per year related to beryllium, since 2003. Although MSA has not performed any assessment activities under their contract, a program assessment is scheduled for the fourth quarter of fiscal year 2010. No specific assessment of the Hanford management contractor implementation of the CBDPP has been performed since July 2008.

The previous contractor conducted program reviews in 2005 and 2008. These were limited in scope and/or insufficiently rigorous. The 2005 assessment primarily described processes, without assessing quality or implementation (e.g., a discussion of the AJHA and EJTA processes but no reviews of work or adequacy of these documents). The 2008 assessment was limited to determining whether conditions noted in a safety advisory issued by DOE Headquarters existed at Hanford and, if so, whether they were adequately controlled. These assessments identified no findings.

More focused assessments of training and the medical removal process, and the decontamination and decommissioning BEA process, were conducted in 2005 and 2007, respectively. These assessments identified deficiencies in work controls (AJHAs and BEAs), training, and inadequate procedures for medical removal. The assessments resulted in corrective action plans. With the exception of weaknesses in work planning and control, no trends or major programmatic deficiencies were identified by contractor assessment activities.

No concerns related to beryllium have been reported to the MSA formal employee concerns program since the beginning of their contract. Between 2004 and 2008, nine formal employee concerns related to beryllium were reported. Four of the concerns reported in 2004 related to the shipment of potentially contaminated equipment off site from Building 272W. Three concerns were related to time off and overtime when working with beryllium. One case related to concerns about potential ground contamination downwind of buildings undergoing demolition in the 300 Area, and one concern related to changing personal protective equipment and other controls in Building 313. With the exception of concerns related to the 2004 issue, which resulted in an extensive investigation and sampling program in Building 272W, no discernable trends or notable beryllium safety issues were reported.

E.3 Summary

Implementation of the Hanford Site CBDPP is ongoing, but has not met the expectations for completion of certain criteria by January 1, 2010, identified in an October 1, 2009, letter from RL. The re-baselining of MSA facilities was generally conducted in a conservative and rational manner. However, MSA conducted no gap analysis between MSA policies, procedures, and practices and the Hanford Site CBDPP issued in May 2009, nor did it develop an implementation plan with action items and completion schedules to monitor implementation. Facility assessment reports for the required re-baselining of facilities had not been finalized or approved by MSA management as of the end date of this HSS inspection. The completed assessment reports contained a number of errors and inconsistencies. In addition, numerous procedures, revised or issued after publication of the Hanford CBDPP, contained errors or referred to outdated materials, thereby providing misinformation regarding the CBDPP. Several MSA websites contained or linked to documents that contained erroneous or outdated information regarding the CBDPP. Requirements and processes for some elements of the CBDPP are not addressed by MSA procedures. Lists of beryllium-contaminated or potentially contaminated buildings for the Hanford Site, which are required to be maintained by MSA, have not been developed.

MSA has established work control procedures and processes that address the identification and control of beryllium hazards, although these procedures also reference incorrect or outdated information that could be relied upon by work planners. Although re-baseline assessments have identified few potential exposures to beryllium in MSA-controlled facilities, MSA employees performing a variety of services in buildings controlled by other Hanford contractors are at some degree of risk and vulnerability for beryllium exposures. Beryllium hazard identification, analysis, and control have been essentially delegated to the contractors who use the services of MSA personnel to perform maintenance, inspection, and support services. Training and counseling of affected beryllium employees are generally adequately performed, although outdated materials are also referred to in counseling and advocacy programs. Some assessments of the beryllium program and its implementation were performed by the previous Hanford management contractor, but few issues were identified. Other than some work control deficiencies, the results of the Fluor Hanford assessment activities do not substantially relate to the deficiencies and weaknesses noted in the implementation of the current CBDPP.

E.4 Opportunities for Improvement

1. Develop and implement a comprehensive beryllium program implementation plan. Specific actions to consider include:

- Conduct a formal gap analysis to identify all actions required to implement the Hanford Site CBDPP and contractual requirements related to the CBDPP, prioritize the actions, and establish milestones and responsible parties. Maintain the implementation schedule to completion.
- Establish a procedure and communicate expectations to other Hanford contractors for developing the required beryllium facilities lists, including interim controls for maintenance, publication, and use of these lists pending completion of re-baselining and characterization activities.
- Consider evaluating the application of the exemption for the WSCF laboratory with a particular focus on the worker protection and medical rights (e.g., are WSCF workers covered by the beryllium rule protections for workers, such as the medical removal protection benefits), and

evaluating the potential benefits (e.g., consistency across the site) of covering all workers under the CBDPP.

2. Finalize and approve the baseline beryllium contamination reassessment reports for MSA facilities. Specific actions to consider include:

- Review and correct errors and omissions. Clarify inconsistencies in sampling and recommended controls for electrical switchgear with potential for beryllium contamination.
- Address the recommendations for additional sampling at Building 105B.
- Conduct a review of materials moved from other Hanford facilities to storage in the 2102M warehouse, and conduct additional inspection and sampling for beryllium contamination.
- For facilities that contain electrical switchgear cabinets that are considered to be potentially contaminated internally with beryllium but that have not been surface sampled internally, either (1) re-categorize and post the facilities as beryllium-controlled facilities or (2) conduct timely internal characterization sampling of suspect cabinets.
- Revise assessment reports to reflect the level of effort and source of information reviewed regarding past practices that reflect the use of beryllium materials in MSA facilities, and identify the information obtained from interviews with individuals cited on the assessment form.
- Have the designated beryllium program manager and/or the manager of safety and health formally approve and sign all final assessment forms and reports.

3. Promptly develop and implement additional controls to ensure the adequacy of work planning related to beryllium exposures. Specific actions to consider include:

- Issue a directive to all MSA planning personnel and other contractors stating that previously-published lists of beryllium-contaminated or potentially contaminated buildings are in error and are not to be used as a basis for work planning without confirming current classifications and status with the contractor's beryllium program subject matter expert or an official current contractor facility classification listing.
- Establish formal and consistent methodologies for all MSA organizations to coordinate work planning activities for MSA employees who provide services or conduct inspections and tests in facilities controlled by other contractors. Establish some mechanism for MSA review and oversight of work planning conducted by other contractors for work performed by MSA employees.
- Establish a formal process to address the controls needed to perform maintenance on electrical switchgear, switchgear cabinet internals, and overhead crane equipment or maintenance in other areas (e.g., Building 105B above six feet) that have a potential for beryllium contamination. Pending internal sampling, consider posting electrical switchgear cabinets that contain (or previously contained) breakers that may have had beryllium-containing components as "potential beryllium internal contamination" to provide another barrier protecting maintenance workers.

- Require work supervisors, work planners, and IH personnel to attend Beryllium Worker Training, and require the beryllium health advocate and personnel responsible for counseling beryllium-affected workers to attend additional training on CBDPP requirements beyond GET.
- Focus the attention of the upcoming CBDPP assessment on work control and protection of MSA workers from inadvertent exposure to beryllium.

4. Prioritize the review and updating of all procedures, guidance, and website information related to the CBDPP. Specific actions to consider include:

- Conduct a formal review of all MSA and Fluor Hanford websites to identify and correct or remove outdated or erroneous material related to the CBDPP.
- Conduct a formal review of all MSA procedures and guidance documents to ensure that beryllium-related information conforms to current CBDPP requirements and information.
- Prioritize the updating of the MSA CBDPP description document to conform to DOE-0342 or develop a Hanford Site CBDPP implementation procedure and cancel the contractor CBDPP.
- Develop technical instructions for conducting IH sampling and personal monitoring.
- Advertise the beryllium employee advocate resource in a dedicated article in a MSA company publication to introduce the advocate and associated roles and responsibilities to better communicate this function to MSA workers.
- Update EJTA's of WSCF employees who handle beryllium samples to include beryllium as a work hazard, and evaluate existing controls for adequacy.
- Update WSCF IH Baseline Hazard Assessment to identify beryllium as a potential hazard.

5. Develop and implement training courses targeted to beryllium-associated workers other than beryllium workers as defined in 10 CFR 850. These work groups include current workers whose work history indicates actual or potential beryllium exposure, current workers showing signs or symptoms of beryllium exposure (affected workers), and current workers receiving medical removal benefits (also affected workers).

6. Ensure that all workers, support staff, and supervisors receive the appropriate beryllium training to enable them to effectively perform their jobs as required by applicable regulations. Specific actions to consider include:

- Consider requiring the all personnel directly or indirectly associated with beryllium work or beryllium workers to attend Beryllium Worker Training to ensure that they understand the roles, responsibilities, and expectations for beryllium workers. Ensure that personnel, such as planners; Persons In Charge; first line supervisors; ES&H support staff (including industrial hygienists and IHTs); and Human Resources and employee concerns program personnel are included.

- Consider revising, updating, and/or establishing a training course for supervisors and managers to be presented in addition to the Beryllium Worker Training course to ensure that they are aware of the procedures and processes for addressing the needs of beryllium-affected workers, as well as all employees with medical restrictions.
- 7. Improve communications between the HAMMER training organization and outside organizations by facilitating the sharing of comments or concerns with training courses.** Consider implementing a formal feedback mechanism where individuals with comments or concerns can submit written feedback. Ensure that the process includes a feature to provide communication back to the originator on the disposition of the comments, if requested by the originator.
- 8. Increase efforts to ensure that beryllium training course content is factually accurate.** Ensure that the following items are corrected or otherwise revised as needed in the course materials:
- Accurate discussion of beryllium particle characteristics and mechanism of biological effects in the lungs.
 - Accurate representation of the number of beryllium-affected employees. In revising this information, MSA and HAMMER should consider and address concerns expressed by workers about past approaches for presenting such information (e.g., higher risk categories of longer term workers potentially being masked by large numbers of tests of newer employees, insufficient information about specific types of workers, such as electricians, instead of combining all craft workers into one group). In this effort, MSA should consider presenting high-level summary information during the training, but also working with AdvanceMed Hanford to develop more detailed information for employees who request more detailed information.
 - Accurate representation of the different types of beryllium areas and facilities.
 - Accurate representation and description of the current posting and labeling required by the Hanford Site CBDPP.
 - Accurate, but simplified description of the AdvanceMed Hanford flowchart for beryllium lymphocyte proliferation test results.
 - Accurate, but simplified presentation of current beryllium exposure, release, and contamination limits, both regulatory and administrative.

Appendix F

Washington Closure Hanford

F.1 Introduction

Since 2005, Washington Closure Hanford (WCH) has been the River Corridor Cleanup Project contractor for the U.S. Department of Energy (DOE). The scope of the contract includes: demolishing hundreds of excess facilities in the 100 Area, 300 Area, and 400 Area; cleaning up waste sites and burial grounds; placing deactivated plutonium production reactors in safe storage; and managing the Environmental Restoration Disposal Facility (ERDF). Many of the past beryllium activities at the Hanford Site occurred at the 300 Area, which is one of the WCH areas of responsibility.

Because past operations in some of the facilities involved the use of beryllium, the potential for worker exposure to beryllium is a recognized hazard. WCH is currently implementing the May 2009 Hanford Site chronic beryllium disease prevention program (CBDPP) and WCH-specific procedures, which flow from the sitewide CBDPP. WCH also applies the CBDPP requirements to subcontractor activities and, prior to the start of this inspection, had issued a change notice to subcontractors that outlined the revised program requirements.

In many respects, the transition to the Hanford CBDPP will not result in substantive changes to the way WCH manages beryllium hazards because the provisions of the Hanford CBDPP are similar to provisions that WCH had been using. WCH activities to implement the Hanford CBDPP are focused on replacing signs/labels for sitewide consistency, reformatting beryllium work permits (BWPs) to the standardized format, updating building assessments, and conducting limited additional sampling to improve building characterizations. WCH is making progress toward completing these implementation activities.

The DOE Office of Health, Safety and Security (HSS) team assessed the adequacy of the WCH beryllium program through interviews, document reviews, and field observations. The inspection focused on current procedures and practices for controlling worker exposures to beryllium. Activities conducted by the team during this inspection, with respect to the beryllium program, were as follows:

- Interviewed workers: six WCH workers who requested an opportunity to provide their perspectives on the program; a variety of WCH personnel responsible for various elements of the CBDPP (including program management, facility assessment and characterization, and work planning and control); Hanford Atomic Metal Trades Council safety representatives; Beryllium Awareness Group representatives; a subcontracting technical representative supervisor; and a DOE Richland Operations Office (RL) representative.
- Toured facilities and observed work: several characterized buildings, work observations at locations in the 100/300 Areas and ERDF, and review of postings and labeling at various locations.
- Attended meetings: pre-evolution meetings in the 100 and 300 Areas, all-hands weekly safety meeting, 10 to 6 (plan of the day) meetings, Beryllium Awareness Group meeting, and the Hanford CBDPP Committee meeting.

- Reviewed documents: implementing schedules and procedures, correspondence, work control packages and work permits, training records and documents, sample plans and results, facility assessment forms, and characterization reports.

F.2 Results

Program Management. WCH submitted a CBDPP implementation schedule as part of its submittal to RL of a Request for Equitable Adjustment. The adjustment requested additional funds to implement the new sitewide CBDPP. Based on the Request for Equitable Adjustment approval date, the scheduled completion date for implementing these actions was April 30, 2010.

Currently, WCH is operating under a detailed schedule for implementing specific parts of the program. Specific items identified and tracked include updating facility assessments and characterization, revising the WCH beryllium procedure, procuring and installing new beryllium-related signs and labels, developing a briefing package for Human Resources to provide to affected workers, setting communication milestones, and ensuring that all beryllium workers complete the Beryllium Gap training.

Inventory, Interim Controls, and Characterization. Assessment and characterization of facilities under WCH control are generally conducted in accordance with the sitewide CBDPP. WCH uses bulk sampling results for this process instead of relying on historical records/interviews. Most of this effort is complete, with additional sampling identified and in progress at 22 facilities. The majority of samples currently collected for building characterization are bulk samples because of the amount of settled dust. The sampling plans call for collecting a substantial portion of the samples from locations above 8 feet.

Although most sampling currently conducted consists of bulk samples because of heavy dust accumulation in the buildings, the revised characterizations incorporate prior characterizations by reference. These prior characterizations include a data mix of wipe and bulk sample results. Based on a review of several updated characterizations, the characterizations are generally complete and thorough.

A review of a sample of characterizations indicated that WCH has been proactive in conducting additional characterization sampling when issues are identified. For example, an initial characterization of Building 337 was updated in 2007 to include additional sampling near overhead cranes following a lesson learned from the Pacific Northwest National Laboratory (PNNL) that indicated that these may be a source of beryllium contamination. As part of the current re-characterization effort, Buildings 151B, 151D, and 4734B were identified as needing additional sampling in electrical switchgear areas because of their potential as a source of beryllium contamination.

In addition, WCH periodically conducts random bulk sampling in facilities characterized as “clean” as an additional check. During this HSS inspection, one of these samples collected in Building MO425/426 exceeded the 2.0 ppm limit established by the sitewide CBDPP. WCH quickly initiated action to protect workers (see “Work Control/Posting” section for details) and to conduct additional re-characterization sampling in this building. This re-characterization effort was ongoing at the end of the HSS site visit.

Although most of the assessments and characterizations that were reviewed demonstrated a proactive and responsive effort, in one case, an assessment and characterization did not fully meet the sitewide CBDPP requirements. The February 2010 assessment for Building 309 identified the facility as a

beryllium-clean facility based on the characterization that was last updated in December 2008. That characterization included a wipe sample result of 0.26 $\mu\text{g}/100\text{cm}^2$, which exceeds the 0.2 $\mu\text{g}/100\text{cm}^2$ established in Appendix A of the sitewide CBDPP. The sitewide CBDPP provides three options for declaring a survey unit clean if one or more wipes exceed the limit; however, the characterization simply discounts this result as evidence of background contamination. Although the characterization pre-dates the sitewide CBDPP, the current assessment did not resolve this wipe sample that exceeded the criteria following one of the approved options. Also, the assessment and characterization both identified the potential for beryllium contamination in inaccessible areas that could not be sampled; however, the assessment identifies the facility status as beryllium-clean, which is contrary to the sitewide CBDPP definition. WCH will conduct additional sampling of the previously inaccessible areas and in the vicinity of the elevated wipe sample results to update the characterization.

In addition, although WCH is conducting facility characterizations in accordance with the Hanford Site CBDPP, these characterizations may be impacted by the general concern on how the sitewide program accounts for naturally-occurring beryllium from background soil. (See Appendix H, Section H.2.1.)

Work Control/Posting. The inspection examined implementation of work controls at the 300 Area, the 100 Area, and the ERDF.

300 Area. WCH conducts beryllium-related work in the 300 Area under a BWP that does not follow the format required under the sitewide CBDPP; however, a cross-walk between the existing BWP and the new format confirmed that the existing BWP includes most of the required elements. There are minor differences in the level of detail, such as point-of-contact information, references to a WCH procedure for waste handling in lieu of specific requirements on the BWP, and outdated posting requirements. The Beryllium Program Manager indicated that WCH will need to develop multiple BWPs when the general BWP is converted to the new format. At the time of the HSS inspection, WCH was working to develop a draft of the first BWP in the new format to use as a model for developing the remainder by the scheduled April 30, 2010, completion date. To meet the requirements of the sitewide CBDPP within the 300 Area, WCH personnel correctly indicated that BWPs will be needed for work activities conducted in the posted beryllium-controlled areas (BCAs), such as Building 308, Building 324, and multiple conex boxes housing unlabeled beryllium-contaminated tools and equipment, as well as for accessing the site of former Building 321 and any other locations identified as BCAs or beryllium-regulated areas (BRAs).

For work conducted within BCAs, WCH has implemented effective mechanisms to define the scope of work activities, ensure worker involvement and solicit worker feedback, and protect workers from a variety of hazards within the BCAs. A general health and safety plan has been developed for work within the 300 Area project zone, and all personnel must be briefed on the contents before receiving authorization to enter. For work activities involving BCAs or BRAs, the Beryllium Program Manager is included as a team member in the development of activity hazard analyses and work planning activities.

Before the start of work activities each day, pre-evolution briefings were conducted for work activities planned for the Building 308 and 324 BCAs. These pre-evolution briefings included a review of the BWP, job hazard analyses, and, where applicable, the radiation work permit. The briefings addressed a variety of issues, such as personal protective equipment (PPE) and respiratory protection requirements, work practices, waste handling requirements, radiological controls, and a variety of general safety issues.

There was good participation by employees, including requests for clarification of some information.

However, current controls are not always sufficient to prevent the potential spread of beryllium contamination beyond the boundaries of the established BCAs. Within the 300 Area, this situation was most evident for work in the Building 324 BCA, which encompassed a portion of Room EDL-102. For example (see Finding #4):

- Within EDL-102, a portion of the room was excluded from the BCA by a rope marking the perimeter, although level 2 tasks (potentially dust-producing) were conducted in the BCA that could potentially contaminate areas outside of the BCA. After discussion of this issue, WCH was considering isolating this area by constructing a critical barrier (such as plastic sheeting over studs) and decontaminating that limited area.
- The HSS team questioned the lack of specific requirements or guidance for downgrading a BCA after performing level 2 tasks (i.e., dust-producing activities) requiring respiratory protection. For example, after dust-producing activities are performed, there was no guidance for determining when workers could again enter a BCA without the need for respirators. After this issue was raised, WCH determined that, based on historical air monitoring and appropriate settling time, the BCA could be downgraded one complete work shift following the end of level 2 activities. Following discussions with the inspection team, WCH also decided to include additional information on the BCA posting to clarify whether workers needed respiratory protection for entry.
- Workers used the entry area to the BCA as a PPE doffing area, but this area was external to the BCA. Although WCH deemed this area to be potentially contaminated, the perimeter was marked by a rope and table, with no posting that the rope demarcated an area with potential beryllium contamination. After discussion with the inspection team, the WCH relocated the BCA postings to the rope/table perimeter.
- Within the entry area to the BCA, several trash receptacles were used to collect potentially contaminated PPE, such as gloves and disposable coveralls. These receptacles were not labeled to indicate that the contents and the receptacle surface may be beryllium-contaminated. WCH subsequently labeled these containers as “Contaminated with Beryllium.”

WCH has initiated installation of revised postings and labeling in accordance with the sitewide CBDPP, and was working to complete the effort on an accelerated schedule. The revised BCA and beryllium-controlled facility postings were installed on all exterior doors of Building 308 that could potentially lead to the BCA. Most entrances to Building 324 were also appropriately posted, with the exception of one door that was identified for posting but was missed and one additional door that should have been posted but had not been identified for posting. These postings were corrected by WCH. In addition, most of the larger pieces of equipment that WCH identified as potentially internally beryllium contaminated were labeled appropriately. However, there were instances where posting and labeling did not fully meet the requirements of the sitewide CBDPP, including (see Finding #4):

- Labeling of some equipment had not been updated. A large negative air machine in Building 327 was labeled with an old beryllium material storage area label. Two Genie lifts outside of Building 327 were posted with old beryllium contamination labels, and one lift also was wrapped with a rope holding a beryllium material storage sign.

- The site of former Building 321 was posted with old signage around the perimeter. Numerous postings at this site need to be replaced.
- Numerous pieces of beryllium-contaminated equipment are stored in multiple conex boxes. The boxes were posted with old signs as either BCAs or beryllium material storage areas, but they require updated BCA postings. The contents of the boxes are not labeled as contaminated; individual labeling of these items is not required under the sitewide CBDPP until they are relocated from these boxes.
- Beryllium-controlled facility signs have not been posted on the entrances to Building 309. Posting is required under the sitewide CBDPP for two reasons. First, the characterization includes a sample exceeding the 0.2 µg/100cm² limit that has not been appropriately resolved. Second, the characterization identifies that some inaccessible areas “have not yet been characterized and are still considered potentially contaminated.”

WCH routinely performs personal air monitoring to measure airborne beryllium concentrations in the worker’s breathing zone during activities that may disturb beryllium contamination, such as work activities in BCAs/BRAs and during bulk or wipe sample collection. The results of this monitoring are posted in Building MO270, which is accessible during normal working hours. Employees are assigned unique identification numbers to protect their identities on these postings. However, based on discussions with some employees, not all current employees are aware that these results are posted for their information.

100 Area. One WCH work activity was observed in the 100 Area during this inspection. The activity involved the collection of additional characterization samples in Building MO425/426 (Industrial Hygiene Tech Facility). Because an earlier bulk sample from above the ceiling in this building exceeded the background level of 2.0 ppm, WCH had established the building as a BCA and quickly developed a work package to conduct this activity. As a part of this work activity, industrial hygiene technicians (IHTs) conducted bulk sampling in accordance with an approved sampling plan that randomly selected several ceiling tiles for sampling throughout the ten rooms in the building. Various ceiling tiles had to be moved to allow the sampling – a dust-producing activity, requiring the use of respiratory protection, coveralls, nitrile gloves, and shoe covers within the BCA. The area was posted as a BCA, and a doffing exit point was roped off in the rear of the building. Positive observations during this work activity include:

- The pre-evolution briefing was effective, and key tasks were discussed. The supervisor was very careful to ensure that ladder safety was understood and that each worker watched out for co-workers’ safety, such as noting fatigue. There were provisions for a two-hour check point for individuals continuously in respiratory PPE. The briefings emphasized that individuals needed to exit the area immediately if any tear occurred in their coveralls.
- During observation of the work activity in the BCA, the HSS team noted that workers were careful about ladder safety and routinely checked other workers’ coveralls for tears. In one case, a tear was discovered, and the individual immediately exited the area.

- IHTs were careful to identify bulk samples by sample location. As an added control, the unique sample cassette number was written on the ceiling tile where the sample plan number had been identified. Also, the IHTs took photographs of the ceiling tile after sampling had been completed.
- Industrial hygiene coverage for the work activity was thorough.

Although most aspects of the work activity followed the requirements of the sitewide CBDPP, there were two concerns about this activity that are similar to concerns identified in the 300 Area. First, the PPE doffing area was outside of the building and beyond the BCA boundary. Following discussions between the inspector and WCH staff, the doffing process was modified to minimize the potential for spreading contamination beyond the BCA boundary. Second, the BWP developed specifically for this activity did not meet some requirements of the sitewide CBDPP. Although the existing BWP in the package addressed most of the required elements, it did not completely cover some of the areas required by the CBDPP, including industrial hygiene coverage and sampling. This limitation had little direct impact on this particular work activity because, although not fully defined in the BWP, the applicable requirements were met because of the nature of the work (i.e., the work was performed by industrial hygiene personnel, so there was continuous industrial hygiene coverage of the work; the full range of sampling was conducted; and the pre-evolution briefing discussed the sampling). (See Finding #4.)

Environmental Remediation Disposal Facility. ERDF is a state-of-the-art waste landfill on the Hanford Site used for disposal of radioactive and beryllium-contaminated soil and debris from building demolition and soil remediation projects. As a WCH-operated facility, ERDF operations are subject to the CBDPP requirements. Because beryllium contamination in the forms found at Hanford remediation sites is not a Resource Conservation and Recovery Act regulated waste, it can be safely disposed of at ERDF along with low-level radioactive waste.

The ERDF's design incorporated extensive engineering controls to protect both the workers and the environment, such as impermeable linings for the landfill and associated liquid collection and treatment systems; design of cells within the landfill and dump ramps to always accommodate upwind dumping of the waste; and provisions for fire hoses to be used for dust control, thereby minimizing the possibility of airborne radioactive or beryllium contamination. Administrative controls complement the engineering controls and include provisions for roping and posting individual disposal cells as BCAs and use of a full-time health physics technician at each active waste cell to watch for wind shifts or any visible dust, both from a radiation and beryllium contamination perspective. ERDF disposal operations are controlled by operations procedures and are subject to an extensive beryllium sampling plan. Years of historical data show exposures to be non-detectable or a very small fraction of administrative exposure limits during disposal operations. These factors contribute to a high confidence level in the protection of workers from potential beryllium exposure.

ERDF personnel also maintain and repair the waste containers at ERDF, which include approximately 65 waste containers specifically designated for beryllium-contaminated waste. As part of the implementation of the Hanford Site CBDPP, ERDF was in the process of transitioning from a work package to a procedure and a new BWP for routine beryllium waste container maintenance work, such as door gasket replacement, puncture or minor structural repairs, and wheel replacements. The draft procedure, "Beryllium Container Inspection and Routine Maintenance," and the associated draft BWP are comprehensive and, with respect to beryllium, provide a conservative approach to work on the containers. The new documents

incorporate the previous approach used by a work package and establish administrative controls to designate the area around the open door of the box a BCA; if anyone needed to actually enter the box, the box would be designated a BRA with the associated controls. According to the work lead, from a practical standpoint, if anyone ever needed to actually enter the box, it would be decontaminated, verified beryllium-free by sampling, and then released as clean before working inside.

Although beryllium operations at ERDF were generally well established, one deficiency in the implementation of the new CBDPP was that the designated beryllium waste containers were not labeled in accordance with the CBDPP requirements, and there were no plans to address the deficient labeling. The designated beryllium containers have been traditionally labeled with a large “B” on them, but this approach does not meet the CBDPP labeling requirements. After this issue was raised by the HSS team, WCH personnel began to evaluate options for compliant labeling. (See Finding #4.)

Training and Qualification. All WCH beryllium workers were required to complete an on-line Beryllium Gap training program, which outlines the requirements of the new sitewide CBDPP. Beryllium workers may also have additional training requirements, such as respiratory protection training, if required for entry into a BCA or BRA. WCH has instituted procedures to ensure that, before being authorized entry into a BCA or BRA, workers are current on their training requirements. A review of training records for a sample of workers involved in observed activities verified that the required training requirements had been met.

Medical Surveillance and Counseling. WCH completed a package for Human Resources personnel to use, following review by the CBDPP Committee, during briefings of affected workers. The package provides information, procedures, and appropriate contacts for affected workers regarding such items as application for benefits and managing payroll time.

All WCH beryllium workers are required to be medically cleared for work in beryllium locations. Observations during work activities in 100N verified that WCH has procedures in place to verify that workers are medically cleared.

Feedback and Improvement. During the course of this HSS inspection, several instances were observed where feedback resulted in positive action. For example:

- A concern about the BCA posting in Building 324 was appropriately raised by workers. Because the BCA did not include the entire room, workers questioned the adequacy of the controls when they were performing intrusive work requiring respiratory protection. The IHT supervisor agreed that posting should be moved back to the door and the entire area should be a BCA until intrusive work is completed and the prior “pass-through” area is decontaminated. Workers also pointed out that there was another entrance from the utility tunnel that led to the pass-through area; as a result, this was also posted as an entrance to the BCA.
- At the pre-evolution briefings for work in the BCAs in Buildings 308, 324, and MO425/426, workers questioned various aspects of the planned work that resulted in modification or clarification of the tasks.

- Building characterizations included additional sampling in the vicinity of overhead cranes based on a lessons learned from PNNL. Additional characterization sampling of switchgear locations was included in the current sampling plans based on input from workers.

The WCH self-assessment and surveillance schedule for fiscal year 2010 includes a fourth-quarter CBDPP assessment and several other general reviews throughout the year that may address beryllium-related processes and performance. Since August 2006, WCH has conducted three surveillances and three assessments involving beryllium activities. However, several of these reviews were insufficiently rigorous, lacking focus on performance or adequate documentation.

F.3 Summary

WCH is actively implementing the requirements of the Hanford CBDPP and has outlined many of the actions necessary to complete this effort. For example, most facilities have been re-assessed, and additional characterization sampling is in progress. Beryllium workers have completed the Beryllium Gap training, which provides them with information on the revised requirements under the Hanford CBDPP. Work activities are conducted under BWPs that have equivalent content of the BWPs required under the Hanford CBDPP; however, additional work is needed to update the format and further customize the new BWPs to the work activities, and additional controls are needed to prevent the potential spread of beryllium contamination beyond the boundaries of established BCAs. Extensive exposure monitoring of workers has been conducted, and a process is in place to communicate monitoring results to workers, although there are opportunities to improve this communication process. Efforts to update signage and labeling are in progress, but additional effort is needed to install the postings in all locations necessary.

F.4 Opportunities for Improvement

- 1. Identify and implement interim compensatory measures to protect WCH and subcontractor workers until the Hanford CBDPP is fully implemented, assess the effectiveness of completed actions, and resolve any observed deficiencies.**
- 2. Review and revise work control processes to minimize the potential for worker exposure and spread of beryllium contamination.** Specific actions to consider include:
 - Review and revise criteria for establishing BCAs and BRAs to ensure that disturbed beryllium contamination does not migrate beyond the area perimeter.
 - Consider requiring and using physical barriers in lieu of rope barriers for BCAs where dust-producing activities occur.
 - Analyze air monitoring data from BCAs and BRAs to document the basis for decisions to downgrade PPE requirements following activities that may disturb beryllium contamination.
 - Ensure that BWPs reflect revisions.

3. Enhance communication of personal air monitoring data to workers. Specific actions to consider include:

- Ensure that central posting areas are in reasonable proximity to where employees work.
- Provide reminders to workers that personal air monitoring results are centrally posted. Include a brief statement in BWPs, discuss at pre-evolution briefings, or inform workers through other appropriate means.

Appendix G

Washington River Protection Solutions

G.1 Introduction

Washington River Protection Solutions (WRPS) performs the work associated with monitoring and managing the 177 underground storage tanks at Hanford. WRPS has performed this work under contract to the U.S. Department of Energy (DOE) Office of River Protection (ORP) since 2008.

Beginning in the 1980s, beryllium-copper (Be-Cu) alloy non-sparking tools were used at the Hanford tank farms to minimize the potential of a hydrogen explosion when working within the underground waste tanks. Typically, the Be-Cu tools would have posed limited exposure concern if the tools remained fully intact. However, this was not the case since routine tool use required tool maintenance (such as sharpening of edges), and storage of tools in tool boxes with other tools, often resulting in Be-Cu dusts accumulating in tool box drawers. In addition, at the tank farms, tools were also modified into long-handled versions via welding and grinding, creating airborne hazards during modification, as well as legacy hazards in locations where tools had been modified and/or stored. Be-Cu alloy tools were stored in tool cribs that were tended by tool operators. The potential risk of unauthorized tool modification by an employee (i.e., grinding, welding, and reshaping Be-Cu tools) was recognized as problematic, and a decision was made to eliminate and replace all Be-Cu tools in 2000.

Another potential source of beryllium exposure is the handling of beryllium-containing tank waste. Of the 177 waste-containing tanks, 16 were identified as having beryllium contamination in the sludge ranging from 0 ppm to 40 ppm, with an average concentration of 3 ppm. WRPS has determined that the waste sludge during static state, waste retrieval, and waste-disturbing activities would not be expected to cause any measurable exposure of workers to airborne beryllium, and the concentration of beryllium in the tanks is less than one-tenth of one percent of the total volume (less than 1000 ppm) and therefore, according to WRPS interpretation of the rule, is exempt from the rule.

In September 1999, the Hanford Site managing and integrating contractor – at that time Project Hanford Management Contractor – issued an “Initial Beryllium Characterization Report” for the Hanford Site, including waste tank farm operations. The site characterization focused on 25 site buildings where beryllium was believed to have been used, including five Tank Operating Contractor (TOC) facilities currently managed by WRPS, namely 272AW, 272WA, 272S, 2101HV, and 2703E (hereafter referred to as the TOC legacy facilities). In 1998 and 1999, some beryllium sampling of tool cribs, offices, and shops at the waste tank farms was conducted; the sampling practice at that time was to wet-wipe tools before and after use. In 2003, a baseline beryllium hazard assessment of TOC legacy facilities was conducted. In the 2004-2006 timeframe, air sampling and surface sampling of air ducts in Building 272AW was conducted, and additional sampling was performed within other buildings. Prior to the current WRPS efforts to evaluate all of the 241 TOC facilities for potential beryllium contamination, fewer than 12 buildings had been evaluated and/or sampled for beryllium since the issuance of 10 CFR 850 in 1999. Over the years, a significant number of beryllium surface and air samples had been collected from these facilities and analyzed. While a number of surface samples were above the chronic beryllium disease prevention program (CBDPP) action level, there have been no air samples above the action level. At present, 1 facility has been fully characterized, 5 of the 241 WRPS buildings and facilities have been identified as controlled or requiring full beryllium characterization, 97 facilities are

presumed to be clean but may require additional beryllium sampling for cleanliness validation, 27 are exempted because the only known beryllium use was with beryllium articles, and 111 are judged to be clean with no additional sampling required.

Activities conducted by the DOE Office of Health, Safety and Security (HSS) team during this inspection, with respect to the WRPS beryllium program, were as follows:

- Interviewed workers: 18 interviews of pipefitters, electricians, laboratory technicians, radiological and industrial hygiene technicians (IHTs), and millwrights.
- Toured four WRPS buildings and observed work activities: 272AW, 2703E, 213W, and 616.
- Attended beryllium-related meetings: 2703E stop-work fact-finding meeting.
- Observed beryllium-related training: Tank Farms General Employee Training (GET); Beryllium Worker Training.
- Reviewed WRPS documents: WRPS work control and industrial hygiene (IH) procedures, CBDPP plans and implementation procedures, beryllium sample data, beryllium building assessment forms, WRPS building characterization data, 272AW beryllium work permit (BWP), a sampling of worker employee job task analyses (EJTAs), and draft BWPs.
- Reviewed Advanced Technologies and Laboratories International, Incorporated (ATL) documents: 222-S Chemical Hygiene Plan, 222-S Laboratory Chemical Hygiene Plan Training, ATL 222-S ChemTech Qualification Card for Routine Activities, Technical Control Procedure Process, Worksite Hazard Analyses, and Laboratory Analytical Procedures.

G.2 Results

WRPS/ORP Beryllium Program Management. In March 2010, WRPS issued a revision to the Management Plan (TFC-PLN-24) for implementing the Hanford Site CBDPP for work activities and facilities managed by the TOC. The plan provides a clear statement of roles and responsibilities for implementing the site CBDPP for the WRPS safety and health program manager, beryllium coordinator, WRPS industrial hygienists, and WRPS project management. The plan also addresses the baseline beryllium inventory, managing beryllium-affected worker exposures, performance feedback, and subcontractor compliance.

The WRPS implementation of the Hanford Site CBDPP, although in the early implementation phase, has a number of positive attributes. For example, WRPS has contracted an IH consultant, experienced and knowledgeable in beryllium programs and characterization, to provide direction and oversight for implementation of the Hanford Site CBDPP at WRPS facilities and activities. WRPS plans to use a robust building characterization design process based on well-proven methodologies successfully used at the Nevada Test Site. The initial WRPS building assessments identified, categorized, and organized WRPS facilities with respect to the need for further action, although the building assessment process contains a number of flaws, as discussed later. In addition, the WRPS Problem Evaluation Report (PER) process has been a useful mechanism for WRPS workers and line management to identify and

document beryllium facility concerns, as discussed under the Feedback and Improvement section of this appendix.

However, at present, neither the Management Plan nor any other WRPS document identifies and schedules the full spectrum of tasks required to implement all of the various elements of the Hanford CBDPP. The current Hanford Site CBDPP (DOE-0342) was initially issued in May 2009. Following the issuance of the CBDPP, ORP evaluated the impact of the new CBDPP on TOC operations and cost, and, in October 2009, ORP tasked WRPS to implement the Hanford CBDPP using a three-phase implementation approach. Phase I of the approach involved implementing only certain activities, namely gap training for beryllium workers and affected workers, revision of program documents/procedures, revision of facility postings, conduct of beryllium facility assessments, development of a prioritized building characterization, and submittal of a cost and technical proposal for Phase II. According to a letter from WRPS to ORP, dated November 18, 2009, once these “Phase I activities are completed, WRPS would be able to declare the Hanford Site CBDPP has been implemented.” Most of these Phase I tasks are nearing completion. Phase II of the Hanford CBDPP implementation is focused on detailed building characterization and on facility and personal monitoring/sampling. WRPS has submitted a proposal to ORP for Phase II, but no Phase II activities have commenced, pending a decision on the proposal by ORP. WRPS estimates that Phase II will require 8 to 12 months to complete, once authorization is provided by ORP. Phase III of the implementation approach is facility cleanup, with the intent to remove beryllium contamination from all WRPS facilities. In October 2009, WRPS estimated to ORP that the baseline facility assessment and characterization would require four years, with building cleanup concluding in 2017. WRPS currently estimates that Phases I and II (i.e., those phases required to implement the CBDPP) will be completed by 2011 – 2012.

There are some concerns, as well as opportunities for improvement, in the WRPS approach to assessment and characterization, including the following (see Finding #1):

- A detailed plan and schedule for implementation of Phases II and III of the CBDPP implementation has not been developed and resource loaded, although WRPS provided a preliminary draft CBDPP implementation plan with resource loading to ORP in August 2009. In addition, a more detailed proposal for Phase II activities was provided to ORP in March 2010 and is awaiting ORP review and approval. A formal gap analysis has not been performed to identify the WRPS activities that will be required to fully implement the Hanford Site CBDPP, with the exception of those activities identified in Phase I and the need for additional sampling and characterization as documented in the Phase II proposal to ORP. As a result, WRPS worker training, determination of the impact of the new CBDPP program on IHT qualification and training, modifications to the WRPS work control process, development of beryllium technical basis documents, implementation of potential beryllium waste signage to meet the requirements of the CBDPP, updating of the WRPS beryllium website, and other such activities have yet to be formally identified, planned, or scheduled.
- Full implementation of the Hanford CBDPP is not expected to be completed until 2011 or early 2012, and there are no interim measures to address those CBDPP requirements for which WRPS is currently not in compliance. For example, at present, only five beryllium legacy buildings have been posted as beryllium-controlled facilities (BCFs), namely 272-AW, 272-WA, 2703-E, 2707-SX, and 272-S. There is also some anecdotal evidence that a beryllium activity (i.e., Be-Cu tool welding, grinding, cutting, or storage) may have occurred in the past at a number of other TOC

buildings, such as Buildings 616, 213W, 2101-HV, 242-AC (i.e., the buffalo shop), 2703-E Annex, and 2713-WB (i.e., ATCO shops), but with the exception of Building 213W, these buildings have not been posted as BCFs, contrary to the definition of a BCF in Section 3.0 of the CBDPP. IH has identified these buildings as “needing full characterization” or “controlled: review some data/some sampling” required. There are 40 additional buildings with a characterization score of 3 or greater that are identified as “clean but requiring validation sampling.” Each of these buildings is scheduled for validation sampling during Phase II, but current facility assessment data does not identify historical beryllium usage other than tool use (i.e., according to WRPS, tool use does not include tool storage or maintenance, which are activities that could generate beryllium dust). Further, documented information about tool use, storage, and maintenance is currently very limited; most of the information to date is based on the recollection of current or former workers, which has not been systematically collected. In a second example, Section 6.14 of the CBDPP requires that “sampling shall be performed for each beryllium-affected worker (BAW) at the time the worker receives a diagnosis of beryllium sensitization and/or Chronic Beryllium Disease.” If the sampling results show measureable levels of beryllium at or exceeding 0.02 µg/m³, then additional action will be taken, including the possible relocation of the affected worker away from the potential beryllium exposure. WRPS has an estimated 13 beryllium-affected workers who require surface and airborne sampling of their persons and/or work spaces for beryllium, according to the CBDPP. Although such sampling is identified as a priority task for Phase II, neither funding nor tasking has been provided to complete this task. Several of these affected workers currently work in beryllium legacy buildings posted as BCFs.

- At present, there is no detailed scope or schedule for Phase III, although this cleanup phase is not required by the Hanford CBDPP.
- IH resources have been fully identified to complete Phase II, and may not be sufficient to complete the building characterization in a timely manner.

Another programmatic beryllium concern is associated with employees at the 222-S Laboratory. Analytical production services at the 222-S Laboratory are managed by ATL as a direct contractor to ORP. ATL is also known as the Analytical Services Production Contractor. WRPS has responsibility for facility operations and infrastructure, and AdvanceMed Hanford (AMH) is the medical provider. As of May 2009, there were 72 ATL employees and approximately 100 WRPS employees at the 222-S Laboratory complex. ATL employees are involved in processing low-level beryllium-contaminated samples (i.e., IH and waste tank samples), working with higher-level beryllium standards for instrument calibration, and work in facilities (i.e., the 222-S Laboratory Complex) with known beryllium alloy tool usage and storage, as well as potential machining of Be-Cu components in the past. Building 222-S has been identified by WRPS facility assessments and PERs as needing additional beryllium validation sampling during Phase II of the WRPS characterization process. In addition, a sampling of two completed EJTA for ATL laboratory chemists indicated that the employees; their supervisors; and the ATL environment, safety, and health representative concurred that these workers “have the potential to work around beryllium.”

Although small quantities of beryllium are present, ATL employees are not provided the full measure of protective benefits afforded through the CBDPP, because the 222-S Laboratory has classified their operation as a non-production analytical laboratory, covered by Occupational Safety and Health

Administration (OSHA) regulation 29 CFR 1910.1450. If correct, this designation would exempt these operations from coverage under the beryllium rule (10 CFR 850). ORP provided ATL an opportunity to review the draft Hanford CBDPP; however, ATL indicated that laboratory operations were not subject to the requirements of 10 CFR 850 (ATL letter to ORP, dated March 12, 2009). This determination of exemption from the beryllium rule is questionable for several reasons. Based on OSHA letters of interpretation issued in 1990, analytical laboratory testing associated with analytical tests that are not production related (e.g., IH sample analyses and analysis of samples for compliance with emission or Environmental Protection Agency standards) would be covered under OSHA's Analytical Laboratory Standard (29 CFR 1910.1450) and therefore not subject to the beryllium rule. However, those routine standardized tests that monitor and support production and quality assurance/quality control processes (e.g., tank waste operations) would be considered outside 29 CFR 1910.1450; therefore, such activities would be subject to the beryllium rule. Work activities that do not involve laboratory use of chemicals (e.g., maintenance work performed by WRPS) are also outside the scope of 29 CFR 1910.1450 and are also subject to the beryllium rule. Another indication that the 222-S Laboratory is also a production laboratory, as well as a non-production laboratory, is that the ATL *Worker Safety and Health Program* refers to ATL as the Analytical Services *Production* (emphasis added) Contractor, whose scope of work, as stated in the Worker Safety and Health Program Executive Summary, is "to perform analytical production services and testing." Several WRPS and ATL workers who were interviewed indicated that they were confused with respect to the DOE requirements that were applicable to their work activities. ATL workers, who were interviewed, did not understand why the requirements of the CBDPP applied to their WRPS co-workers but not to them.

For these reasons, the application of the exemption may be inappropriate or inadequately evaluated, justified, and documented. If an exemption is not justified for the type of laboratory operations at 222-S, ATL workers in 222-S may not be afforded certain protective benefits provided under the CBDPP. These may include the following: beryllium worker and associated worker training, particularly since some of the current ATL workers are beryllium-associated workers based on prior work at other Hanford facilities; monitoring and sampling of work spaces for beryllium-affected workers; application of a more rigorous cleanliness standard (i.e., $0.2\mu\text{g}/100\text{ cm}^2$) should a spill of a beryllium standard occur in the laboratory; ATL participation in the sitewide CBDPP committee; more robust beryllium labeling requirements; and beryllium medical surveillance and monitoring and worker inclusion in a beryllium-affected worker program, should the need arise.

Inventory, Interim Controls, and Characterization. Title 10 CFR 850.20 requires employers to develop a baseline inventory of the locations of beryllium operations, as well as other locations of potential beryllium contamination. Although there have been several previous attempts at establishing the required baseline of beryllium facilities managed by the TOC, the Hanford Site CBDPP requires an initial assessment of all facilities to determine whether the facility is a beryllium-clean facility or a BCF. The Hanford Site CBDPP also indicates that contractors may use the Beryllium Facility Assessment Form (Attachment 2 of the CBDPP) to document the initial assessment.

The WRPS facility characterization/sampling process consists of two phases. In Phase I, Beryllium Facility Assessment Forms (similar to Attachment 2 of the Hanford CBDPP) were completed for each TOC facility, and a prioritized characterization list of facilities was developed. Phase I is nearly complete, and an initial assessment form has been completed for each TOC facility. The prioritized characterization list, which was also developed in Phase I, identified 2 uncharacterized facilities, 5 BCFs, and 40 facilities

with a characterization score of three or greater, indicating the need for some validation sampling for a total of 47 facilities and/or trailers (at a minimum) to determine the need for sampling during Phase II. Depending on the outcome of the validation sampling, which has not yet begun, additional facilities may be added to the sampling list. The sampling performed to date has resulted in no airborne beryllium levels above the action levels in the CBDPP, and only a limited number of surface samples above the limits requiring designation of a beryllium-controlled area (BCA). A number of positive attributes were noted in the WRPS approach to facility characterization and cleanup, including:

- The WRPS approach to facility characterization addresses all 241 TOC facilities, whereas previous beryllium characterization studies addressed only 12 of these facilities.
- The WRPS characterization approach is risk ranked, thereby prioritizing the characterization process.
- The architecture of the characterization process is consistent with the CBDPP and is being designed and implemented by the WRPS beryllium coordinator, who has experience at other DOE sites.
- The goal of the cleanup phase is to remove beryllium contamination from all TOC buildings.

However, as indicated previously, sampling activities for these facilities will not begin until funding for the proposed Phase II has been authorized by ORP, which is expected in May 2010. Furthermore, the HSS team identified several other concerns in the current inventory and characterization process (see Finding #1):

- Based on a review of 13 completed Beryllium Facility Assessment Forms, the forms are lacking in several attributes. For example, there is insufficient documentation on the forms to understand the basis of the conclusions. Each of the forms reviewed identifies a conclusion of possible usage, maintenance, or storage of beryllium items as either “yes” or “no,” with no explanation or details upon which the conclusion is based. Most of the conclusions are based on limited information and contacts (i.e., typically only one or two individuals were contacted for each form). Furthermore, the positions of the individuals contacted and their knowledge of the history of the facility, or lack of knowledge, is not described. In some cases, information on the form is conflicting. For example, for Building 241SY271, the form indicates that the facility historical usage is known, yet the date the facility was built is “unknown.” Of the 241 facility assessment forms completed, only one facility manager (Building 616) provided supplemental information to support the conclusions tabulated on the form.
- There are process problems with the facility assessment forms. For example, the “characterization score” is determined by the product of the “legacy probability factor P” times the “occupancy factor F.” However, it is unclear why the occupancy factor should be considered in determining whether a facility requires further sampling and characterization.
- The current two-page “Beryllium Facility User Guide” does not adequately address the concerns with inventories and characterization. Furthermore, WRPS has not developed procedures, instructions, or technical basis documents for the current characterization practices. As a result, although each of the 241 facilities has been segmented into one of five characterization categories, these categories

are not defined, nor is it evident how the categorization score, derived from the assessment forms, was used to determine how a building should be categorized, sampled, and characterized.

- With the exception of seven buildings (i.e., the five beryllium legacy buildings and the two buildings slated for full characterization during Phase II), walkdowns of the facilities by the IH beryllium coordinator and others were not performed when determining either the need for characterization or in estimating the cost for beryllium sampling within these facilities. During a walkdown of two of these buildings with IH during the inspection, additional building characteristics were identified that could impact either the sampling plan (e.g., discovery of floor drains) or the characterization cost estimate (need for overhead sampling and the leasing of a man-lift to access these areas). These considerations were not factored into the initial plan.
- In some cases, insufficient historical information was gathered and used in completing the assessment form. Facility managers, some of whom had less than six months of experience in the facility, completed the assessment with minimal input from former workers, as evidenced by the facility assessment form. The Hanford Atomic Metal Trades Council (HAMTC), for example, was not involved in compiling historical usage of the TOC facilities.
- In one case, the facility assessment form excluded some adjacent building areas, resulting in incorrect conclusions. For example, the facility assessment for Building 222SH did not include equipment cabinets outside but adjacent to Building 222SH that were known to be used for storing beryllium-containing tools. However, the facility assessment form does not address this area. Furthermore, the facility assessment form indicates “no known handling or storage of beryllium items” and concludes that this facility is “clean with no further sampling required.”
- Twenty-seven buildings have been identified as clean and are exempted from further sampling and characterization since only beryllium articles (e.g., tools) were used in the buildings. This may be correct assuming that tool use did not include tool maintenance (i.e., sharpening) or tool storage, both of which have historically resulted in beryllium contamination. However, there is no explanation or technical basis to support this conclusion.
- Prior to the walkdown of Building 2703E by the HSS team and a HAMTC safety representative, the characterization data provided on the WRPS beryllium website was out of date for the five legacy facilities. However, as a result of events surrounding the Building 2703E walkdown and the inability of the website to provide current and accurate data on beryllium contamination within this building when needed, the website has been updated for the legacy facilities. However, the website continues to reflect incomplete information with respect to TOC buildings that are beryllium-clean facilities (i.e., only 4 of the 111 clean facilities are listed on the website).

Prior to sampling of the TOC facilities, which is scheduled to commence during Phase II of the characterization process, there are few interim compensatory measures and controls. For example, posting of BCFs has been limited to the five legacy buildings, even though a number of additional buildings will be characterized or sampled during Phase II. Furthermore, no controls are established for BCFs, such as minimizing dust-producing activities. The lack of well-defined and documented interim controls for BCFs has resulted in worker confusion and the generation of numerous PERs. For example (see Finding #1):

- During Phase I, the facility assessment process and preliminary building characterization process had designated Building 2703E as “Controlled: Review Data/Some Sampling” and the building is posted as a BCF, but no interim controls were identified because the building was to receive additional characterization and sampling during Phase II. However, in the interim, although the building was locked, it was periodically accessed by electricians and some electrical fabrication work was ongoing. In January 2010, workers inadvertently entered BCAs within this building without the appropriate controls (WRPS PER-2010-0159); signage within the posted BCAs has not been in compliance with the requirements of the current CBDPP; in one case, signage was removed without the appropriate authorizations; and beryllium contamination areas could not be readily identified. This event was reported on a PER; however, no immediate/interim corrective actions were taken, and this PER remains in effect with no specified corrective or preventive actions. On the day before the HSS team conducted a walkdown of Building 2703E and identified a number of posting deficiencies, WRPS personnel entered the building and also noted posting issues, but did not initiate a PER or implement any additional interim controls. Following the walkdown of Building 2703E by the HSS team and a subsequent WRPS fact-finding meeting, a stop-work was issued on March 25 for activities in the building, pending further evaluation by IH. Since 2006, four PERs have been written on signage, posting, and BCA boundaries in this building.
- Similarly, Building 272AW was also identified in Phase I as “Controlled: Review Data/Some Sampling” and the building is posted as a BCF, but WRPS has not documented what access controls are needed to minimize worker exposures to potential beryllium hazards in BCFs, as required by the CBDPP. This facility is currently occupied by numerous electricians, mechanics, and health physics technicians, some of whom are beryllium-affected workers. The WRPS website has posted a current BWP for this facility for “non-intrusive, non-dust producing work in 272-AW building,” and the BWP is effective until September 10, 2010. The purpose of this BWP is not clearly specified (i.e., is the BWP intended to address controls for intrusive, dust-producing activities, or simply to only permit non-intrusive, non-dust-producing work?). A number of workers who were interviewed were not aware of this BWP. In February 2010, work was performed in the overheads of this building. According to the postings on the outside of the building at the time of the work, the building overheads were suspected to be beryllium-contaminated. Based on the posting, a HAMTC safety representative stopped work and a PER was written. Substantial dust was disturbed during the work, and workers were not aware of the BWP restricting work activities to non-dust-producing work. Since this event, the old BCF postings on the exterior of the building have been removed and replaced with new postings consistent with the CBDPP. However, the new building BCF postings have no wording concerning the overhead spaces, but the BWP restricting such activities is still in force. Since 2006, nine PERs have been written on concerns or problems with beryllium postings and boundaries in this building.

Work Control/Postings. The elements of the WRPS work control process that are impacted by the Hanford CBDPP are the TOC work control procedures (e.g., TFC-OPS-MAINT-C-01, C-02) and the WRPS job hazard analysis (JHA) process. Recently, one WRPS work control procedure was revised to include a reference to the BWP in an attachment; however, no other changes in the work control process (e.g., procedure changes, training) are evident. A number of concerns or opportunities for improvement in the WRPS work control process are associated with the implementation of the Hanford CBDPP that have yet to be identified and/or scheduled, including (see Finding #4):

- Although the BWP has been added, by reference, to a WRPS work control procedure, there are no instructions on the use or completion of the BWP, either in the work control procedures or in the referenced WRPS CBDPP Management Plan (TFC-PLN-24).
- Based on interviews with WRPS work planners, work planners and their supervisors have not received Beryllium Worker Training or training on the new BWP process.
- Although higher-risk maintenance activities (i.e., Level 1 and 2 planned maintenance activities) are likely to receive a review by a safety professional knowledgeable of beryllium hazards and controls, lower-risk and routine maintenance activities (Level 3 and 4 preventive and corrective maintenance) do not typically receive a review by a safety professional, and those involved in the planning, supervision, and performance of such activities have limited knowledge, training, and experience on beryllium hazards and controls.
- The JHA process does not address beryllium hazards, and the generic JHA used by most craft workers during routine maintenance does not address beryllium hazards or controls.
- The workplace hazard assessment process has been used by WRPS work planners, workers, and supervisors to identify potential hazards in the workplace. The workplace hazard assessment, or a comparable process, is critical to identifying beryllium hazards in the workplace and ensuring that routine work activities in such areas are evaluated for potential beryllium hazards. However, according to interviews with WRPS work planners and their supervisors, the workplace hazard assessment process has recently been discontinued, and for routine maintenance activities, such as preventive maintenance, hazards and controls will be incorporated in procedures. A review of one such preventive maintenance procedure associated with the calibration of Eberline PCM-1Bs in Building 272AW that is approved and is “working,” according to the work order, did not identify any potential beryllium hazards and did not reference the current facility BWP that is required for work in this facility, nor did it recognize that this work would be performed in a BCF. A second preventive maintenance for load testing a monorail system in 272AW that is “ready for work” and may involve activities in the overheads also has no reference to the BCF, the BWP, or precautions, if any, for potential beryllium contamination. There are no workplace hazard assessments for either of these work activities (such assessments could potentially discuss the beryllium hazards). These work activities would have been performed without full knowledge of the potential hazards had it not been for a diligent facility manager stopping all such work activities in Building 272AW pending further IH evaluations of the facility.

The Hanford CBDPP provides a useful overview of required beryllium postings and signage, but additional instructions are needed by each contractor to ensure effective and consistent implementation. At TOC facilities, WRPS has replaced the outdated BCF postings on each of the five beryllium legacy buildings with current postings consistent with the CBDPP. However, there is no guidance in the CBDPP or in WRPS instructions and procedures regarding the types of information to be included on each BCF sign under the section entitled “additional information.” For the five TOC legacy buildings, a listing of the facility manager or coordinator and phone number has been added to this section. However, during the fact finding that followed the HSS team’s entry into Building 2703E, WRPS determined that it was not clear whether the information included on the sign meant that this facility manager or coordinator should be contacted for permission to enter the building or only if workers had questions

and requested “additional information” as the posting indicated. Other concerns and weaknesses with respect to beryllium signage/postings include (see Finding #4):

- A number of deficiencies were identified by the inspection team concerning beryllium postings observed in Building 2703E. For example, floor drains were inappropriately labeled with BCF signs. BCAs were not posted with the current BCA postings as required in the CBDPP. One BCA boundary rope and posting had been removed and coiled under the stairs without appropriate removal authorization from IH. Several interior walls within the building were posted with outdated beryllium contamination area signs, and the boundaries of the areas were not designated or identified. The door to the tool room had a beryllium posting that was not in compliance with the CBDPP program. On the day prior to the inspection team’s tour of this facility, WRPS IH and facility management also identified similar signage issues in this building.
- For a number of TOC buildings (in addition to the five legacy buildings), there is some evidence that a beryllium activity may have occurred in the past, and characterization sampling has not been completed. According to the CBDPP, these buildings are BCFs, but they have not been posted as such. For example, Building 242AC (Buffalo Bldg) and Building 2713WB (ATCO Shops) have anecdotal evidence that beryllium-alloy tools may have been modified or stored in these buildings (CH2M Hill-PER-2008-1778). The WRPS Facility Assessment Forms identify these buildings as “possible characterization.”
- WRPS has not developed instructions or guidance for posting or de-posting BCFs and BCAs, or for access requirements into areas and/or facilities posted as BCFs and BCAs. Based on interviews with workers and supervisors, there is considerable confusion about beryllium signage and postings. In some cases, such as Building 2703E, materials have been removed from within posted BCAs, BCA boundaries have been modified, and BCA postings have been removed without authorization from IH and/or supervision. In one case, in Building 2703E, a BCA posting was placed on a door, such that when the door was opened the sign was no longer visible and workers inadvertently entered into this BCA without a BWP (WRPS-PER-2010-0159).
- WRPS waste handlers interviewed are not using beryllium waste labels consistent with the CBDPP and have not received any instruction or training on the CBDPP labeling requirements.
- For Building 272-AW (i.e., the only building that has an active BWP posted on the WRPS beryllium website for building activities), there are no BCAs or beryllium-regulated areas (BRAs) posted in the building. This situation is contrary to the intent of the use of a BWP as defined in the CBDPP, which indicates that the BWP is “a set of written controls and work practices required for work in a BCA or a BRA.”

Training and Qualifications. Section 6.27 of the Hanford CBDPP requires that all employees receive the appropriate level of training on the hazards of beryllium based on the worker’s current and past beryllium activities. For WRPS workers, there are several positive attributes of the current WRPS training and qualification program with respect to implementing this requirement of the Hanford CBDPP. For example, all current WRPS workers received GET for TOC operations, prepared by WRPS, which includes an awareness overview of the general hazards of exposure to beryllium, appropriate controls, and medical information on chronic beryllium disease. Many of the WRPS employees also receive

Hazardous Waste Operations Training as required by 29 CFR 1910.120, which includes similar awareness information with respect to beryllium hazards and controls.

Due to the diversity of potential exposure hazards at the tank farms, particularly from tank vapors, the WRPS IH Department has developed and implemented a robust IHT training and qualification program for the 42 IHTs who perform routine monitoring and sampling activities (including sampling for beryllium). Since air and surface sampling for beryllium typically requires sampling protocols similar to those for other airborne and surface contaminants at the tank farms, IHTs are trained and qualified to perform such sampling. For example, the IH procedure for Industrial Hygiene Pump Preparation and Field Use of Conducting Personal/Area Air Sampling would be appropriate for personal sampling for total beryllium. Additional training and procedures would be required for sampling only the inhalable fraction of beryllium, as indicated in the most recent American Conference of Governmental Industrial Hygienists' threshold limit value for beryllium, because a special sampling device may be required. Furthermore, the IH procedure for Field Wipe Sampling and Bulk Sampling Methods would be applicable to collecting both surface and bulk beryllium samples. Both of these procedures are well written and follow standard IH sampling and monitoring practices.

Notwithstanding these existing training and qualification programs for IHTs, several concerns and opportunities for improvement were identified, including (see Finding #2):

- The current IHT qualification card does not address whether IHTs must be trained and qualified as beryllium workers in order to perform beryllium air or surface sampling. Although this may be an inherent requirement when sampling inside a BCA or BRA, based on the requirements in the CBDPP, it is not clear whether such requirements would apply to IHTs when sampling for beryllium outside a BCA or BRA. The training records randomly selected for six IHTs showed that one IHT had not received beryllium worker training. In addition, several of those who had received the training, received such training seven years ago (well before the implementation of the current CBDPP) and did not meet the current requirement for re-training every two years.
- Similar to other Hanford contractors, the training requirements for some categories of WRPS beryllium-associated workers (i.e., current affected workers, workers with signs or symptoms of beryllium exposure, and current workers with a work history of potential airborne exposure) are unclear, and the current training provided through GET does not meet all of the requirements of 10 CFR 850. (See Section 3.)
- Beryllium training requirements have not been identified for WRPS workers involved with potential beryllium activities, such as supervisors, work planners, safety professionals, waste certifiers, and laboratory chemists working in the 222-S Laboratory.
- The beryllium training program requirements currently posted on the WRPS beryllium website were prepared in 2006, and are outdated and incorrect with respect to the training requirements identified in the Hanford CBDPP.

Medical Surveillance and Counseling. WRPS employees are covered by the Hanford sitewide CBDPP and medical surveillance program. On a positive note, at WRPS, each of the 13 beryllium-affected workers has been interviewed by the WRPS beryllium coordinator regarding work histories. However, discrepancies were identified in the use of EJTA's as part of the WRPS medical surveillance program.

The EJTA system, which is administered by AMH and addressed in the Medical Surveillance section of the CBDPP, is a valuable tool for identifying medical surveillance requirements for employees who may be potentially exposed to beryllium in the workplace. The current EJTA provides a mechanism for documenting whether an employee is a beryllium worker and provides a qualitative assessment to the extent to which a worker may be exposed to beryllium. Furthermore, the EJTA requires a consensus between the employee, their supervisor, and IH when completing or updating the EJTA form. However, completed EJTAs for four WRPS/ATL employees (i.e., two WRPS vent and balance employees and two analytical chemists in the ATL 222-S Laboratory) reflected inconsistent application of controls for potential beryllium exposure. All four of the EJTAs identified the same “potential for working around beryllium,” but only the vent and balance workers were required to be beryllium workers. A partial explanation for the analytical chemists not being considered beryllium workers was that the CBDPP program is not applicable to their laboratories, although the hazard potential documented on the EJTA is the same for both groups. Another concern is that there is no direct correlation from the various potential risk rankings of exposures on the EJTA (e.g., “0,” “1a,” “1c,” “Hz”) to any medical surveillance or training requirements.

Other concerns and opportunities for improvement to the beryllium medical surveillance program with respect to WRPS are as follows:

- As discussed previously, interviews identified that several beryllium-affected workers are currently working within BCFs that have not been fully characterized, nor have these individuals and/or their workspaces been characterized. (See Finding #1.)
- WRPS requirements do not specify methods for considering beryllium medical restrictions in such a situation or any additional actions needed to protect workers with medical restrictions.
- A review of the current medical element of the WRPS beryllium website was performed by AMH at the request of the HSS team. Several statements on the WRPS current website are dated and/or incorrect according to AMH, particularly with respect to the AMH letters sent to workers on May 7, 2007; an incorrect reference to AMH issuing a medical opinion for all beryllium exams; and a reference to the Site Occupational Medical Director providing a signed medical opinion for each medical evaluation performed on each beryllium-associated worker.

Feedback and Improvement. Section 6.31 of the Hanford CBDPP states that responsible contractors must provide periodic analysis and assessments of the effectiveness of the CBDPP program. In the past three years, two assessments of the implementation of the CBDPP program at TOC facilities and operations have been performed: one in 2007 by the previous contractor, and one in 2008 by WRPS. With respect to the assessment performed in 2007, one of the four observations was also identified during this inspection, namely that “building postings did not always reflect the latest available data.” With respect to the WRPS assessment performed in 2008, three of the four observations where improvement was needed were also noted during this inspection: (1) “Documentation of the TOC CBDPP (TFC-PLN-24) is less than adequate in addressing exposure minimization, hierarchy of controls, lab accreditation, personal protective equipment, waste labels and hygiene facilities”; (2) “the site wide beryllium inventory has not been maintained accurately since 2005”; and (3) “recognition of beryllium hazards and potential exposure is still an issue during maintenance and non-routine activities in historic beryllium facilities, such as above-ceiling work.”

Another valuable mechanism for beryllium feedback and improvement at TOC facilities is the use of the PER Issues Management System. The PER process is a useful mechanism afforded to WRPS workers, supervisors, and line managers to report concerns or problems, identify requirements that have not been satisfied, and document immediate actions taken or corrective actions needed to resolve the problem or concern and track actions to closure. Since October 2006, 41 beryllium-related PERs have been issued for TOC facilities or operations either by the current contractor WRPS or its predecessor. Several deficiencies similar to those observed by the HSS team during this inspection were previously identified through the PER process, including:

- In April 2007, a similar concern was identified that “individual employee training profiles do not reflect the level of training required relative to the results contained in EJTA evaluation (e.g., beryllium).”
- In October 2006, an industrial hygienist identified a concern about “assess[ing] the need for additional beryllium informational posting for areas in the 222-S laboratories not accessed during prior surveys. If it is determined that inaccessible areas were not fully evaluated and there is a potential for beryllium surface contamination in these areas, then all entrances should be posted to the facility to apprise workers of the beryllium potential...”
- In October 2008, a concern was identified by the IH programs manager that “the site beryllium inventory has not been maintained accurately.”
- In April 2006, an electrician in Building 272AW identified a beryllium concern about the “ventilation in the electrical shop at 272AW.” According to the electrician, “the exhaust duct was taped off during original testing of 272AW due to a positive test for beryllium, but the two ducts located downstream are not taped off.” During this HSS inspection, workers interviewed in 272AW expressed the same concerns, and the taping of the ventilation ducts remains unchanged except that the tape in the electrical shop exhaust duct has since deteriorated.
- In April 2006, a beryllium sign and caution barrier was found to have been torn down on the west side of Building 272AW and placed on top of the lockers. During this inspection, a beryllium sign was found to have been torn down in Building 2703E and coiled up under the stairway.
- From October 2006 until the stop-work on March 25, 2010, six PERs had been issued on Building 2703E that identified inadequacies with beryllium postings and contamination boundaries.

Effective corrective actions and recurrence controls were not identified, implemented, and maintained for these issues. ORP had also identified a number of open PERs involving beryllium postings, and on March 12, 2010, ORP directed WRPS to address these PERs “before the Health, Safety and Security independent CBDPP assessment for the Hanford Site.”

ORP has not performed any formal assessments or surveillances of WRPS processes or performance related to controlling beryllium exposures, but several operational awareness activities were performed in 2009 and 2010, including visits to Buildings 272AW and 2703E and attendance at Beryllium Awareness Group meetings. No findings or issues resulted from these, other than a finding reporting contractor self-identified posting deficiencies at 272AW. The ORP beryllium subject matter expert stated that a

programmatic IH assessment scheduled for April 2010 and an IH chemical exposure evaluation scheduled for July 2010 will both address CBDPP implementation.

G.3 Summary

In May 2009, a Hanford sitewide CBDPP was issued, and, in October 2009, ORP provided direction to WRPS to implement the Hanford CBDPP in a three-phased approach for all TOC facilities. In March 2010, ORP approved the WRPS revisions to the existing CBDPP implementing procedure consistent with the requirements of the Hanford CBDPP. Implementation of the Hanford CBDPP at TOC facilities is only in the beginning stages. Phase I of this approach involved implementing only certain activities, namely gap training for beryllium workers and affected workers, revision of program documents and procedures, revision of facility postings, conduct of beryllium facility assessments, development of a prioritized building characterization, and submittal of a cost and technical proposal for Phase II. Once Phase I had been completed, WRPS would be able to declare that the Hanford Site CBDPP was implemented. Most of these Phase I tasks are nearing completion. However, much work remains before the Hanford Site CBDPP can be fully implemented. Phase II of the Hanford CBDPP implementation is focused on detailed building characterization, and facility and personnel sampling. WRPS has submitted a proposal to ORP for Phase II, but no Phase II activities have commenced. WRPS estimates that Phase II will require 8 to 12 months to complete, once authorization is provided by ORP. Phase III of the implementation approach is facility cleanup, with the intent to remove beryllium contamination from all WRPS facilities. Completion of Phase III is not required by the CBDPP, and a detailed schedule for Phase III has yet to be established.

A number of positive attributes of the current WRPS beryllium program were identified. These include the competence and experience of the current WRPS beryllium coordinator with respect to beryllium programs at other sites; plans for a similarly robust building characterization and sampling program at TOC facilities; expansion of beryllium facility assessments from the previous 12 TOC facilities to encompass all 241 TOC facilities; a well-developed IHT qualification training program that will be utilized for beryllium monitoring and sampling; and an established PER process that is routinely used by workers, safety professionals, and line managers to identify and report beryllium concerns or problems. The most noteworthy and ambitious attribute of the WRPS CBDPP implementation plan is the cleanup and removal of beryllium contamination from all WRPS workspaces.

However, much remains to be done, particularly in the development of technical basis documents to support the beryllium characterization program, including more rigorous beryllium facility assessment forms; facility sampling, characterization, and cleanup of beryllium contamination; implementation of requirements of the Hanford CBDPP into the WRPS work control system and other impacted procedures and programs (e.g., waste handling and processing); beryllium postings, signage, and labeling; identification and implementation of beryllium training requirements; updating the WRPS beryllium website to reflect current facility characterization, training, and medical surveillance requirements; and resolution of longstanding beryllium concerns identified through the PER process. Of importance initially is the identification of all actions required to fully implement the Hanford CBDPP at TOC facilities and operations, and the development of a detailed plan, schedule, and resource loading to implement those actions.

G.4 Opportunities for Improvement

Office of River Protection

1. **Reassess the overall WRPS strategy for identifying, scheduling, and resource loading the activities required to fully implement the Hanford Site CBDPP.**
2. **Evaluate the benefits (e.g., consistency across the site) and challenges associated with requiring all operations at the 222-S Laboratory to comply with the requirements of the Hanford Site CBDPP.** Specific actions to consider include:
 - Assess the validity of the ATL determination that all ATL activities fall under the scope of 29 CFR 1910.1450, and are therefore exempt from the requirements of 10 CFR 850.
 - Perform a gap analysis for the 222-S facility to identify the worker protection benefits provided under 10 CFR 850, that may not be afforded under 29 CFR 1910.1450 with respect to beryllium use (e.g., beryllium associate training for ATL employees who previously worked at other Hanford beryllium facilities, medical surveillance, medical removal protection).
 - Evaluate the impact of having co-located workers (i.e., ATL and WRPS) following different requirements for beryllium in the same facility.
3. **Ensure routine, continuing, and specific oversight of the implementation of the CBDPP by WRPS, and incorporate beryllium-related assessments and operational awareness activities in ORP oversight plans and schedules.**

Washington River Protection Solutions

1. **Develop and implement a comprehensive management plan for implementing the Hanford sitewide CBDPP.** Specific actions to consider include:
 - Perform a gap analysis between the Hanford Site CBDPP and the current WRPS CBDPP implementation plan.
 - Develop a comprehensive CBDPP implementation plan to encompass all three phases of the current plan that also addresses the wide variety of tasks required to fully implement the various elements of the Hanford CBDPP. Ensure that the CBDPP implementation plan addresses schedule, scope, milestones, and resources.
 - Identify interim compensatory measures to ensure that adequate measures are in place to address short-term non-conformances with the Hanford Site CBDPP while the WRPS beryllium program is being implemented. Particular attention should be devoted to the posting of additional BCFs while awaiting characterization of those buildings, and a review and sampling of areas in which beryllium-affected workers are currently working, particularly those who are working in BCFs.

- Ensure adequate resources are allocated to complete the CBDPP implementation plan, and that specialty skills (e.g., Multi-Agency Radiation Survey and Site Investigation Manual characterization) are optimally used.
- 2. Ensure that all workers who are potentially exposed to beryllium either through work activities or work location are afforded the protective benefits of the CBDPP, including ATL and WRPS workers at the 222-S Laboratories.** Specific actions to consider include:
- Ensure that WRPS employees within the 222-S Laboratories are working under the CBDPP requirements, particularly with respect to performing maintenance in laboratory areas that are suspected to have potential beryllium contamination (e.g., chemical fume hoods and ducting).
 - Complete the re-sampling of the hazardous material control cabinet(s) for beryllium and post accordingly.
 - Revise the 222-S facility assessment forms to include a more robust past history, and include ancillary facilities or cabinets that may have been used for tool storage.
- 3. Improve and document the process for conducting and documenting building facility assessments and facility characterizations for beryllium.** Specific actions to consider include:
- Revise the existing facility assessment forms. Review and correct errors and omissions. Provide additional documentation on each form with respect to the basis for the various “yes” or “no” responses identified on the form. Identify individuals who participated in the assessment by title and knowledge/history of the building, in addition to names. Remove apparent conflicts on the form, such as indicating that the history is known on the building but not knowing when the building was built. Establish a review and approval process with signatures for each facility assessment form.
 - Provide a technical basis document that describes the “rating” or “scoring” system used on the form as well as how this data is used to determine facility categorization and characterization priorities.
 - Provide opportunities and resources for a walkdown of each facility as part of the assessment process, and use the walkdown as a basis for estimating the cost for characterization and/or sampling.
 - Update the building characterization segments of the WRPS beryllium website, and ensure that information on the website is current.
 - Reassess the basis for excluding buildings from characterization based on the use of Be-Cu tools or beryllium articles that may have been subject to modification (e.g., cutting, grinding) that could have generated dispersible beryllium.
 - Update and maintain the WRPS beryllium building characterization website.

4. Review all aspects of the WRPS work control system to ensure that current and planned beryllium work activities are sufficiently addressed. Specific actions to consider include:

- Provide detailed instructions on the use and completion of the BWP.
- Define the expectations for the work control planners with respect to the implementation of the CBDPP, and provide training and modifications to work control procedures, as appropriate.
- Ensure that workers involved in waste handling and packaging are adequately trained in the labeling requirements of the CBDPP and are provided with current labels as indicated in the CBDPP.
- Verify that all TOC buildings awaiting beryllium characterization are posted as BCFs, in accordance with the requirements of the CBDPP.
- Ensure that all facility postings for BCA and contamination areas are appropriately posted per the CBDPP.
- Establish procedures for the establishment, use, and downposting of BCFs and BCAs.
- Consider the re-instatement of the work hazard assessment process, or a comparable process, for ensuring that facility beryllium hazards are identified, assessed, communicated, and controlled for work activities.
- Review the JHA process to ensure that beryllium hazards and controls are identified.
- Prioritize the review and updating of all procedures and guidance related to the CBDPP.

5. Review all aspects of the WRPS beryllium training and qualification programs to ensure that WRPS employees are adequately trained and qualified to perform work activities in beryllium areas. Specific actions to consider include:

- Establish training and qualification requirements for IHTs and IH professionals who conduct beryllium sampling or work in potential beryllium-contaminated facilities.
- Update the beryllium training program requirements currently posted on the WRPS beryllium website.
- Ensure that WRPS beryllium-associated workers receive training as required by 10 CFR 850.

6. Strengthen issues management process implementation to ensure that corrective actions and recurrence controls are effective in identifying the extent of condition, addressing the identified problems, and preventing recurrence. Specific actions to consider include:

- Evaluate current and former PERs with respect to trends, proper categorization, adequacy of corrective actions, effectiveness of closure, and extent of condition.

- Require beryllium subject matter expert review of the disposition on all PERs related to beryllium.
- Ensure that rigorous reviews of the resolutions for all PERs related to beryllium are included in the annual CBDPP program assessments.

Appendix H

Cross-Cutting Beryllium Issues

H.1 Introduction

In the course of the inspection, the U.S. Department of Energy (DOE) Office of Health, Safety and Security (HSS) team identified a number of issues related to the Hanford Site chronic beryllium disease prevention program (CBDPP) that are cross-cutting (i.e., potentially relevant to multiple contractors) or that could have DOE-wide implications. These issues are discussed in this appendix and include:

- A non-conservative application of a soil background contamination level to the interpretation of bulk samples
- Assessment of the 2009 American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) for beryllium and its potential application at the Hanford Site
- Status of research and development efforts for monitoring and sampling beryllium
- Use of the HSS Regulatory and Policy Response Line
- CBDPP provisions for minimizing worker beryllium exposures.

H.2 Results

H.2.1 Application of “Soil Background” Contamination Levels

One issue that arose during the inspection involved the recognition of naturally-occurring beryllium in local soils when characterizing facilities. In essence, the Hanford Site CBDPP establishes a background level in soil that may not be adequately supported or correctly applied, resulting in non-conservative interpretation of sampling data in some cases. Although the issue arose in the review of the Washington Closure Hanford (WCH) program (see Appendix F), the application of estimated soil background levels to adjust sampling results has sitewide, and may have some DOE-wide, implications.

According to the preamble to 10 CFR 850, “DOE included in section 850.31(b)(3) the words ‘or the concentration level of beryllium in local soil at the point of release’ to eliminate the possibility that the rule would compel a responsible employer to clean local soil off of equipment and other items before release.” This regulatory provision has provided a basis for various DOE sites to consider the contribution of naturally-occurring beryllium in local soils when characterizing facilities. According to the rule, contractors are required to conduct sampling as part of the baseline beryllium inventory and, if beryllium is present, perform a hazard assessment to determine the exposure potential from planned activities. Given the performance-based philosophy underlying the regulation, DOE sites that consider background contamination need to have a valid technical basis for determining whether contamination is from surrounding soils, beryllium-related operations, or a combination of both.

At Hanford, the sitewide CBDPP establishes a background beryllium level in soil as 2.0 ppm, in accordance with a September 2000 DOE Richland Operations Office (RL) memorandum (00-ESD-116).

That RL memorandum transmitted a summary of 66 wipe sample results that were all below the release limit of 0.2 µg/100cm² and included a comparative reference to a 1994 report identifying 2.0 ppm as the background concentration for beryllium in the Yakima Basin soil. However, more recent studies and documents referenced in the sitewide CBDPP or provided by WCH indicate that the background beryllium concentrations resulting from local soils may be lower. For example:

- A January 2001 DOE report (DOE/RL-92-24) summarizing a study of metals in soils at the Hanford Site is referenced in both the sitewide CBDPP and WCH-145 Rev 0 (Beryllium Background and Origins, dated January 2007). Data from that DOE report identifies the average beryllium concentration in Hanford Site soil as 1.05 ppm, with a standard deviation of 0.38 and a 95 percent upper confidence level of 1.81 ppm.
- A September 2004 Pacific Northwest National Laboratory report discussed measuring the background beryllium concentration in airborne dust particles to “make inferences to the relative contribution of natural background in the Columbia Basin.” Based on the analysis results of 27 archived samples collected by the Benton Clean Air Authority between 1990 and 1999 at Columbia Center in Kennewick, the average beryllium concentration in airborne dust was 0.62 ppm, with a standard deviation of 0.07. Information about internal or external peer reviews is not addressed in the report. The report is included as an appendix to WCH-145 Rev 0 (identified under the heading “USGS Study”).

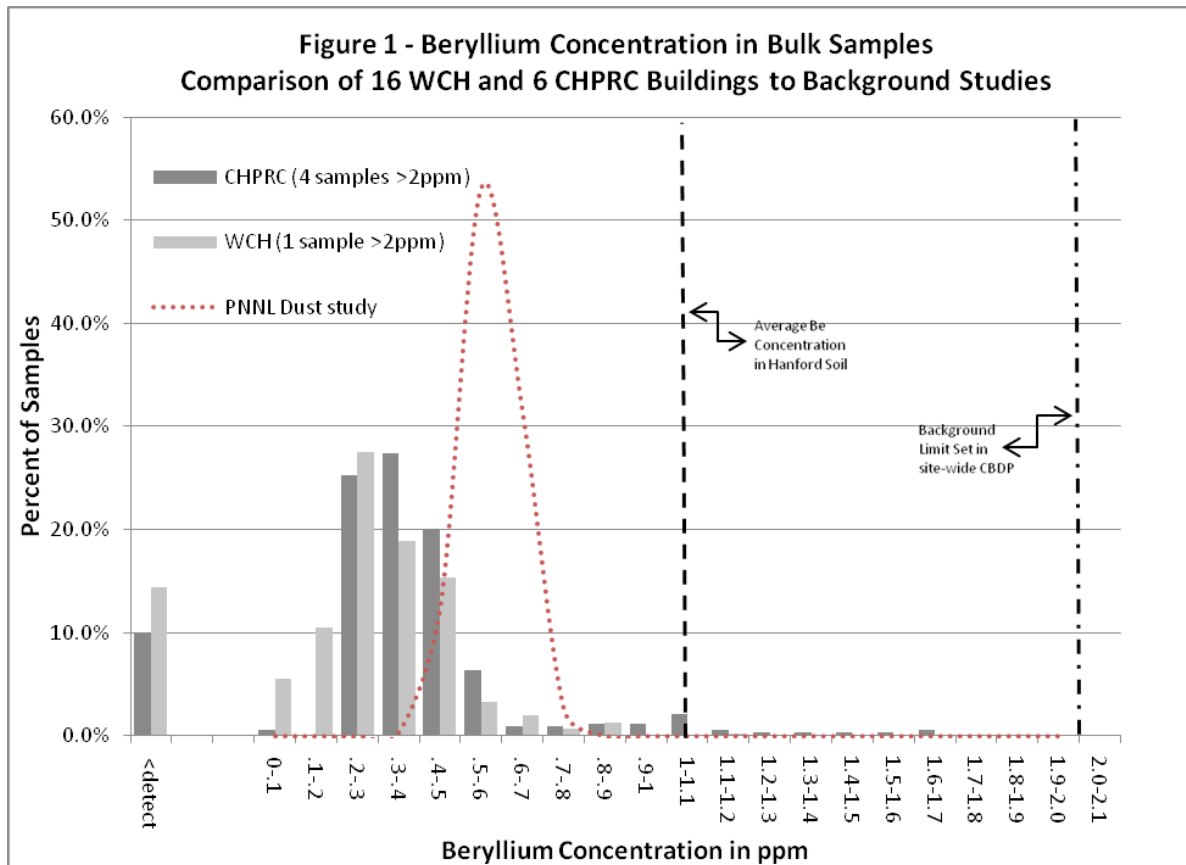
In justifying the assumed background level, WCH cites an August 2006 response, concerning the use of soil background levels, from HSS through the DOE Response Line (D06-08-001), which acknowledges the use of a background of 1.81 ppm. However, based on discussions with the HSS individual issuing the response, the response was not based on a broad-based review or approval of WCH’s specific characterization process with respect to soil background levels. In general, the response line is provided as a support service to DOE and DOE contractor staff and is only intended to provide a technical opinion at the time the question was asked. Official interpretation of 10 CFR 850 can only be made by the DOE Office of General Counsel. (See Appendix H.2.4.)

During this HSS inspection, the practice observed in the field was to simply perform direct comparison of the beryllium concentrations of individual bulk sample results to the 2.0 ppm concentration. Bulk samples below the 2.0 ppm value are considered by Hanford contractors to be less than background and thus clean. Using a value at or above the 95% upper confidence level from the soil distribution study as the threshold for comparison against individual facility sample results does not provide a reasonable assurance that the source of beryllium is only from local soil. This practice essentially demonstrates that the beryllium content is elevated to a level where it is unlikely that soil could be the only source. However, this practice may also exclude anthropogenic beryllium. Since 10 CFR 850.21(a) requires contractors to conduct hazard assessments if beryllium is present, this practice does not adequately ensure compliance with this requirement. To rule out the presence of anthropogenic beryllium contamination, it is appropriate to establish a limit from the opposite end of the distribution curve to demonstrate that the observed beryllium content in a facility sample is highly likely to be solely from local soils.

In addition, the field practices are not consistent with other CBDPP provisions. Section 6.11.6 of the sitewide CBDPP notes that “it is necessary to develop a sampling strategy... that will determine if the beryllium in the dust collected from surfaces is distinguishable from the background beryllium in local

soils. Other information, such as the ratio of beryllium to iron, copper, or other metals, may be of value in determining the sources of beryllium.” Similar wording was included in HSS Response D06-08-001. Although this option is outlined, none of the reviewed characterizations at Hanford used this method. Further, a comparison method, evaluating beryllium ratios to yttrium, niobium, uranium-238, cobalt, nickel, and copper, was successfully used by the Nevada Test Site as part of their characterization process.

To examine the applicability of these background studies to bulk sample results at Hanford, the HSS inspection team compared the bulk sample distribution profile from 16 WCH and 6 CH2M-Hill Plateau Remediation Company buildings to the beryllium background data for local soil and airborne dust. In general, the beryllium concentration in bulk samples collected in the buildings was considerably lower than the average beryllium content in Hanford soil and somewhat lower than the background distribution profile of beryllium content in airborne dust (see Figure 1).



This comparison indicates that, in addition to some fraction of tracked dirt and settled natural dust, the building dust includes a composite of materials from a variety of other sources as well (which may include paper dust, fabric fiber, biological materials – skin cells, insect parts, etc. – and a variety of other materials) that may be essentially beryllium free. The relative fraction of each may vary widely; a bulk sample from a piece of earthmoving equipment may be nearly 100% soil, whereas an interior dust sample from an office mailroom may have a relatively high percentage of cellulose. In some cases, the

dust may also include material from beryllium-handling activities that would constitute contamination. It is not possible from this beryllium concentration data alone to determine the relative contributions of naturally occurring soil beryllium to anthropogenic (human-caused) beryllium from past operations.

Therefore, although there is a reasonable likelihood that bulk sample results exceeding 2.0 ppm indicate the presence of anthropogenic beryllium contamination, there is an insufficient technical basis to conclude that sample results below 2.0 ppm adequately demonstrate the absence of anthropogenic contamination. In addition, based on the variety of sources potentially contributing to the accumulation of dust on most interior building surfaces, it does not appear likely that a single threshold value based solely on the naturally-occurring beryllium concentration in soil or airborne dust background levels can definitively discount the possibility that anthropogenic beryllium contamination exists on those surfaces. Consequently, the current practices for interpreting samples are non-conservative with respect to the facility characterization processes in some cases. (See Finding #1.)

A related concern is the site practice of applying the soil exclusion to bulk samples that are known to be predominantly of non-soil origins. In some cases, such as beryllium content in coal ash and tank sludge, bulk sample results have been compared to background concentrations in Hanford area soils. Although some or all of the beryllium content within these materials may be naturally-occurring, excluding them on this basis is not valid because the issue of unintentional inclusion of common, naturally-occurring forms of beryllium other than those in background soil was not raised during the 10 CFR 850 rulemaking process. Consequently, those forms of beryllium are not explicitly excluded from the rule. A determination that those forms of beryllium are not covered by 10 CFR 850 would require a formal interpretation by the DOE Office of General Counsel. Although other bases for evaluating the hazards of these non-soil materials may be permitted under the rule, the CBDPP does not establish an alternative. (See Finding #1.)

H.2.2 Application of the 2009 Beryllium ACGIH TLV

A second issue that arose during the inspection involved the status of DOE's ongoing evaluation of the ACGIH TLV for beryllium exposure. The Hanford Advisory Board and some Beryllium Awareness Group members have indicated that DOE or the Hanford Site should adopt the ACGIH TLV as a mandatory standard. The ACGIH TLV is lower than the action level in the DOE beryllium rule but requires different sampling methods, so the values are not necessarily directly comparable. Although decisions about exposure standards are not within the HSS team purview, the HSS team collected information about the new standard to provide DOE Headquarters and Hanford Site management with current information about the issue and opportunities to improve the ongoing evaluation of the ACGIH TLV.

DOE's beryllium rule (10 CFR 850.23) establishes an action level designed to trigger certain protective requirements of the rule. The action level in the beryllium rule for airborne beryllium concentrations is $0.2 \mu\text{g}/\text{m}^3$, calculated as an eight-hour, time-weighted average (TWA) exposure as measured in the worker's breathing zone by personal monitoring. This action level is established at a value that is one-tenth the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) of $2.0 \mu\text{g}/\text{m}^3$, which has been shown to be ineffective in preventing beryllium disease. According to the rule, if airborne concentrations of beryllium are potentially at or above the action level, the responsible employer must implement periodic monitoring, exposure reduction and minimization, regulated areas, hygiene facilities and practices, respiratory protection, protective clothing and equipment, and warning signs. Section 3.0 of the Hanford Site CBDPP identifies an airborne beryllium action level that is lower

than the value in the rule (i.e., $0.1 \mu\text{g}/\text{m}^3$, calculated as an eight-hour TWA exposure as measured in the worker's breathing zone by personal monitoring, which is one-half the value specified in the rule).

The ACGIH TLVs are values that the ACGIH believes will protect nearly all workers if they are not exceeded and are based solely on health factors, with no consideration of economic or technical feasibility. Prior to 2009, the ACGIH TLV-TWA (or ACGIH TLV) for airborne beryllium was $2.0 \mu\text{g}/\text{m}^3$, the same value as the current OSHA PEL. However, in 2009, ACGIH recommended a reduction in their previous beryllium TLV-TWA of $2.0 \mu\text{g}/\text{m}^3$ to $0.05 \mu\text{g}/\text{m}^3$, based on a number of recently published health studies that provided estimates of the exposure levels of individuals with beryllium sensitization and disease. The ACGIH concluded that a TLV-TWA of $0.05 \mu\text{g}/\text{m}^3$ would be expected to protect the beryllium-sensitive population because the reported cases of beryllium sensitization or disease were exposed above this level. In addition, the ACGIH further recommended that an inhalable sampler should be used to perform the measurement in a worker's breathing zone in lieu of sampling for total dust. This change was made because it is believed by some experts that sensitization may occur anywhere in the respiratory tract and not just in the lungs. The use of an inhalable sampler would enhance the collection of larger particles, should those particles be present in the air stream.

DOE Headquarters is currently evaluating the 2009 change in the ACGIH TLV, although as a PEL. According to the DOE *Worker Safety and Health Program Rule* (10 CFR 850), DOE contractors are only bound to follow the lower of the 2005 ACGIH TLV ($2.0 \mu\text{g}/\text{m}^3$) or the OSHA PEL (also $2.0 \mu\text{g}/\text{m}^3$). The beryllium rule establishes a lower action level of $0.2 \mu\text{g}/\text{m}^3$, and the Hanford Site CBDPP further lowers this action level to $0.1 \mu\text{g}/\text{m}^3$. However, the 2009 ACGIH TLV-TWA of $0.05 \mu\text{g}/\text{m}^3$ is one-half of the current Hanford CBDPP action level, although one measurement is based on the total beryllium fraction, whereas the other measurement is only the inhalable fraction.

There are a number of technical and financial issues in implementing the 2009 ACGIH TLV, such as the ability of site laboratories to measure beryllium concentrations at this level with good quality assurance, requiring a sampling method that currently is not established for beryllium, increased sampling costs, and the recognition that the 2009 ACGIH TLV does not reflect the uncertainty associated with airborne versus dermal exposures. There are other issues associated with adopting the 2009 ACGIH TLV. For example, the 2009 ACGIH TLV specifies the use of aerosol samplers compliant with the International Organization for Standardization inhalable particulate matter convention (i.e., 50% collection efficiency for 100-micron particles). The samplers that are currently available that have been shown to be compliant with the inhalable convention are designed for gravimetric laboratory analysis and are not suitable for the chemical analysis currently used for beryllium. Publications of work validating a usable sampler are expected in the near future. There will be some costs associated with this change. Another issue concerns the need to establish a new CBDPP action level for inhalable beryllium. If the 2009 ACGIH TLV is to be considered an exposure limit, then what value should be designated as the new beryllium action level? If the action level is to be set at one-half the exposure limit, the new Hanford airborne beryllium action level would be $0.025 \mu\text{g}/\text{m}^3$, which in some cases is at or below the detection limit.

In addition, the value-added benefit of the 2009 ACGIH TLV is questionable because, historically, there have been few measured airborne beryllium concentrations that are above the detection limit and below the current CBDPP action level of $0.1 \mu\text{g}/\text{m}^3$. For example, since 2003, the Hanford waste tank operating contractor has analyzed 116 beryllium breathing zone samples (i.e., personal air samples). All of these personal air samples, based on an eight-hour TWA, were below the current CBDPP action

level of $0.1 \mu\text{g}/\text{m}^3$, and would have also been below the 2009 ACGIH TLV-TWA of $0.05 \mu\text{g}/\text{m}^3$ as total dust. During the same seven-year period, 139 area air samples were also analyzed for beryllium. All of the beryllium air concentrations for the area samples were below the occupational exposure limit of $2 \mu\text{g}/\text{m}^3$ that was applicable at the time of sampling. Each of six of these area air samples resulted in an airborne beryllium concentration of less than $0.1 \mu\text{g}/\text{m}^3$, and one sample was recorded at less than $0.2 \mu\text{g}/\text{m}^3$. However, the detection limit or limit of quantification is not known for these samples, so each of these samples could have been above $0.05 \mu\text{g}/\text{m}^3$ for the specified sampling period. An analysis of WCH personal monitoring data resulted in a similar observation. That is, of the 822 personal beryllium air samples analyzed from June 2007 through March 2010 for WCH workers, only 19 samples had detectable levels of beryllium and all were below $0.05 \mu\text{g}/\text{m}^3$ as an eight-hour TWA. Of the 801 samples that were below the detection limit, only 13 samples could have been above $0.05 \mu\text{g}/\text{m}^3$. However, in 11 of these cases for WCH workers, workers were wearing the appropriate personal protective equipment, such as respirators, and in the remaining two cases, the monitoring results showed exposures below $0.051 \mu\text{g}/\text{m}^3$ as an eight-hour TWA.

In summary, it should be feasible to consider the incorporation of the 2009 ACGIH TLV-TWA in contractor sampling strategies, with some limitations, challenges, and increased costs. Further, considering inhalable beryllium samples is encouraged since this is a standardizing step that is likely to be widely adopted in the future. The Hanford CBDPP also states in Section 6.11 that “contractors are encouraged to include both total and inhalable beryllium sampling in their sampling plans whenever measurable levels of beryllium are expected, and that a summary of the data will be provided to the Committee upon request.” However, the value added in adopting this 2009 ACGIH TLV, based on historical sampling information, is minimal. Of far greater importance than adopting the 2009 ACGIH TLV with respect to reducing workers’ risk of beryllium sensitization and chronic beryllium disease is to be better able to identify, assess, and characterize those facilities that have the potential for beryllium contamination and to remove the source of beryllium contamination whenever possible.

H.2.3 Beryllium Analysis Techniques

During this evaluation, the HSS team observed that a significant challenge to identifying and implementing beryllium controls in the workplace is the ability to obtain and analyze air and surface beryllium samples in an expeditious and cost-effective manner. Each of the four Hanford operating contractors must rely upon timely beryllium sample results to determine whether workers are potentially being overexposed to airborne concentrations of beryllium, and whether equipment and facility surfaces are beryllium-contaminated or could be designated as beryllium-clean facilities. Both airborne samples and surface samples currently rely upon the collection of the beryllium samples either as a collection media (e.g., 37 mm Whatman filter paper or ghost wipe) or directly (e.g., bulk dust sample) and are subsequently supplied to an American Industrial Hygiene Association-accredited laboratory (onsite or offsite) for further sample processing and analysis. The laboratory analysis could be completed within a few hours for a limited number of samples if the laboratory is dedicated to only this task. However, due to the large number of samples routinely submitted, cost considerations, and competing tasks within the laboratory, this process typically requires several days to weeks to complete (or, in a few observed cases, months). In the interim, while samples are undergoing laboratory analysis, there is considerable uncertainty in the workplace.

Consequently, HSS examined that status of research efforts into beryllium analysis techniques. Advancements in this area could enhance DOE contractors’ abilities to identify beryllium contamination

and ultimately to use that information to ensure that areas are clean or that appropriate controls are in place to protect workers.

Current methods of determining beryllium surface contamination do not directly interrogate the surface (i.e., using a direct reading instrument) but rely on methods to transfer the contaminant to a laboratory for further chemical and hardware analysis. A widely used method for environmental and workplace beryllium assessment is wiping a surface with a ghost wipe to collect loose material for subsequent analysis through sample weighing and chemical digestion, followed by inductively coupled plasma analysis, atomic absorption spectrometry, and/or mass spectrometry. OSHA, the National Institute for Occupational Safety and Health, and the American Society for Testing and Materials have developed a number of methods for such surface sampling and analysis.

Similar methods are also applied to bulk samples and sample-collection filters, such as those collected by sampling air from a worker's breathing zone. Although these methods are well established and detection limits are good, these methods are often costly and time consuming, and require considerable sample processing and analysis time (hours to days).

Research for beryllium detection and analysis currently focuses on two areas: (1) new chemical analysis techniques that can be applied in the field; and (2) real-time monitoring using a direct reading instrument in the field. Each of these methods would provide a more rapid detection capability, but each method has limitations (e.g., spectral interference from the surface material upon which the beryllium contaminant resides, inaccessibility of the surface being investigated to the detector, or a level of surface contamination below the detection limit of the instrument). To minimize these complications, the contaminant would most likely continue to be collected on a filter or swipe that can then be analyzed directly in the field.

One of the most promising chemical analysis techniques is chemical fluorescence, which relies on the exposure of the beryllium sample to a dilute ammonium bi-fluoride solution, followed by the addition of a detection solution and a fluorometer measurement. Automated versions of this process are under development at four DOE sites. Advantages of this process include: the lower reporting limit is lower (0.0002 µg/sample), the fluorescence method is field-deployable, the system is relatively inexpensive (i.e., approximately \$10,000 per system), and the analysis is specific to beryllium. Disadvantages of this process include: the process is labor intensive, requires the use of a detection solution that presents some hazards to workers (i.e., pH of 12.85) that need to be controlled, and 10 CFR 850.24(f) requires that the sample analysis be performed by a laboratory that is accredited by the American Industrial Hygiene Association (AIHA), which would not be afforded by this method.

Real-time monitoring involves the use of a direct reading instrument in the field to provide real-time or near real-time results. The use of a direct reading instrument in the field could save significant analytical costs, improve worker protection by providing faster results, and eliminate the current issue of collecting and analyzing potential beryllium deposits accumulated on the interior walls of sample collection cassettes. Laboratories that only analyze beryllium samples collected on the sampler filter paper without analyzing the sampler wall deposits may underestimate the amount of beryllium to which workers are exposed. A number of real-time measurement techniques are currently under consideration; these include laser-induced breakdown spectroscopy (LIBS), microwave-induced plasma spectroscopy, surface enhanced Raman spectroscopy, and colorimetric wipes. Each of these methods has limited research, incomplete validation, and generally a lack of established or published standard methods. In

addition, many of these devices are large and expensive, and they lack precision and detection capability at trace levels.

For example, LIBS is a type of direct reading instrument based on atomic emission spectroscopy that uses a highly energetic laser pulse as the excitation source. The laser is focused on a small area at the surface of the specimen, and when the laser is discharged, it ablates a very small amount of material (i.e., nanograms), generating a plasma plume with temperatures in excess of 100,000 degrees Kelvin. At these high temperatures, the ablated material (e.g., beryllium) breaks down into excited and atomic species, and characteristic atomic emission lines of the elements can be observed. LIBS, like all other direct measurement techniques, has limitations. LIBS is subject to variation in the laser spark and resultant plasma, so reproducibility is often limited. The accuracy of LIBS measurements is typically 10% or better, and precision is often only 5% or more. The detection limits for LIBS vary from one element to the next depending on the specimen type and the experimental apparatus used, but detection limits of 1 to 30 ppm by mass are typical. However, even at these detection limits, background beryllium samples of 2 ppm or less would be difficult to detect.

Another real-time measurement technique using a direct reading instrument is portable x-ray fluorescence. Portable x-ray fluorescence is a well-established, real-time field direct measurement technique currently used for detection and measurement of a number of light and heavy metals, such as lead. Portable x-ray fluorescence analyzers have been used for years to quickly and non-destructively determine the elemental composition of metal samples, rocks, soils, dust collected on wipe samples, and airborne heavy elements collected on filters. Portable x-ray fluorescence analyzers rely upon the use of x-rays that are emitted from either a miniaturized x-ray tube or from a small sealed capsule of radioactive material contained within the analyzer. A fluorescent x-ray is created when an x-ray of sufficient energy strikes an atom in the sample, dislodging an electron from the atom's inner orbital shells that is characteristic of the specific element being measured (i.e., beryllium). Recent advances in technology have improved the performance of portable x-ray fluorescence analyzers on elements below an atomic weight of 17, but limited research has been conducted on beryllium (atomic weight of 4). Portable x-ray fluorescence is unlikely to work for beryllium because beryllium is transparent to x-rays.

Based on the above information, HSS concludes that:

- **Much research remains to be performed before a cost-effective method and reliable field measurement for beryllium samples can be achieved.** Significant research is under way within DOE and commercial laboratories to improve the analysis techniques, throughput, and processing time for beryllium samples, as well as reducing analysis costs while improving detection limits, accuracy, and precision. The most promising method currently under investigation is automated chemical fluorescence. Based on research being performed at Savannah River, Y-12, and Los Alamos, it appears that high-throughput automated chemical fluorescence is the preferred method for analyzing beryllium samples with large sample loads (i.e., 200-250 samples/day). Initial studies indicate that results can be obtained in less than four hours, with trays of 96 samples being analyzed within three minutes. This process can be used to analyze both air and wipe samples and is being designed for use in the field, although much research remains before questions of accuracy, reliability, and detection limits can be determined. X-ray fluorescence is unlikely to work for beryllium because beryllium is transparent to x-rays.

- **Additional beryllium detection research is needed to develop measurement techniques that can distinguish among the various forms of beryllium and that can accommodate dermal sampling.** There is a need to differentiate between various anthropogenic forms of beryllium (metal, alloy, oxide) and natural forms of beryllium, since some of these forms may be more toxic than others. For example, cases of beryllium sensitization and chronic beryllium disease from natural forms of beryllium (i.e. silicates and borosilicates) are generally unknown, whereas exposure to beryllium oxides may be worse than exposure to beryllium metal. With respect to dermal sampling, recent studies have suggested a possible dermal exposure route for beryllium sensitization. Possible dermal exposure methodologies include removal techniques (such as wiping) and in-situ detection on skin surfaces, although such techniques have not been applied to beryllium.

H.2.4 HSS Regulatory and Policy Response Line

The Regulatory and Policy Response Line (Response Line) has been in service since 1992 (under various different names). The HSS Office of Safety and Health manages and operates the system as a service to DOE, DOE contractors, and DOE subcontractors, and provides responses to questions about the applicability of worker safety and health standards and directives. The Response Line was recently converted into primarily a web-based system, although questions may be submitted by e-mail or phone as well. Previously, the system was managed as a database on an HSS staff computer. Questions and responses are accessible through the website, and users are encouraged to review existing responses to determine whether their question has previously been addressed.

As discussed in Section H.2.1, during the review of the Hanford CBDPP, the HSS team identified concerns about the facility characterization process with respect to attributing beryllium content of bulk samples to background soil levels. During discussion of these concerns, contractor representatives and RL indicated that their process for attributing bulk sample results below 2.0 ppm was approved by DOE Headquarters. The basis for believing that the process had Headquarters approval was an August 2006 response from the DOE Office of Worker Health and Safety, with the heading “DOE OSH Standards Interpretation Response Line,” to questions posed by WCH. The HSS Office of Safety and Health did not have the same interpretation of the interactions. As a result of the miscommunications, the HSS team reviewed the use of the Response Line.

The website currently includes two significant disclaimers related to responses provided through the Response Line. First, the Response Line does not provide official interpretations of Federal regulations; only Office of General Counsel can issue official interpretations of regulations promulgated under Title 10 (Parts 200-1099) of the Code of Federal Regulations. Second, the website indicates that the responses are official record copies and have not been updated or altered to reflect newer or current regulations; it includes a notation indicating that responses predating the issuance of 10 CFR 851 may be out of date and should be validated prior to use.

Although these disclaimers are included on the website, the original response provided to WCH did not include similar wording and printed copies of responses do not include the disclaimers. In addition, the original response heading includes the words “standards interpretations,” which could have contributed to its being mistakenly accepted by site personnel as an official interpretation of Federal regulations. The HSS Office of Safety and Health has already addressed this issue and has removed the term “interpretations” from the Response Line title. Finally, the complexity of the questions posed resulted in responses that included references to data provided in the original questions, such as repeating the

value provided as the background beryllium content in soil. These references may have created the appearance that the basis for such data had been reviewed and accepted; however, based on an interview with the author of the response, it was not the intent to imply such review or acceptance. Although these factors may have contributed to miscommunications between WCH and DOE Headquarters, it does not obviate the need for the Hanford CBDPP, absent an official Office of General Counsel interpretation to the contrary, to address characterization deficiencies that are in conflict with 10 CFR 851. However, the differing interpretations of the information indicate a need to improve the processes to prevent future miscommunications of this type.

The responsible HSS organization (the Office of Safety and Health) reports that it is in the process of developing a strict standard operating procedure for handling responses and updating the website. These actions will provide for a clear disclaimer that will appear on any document retrieved from the system and ensure users of the system are informed that only the Office of General Counsel can issue an official interpretation.

H.2.5 CBDPP Provisions for Minimizing Worker Beryllium Exposures

Although the CBDPP is a positive step and includes many appropriate provisions, the HSS review indicates that some aspects of the CBDPP warrant additional clarification in the areas of sampling method and worker protection controls and minimizing exposures to beryllium-affected workers.

The CBDPP provisions do not fully address worker activities that could generate dust and other upset situations (e.g., deep cleaning, installing or removing utilities, remodeling). For example, the CBDPP calls for sampling before such work activities but not after, when beryllium contamination could be evident because of the disturbances. Various examples of the impacts of this concern, identified in Appendices D through G, indicate a need to clarify aspects of the CBDPP.

A related concern is that requirements for minimizing exposure to beryllium-affected workers are not well defined. Under the beryllium rule, contractors are required, when medically indicated, to offer beryllium-affected workers a work environment in which beryllium exposures are as low as possible. The rule establishes an exposure limit of $0.2 \mu\text{g}/\text{m}^3$ (eight-hour TWA) during temporary medical removal, but does not directly state an airborne limit during permanent medical removal. In the absence of a specific regulatory mandate, the Hanford CBDPP establishes an exposure limit of $0.02 \mu\text{g}/\text{m}^3$ (eight-hour TWA) with the concurrence of the DOE site office. Based on discussions with RL, site organizations sought recommendations from National Jewish Health and the University of Colorado School of Public Health in 2008 for input in setting this limit. National Jewish Health recommended keeping exposures less than $0.01 \mu\text{g}/\text{m}^3$, while recognizing that there is difficulty in measuring this level. The University of Colorado recommended keeping exposures below the limits of detection and sampling on a routine basis. The decision to establish the exposure limit of $0.02 \mu\text{g}/\text{m}^3$ (eight-hour TWA) in the CBDPP was based on this input and a consideration of the analytical limits of detection. This exposure limit is near the limit of detection of $0.014 \mu\text{g}/\text{m}^3$ for an eight-hour sample under the OSHA ID-125G methodology.

However, current analytical technologies are capable of detecting significantly lower levels of airborne beryllium for samples collected over the majority of a work shift, although limits of quantification may be higher than the limits of detection, and may vary among laboratories. For example, under the National Institute for Occupational Safety and Health 7300 method, which allows a higher sample collection flow rate and can also detect lower quantities of beryllium on the sample filter, the limit of detection for full-

shift samples can be as low as 0.003 $\mu\text{g}/\text{m}^3$. Recognizing that some sampling conditions may require lower collection flow rates and that sample collection for a full eight hours may be difficult, a limit of detection between 0.005 to 0.01 $\mu\text{g}/\text{m}^3$ would be achievable with current technology on a consistent basis. Newer instrumentation at some laboratories can detect lower levels, although the availability of such laboratory services may be limited.

While establishing an airborne exposure limit is a good practice, the CBDPP does not provide sufficient direction to contractors for applying this limit to effectively demonstrate compliance. The sampling protocols for beryllium-affected workers require a single annual exposure sample for most work environments, with sampling twice a year if the employee works in multiple work areas with potential beryllium contamination sources. The protocols also include the phrase “or on change of conditions;” however, the protocols do not define criteria for determining the types of changes that warrant new sampling and do not provide examples to guide contractors in applying this philosophy in practice. Also, there is no defined protocol for how these limited airborne samples will be determined to be representative of the potential beryllium exposure in the defined work space(s) for the entire time between samples, either for an individual or for a group of beryllium-affected workers performing similar work.

Various situations could result in disturbance of beryllium-contaminated surfaces and/or elevated concentrations in a work location. These include dust-producing activities within beryllium-controlled areas (BCAs) near an employee’s work location; maintenance/custodial activities in nearby locations where characterization is limited (such as overhead locations in some facilities); and seasonal heating, ventilation, and air conditioning changeover. However, there is no evidence that Hanford contractors conducted monitoring of beryllium-affected workers under these circumstances, and contractor procedures do not provide additional definition or direction for industrial hygienists or industrial hygiene technicians to conduct such sampling under changing conditions.

In addition, demonstrating that exposure levels during monitoring remain below the CBDPP-established limit does not ensure compliance with the rule requirement that “beryllium exposures are as low as possible.” Although the CBDPP directs that protective measures must be established through the work planning process, there is no mechanism for addressing potential exposure of beryllium-affected workers resulting from nearby work activities that may generate dust or otherwise cause an upset condition. In general, the CBDPP provides little direction on specific actions to be taken to minimize potential exposures and allows workers to be assigned to locations where potential contamination sources exist and to locations where known contamination sources are within the same facility. These locations increase the potential for episodic exposures to airborne beryllium or the spread of beryllium surface contamination.

H.3 Opportunities for Improvement

Soil Contamination Issue

- 1. As an interim compensatory measure, RL and the Office of River Protection (ORP) should ensure that contractors evaluate whether facilities already characterized as beryllium-clean facilities require re-designation as beryllium-controlled facilities and application of associated interim controls to prevent the possibility of employee exposure to beryllium. Consider the following actions:**

- Establish an interim threshold based on the 95% lower confidence level of background beryllium levels, with appropriate consideration of any background sample results below the limit of detection.
- Evaluate existing facility characterization bulk sample results against the interim threshold. For facilities with a sufficient number of samples, evaluate using a statistical comparison of the 95% upper confidence level of the facility sample population against the 95% lower confidence level of the background beryllium sample population. In addition, consider outlier results within the characterization data that may indicate localized areas of potential beryllium contamination.
- Identify and implement appropriate interim control measures.
- Communicate process and results of review to workers and other interested parties.
- Use the CBDPP Committee or another appropriate mechanism to ensure appropriate levels of consistency among contractors.

2. RL and ORP should ensure that contractors establish a revised characterization process for evaluating existing bulk sample results. Consider the following actions:

- Identify representative characterized facilities with detailed assessments (well-documented historical activities, thorough interviews of personnel knowledgeable of past operations, etc.).
- Evaluate the sample result distribution(s).
- Establish distribution profiles of these facilities to use as comparison models for characterizations of other facilities. As part of this effort, consider the likely contribution of tracked soils (such as a vehicle maintenance bay floor) and/or ambient dust deposition to the overall dust loading. Parameters may include location-specific functions (for example, vehicle maintenance bay floor vs. office space), systems that can contribute to dust transport (central heating, ventilation, and air conditioning vs. electric resistance/infrared heating), and activities contributing to anthropogenic dust generation that may have different degrees of beryllium content (document shredding vs. metal fabrication).
- Validate the qualitative assessment model through adequate sampling and analysis, and quantify uncertainties in its application.
- Develop a revised assessment process based on the sample result distribution(s) in the representative characterized facilities, the qualitative assessment model, and other relevant factors. Include provisions for defining and addressing outlier results and relative “hot spots.”
- Use the CBDPP Committee or another appropriate mechanism to ensure appropriate levels of consistency among contractors.

3. As an alternative to (or in conjunction with) the above opportunity for improvement (#2 above), RL and ORP should ensure that contractors develop a revised characterization process that

compares the relative ratio of beryllium to other constituents to “fingerprint” the naturally-occurring beryllium in local soils. Consider the following actions:

- Identify statistically valid ratios of beryllium to other soil constituents for comparison to building wipe samples that exceed 0.2 µg/100cm² or bulk samples with beryllium concentrations that exceed the 95 % lower confidence level concentration in the background distribution.
- Contact laboratories used for past sample analyses to determine whether data on those constituents of interest is available in archived analytical results.
- Ensure that future analysis of samples includes reporting of those constituents of interest.
- Develop and implement requirements to apply this model for determining whether the surrounding soil is the source of beryllium found in samples.

4. RL and ORP should ensure that contractors implement the revised characterization process and applicable controls. Consider the following actions:

- Provide training/instruction to individuals who will implement the revised characterization process.
- Review existing characterization data and prioritize facilities for implementing the revised characterization process.
- Inform workers and other interested parties of the revised characterization process and how it will be implemented.
- Implement the revised characterization process.
- Implement compensatory measures based on the results of that review. Such measures may include additional characterization sampling, routine air monitoring and wipe sampling on a more frequent basis, informing beryllium affected workers and their supervisors of changes in the contamination status of buildings, updated postings, and other appropriate measures.
- Inform workers and other interested parties of the characterization results, any compensatory measures, and any additional planned actions. Post characterization results at entrances to BCAs and beryllium-regulated areas.
- After the revised processes are in place, perform one or more focused audits/appraisals to determine the effectiveness of implementation.

Assessment of the 2009 Beryllium ACGIH TLV

- 1. In coordination with RL and ORP and other interested parties at Hanford, each Hanford Site contractor should identify and evaluate mechanisms of achieving the 2009 ACGIH TLV and including this TLV in their sampling regimen.** Specific actions to consider include:

- Continue to follow the current CBDPP action level of 0.1 $\mu\text{g}/\text{m}^3$. However, in the interim, investigate all personal air samples that exceed 0.02 $\mu\text{g}/\text{m}^3$ on an eight-hour TWA and all personal air samples where the detection limit is 0.05 $\mu\text{g}/\text{m}^3$ or greater. Include this consideration in the CBDPP and communicate it to the workforce. This action is implied in Section 6.13 of the CBDPP, but lacks explanation.
 - Communicate to each worker the 2009 ACGIH TLV and the current status of ongoing evaluations within OSHA, at the site, and at Headquarters concerning the plausibility of adopting this value at Hanford and across the DOE complex, if and when such information becomes available. Inform workers of the pros and cons of adopting the 2009 ACGIH TLV and the impact and benefits that this new value may have at the site, if any. Also, inform workers of any interim site policies (e.g., as summarized in the preceding bullet), and indicate that for the interim, sampling policies will be based on the total dust methodology, since it is likely that most samples are composed of particles less than 10 microns in diameter; particles are not likely to be of the inhalable size (i.e., 30 microns or larger) that would be associated with beryllium machining operations.
 - For each contractor, review historical personal breathing zone sample data for beryllium, and determine the number of beryllium air samples with detectable beryllium and the percentage of samples with beryllium concentrations below 0.1 $\mu\text{g}/\text{m}^3$ but above 0.05 $\mu\text{g}/\text{m}^3$ as a TWA. (Note: To date, WCH may be the only contractor who has identified measurable airborne beryllium.)
 - Assess the practicality and cost impact of using inhalable samplers. Include such considerations as development of sampling protocols, staff training, sample analysis capabilities and costs, detection and quantification limitations, confidence levels, sampling periods, and sampling flow rates.
 - Develop and prototype a sampling protocol for inhalable beryllium sampling, and modify existing sampling plans to include inhalable beryllium sampling whenever measurable levels of beryllium are expected. There are published conversion factors that can be used to estimate the “total” component of the inhalable sample, thus avoiding the need to obtain two samples (one for inhalable and one for total beryllium). Dividing the inhalable result by 1.5 provides a reasonable “best estimate.”
2. **HSS should accelerate efforts to evaluate the benefits of adopting the 2009 ACGIH TLV on a DOE-wide basis and consider streamlining the rulemaking process to achieve this result.**

Beryllium Analysis Techniques

1. **RL and ORP should ensure that contractors continue to support and participate in the Beryllium Health and Safety Committee.** Specific actions to consider include:
- Participate in Beryllium Health and Safety Committee Subcommittees involved in the development and improvement of beryllium sampling and detection technologies (e.g., subcommittees on research needs, sampling and analysis, and technical practices).
 - Continue to follow new technological developments in beryllium instrumentation, such as LIBS.

- Consider the use of an automatic chemical fluorescent system (as currently in use at the Savannah River Site and Oak Ridge National Laboratory) in a laboratory application for analysis of surface and air samples.

2. ORP, RL, and Hanford contractors should continue efforts to provide more timely analyses of beryllium hazards. Actions to consider include:

- Set a goal for sample turnaround time that is commensurate with the need to control the spread of beryllium contamination and to control worker exposures. Take steps to meet this goal as soon as reasonably achievable.
- Continue to evaluate new instrumentation for direct measurement of beryllium. Obtain, test, and use instrumentation as it becomes available and beneficial to worker protection.

DOE Headquarters Regulatory and Response Line

1. HSS should update the process for addressing questions submitted through the Regulatory and Policy Response Line to enhance communications between users of the system and HSS. Specific actions to consider include:

- Ensure that appropriate disclaimers, consistent with those posted on the website, are included on printed copies of responses.
- Review requests to identify whether the complexity of the issue is appropriate to address through the Response Line.
- HSS organizations whose function is to provide technical assistance should review responses to identify a potential need for HSS to offer more focused technical assistance to the requestor.
- Formalize procedures for operating the updated web-based Response Line through a standard operating procedure or other appropriate document, including a documented vetting process for draft responses to solicit review and concurrence by appropriate individuals.

CBDPP Revisions Related to Minimizing Worker Exposures

1. RL and ORP should ensure that contractors establish and implement specific requirements for minimizing potential exposures to beryllium-affected workers. Consider the following actions:

- Define minimum expectations for separating known or potential beryllium contamination sources from work locations where beryllium-affected workers are assigned, including consideration of the adequacy and completeness of the facility characterization.
- Incorporate, in work planning and control processes, considerations for protecting beryllium-affected workers from inadvertent exposure to beryllium from nearby activities that could disturb potential sources of beryllium contamination.

- CBDPP Section 6.14 should include an acknowledgement that beryllium-affected workers should not be stationed in a building that has surface beryllium unless the worker has been informed of the potential risks and adequate compensatory measures have been established.
 - Use the CBDPP Committee or another appropriate mechanism to ensure appropriate levels of consistency among contractors.
2. **RL and ORP should re-evaluate the exposure limit for beryllium-affected workers based on expected minimum controls and currently available analytical methods.** This effort should include defining and documenting the basis for the exposure limit, including any analytical limitations that were considered.
 3. **RL and ORP should ensure that contractors establish and implement exposure monitoring requirements to ensure that beryllium-affected workers' exposures are consistently below the established limit.** Consider the following actions:
 - Define processes to identify changing conditions and worst-case scenarios that require monitoring.
 - Ensure sufficient sampling time, and use analytical methods that achieve detection below the limit established by the site offices.
 - Periodically analyze exposure monitoring data to identify potential weaknesses in the established exposure controls, implement action to address those weaknesses, and ensure that lessons learned are shared between contractors.
 4. **RL, ORP, and contractor organizations should revise the CBDPP to strengthen worker sampling methods and controls to better ensure worker protection, particularly for upset conditions.** Specific changes that should be considered include:
 - Revise or expand the definition of a BCA in two respects. First, areas should be designated a BCA if surface contamination levels are determined to be $> 0.2 \text{ ug}/100 \text{ cm}^2$ either before or after decontamination. Secondly, change the last sentence in this definition to read: "A BCA can be an entire building, room, system, or a geographical area, preferably with physical boundaries (e.g., walls) or sufficient controls to prevent beryllium surface contamination from spreading outside the designated BCA boundary(s)."
 - Revise or expand the definition of a "Beryllium-Clean Facility" in Section 3.0 of the CBDPP to clarify that beryllium clean facilities cannot contain beryllium-contaminated geographical areas, unless such areas are totally isolated (e.g., separate ventilation system and separate access).
 - Consider adding a footnote or parenthetical explanation to Section 6.9 of the CBDPP to clarify for workers that the reference to the 2005 ACGIH TLV is provided for consistency with the DOE regulatory requirement in 10 CFR 851 to use the 2005 ACGIH TLVs.

- In support of CBDPP Section 6.11.2, contractors should develop a technical basis to define when personal monitoring data is “statistically significant and representative of the work being conducted.” Include a methodology for using samples with results that are below the limit of detection in the negative exposure assessment.
- Include a statement in CBDPP Section 6.11.3 that surface sampling should also be conducted after dust-producing or intrusive activities, as well as before such activities.
- Strengthen CBDPP Section 6.11.7 to ensure that the total beryllium value is properly determined. The CBDPP currently identifies American Society for Testing and Materials D7144-05 as an acceptable methodology for dust collection; however, this methodology will not collect all of the beryllium at that location (e.g., dust that adheres to the surface). To properly collect all of the beryllium on a surface, a bulk dust collection method should be used first, followed by the wipe method, and the amounts of beryllium using these two methods should be added to determine the total beryllium at that sample location.
- Revise CBDPP Section 6.13 to use the limit of quantification or the limit of detection from the laboratory. The CBDPP currently uses the term “reportable detection limit;” this term is confusing, is not defined in the document, and should not be used.
- Revise CBDPP Section 6.14 to stress the importance of considering both beryllium surface samples as well as air samples in managing beryllium-affected worker exposures.
- Revise CBDPP Section 6.16 to clarify that a BCA shall be established if removable surface beryllium levels exceed 0.2 ug/100cm² regardless of whether the surface being sampled was decontaminated or not.
- The CBDPP should identify conditions that require a change in the facility characterization or assessment to reflect changing conditions within the facility (e.g., movement of equipment that is or was beryllium-contaminated).
- When new areas or buildings with beryllium contamination are identified through the hazard assessment or facility characterization process, a mechanism should be identified in the CBDPP to contact current and former workers associated with those areas.