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Response to Request for Information
February 17, 2011

QUESTION 1

Should the Department continue to use the OSHA PEL?

DOE should defer to the OSHA 8-hr TWA PEL in section 850.22. This is in line with the promulgation of 10 CFR 850. This is due to the DOE limits already being more restrictive.

As far back as 2001, medical experts argued for beryllium exposures to be managed ALARA (ref 1). In the ten year history since the 10 CFR 850 rule was initially implemented within the complex, the continuing need for the program has been advocated due to changes in beryllium sensitization rates among participating workers. Since sensitizers by their nature have no threshold of exposure against which to manage, managing such exposures means essentially keeping exposures as low as reasonably achievable (similar to conventional carcinogenic agents and radiological exposure). By and large the OSHA PEL is irrelevant as it exists today at a DOE site (2 microgram per cubic meter of air as a total fraction air sample (2 $\mu\text{g}/\text{m}^3$ TWA)), due to the level of effort already existing when a DOE Action level of 0.2 $\mu\text{g}/\text{m}^3$ is in place. This action level is effectively the allowable limit. Any change to the Permissible Exposure Limit by OSHA has little effect on worker exposures at SRS.

In addition, since the 10 CFR 850 rule implementation, no exposure has been recorded where planned controls (to include appropriate respiratory protection) yielded an “effective exposure” greater than 0.79 $\mu\text{g}/\text{m}^3$ (actual TWA divided by respiratory protection assigned protection factor of the device). [Personal communication, Paul Wambach, DOE HSS, to author, January 19, 2011.] This also shows across the complex that the OEL is irrelevant, as invoking it currently has established no supplemental actions beyond those already demanded in the current 10 CFR 850 by the DOE action level.

Mission Impacts

None at Savannah River Site as the PEL has never come into decision making.

Cost Impacts

None at Savannah River Site as explained above.

References

1. Beryllium Health Effects in the Era of the Beryllium Lymphocyte Proliferation Test by Lisa A. Maier, in Applied Occupational and Environmental Hygiene 16 (5) pages 514 to 520, 2001.

QUESTION 2

Should the Department use the 2010 TLV of 0.05 micrograms/m³ inhalable as its allowable limit?

I do not recommend that the Department adopt the 2010 ACGIH TLV of 0.05 µg/m³ as an 8-hour TWA for its allowable exposure limit because currently there exists no technical basis for standardization of the sample collection and analytical protocols. (Note that the actual adoption of the TLV occurred in 2009 by the actions of ACGIH).

The DOE may elect to use the 2010 TLV but could only do so if meeting the American Conference of Governmental Industrial Hygienists (ACGIH[®]) Policy Statement on the Uses of TLVs[®] and BEIs[®]. In addition, you are referred to the Statement of Position regarding the TLVs[®] and BEIs[®], specifically paragraph six which reads:

“Since ACGIH TLVs and BEIs are based solely on health factors, there is *no consideration given to the economic or technical feasibility (author’s emphasis added)*. Regulatory agencies should not assume that it is economically or technically feasible for an industry or employer to meet the TLVs[®] or BEIs[®]. Similarly, although there are usually valid methods to measure workplace exposures at the TLVs[®] and BEIs[®], there can be instances where such reliable test methods have not yet been validated. [Note: *such is the case with the beryllium inhalable TLV*]. Obviously, such a situation can create major enforcement difficulties if a TLV[®] or BEI[®] was adopted as a standard.” (ACGIH Statement of Position, 2010 TLV Booklet) (Ref. 2)

Having alerted DOE to the burden for placing the 2010 beryllium inhalable TLV into the Beryllium Rule as a standard, there is the matter of consensus around the **basis** of the TLV. The TLV documentation expressly states that it is intended to protect against beryllium sensitization (BeS) as well as Chronic Beryllium Disease; however, there is disagreement in the scientific community concerning the need to protect against BeS. Beryllium sensitization by itself is not necessarily a disability, much as an allergy of any kind is not necessarily a disability. Alternately, beryllium sensitization is considered by many to be a serious adverse health affect, especially among worker populations with demonstrated sensitization moving to CBD. These primarily are associated with current and former DOE site workers. Although there may be a recommendation that sensitized individuals be removed from working with beryllium, there is insufficient evidence to definitively conclude whether or not continued work with beryllium by sensitized individuals increases the risk of progression to CBD, or what the exposure threshold for beryllium sensitized workers should be.

In addition, there are a number of **technical difficulties** to be overcome with targeting this TLV as a compliance matter (in other words, a defense of technical feasibility). None are insurmountable, but all will be expensive, and may have no bearing upon a demonstration of an effectively protective occupational health posture relative to beryllium sensitization and chronic beryllium disease. Those technical difficulties are:

- Knowledge of particle size distribution (A)
 - Knowledge of orientation to the wind and wind speed effects on sampler (B)
 - Sample run time as a function of sample volume and its’ impact on analytical reporting limits (C)
 - Lack of available masses of beryllium to detect at the action level, based on sample intervals (D)
 - Quality control among the devices represented in marketing literature as capturing “inhalable fraction” (E)
 - Demonstration of method precision and accuracy with respect to [current] obligations for AIHA Laboratory Accreditation for sample analysis (F)
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- Need for “less than reporting limit” data if trying to demonstrate compliance with the TLV as a lifetime weighted average (G)
 - Comparison of current data to historical data for trending (control chart) acceptable performance and / or compliance (H)

Due to the timing and due date of this Request for Information, planned actions by subcommittees and members of the Beryllium Health and Safety Committee (www.sandia.gov/BHSC) are incomplete. Those actions planned by the members would establish technical position papers on these matters leading to peer reviewed journal articles of original data. In the meantime, all of these eight (8) bulleted items above have been addressed elsewhere:

- A. “Beryllium Aerosol Characteristics in the Magnesium and Aluminum Transformation Industry in Quebec: A Comparison of Four Different Sampling Methodologies” by Dufresne et al. *Journal of Occupational and Environmental Hygiene* 6:687-697 November 2009; “Aerosols Generated During Beryllium Machining” by Martyny et al. *Journal of Occupational and Environmental Medicine*: Volume 42 (1) January 2008.
- B. “Performance of Personal Inhalable Aerosol Samplers in Very Slowly Moving Air When Facing the Aerosol Source” by Witschger, et al. *Annals of Occupational Hygiene*, Volume 48, #4 pages 351 -368, 2004; “Determining the Spatial Variability of Personal Sampler Inlet Locations” by Vinson et al. *Journal of Occupational and Environmental Hygiene* 4: 708-714 September 2007.
- C. January 25th, 2011 conference call, BHSC comment by Mr. Gary Whitney, CIH, LANL that the majority of beryllium air samples represent task durations not greater than 240 minutes.
- D. “Trace-Level Beryllium Analysis in the Laboratory and in the Field: State of the Art, Challenges and Opportunities” by Brisson et al. *Journal of Environmental Monitoring* 8 (6): 605-611 June 2006.
- E. Section 2.3.9, Calibration and Quality Control. Chapter 2 by Martin Harper in Beryllium Sampling and Analysis by Royal Chemistry Society, 2009.
- F. 10 CFR 850 Section 24, Exposure Monitoring, element (f).
- G. “When Not to Censor Data, and Why” by Charles Davis and Nancy Grams presented at the U.S. EPA’s 25th Annual Conference on Managing Environmental Quality Systems, April 27, 2006, Austin, Texas; “Misinterpretation and Misuse of Exposure Limits” by Paul Hewett in *Applied Occupational and Environmental Hygiene* February 2001, 16 (2): 251-256.
- H. Section 3.5, Chapter 4 *Sampling for Inhalable Fraction* in Particle Size-Selective Sampling for Particulate Air Contaminants by ACGIH, James Vincent, editor.

In addition to the technical issues above is the policy matter of the interpretation of use of this limit in compliance with 10 CFR 851. The Documentation of the TLV states “when applying this TLV-TWA it should be kept in mind that it is based on a long-term average concentration”. (Ref 3). If the inhalable TLV is mandated by DOE, then the manner of interpretation of data sets from it should also be defined by DOE in accordance with the AIHA’s Strategy for Assessing and Managing Occupational Exposures, 3rd Edition (page 27) (Ref 4).

Mission Impacts

At Savannah River Site, air sampling under 10 CFR 850 is conducted for three purposes: a demonstration of compliance to the rule and submittal of exposure data to the Beryllium Registry; verification of effective

engineering controls, primarily isolation; and verification of the protection factor of selected respiratory protection. At SRS, the application of air sampling occurs in legacy area investigations and decontamination efforts only minimally (current 2010 Inventory List contains five legacy areas; all were targeted for remediation and have subsequently been cleared except for one which remains posted and isolated) (Ref 5). But sampling occurs significantly at and around substantially *radiologically* contaminated work for DOE Approved Beryllium Activities at SRS. Currently, none of these operations use conventional personal air monitoring; all are supported with area high volume sampling employing radiological controls organization air sampling equipment. It is anticipated that selection of the lower TLV[®] and conversion to inhalable fraction will not impact the mission, as Integrated Safety Management System (ISMS) decisions have already established the need for high volume area sampling protocols in lieu of personal lapel sampling. (Ref 6). This is due to the need for emergency egress from supplied air respiratory protection upon a “loss of air” event.

However, it will take development of position papers and management concurrence to show the auditing community that such an approach is “compliant” with 10 CFR 850. Alternately, if directed by DOE to collect only personal lapel inhalable samples in accordance with ISO Particle Size Selective sampling, then we would undertake development of an implementation plan to transition current practices to meet the DOE objective. Below find a table estimating the cost of *only* the inhalable sampling devices that would be needed to switch from current practice (37 mm closed face cassettes) to use of a consumable IOM sampler; they would be single use because of the radiological contamination (real or potential). Our initial program implementation estimate conveyed to DOE SR in 2009 was approximately \$400,000 to include lab analysis development and other soft costs.

Activity	Number of Samplers (1)	Number of Shifts	Number of Days Sampled per week (2)	Number of campaigns (3)	product	Cost per Sample Device (4)	
KIS 3013 (BE7)	2	2	2	8	64	\$104	\$6,838
					0		
F Drum TRU (BE8)	2	2	5	4	80	\$104	\$8,320
					0		
F Truckwell TRU (BE10)	2	2	6	2	48	\$104	\$4,992
					0		
HB Line 3013 (BE5)	2	2	5	4	80	\$104	\$8,320
					0		
H Canyon (BE9)	2	2	6	24	576	\$104	\$59,904
						Grand Total	\$88,374

Note 1: Persons who will be sampled from a crew executing the activity.

Note 2: Number of days or shifts sampled in 7 days

Note 3: A campaign is the process (start to finish) of accomplishing the goal of the Be Activity (ie in KIS or HB Line, process a can), or maintenance evolution

Note 4: From SKC Catalogue, using the plastic IOM sampler as basis including MCE 0.8um filter

Additional cost hurdles: Hot lab capability through put, means of securing the inhalable sampler to the breathing zone while in a plastic suit

Cost Impacts

None if ISMS practices are maintained, as we would justify the logic to not collect an inhalable sample. Refer to the table above for one of the considerations in implementation (sample media device cost only), among many not yet understood.

References

2. ACGIH Policy Statement, Inside Cover of ACGIH TLV Booklet and page vi, 2010.
 3. Documentation of the Beryllium and Compounds TLV, ACGIH 2009.
 4. A Strategy for Assessing and Managing Occupational Exposures, 3rd Edition, American Industrial Hygiene Association, 2008.
 5. Savannah River Nuclear Solutions (SRNS) Chronic Beryllium Disease Prevention Program Implementation Plan, March 30, 2010, page 36.
 6. H Canyon TRU Project Sampling Plan, SRNS-J1100-2010-00004.
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QUESTION 3

Should an airborne action level that is different than the 2010 TLV be established?

I do not support establishing an action level different from the current value of 0.2 micrograms/cubic meter without a technical basis defending the relationship to a health consequence.

The common convention from OSHA in defining the need for an airborne action level results in a lower limit (to install supplemental control strategies in an ongoing operation where the PEL is anticipated to be exceeded). Most frequently this is 50 % of the Permissible Exposure Limit. Given the technical difficulties with a demonstration of compliance to 0.050 µg/m³ inhalable fraction due to job durations, sample flow and time constraints, and available masses of material to collect and subsequently analyze, a lower number (anticipated to be 0.025 µg/m³ inhalable fractions) would be that much more difficult for use.

If yes, what should it be?

In the event that DOE did demand use of an airborne action level, then they must pick a size selective sampling tool used with sufficient flows and volumes to meet detection limit needs. Kent et al (Ref 7) identified that use of the MOUDI sampler showed better correlation of mass of alveolar deposition region particle size to health outcomes of sensitization and CBD. However, the occasion of beryllium masses sufficient to employ this tool are probably limited to only a few sites with uncontrolled beryllium activities (weapons component testing). Alternately, DOE might consider the continued use of the closed face cassette with wall deposits included in the analysis as discussed by NIOSH's Martin Harper (Ref 8). Such direction from DOE would require validation studies.

Mission Impacts

Should a lower action level be established, additional work would be necessary for those occasions of exposure being sampled for determination of valid sample collection.

Cost Impacts

Unable to be determined at this time.

References

7. Kent, M. S., Thomas G. Robins, and Amy K. Madl. "Is Total Mass or Mass of Alveolar-Deposited Airborne Particles of Beryllium a Better Predictor of the Prevalence of Disease? A Preliminary Study of a Beryllium Processing Facility" in Applied Occupational and Environmental Hygiene, Volume 16 (5) Pages 539-558, 2001.
 8. Brisson, Michael J. and Archuleta, Melecita M.(2009) 'The Real Issue with Wall Deposits in Closed Filter Cassettes—What's the Sample?', Journal of Occupational and Environmental Hygiene, 6: 12, 783 — 788, First published on: 01 December 2009 (iFirst)
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QUESTION 4

In the past DOE encouraged, but did not require, the use of wet wipes rather than dry wipes for surface monitoring. DOE's experience with wipe testing leads the Department to consider requiring the use of wet wipes, unless the employer demonstrates that using wet wipes may cause an undesirable alteration of the surface, in order to achieve greater comparability of results across the DOE complex and in response to studies demonstrating that wet wipes capture more of the surface contamination than dry wipes. Should the Department require the use of wet wipes?

In light of the RFI statement “in order to achieve greater comparability of results across the DOE complex”, I recommend that the Department review its goal for surface monitoring and establish a technical basis for a single method across all sites.

The Department should first consider why it wants to define any standard wipe media, and then justify its selection of the wet wipe over a dry wipe. Many DOE beryllium components and items (when involved in characterization or release), as well as facilities, have Design Authority constraints on the application of wetting agents. If DOE HQ (HSS) were to demand such a standard requirement, they should also define the means of seeking a variance from that requirement. If other Program Offices of the Department of Energy deny a Beryllium Subject Matter Expert use of a wet wipe in the conduct of work involving wipe media, they must define an alternative. They must be assigned the burden of supporting an alternate compliance strategy by defining what will be an allowable and acceptable wipe media. This is in contrast to the introductory statement in this Request for Information question, which would place the burden on the contractor.

Earlier discussions of this issue during the 2004 Technical Standards meeting (September, 2004 at Germantown, MD) made clear the impacts where dry wipe conventions had been employed. Should the Department require wet wipes, there will be significant costs affiliated with it as contractors will spend more money to meet sample prep and turn around time complications where dry wipes have been convention and would have to change. This primarily appears to be applicable to Oak Ridge, but has also occurred with program implementation at Los Alamos. These costs are specific to the sites that would have to change their current wipe sampling protocols; all have begun using the Ghost Wipes for some portion of their sampling program.

Subsequently since the 2004 attempt at a Technical Standard, LLNL established broad variability (up to three orders of magnitude) in results from differing sampling protocols (dry or wet with water or wet with alcohol) (Ref 9). At SRS, surface wipe results are employed in the verification of assumptions about closed containers (Ref 10); in clearance protocols of equipment (11) and initial characterizations of possible legacy areas (12). They could also be used in demonstration of “de-posting” activity locations. In no case are they employed solely as a means of exposure assessment.

Additional references for consideration would be:

A. Millson, Mark , Eller, Peter M. and Ashley, Kevin(1994) 'Evaluation of Wipe Sampling Materials for Lead in Surface Dust', American Industrial Hygiene Association Journal, 55: 4, 339 — 342
and

B. Chavalitnitikul, Chaiyuth and Levin, Lester(1984) 'A Laboratory Evaluation of Wipe Testing Based on Lead Oxide Surface Contamination', American Industrial Hygiene Association Journal, 45: 5, 311 — 317.

Mission Impacts

None, as wet wipes are currently and routinely used. However, limited classified activity characterizations might be affected.

Cost Impacts

Unknown.

References

9. Johnson, et al. "Relative Collection Efficiencies of Dry and Wet Surface Sampling for Particular Contamination" Presented at the 2nd Symposium on Beryllium Particulates and their Detection, November 8, 2005.
 10. Hook, MB et al. "Sampling Plan for Validation of Assumptions regarding Beryllium Materials in Closed Containers", SRNS-J1300-2008-00002, August 20, 2008.
 11. MEDGATE Survey 717A090211, Samples 1-38, February 11, 2009.
 12. SRNS 4Q1.1 Industrial Hygiene Survey Manual, Procedure 125, Beryllium Sampling.
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QUESTION 5

How do current wipe sampling protocols aid exposure assessments and the protection of beryllium workers? How reliable and accurate are current sampling and analytical methods for beryllium wipe samples?

My examination of the issues surrounding the first question:

With respect to the first question, the beryllium rule as written and implemented currently at SRS establishes an ALARA concept for beryllium. As a result, wipe samples and settled dust samples are used to define contaminated areas. Contamination areas are posted and formal evaluation of activities occurs for every occasion of disturbance or entry to that area. An activity would only be allowed upon completion of an exposure assessment.

My examination of the issues surrounding the second question:

How reliable and accurate are current sampling and analytical methods for beryllium wipe samples? I am unaware of ANY validated research on the matter of reliability and accuracy of wipe sampling. Plenty of information is available on these matters related to laboratory analytical performance.

As early as 1951, Viles (Ref 13) used the particle dynamics equations of Drinker and Hatch (1954 text) to show that “any sample of settled particulates would be primarily non-respirable in size (where in the respirable upper limit was 10 micron).”

Because of the lack of correlation, Cohen and Kurian (Ref 14) observed that several “major beryllium working facilities conduct no surface sampling at all; they rely solely on environmental monitoring, *coupled with excellent housekeeping practices.*” (*Author’s emphasis added*) [This same lesson is observed by the principle manufacturer Brush Wellman, who depends on creating a culture of cleanliness in their facilities. (Ref 15)] Sanderson (Ref 16) observed that “surface wipes are useful in monitoring potential contamination and the effectiveness of cleaning efforts, but they are too imprecise and there is no quantitative relationship between surface contamination and air concentration for them to serve as health standard for reducing the potential risk of CBD.” Lichtenwalner (Ref 17) compared surface sampling protocols and reported wide variability in efficiency of collection. Caplan (Ref 18) appropriately focused on the purpose and significance of surface sampling protocols, deciding that “as clean as practical” for the user of the sampling data was the most prudent decision one could make around surface sampling data. Dufay and Archuleta (Ref 19) compared the performance of wipe media in a field test and found wide variation in performance attributable to those collecting the data.

The AIHA text, “A Strategy for Assessing and Managing Occupational Exposure”, Third Edition defines “wipe testing” as “collection of chemical, mineralogical, or radiological agents on wipe media (typically a wipe of filter paper on an area 100 cm²); results are useful indices of contamination level, *but they are not direct estimators of exposure (author’s emphasis added)*” (Page 434, Ref 4). Use of the AIHA text is codified into the 10 CFR 851 rule.

Finally, the utility of assessing surface contamination by means of a wiping protocol for correlation to a sensitization mechanism in workers is only useful if one can eliminate alternate, uncharacterized beryllium exposures outside of the workplace. As current sensitization cases at Savannah River show, there remains no clear cut example of a known beryllium exposure at SRS to link as cause for the effect of sensitization; only an inference to previous DOE site employment.

It is important to consider both sample preparation and instrumental analysis with respect to the analytical performance. With respect to sample preparation, many labs both within and outside of DOE are modifying the

published techniques, so their reliability may not be known. Also, the BHSC round robin on beryllium oxide, conducted in 2009, demonstrates that sample preparation techniques involving sulfuric acid, hydrofluoric acid, or ammonium bifluoride are effective, while those that do not use any of these have less than adequate effectiveness (the round robin report is available on the BHSC web site). With respect to instrumental analysis, reliability (in the form of detection limits, precision and bias) is available in the published methods

Mission Impacts

None. Current work activities involving beryllium at Savannah River Site are bounded under ISMS by the radiological hazards that co-exist where beryllium exposures could be associated with an activity, with rare exceptions. Should a protocol and its link into exposure assessments be promulgated by DOE, there will be some impact. Most wipe sampling work by industrial hygienists and radiological control inspectors deals with investigation of non radiological work environments to determine compliance with the inventory of legacy areas burden within the rule. Should an activity be conducted in a defined beryllium legacy area, work planning controls are already implemented to maintain exposures as low as practical.

Cost Impacts

If a wipe sampling protocol was established as a compliance burden, then our organization would return to the original and master listing of all beryllium data maintained at SRS (Table 1 in Reference 5). That listing is currently 6 activities (each space where one of these activities is conducted would now require this survey method at the times and for the reasons that may be laid out in the revision to the regulation), resulting in potentially 6 times 59 numbers of samples per our current procedure (total of 354). In addition, the legacy listing includes 46 spaces that were formerly considered to contain legacy contamination. Of these, only 5 remain on the list, as 7 spaces have been lost to demolition conduct and 34 have been cleared through sampling protocols. Should each of the remaining legacy spaces have to be reexamined under a requirement for surface sampling to serve exposure assessments, then assuming a minimum of 59 samples per space would result in (39 times 59 =2301). Rad samples cost approximately \$300 each, with clean samples at approximately \$60 each. Total could be \$138,060 for clean, and \$17,700 for contaminated samples. Grand total of \$155,760 in analytical cost alone.

References

13. F.J. Viles, *Review of Control Problems in Operations Using Various Beryllium Compounds* AMA Journal of industrial Health, pp 157/239 – 171/253, February 1959
 14. *The Significance of Beryllium Surface Contamination to Health* in Nuclear Instruments and Methods by K. Siegbahn-Upsala. Proceedings of the Second International Conference on Particle Induced X-Ray Emission and Its Analytical Application, March 1-15, 1981. Volume 181, Nos. 1-3
 15. Personal observation, Dr. David Deubner, Medical Director for Brush Wellman, Committee Meeting, Lawrence Livermore National Laboratory, November 3, 2010.
 16. *Beryllium Contamination Inside Vehicles of Machine Shop Workers* by Wayne T. Sanderson, et al. Applied Occupational And Environmental Hygiene Volume 14: 223- 230.
 17. Lichtenwalner, Evaluation of Wipe Sampling Procedures and Elemental Surface Contamination, AIHAJ 53:657 to 659. (1992)
 18. Caplan, The Significance of Wipe Samples, AIHAJ 54: 70-75 (1993)
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19. Dufay and Archuleta Journal of Environmental Monitoring 2006 8, 630 to 633: "A Comparison of collection efficiencies of sampling methods for removable beryllium contamination."

Question 6

What is the best method for sampling and analyzing inhalable beryllium?

I do not believe that there is sufficient information to provide an adequate answer to this question.

The term “best” is highly subjective but should consider cost as well as efficacy. In the absence of a simple method of collection and analysis for inhalable particle size, and confounded by the radiological hazards that exist at Savannah River Site with both current and forecast beryllium activities, our best method is to collect high volume samples and do surveillance looking for ANY airborne beryllium.

Mission Impacts

Unknown.

Cost Impacts

Unknown

References

None

QUESTION 7

How should total fraction exposure data be compared to inhalable fraction exposure measurements?

I believe that total fraction exposure data should NOT be compared to inhalable fraction exposure measurements without understanding factors (e.g. particle size, workplace factors) that may influence variations in exposure data.

Workplace evaluations comparing exposures as measured in terms of inhalable aerosol with exposures as measured in terms of total aerosol have been conducted and indicate that the level of exposure based on inhalable aerosol consistently exceeds that for total aerosol (Ref 20). The performance of an inhalable sampler is dictated by the particle size distribution. Without that distribution being known, it is illogical for application of some generically defined and technically faulty correction factor.

Mission Impacts

None, as SRS has not identified any positive air sampling data above the action level.

Cost Impacts

Unknown.

Reference

20. Werner, et al. "Investigation Into the Impact of Introducing Workplace Aerosol Standards Based on the Inhalable Fraction" in Analyst, 121(9), pages 1207- 1214. September 1996.
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QUESTION 8**Part A:**

Should surface area action levels be established, or should DOE consider controlling the health risk of surface levels by establishing a low airborne action level that precludes beryllium settling out on surfaces, and administrative controls that prevent the buildup of beryllium on surfaces?

I believe that DOE should not establish a surface action level and should not seek to control the health risk of surface levels by establishing a low airborne action level that precludes beryllium settling out on surfaces. This position is stated because there is no clear relationship between surface contamination and an airborne fraction, and in turn that relationship causing a health consequence of Chronic Beryllium Disease.

On the first element of the first question, should surface area action levels be established?

No, surface area action levels should not be established as there are occasions where they would be meaningless in application, and open to abuse by the auditor. As has been seen with the current release limit of 0.2 micrograms per 100 square centimeters *applied to beryllium work activities as was originally intended*, such a number would be misappropriated for other purposes (for example compliance audits outside of beryllium activities).

On the second element of the first question, should DOE consider controlling the health risk of surface levels by establishing a low airborne action level that precludes beryllium settling out on surfaces?

No, DOE should not establish a low airborne concentration in the hopes to avoid surface buildup. Understanding the mechanisms leading to an exposure pathway allows consideration of the impact of surface contamination. Only at such time should "surface buildup" be addressed, and then a number would be useful from the perspective of effective clean up programs. A number would assist exposure management, not exposure assessment. The documentation for the TLV for beryllium and compounds alludes to practices by the industrial hygienist in its' recommendation for a skin notation. (Page 1 of 14, 5th paragraph). In addition, there is the matter of challenging low level detection capability (see previous discussions in this Response to the RFI).

The experience with the recent hexavalent chromium standard in the Air Force (Ref 21) shows the management of a surface level for control of an airborne release to be an exercise in futility.

On the third element of the first question, [should DOE develop] administrative controls that prevent the buildup of beryllium on surfaces?

The imposition of administrative controls to avoid the buildup of beryllium on surfaces is imprudent. Instead, the considerations for managing exposures through qualitative hazard analysis are already in place, and responsible and ethical performance by line management and ESH expertise would appropriately do cost/benefit for the application of the hierarchy of controls. For example, the need to clean a half inch of material from the crane haunches of a reactor building at Savannah River does not exist, because no routine entries occur to these areas (these had been considered legacy areas but have now been shown to contain background environmental beryllium). Use of strippable decontamination protocols have been shown *on average* to clean up legacy beryllium contamination, but do not consider addressing the 95% confidence limit sought as demonstration of an acceptable exposure risk (Ref 22).

Cohen and Kusick (Ref 23) reported on the relationship of the data created at LLNL:

“At Lawrence Radiation Laboratory [Lawrence Livermore National Laboratory], no correlation has been found between surface contamination data and air sampling data – except that both are usually below our limit of detection [by their data recorded in Table 1 of the reference, a reporting limit of 0.01 micrograms per cm² (1 microgram per 100 cm²).]”

Fowler and Chatfield (Ref 24) examined the characterization of surface contamination and its relationship to airborne concentrations, and found that:

“The only practical quantitative measurement method for asbestos in surface dust is an indirect-transfer method (like sticky tape); there is no guarantee of preservation of size distribution as existed on the sampled surface; lacking knowledge of the size distribution of the settled dust, one cannot predict how much of the dust will become airborne due to disturbance, therefore resulting [in] highly inaccurate (over) estimates of asbestos [airborne] concentrations than those actually observed in buildings under normal occupancy conditions.”

Deubner et al (Ref 25) examined the contribution of resuspension to an overall review of incidental exposure pathways. The authors concluded that “while it is unlikely for this pathway of exposure to exceed the exposure from inhalation of workplace air, resuspension may contribute a non-trivial portion of total exposure.” The authors go on to postulate that “[E]xamples would include instances where either a worker is protected by personal protective equipment while working with beryllium, but the loading to clothing is liberated during periods when the respirator is not in use”.

With respect to conduct of operations principles (Conduct of Operations) at Department of Energy sites considering beryllium contaminated environments, there would be no occasion as outlined in the quote of Dr. Deubner; work areas and transition into and out of them would be controlled (based upon both a qualitative industrial hygiene exposure judgment, and a radiological controls judgment) with mandatory PPE. Entry to a legacy area that would result in resuspension of surface dust at Savannah River would require respiratory protection and disposable clothing. In the conventional doffing sequence for PPE, respiratory protection is the last to be removed.

Part B:

If surface area limits are established, what should be the DOE surface area action levels?

I am not in a position to appropriately answer this question because I do not see a premise in the relationship of surface contamination levels with airborne concentrations. However, any such level should have a technical basis. In addition, it should be clearly stated that its use is restricted to legacy area maintenance or clearance, and to current activities approved by DOE. Please refer to the “additional considerations” section at the end of this document.

Part C:

If a low airborne action level should be established in lieu of the surface area action level, what should that airborne action level be?

I am not in a position to appropriately answer this question, because I do not see a premise in the relationship of surface contamination levels with airborne concentrations. Please refer to the “additional considerations” section at the end of this document.

Part D:

What, if any, additional administrative controls to prevent the buildup on surfaces should be established?

I am not in a position nor has sufficient information been provided to appropriately answer this question. Please refer to the “additional considerations” section at the end of this document.

Mission Impacts

Unknown

Cost Impacts

Unknown

References

21. January 25th, 2011 conference call, BHSC comment by US Air Force staff IH that the management of surface contamination under the Hexavalent Chromium standard was “futile”.
 22. U.S. Department of Energy, Office of Environmental Management; Office of Science and Technology: ALARATM 1146 Strippable Coating Innovative Technology Summary Report OST/TMS ID 2314; Deactivation and Decommissioning Focus Area. Washington, D.C., DOE April 2000.
 23. Cohen and Kusick, “The Significance of Beryllium Surface Contamination to Health” in Nuclear Instruments and Methods, Volume 181, Nos 1-3. Proceedings of the Second International Conference on Particle-induced X-Ray Emissions and its Analytical Applications
 24. Fowler and Chatfield, Annals of Occupational Hygiene, Volume 41, Supplement 1, pp.279-286, 1997
 25. Deubner et al. Contribution of Incidental Exposure Pathways to Total Beryllium Exposures Applied Occupational and Environmental Health, Volume 16 (5): 568-578, 2001.
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QUESTION 9

Should warning labels be required for the transfer, to either (1) another DOE entity or (2) to an entity to whom this rule does not apply, of items with surface area that are free of removable surface levels of beryllium but which may contain surface contamination that is inaccessible or has been sealed with hard-to-remove substances for example paint?

I believe that warning labels are appropriate where reasonable expectations are that handlers could be exposed during the handling of an item (for example servicing a seldom-accessed part or opening a waste container), or to warn the uninformed so as to prevent unplanned beryllium exposures.

Within the concept of hazardous materials management (not simply regulatory authority), warning labels *and supporting characterization data* support the use of a label to warn downstream workers, such as waste handlers and verifiers. Such a practice should continue where the warning label or waste label is being posted to another DOE site.

The issue is moot for current CBDPP operations giving equipment to “an entity to which this rule does not apply” because of the assigned liability to the DOE contractor for failure of a third party (for example a scrap metal recycling facility) to honor controls. During a BHSC sponsored call (February 2, 2011) addressing this question, four participants speaking for their site’s CBDPP Document indicated they do not release beryllium contaminated equipment to offsite use. Two limited exceptions were communicated: at Los Alamos, a piece of equipment with uncharacterized (inaccessible) surfaces may be released but necessitates the release signature of senior site management (Ref 26). And LLNL sends off devices containing beryllium articles (radiological detection equipment “windows”) with a label. These are shuttled back to the manufacturer who is aware of the device they manufacture (Ref 27). The four sites were SRS, Y-12, LLNL and LANL.

Mission Impacts

Currently contractor performance is measured by the DOE at the local office in our contributions back to the community. Under the proposed labeling within this RFI, no reasonable contractor would be willing to risk the liability of releasing a beryllium bearing item to “an entity to whom this rule does not apply”. We have already released (inadvertently) equipment from a legacy area that lead to considerable costs in recovery, retrieval and investigation that far exceeds the value of the asset. The item was confirmed after retrieval to have no detectable levels of beryllium, and was subsequently released.

Cost Impacts

Costs are minimal, as assignment of labels occurs as part of waste packaging activity. When transfer is commenced, the container is most often directed to holding in our Solid Waste facility for burial. Most of our current DOE approved activities deal with repackaging of Transuranic Wastes destined for WIPP. SRS confirmed that WIPP undergoes no physical opening of any containers in its work. (Ref 28)

References

26. BHSC Call, February 2, 2011, comment from LANL Beryllium Program SME Gary Whitney of release of equipment from beryllium use.
 27. IBID, LLNL Beryllium Program SME Steven Lee.
 28. Personal Communication, S. Jahn to WIPP Waste Authority on beryllium program application at WIPP (they have none).
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QUESTION 10

Should the Department establish both surface level and aggressive air sampling criteria for releasing areas in a facility, or should the Department consider establishing only the aggressive air sampling criteria?

I believe that DOE should not utilize a surface level and/or an aggressive air sampling criteria to release an area or facility. Instead, DOE should consider a requirement for site specific criteria development, based on a statistically-based sampling plan for surface characterization, and a quantitative measure of releasable surface contamination. Such an approach would establish a technical basis for the allocation of resources in the protection of the health of the workforce.

The question as written implies that the Department is only inquiring to pair surface action levels as criteria to be met following aggressive air sampling techniques. From presentation by DOE HQ staff at the Beryllium Health and Safety Committee meeting, November 3&4, 2010, the intent of the demonstration project was to prove an absence of an airborne hazard to a future occupant, despite the remaining beryllium from a former activity.

The question does not make clear if the intent of an aggressive sampling campaign is to apply solely as final demonstration of acceptable beryllium concentrations prior to release of an entire facility. I believe this was the intention of the DOE funded demonstration project at the Kansas City Plant (KCP) on beryllium “clearance sampling”, executed (in principle) to match that of asbestos clearance activities. Such a use might be prudent if improvements and standardization to the facility characterization processes originally identifying beryllium are retained. (Such processes across the complex have historically found all manner of contamination that may not be of a health consequence as it is background environmental soils or fly ash from coal burning power plants).

However, if the intent of aggressive air sampling were to be used as a means to release an area in a facility with remaining beryllium activities, it would be foolish where activities involve mixed hazard profiles: primarily radiological surface contamination, but plausibly heavy metals (lead from peeling paint), or biological contaminants (pigeon or rodent dung). The reasons would include the potential consequence of an airborne hazard, or the cost to do a cleaning of the facility as a means of removing the chance of exceeding the limit. Instead, if this intent of limited release of former spaces from activities or legacy postings, it must be coupled to a requirement for a decontamination step, and a mandated protocol for sampling and analysis of the surfaces involved so as to determine a beryllium content. Such is the case with closure of an asbestos abatement action from EPA and OSHA, and is standardized in American Society for Testing and Materials (ASTM) Method E 1368-90, "*Standard Practice for Visual Inspection of Asbestos Abatement Projects*".

With respect to regulatory allowances, neither 10 CFR 835 nor SRS Manual 5Q, Radiological Controls, specifically disallows the use of compressed air in a Contamination Area (CA). However, the use of compressed air in a plutonium facility CA “is just plain dumb, since you have a very high potential from changing the radiological conditions from one of contamination on surfaces to one which has airborne contamination, which would make it an Airborne Radioactivity Area (ARA) with more stringent protective requirements. Such detail of what kind of activity or use of air moving equipment can be used in a specific CA is probably covered either in facility-specific procedures and probably dealt with in the DOE Manual on Safe Operations in a Plutonium Facility, available on the HS web site.” (quote from Ken Crase, HP Fellow of Health Physics Society and 42 years of DOE site(s) experience).

With respect to 10 CFR 850, compressed air use is essentially banned by compliance to 850.30 (b), prohibiting “compressed air use”. The rule would need a modification to allow use of all modes of imparting energy to air so as to make use of an “aggressive sampling” approach.

Mission Impacts

SRS generally could not accommodate the requirement without significant energies in variances from regulations dealing with radiological contamination. In addition, it would offer NO BENEFIT in health protection, as the areas to be cleared of beryllium contamination have not and will not be cleared in the foreseeable future due to radiological contamination.

Cost Impacts

Unknown

References

None

QUESTION 11

Currently, after the site occupational medicine director has determined that a beryllium worker should be medically removed from exposure to beryllium, the worker must consent to the removal.

Should the Department continue to require the worker's consent for medical removal, or require mandatory medical removal?

I believe the Department of Energy should continue to require the worker's consent for medical removal.

The department should continue with the practice of informed consent for medical removal. Maier (Ref 1) verified that medical removal "from work" is prudent as both BeS and CBD are hypersensitivity diseases. However, DOE's current posture that "an activity for the department" equals work within the rule that requires medical surveillance (because of an inferred exposure) is vastly different from the exposure assessment of the same work that would allow crediting of controls. Where radiological hazard management has established the highest levels of control, and work practices are rigorously constrained, a concomitant beryllium hazard has little opportunity of the real exposure that medical removal is supposed to abate.

If DOE seeks to optimize a risk *management* strategy while deploying the BeLPT as the means of determining sensitization, then it must make the test mandatory. Otherwise, the management of risk will only occur for the portion of the workforce that agrees to be under surveillance. And in turn, a mandatory surveillance can equally accommodate all employees whenever a judgment of mandatory removal might be made.

Further, DOE should consider the mandatory nature of actions by a medical authority within the context of exposures. Some potential and real exposures would be so low as to fail to challenge any expectation of an exposure above the action level. In such cases, the mandatory removal provision should be waived.

Mandatory removal of a worker has its place where a worker can be shifted to an alternate job, or where there is very low confidence in the basis of the exposure assessment due to less than complete hazard characterization data such as one faces with D&D scopes. At Savannah River Site, our initial posture with respect to D&D work adopted this logic. The job required a determination of no sensitization for D&D workers prior to activities. Those declining testing understood that they could not do that work. And those accepting testing understood that alternate jobs awaited them if they were declared sensitized.

Applied more broadly, especially with the pending reduction in force at SRS, the consequence of mandatory testing would be a decline in the enrollment of personnel into the voluntary program. If anything should occur, it should be consideration of adopting a mandatory enrollment for any person supporting beryllium work as DOE defines it in the rule, irrespective of any judgments of possible, probable, or real exposure in the judgment of an industrial hygienist.

An informal poll of maintenance and radiological protection staff qualified for work in a current DOE approved Beryllium Activity at SRS found no one (n=6) endorsing the concept of a mandatory removal program from exposure. In each case, the option of personal choice was cited. As discussions occurred the underlying reason was the impact to employment.

Mission Impacts

Future operations at SRS will involve beryllium metal handling in many ways, but all of it under rigorous radiological controls. As a result, all work will occur in gloveboxes, or in temporary enclosures when those gloveboxes are to be opened for maintenance evolutions. There will be no reasonable job where the definition of a beryllium activity, triggering worker medical surveillance as a qualification, will not be applied. The work will be considered a premium assignment, and competition will be significant for the work. If mandatory removal is to be written into the law, then a mandatory surveillance requirement (no declination policy) must accompany it. Without it, participation will fall and continue to not provide information to meet the goal of eliminating the disease.

Cost Impacts

Unknown

References

None

Additional Considerations

The following section offers a real improvement to the 10 CFR 850 rule from the perspective of implementation, based upon SRNS Subject Matter Expert and Program Owner with ten years of operational experience with the current rule.

Proposal 1:***Make the contractor accountable for a defense of its' beryllium exposure assessment strategy***

In a conventional exposure scenario, one would seek to establish the variability of the exposure profile in order to inform the decisions management would make to allocate resources (to engineering to design a better control strategy, to medical surveillance to develop biomarkers, to industrial hygienists for more sampling support). In the case of beryllium specific to Savannah River Site, we are already managing the concomitant radiological exposure through isolation techniques. We do not expect, nor have we seen, any positive beryllium air sampling data, with a single exception (method detection limit was met in a single personal air sample during collection of 120 wipe samples by a site industrial hygienist). This is after ten years of data collection.

In purely theoretical application, our job in assessing the exposure is complete (save for new activities yet to be assessed). SRNS effectively is constraining ANY beryllium exposure under ALARA, not under a threshold concept.

What is the purpose in the collection of air sampling data?

Mark Hoover of NIOSH in his text on Radiological Air Sampling provides a valuable picture of the reasons one may elect to collect an air sample. One of these would be for characterization of an exposure profile, wherein there (should be) a demonstrable link between applicable limit and the means of acquiring a comparative sample result. If DOE demands such sampling, then the mission impacts would be as framed in the response to question #2.

Instead, DOE should consider that ethical practice would demand of any professional (and any ethical contractor) a clear demonstration of their exposure assessment strategy, the supporting sampling acquisition strategy, and the use of the data as part of an effective occupational exposure management program. Compliance determinations would then be made on a technical defense of the strategy, the collection of data in accordance with the sampling plans and the use of the data. As already exists within 10 CFR 850, the local DOE office could then direct improvements through the approval mechanisms already in place for CBDPP implementation plans.

Proposal 2:***Mandate particle distribution protocol for appropriate sampling collection measures.***

If proposal 1 were implemented and the local office could be convinced of the merits of managing beryllium under an integrated hazards approach, then nothing more would be needed; their decision would be reflected in the approval of the annual CBDPP Implementation Plan. But if such is not an acceptable approach, then DOE should drive the improvement in implementation of ALL TLVs by demonstrating the particle distributions needed for use of Particle Size Selective data.

Proposal 3:

Mandate the use of process/operation/task nomenclature to aid in the epidemiological utility of this mandatory data submission to the Beryllium Registry.

This proposal is perhaps the most important facet of business. DOE has repeated over the years that they strive for data quality to serve epidemiology, yet they do not direct the simplest of constructs to make data comparable.

Proposal 4:

Strengthen the Risk Communication tool developed with Oak Ridge affected parties and contractors in 2001 to incorporate lessons from the LLNL and Hanford inspections, including the data analysis undertaken thus far, and its contribution to understanding the risk factors associated with the disease.

This is perhaps the only way to move away from the out-of-control perspective that has been adopted by some worker groups, managers and DOE site personnel attempting to avoid all risk at any cost from any beryllium. We owe it to the next generation of professional occupational health practitioners to use a reasoned and logical approach to integrating beryllium risk with all others.

Respectfully Submitted,

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**Beryllium Program Subject Matter Expert
February 19, 2011**
