DOE would like to have more data and information to decide whether its current CBDPP can be improved, and if so, how it can be improved. When answering specific numbered questions below, key your response to the number of the question and, if possible, include the mission and cost impacts implied by the question and by your answer.

Q1. DOE currently defers to the Occupational Safety and Health Administration (OSHA) for establishing the permissible exposure limits (PEL) and uses an action level as the administrative level to assure that controls are implemented to prevent exposures from exceeding the permissible exposure limits. Should the Department continue to use the OSHA PEL? Please explain your answer and provide evidence to support your answer.

R1. The OSHA PEL of 2.0 (micrograms per cubic meter) µg/ m^3 should be considered outdated based on the following.

- OSHA has requested additional information on beryllium's health effects (Occupational Exposure to Beryllium; Request for Information. Notice 67:70707-70712, (2002, November 26)).
- The current Threshold Limit Value (TLV®) adopted by the American Conference of Governmental Industrial Hygienists (ACGIH) is 0.05 µg/m^3 of air using an Inhalable sampler. No Short Term Exposure Limit (STEL) is currently established so applying the ACGIH Excursion Limits would be appropriate.
- Using workplace beryllium exposure data, EPA has identified lowest-observed-adverse-effect levels (LOAEL) and LOAEL Human Equivalent Concentrations (HEC) that are lower than the current OSHA PEL (*EPA Toxicological Review of Beryllium and Compounds, EPA/635R-98/008*).
- The OSHA PEL does not appear to take into account that beryllium can trigger the immune response that characterizes beryllium sensitivity.

It must be recognized that the TLV® is based on a Lifetime Weighted average. As a result, 0.05 µg/m^3 may be considered as overly protective for workers unless they are routinely exposed at this level.

In EPA's review identified above, it identified LOAELs of 0.55 µg/m^3, 0.52 µg/m^3, 1.04 µg/m^3, and 0.1 µg/m^3 (identified with limitations. These LOAELs exceed the ACGIH TLV® but are all less than the current OSHA PEL.

While it is not known what value OSHA will eventually choose, it is likely to be between EPA's LOAEL and the ACGIH TLV® of 0.05 µg/m^3. DOE should consider an exposure limit somewhere between the EPA and the ACGIH values.

Since exposures are already so low, with the exception of purchasing and maintaining inhalable samplers as well as increased analytical costs, it is unlikely that costs will be excessive

Q2. Should the Department use the 2010 ACGIH threshold limit value (TLV) of 0.05 [mu]g/m\3\ (8-hour time-weighted average of 0.05 microgram of beryllium, in inhalable particulate matter, per cubic meter of air), for its allowable exposure limit? Please explain your answer and provide evidence to support your answer.

R2. Despite difficulties in achieving lower analytical detection limits, it appears that limits currently in affect are not low enough to prevent sensitization. A value of 0.05 µg/ m^3 may be overly conservative for use within the DOE complex and a value between the EPA LOAEL and the ACGIH TLV® seems prudent. However, assuming the value of 0.05 µg/m^3, or a value between EPA's LOAEL and the ACGIH TLV®, is selected, the basis for collecting an Inhalable versus a closed face 37-mm sample is supported by the ACGIH Documentation of the TLV.

Since exposures are already so low, with the exception of purchasing and maintaining inhalable samplers as well as increased analytical costs, it is unlikely that costs will be excessive

Q3. Should an airborne action level that is different from the 2010 ACGIH TLV for beryllium (8-hour time-weighted average of 0.05 microgram of beryllium, in inhalable particulate matter, per cubic meter of air) be established? If so, what should be the level? Please explain each of your answers and provide evidence to support your answers.

R3. In substance specific standards, OSHA typically sets action levels at 50% of an OSHA PEL. An action level, as stated in 10CFR850, triggers specific provisions of a rule. However, meeting the 0.05 µg/m^3 Inhalable value will be challenging as is; further reducing this value would likely be impossible at this time. In addition, since the ACGIH Committee determined that 0.05 µg/m^3 is "…expected to be protective of the beryllium-sensitive population because available data indicate very low or no incidences of beryllium sensitization or disease…", there is no basis for an action level.

Q4. 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 do dry wipes. Should the Department require the use of wet wipes? Please explain your answer and provide evidence to support your answer.

R4. Wet wiping, versus dry wiping, is generally accepted as being more effective at removing surface contamination. The fact that DOE encourages wet wiping by referencing NIOSH Method 9100 in 10CFR850 demonstrates that wet wiping is preferable over dry wiping.

Different media (ashless quantitative filter paper, cotton gauze, Wash'n Dri™ towelettes, Ghost Wipe®) are available and each will have properties that make them be a superior choice for different surfaces and analytical processing. DOE should select several media and identify them as being acceptable media that should be used.

For any media that is not already wetted, a wetting media should be identified. NIOSH 9100 identifies one to two milliliters of distilled water be used as the wetting agent for ashless quantitative filter paper or cotton gauze. Brookhaven National Laboratory, for example, identifies distilled water as well as alternate solvents such as isopropanol, methanol, or ethanol as the wetting agent in Surface Wipe Sampling Procedure, IH75190.

Having technically equivalent techniques is necessary to allow consistent comparison of workplace contamination levels between worksites and contractors. DOE should standardize wipe media, wipe methods, and analysis of the wipes.

Recognizing that it may be undesirable to wipe some surfaces, contractors should be encouraged to provide technically defensible bases for what alternative equivalent method is necessary. In these cases, Subpart D of 10CFR851 (Variances) can be employed.

Q5. Since the use of wipe sampling is not a common occupational safety and health requirement, 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? Please explain your answers and provide evidence to support your answers.

R5. Wipe samples aid in the identification of beryllium that could potentially become airborne, and are therefore an important tool that should be used when assessing potential beryllium haards [sic]. Wipe sample methods and techniques should be standardized across the DOE complex.

While wipe sampling for nonradiological chemicals is not used to the extent that it is used in the Health Physics (HP) field, this is more likely due to the fact that 1) there are regulatory drivers (10CFR835, Appendix D) within DOE that require wipe sampling 2) no pre-treatment is needed for many HP samples, 3) instrumentation is available to measure very low levels of radiological materials, and 4) there are few established limits for nonradiological chemicals.

It is intuitive that as a contaminant's airborne exposure limits is reduced, inhalation of the contaminant will be reduced through engineering and administrative controls as well as through the use of respiratory protection. As a result, the impact surface contamination can have a larger effect on potential worker dose, in particular if the contaminant is absorbed when ingested or subject to being absorbed through intact skin as well as cuts, scratches, or wounds. Surface contamination can be tracked to lunch rooms, personal vehicles, and even to worker homes.

Some compounds of beryllium are absorbed via the GI tract. NIOSH has reported that beryllium particles can penetrate intact skin *NIOSH Alert Preventing Sensitization and Disease from Beryllium Exposure* and *Communicating Health Risks Working Safety With Beryllium, April 2002, U.S. Department of Energy* .

Recognizing that beryllium exposure can occur through surface contamination, any program that uses wipe samples to control surface beryllium contamination is obviously protection workers. As stated in the response to question 4, DOE should standardize wipe media, wipe methods, and analysis of the wipes.

Regarding laboratory reliability and accuracy of sampling and analytical methods, it should be satisfactory that a laboratory be accredited under programs such as the American Industrial Hygiene Association's Laboratory Accreditation Program which will meet the requirements of ISO/IEC 17011. Such a laboratory will use methods developed by NIOSH, OSHA, or internally and will have shown it can provide the required level of reliability and accuracy. Equally important, however, the sample collection, preparation, and analytical methods chosen should be based on the forms of beryllium and types of interferences present. A contractor should request that an accredited laboratory use a method suitable for air and wipe samples based on the forms of beryllium (i.e., degree of solubility) present as well as any interferences present. If a contractor has not established what forms of beryllium are present, then a method that has been demonstrated to be effective on preparing and analyzing insoluble beryllium should be required. Likewise, if a contractor can demonstrate that insoluble forms of beryllium are not present, then a less aggressive sample preparation and analytical method would be acceptable.

Q6. What is the best method for sampling and analyzing inhalable beryllium? Please explain your answers and provide evidence to support your answers.

R6. The ACGIH TLV® Committee has for some time been establishing Particle Size-Selective (PSS) TLVs® for aerosols. The bases, 1 - particle size affects deposition in the respiratory tract and 2 - disease is often related to the deposition region, for establishing PSS TLVs® are explained in Appendix C of the ACGIH Threshold Limit Values for Chemical Substances and Physical Agents.

The ACGIH TLV® Committee concluded that beryllium particles can have an effect even when deposited in the upper respiratory system and the gastrointestinal (GI) tract. Recent publications indicate that the standard 37-millimeter closed face cassette tends to exclude larger particles that would be expected to be inhaled and intercepted by the upper respiratory system and possibly transferred to the GI tract. Based on these facts, an Inhalable sampler should be required unless it can be shown that alternate methods are satisfactory.

An example of when an alternative method could be acceptable could be in the case of welding where the aerosol generated has is in the respirable region. In this case, a cyclone or even a 37-mm closed face cassette could be used.

With the exception of purchasing and maintaining inhalable samplers as well as increased analytical costs, it is unlikely that costs will be excessive

Q7. How should total fraction exposure data be compared to inhalable fraction exposure measurements? Please explain your answer and provide evidence to support your answer.

R7. Unless one has conducted studies to determine the Mass Median Aerodynamic Diameter of an aerosol or the particle size is well understood as occurs during welding, it is difficult to convert a total fraction (assumed to be a 37-mm closed face cassette) sample to an Inhalable fraction. The American Industrial Hygiene Association Journal ((58) September 1997) has a discussion on this subject and provides some conversion factors that may be used.

Q8. 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? If surface area action levels are established, what should be the DOE surface area action levels? If a low airborne action level should be established in lieu of the surface area action level, what should that airborne action level be? What, if any, additional administrative controls to prevent the buildup on surfaces should be established? Please explain each of your answers and provide evidence to support your answers.

R8. Part 1 – The airborne levels of beryllium reported in the *2009 Current Beryllium-Associated Worker Registry Summary* report demonstrates that workers are not routinely being exposed to beryllium in excess of the current DOE Action Level of 0.2 µg/m^3. In fact, the airborne levels of beryllium are well below this value with 81% (from Figure 7 in the report above) being below laboratory reporting limits. With airborne levels so low, the concern with workers becoming sensitized may actually be due to exposures other than airborne sources. These can include delayed onset of sensitization, exposure to a non-DOE source (anthropogenic or natural), or surface contamination – this short list should not be considered to be all-inclusive. As a result, there is value in maintaining an airborne limit as well as a surface limit since surface contamination can be considered to be a source of sensitization (*NIOSH Alert Preventing Sensitization and Disease from Beryllium Exposure* and *Communicating Health Risks Working Safety With Beryllium, April 2002, U.S. Department of Energy)* as well as airborne exposure.

Part 2 - DOE currently uses a surface limit of 0.2 µg/100 centimeters squared (cm^2) for release (10CFR850.31). Unless information is available to demonstrate that this value is not protective, it should remain the limit. However, this value is often used regardless of the origin of the beryllium. Since beryllium is commonly used in equipment that is commercially available and is present in emissions from burning fossil fuels, DOE should clarify its position that 10CFR850 does not - or does - apply in these situations. The current section of 10CFR850.31(b)(1) dealing with naturally occurring beryllium is unclear since the method of determining this level is viewed differently and some individuals feel that beryllium released from burning coal to generate steam to operate a heating plan is covered by 10CFR850.

Part 3 – As explained in the response to Question 1, DOE should consider an airborne exposure limit somewhere between the EPA LOAEL and the ACGIH values.

Part 4 – Unless information becomes available to demonstrate that it is inadequate to protect workers, the current surface limit of 0.2 µg/100 cm^2should be adopted as a level satisfactory administrative control level.

Q9. Should warning labels be required for the transfer, to either another DOE entity or to an entity to whom this rule does not apply, of items with surface areas 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, e.g., paint? Please explain your answer and provide evidence to support your answer.

R9. Release of items that contain, or may contain, beryllium in excess of 0.2 µg/100 cm^2 should not be permitted. If an item cannot be cleaned to this value, internally as well as externally, the item should not be released. This approach is similar in principle to the DOE policy initiated in July 2000 that suspended the unrestricted release of scrap metal for recycling from radiological areas within DOE facilities. If an item cannot be demonstrated to meet the 0.2 µg/100 cm^2limit, then the item should not be released to the public even if it is sealed with a hard-to-remove substance such as paint since the substance can be removed. DOE cannot be certain that any label will be retained, will remain legible, or will be translated into a language that might be needed if end users are not primarily English-speaking.

Q10. Should the Department establish both surface level and aggressive air sampling criteria (modeled after the U.S. Environmental Protection Agency's aggressive air sampling criteria to clear an area after asbestos abatement) for releasing areas in a facility, or should the Department consider establishing only the aggressive air sampling criteria? Please explain your answers and provide evidence to support your answers.

R10. Surface level criteria already exist and should be retained. Aggressive air sampling can be considered as a means to release an area where beryllium is suspected to be in hard to reach areas provided DOE develops a standard protocol such as that described in the presentation *Validating Aggressive Air Sampling For Beryllium Clearance* discussed at the 11/4/2010 Beryllium Health and Safety Committee Meeting. Such a practice can provide a twofold benefit, 1) resuspend beryllium into the general area where it can be removed through HEPA filtration and wiping, and 2) once cleaning is complete and the aggressive air sampling is repeated with acceptable air and surface levels, demonstrate that the beryllium has definitely been removed from the area.

However, reviewing the presentation, it is unclear if the facility was actually thoroughly cleaned prior to initiating the air washing. The visible dust created while air washing indicates that the work area could have been more thoroughly cleaned. A more thorough cleaning might have resulted in smear results that demonstrated the area could be removed from a beryllium legacy area. In addition, unless they are HEPA filtered, the vacuum units used to maintain negative pressure on the room can draw naturally occurring beryllium into the legacy area, hence the need for element ratio comparisons which might be difficult in some locations. In addition, it must be recognized that the air

washing protocol associated with aggressive air sampling may be difficult to employ in a radiological area with fixed or transferable contamination.

It would be difficult to estimate the cost of aggressive air sampling but it is likely to be costly since it is unlikely that DOE contractors currently have the necessary equipment to perform this activity.

Q11. 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? Please explain your answers.

R11. Deferred to Medical staff.