

# **COMMUNICATING HEALTH RISKS WORKING SAFELY WITH BERYLLIUM**

## **Training Reference for Beryllium Workers and Managers/Supervisors**

### **Facilitator Manual**

**Prepared by the**

**Beryllium Health Risk Communication Task Force**

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**COMMUNICATING HEALTH RISKS:  
WORKING SAFELY WITH BERYLLIUM**

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These training materials have been designed for use by any Department of Energy (DOE) site that conducts training on the health risks of beryllium. Electronic files of the modules and overheads may be downloaded from the DOE Chronic Beryllium Disease Prevention Program (CBDPP) web site ([http://tis.eh.doe.gov/health/hservices/fb\\_surv.html](http://tis.eh.doe.gov/health/hservices/fb_surv.html)) and adapted to your site's specific needs. The materials were prepared in a collaborative effort by the Beryllium Health Risk Communication Task Force, a diverse group of DOE and DOE contractor employees and other individuals who share a commitment to consistent, effective messages in dialogs on health risks, and specifically on the risks of occupational exposure to beryllium.

The Office of Health Programs (EH-6), Assistant Secretary for Environment, Safety and Health, has sponsored the project since June 1997. During 1997 and 1998, the Office of Technical and Environmental Support, Assistant Secretary for Defense Programs, and the Environmental Restoration Office of Program Integration, Assistant Secretary for Environmental Management, joined EH as partners in developing the initial materials.

Task Force members from the DOE community include workers with chronic beryllium disease, workers currently employed in beryllium operations, union representatives, line managers, site occupational medicine doctors, site industrial hygienists, site trainers, epidemiologists, and toxicologists. DOE operations and program office personnel with responsibilities for oversight of safety and health in DOE facilities have also participated. Other Task Force members are environment, safety, and health staff from Brush Wellman, Inc.; and communication, health, and medical specialists from the National Institute for Occupational Safety and Health, National Cancer Institute, Agency for Toxic Substances and Disease Registry, and several research institutes and universities. In preparation for the training pilot, Y-12 National Security Complex trainers and line managers conducted a careful review of the materials. (All Task Force members are listed at the end of the Foreword.)

In 2000-2001 the materials were updated to incorporate new information and to reflect the requirements of the final DOE rule on chronic beryllium disease prevention (10 CFR 850). Initial recommendations on the update came from a team of Task Force members in the Oak Ridge area. Joining the original participants from Y-12 were representatives of Oak Ridge National Laboratory and the East Tennessee Technology Park (ETTP). Representatives of the Paper, Allied-Industrial, Chemicals and Energy Workers International Union (PACE) and its ETTP bargaining unit (PACE Local 5-288) also joined the team. All Task Force members reviewed the update in 2001.

These training materials represent the group's effort to integrate current, technically accurate information about beryllium, presented in lay language, with a structure defined by risk communication best practices. The Office of Health Programs wishes to thank all the Task Force members who gave their time, creativity, and expertise to this project by contributing data and perspectives and by reading and reviewing the training material at various stages of its development.

If you have questions or suggestions for future modifications to these training modules, please call or e-mail Ms. Libby White, Office of Health Programs, 301-903-7582 ([Elizabeth.White@eh.doe.gov](mailto:Elizabeth.White@eh.doe.gov)).



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In the module you will be introduced to:

- The overall effects on health of exposure to beryllium
- The uses of beryllium in industry and defense
- The importance of knowing your personal risk of exposure
- The Department of Energy's Chronic Beryllium Disease Prevention Program

## **I. WHY ARE WE CONCERNED ABOUT BERYLLIUM?**

### **A. Because Beryllium Is a Significant Workplace Health Hazard**

Exposure to beryllium particles can cause a serious illness in certain people. This illness is chronic beryllium disease, or CBD—an incurable and sometimes fatal scarring of the lungs.

- Medical studies show that even small amounts of beryllium particles that are of a size that can be breathed deeply into the lungs have triggered an allergy-like sensitivity in 2-5 percent of people exposed.
- About 2 percent of all people exposed to beryllium develop CBD. For people who worked in occupations like beryllium machining where historically exposure to airborne beryllium was greatest, studies have found between 8 and 16 percent with CBD.

In Module 2 we will discuss the medical surveillance studies currently being conducted at DOE facilities. These studies are looking at the relationship between work experience and rates of beryllium sensitization and CBD.

Introduce yourself and give any needed information about course logistics and the building where you are meeting (fire exits, etc.).

If you have the DOE "Beryllium Worker Safety Training Video" (available from DOE/EH-6, by calling 301-903-7582), you may want to play the introductory section. "Why We're Here" at this point. (Keys to other sections of the video appear in the notes for the corresponding training content.)

Emphasize that the session will be interactive and encourage all participants to ask questions, share experiences, and state concerns. Participants interested in improving their communication skills will want to review Appendix A.

Stress that no one has all the



- An estimated 20,000 individuals may have been exposed to beryllium in DOE facilities. By April 2001, DOE had screened 15,327 workers and former workers with a test for beryllium sensitization. A total of 483 of those screened have repeatedly positive tests. To date, 156 of this group are either definitely diagnosed with CBD or show CBD symptoms. The total number of cases has increased as more people have been tested.
- Workers in private industries that process or use beryllium have also been diagnosed with CBD.

Beryllium sensitization and CBD are seen **only** in individuals who have experienced some exposure to beryllium particles, dust, or fumes.

“Workers are getting sick from beryllium. As we work to understand more about the disease, the interim solution is simple—minimize incidents of the disease by minimizing exposure.”

Federico Peña, Secretary of Energy  
July 16, 1997

“We want to provide strong protection for the workers who may be exposed to beryllium as the department dismantles and decommissions the facilities of the nuclear weapons complex. ... Because of the involvement of the workers, public health experts and other stakeholders in this process, we now have in place the toughest and most comprehensive protections in the world to prevent future cases of this terrible disease.”

Bill Richardson, Secretary of Energy  
December 8, 1999

“My concern is that we take care of men and women who were harmed as a result of loyal service to their country.”

Elaine Chao, Secretary of Labor  
May 2001

answers about beryllium, but if questions arise that you cannot answer, you will help participants find the right source of information.

Show Overhead 1-1. Emphasize that DOE and this facility take the hazards of exposure to beryllium very seriously. Briefly note any relevant data for your facility here such as current rates of sensitization or CBD.

Show Overhead 1-2.



## B. Because DOE and Other Industries Expect to Continue Using Beryllium

Because of its unique properties, beryllium is likely to continue to play a role in weapons production and in several other DOE missions where substitute materials are not available. Beryllium is also widely used in many other products (electronics, sports equipment) and industrial processes. The *What Is Beryllium?* fact sheet (at the end of this module) describes the properties and uses of this metal.

### Weapons Production

Beryllium oxide ceramics are a critical component of nuclear weapons. These ceramics are machined and were formerly hot pressed at several DOE facilities.

Beryllium metal components of nuclear weapons are also machined at DOE weapons plants. Beryllium alloys are used in electronic and other “weaponizing” components of nuclear weapons.

Workers handle beryllium-containing parts in weapons assembly and disassembly. Workers crush, press, or otherwise deform these parts to ensure declassification and to render the parts unusable for military purposes.

Machining and crushing are types of operations that can release beryllium particles to the air. Containing these processes is important to reduce worker exposure. Module 4 will present more information on methods of control.

### Defense and Energy Research

Beryllium is used as a moderator or reflector of neutrons in test nuclear reactors.

Beryllium foils are used as X-ray windows and in accelerator targets.

Beryllium compounds and alloys are used as nuclear fuel-element cladding. They are also the subject of research and have other, experimental uses at various DOE labs. For example, beryllium hydride is used in tritium research.

Show Overhead 1-3 and point out the fact sheet.

You may show the beryllium video module “Past and Present” here.

If slides showing activities at your site are available, you can use them here to provide an overview. Again, remind participants not to discuss classified activities.



**C. Because Beryllium Wastes Must Be Cleaned Up at Former Weapons Production and Research Sites**

- Even if all other uses of beryllium stopped tomorrow, DOE still has buildings, equipment, and storage areas where beryllium materials are found. For example, since 1993, Rocky Flats, which once machined weapons parts, has shipped about 130,000 pounds of recycled beryllium to other locations.
- Decontamination and decommissioning (D&D) of areas with beryllium contamination will continue for many years. D&D activities may range from simple cleaning of these areas to major projects of treatment, removal, and disposal of contaminants.

Show Overhead I-4. Briefly note any D&D activities at your site, using slides or maps if available.

**II. WHAT IS BERYLLIUM?**

Review the *What Is Beryllium?* fact sheet. The course facilitator may present additional information on beryllium use or lead a class discussion on sources of exposure at your site. *Remember to observe restrictions on discussing classified information.*

Be prepared for questions about why other materials cannot be substituted in specific operations at your site.

**III. WHAT DO BERYLLIUM'S HAZARDS AND USES MEAN FOR YOU?**

**A. Current and Former Workers at DOE Sites May Have Been Exposed to Beryllium**

If you have ever worked in or near operations using beryllium, you could have breathed airborne particles into your lungs. This exposure may have put you at risk for beryllium disease. You should know:

Show Overhead 1-5

1. What the health hazards are
2. How to get more information on your personal risks of disease
3. What assistance DOE offers to current and former workers



**B. Current Workers Also Need to Know How to Protect Themselves Now and in the Future**

If you currently work where beryllium is present or near such areas, you also need to know:

1. How to protect yourself, your co-workers, and your family from future beryllium exposure
2. What DOE and your facility are doing to protect you

**C. DOE Has a New Regulation and a Program to Protect Employees from Beryllium Hazards**

In December 1999, DOE's Chronic Beryllium Disease Prevention Program Rule became final. The purpose of the new rule is to reduce the occurrence of CBD among workers in DOE facilities. This rule is found in Title 10, Part 850 of the *Code of Federal Regulations* (10 CFR 850).

The new rule strengthens earlier DOE and DOE contractor programs to protect workers from the health hazards of beryllium. Sections of the rule require DOE facilities to:

- Reduce the number of people exposed to beryllium by limiting worker access to areas and operations where beryllium is used, handled, or stored.
- Minimize worker exposures and the potential for exposure to beryllium through the use of engineering and work practice controls to prevent the release of beryllium to the air and/or capture or contain particles before they can be inhaled.
- Establish medical surveillance to monitor the health of exposed workers and to ensure the early detection of disease.
- Monitor the effectiveness of the program in preventing CBD and make any changes needed to improve the program.

Introduce information on your site program. Note that more detail on the site program will be given in Modules 3 and 4 and in any facility- or job-specific training the participants may attend later.

Show Overhead 1-6. Point out the web site for the full text of the rule is given in the Module 1 References. Tell participants where they can obtain paper copies on site.



#### **D. Who Is Present Today? What Do You Want to Know?**

Most of the site employees attending this course are “beryllium-associated workers.” Under the Beryllium Rule, this term includes:

1. Beryllium workers—which means those regularly working in a DOE beryllium activity
2. Other current workers whose work histories indicate the possibility of exposure in a previous job
3. Current workers who have signs or symptoms of beryllium exposure
4. Current workers who have been voluntarily removed from beryllium work on the advice of the site occupational medicine director

If you did not do so before coming to the course, you may be asked to complete the short pre-course survey (at the end of this module) about your job and your concerns.

Please use this information and other information you may choose to share to introduce yourself to the group.

The facilitator will start a “parking lot” on a flipchart or marker board to note issues, concerns, and questions that come up in these brief introductions. During the class, you and other participants should check this list to make sure that these topics are addressed to your satisfaction.

If time does not permit extended discussion of a given topic, the facilitator will guide you to reference materials or to individuals on site who can better answer particular questions you may have.

#### **IV. WHAT DO WE WANT TO ACCOMPLISH TODAY?**

The goals of the DOE program also include better training and communication about the hazards of beryllium exposure.

Anyone working in or near operations that include beryllium needs to understand:

Note that more information on these categories will be covered in the session. For example, signs and symptoms will be explained in Module 2. Point out the glossary in the training materials. Terms used in the rule are defined in 10 CFR 850.3.

If you sent out the survey before the course began, collect it now and make time for participants to introduce themselves and briefly discuss their experiences with beryllium operations and their concerns—*remembering to avoid any discussion of classified information*. Start the “parking lot” of concerns and questions on a flipchart.

Show Overhead 1-7. Take additional comments, but remind participants of how much needs to be accomplished. Note that they may keep their manual for future reference.



- The health risks associated with exposure to beryllium particles
- The program required by the DOE Beryllium Rule to protect you and others from beryllium exposure
- Steps you can take to reduce beryllium exposure

To meet those objectives, today we will cover information about beryllium and its health effects and site-specific guidance on reducing exposures.

This session also offers an opportunity for the group to share experiences, to raise concerns about beryllium exposure, and to ask questions about requirements and practices across industry and at this site.

Let's get started by discussing the health effects of beryllium exposure and the medical programs that address them. We will then discuss practices for monitoring and controlling beryllium exposure in the workplace.

### **The Message to Remember**

1. Beryllium is a hazardous material that will continue to be used and handled in DOE operations.
2. Employees at DOE sites who currently work with or around beryllium-containing materials, or did so in the past, need to learn about their personal risks of beryllium disease.
3. Employees working with or around beryllium-containing materials need to know how to protect themselves from exposure.

Show Overhead 1-8.



## V. REVIEW QUESTIONS FOR MODULE 1

Please take a minute to review Module 1 by answering the following review questions:

1. Chronic Beryllium Disease is seen only in individuals who have experienced some exposure to \_\_\_\_\_ in the form of \_\_\_\_\_, \_\_\_\_\_ or \_\_\_\_\_.
2. One of the ways DOE research facilities use beryllium is: \_\_\_\_\_.
3. The purpose of DOE's Beryllium Rule is: \_\_\_\_\_.

## VI. REFERENCES

Several research groups are studying beryllium sensitization and CBD among current and former workers at DOE sites. The DOE Office of Health Programs collects data from these studies. A list of publications and other information about research on beryllium health effects is provided at the end of Module 2.

For an overview of the association between beryllium exposure and disease and summary information on the results of medical studies, see these two publications:

Possible answers to the questions are as follows:

1. beryllium particles, dust, or fumes
2. moderator or reflector in nuclear reactors, X-ray windows, accelerator targets, or nuclear fuel-element cladding
3. reduce the occurrence of chronic beryllium disease among workers in DOE facilities



Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services. September 2000. *Toxicological Profile for Beryllium*, draft for review, 280 pp. The draft can be found on the following web site:

<http://www.atsdr.cdc.gov/toxprofiles/tp4.pdf>

ATSDR expects this profile to be final in 2002. For more information on this or other ATSDR publications, call 1-888-42-ATSDR (1-888-422-8737) or email [atsdric@cdc.gov](mailto:atsdric@cdc.gov).

U.S. Environmental Protection Agency. 1998. *Toxicological Review of Beryllium and Compounds (CAS No. 7440-41-7)*, 94 pp. This document can be downloaded from the following web site:

<http://www.epa.gov/iris/toxreviews/0012-tr.pdf>.

To request a paper copy, call the EPA's Risk Information Hotline at 513-569-7254.

The DOE Chronic Beryllium Disease Prevention Program Final Rule, 10 CFR 850, with additional background information on CBD, may be found in the *Federal Register*, vol. 64, no. 235, pp. 68854-68914.

You may also find the rule on the DOE web site at:

<http://tis.eh.doe.gov/be/berule.pdf>

or through the Government Printing Office database, available on line at:

[http://www.access.gpo.gov/su\\_docs/aces/aces140.html](http://www.access.gpo.gov/su_docs/aces/aces140.html)

For short reviews of findings on CBD, see:

Newman, L.S., Lloyd, J., Daniloff, E. 1996. The Natural History of Beryllium Sensitization and Chronic Beryllium Disease. *Environmental Health Perspectives* 104, Suppl. 5: 937-943.

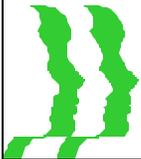
Maier, L.A. 2001. Beryllium Health Effects in the Era of the Beryllium Lymphocyte Proliferation Test. *Applied Occupational and Environmental Hygiene* 16 (5): 514-520.

## Why Are We Here?



**Breathing beryllium particles can cause serious illness. Beryllium is a significant workplace hazard.**

- Chronic beryllium disease (CBD) is treatable, but not curable at this time.
- About 2 percent of all people exposed to beryllium develop CBD.



## Why Are We Here?

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“Workers are getting sick from beryllium. As we work to understand more about the disease, the interim solution is simple--minimize incidents of the disease by minimizing exposure.”

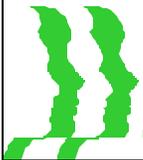
Federico Peña, Secretary of Energy, July 16, 1997

“...we want to provide strong protection for the workers who may be exposed to beryllium...”

Bill Richardson, Secretary of Energy, December 8, 1999

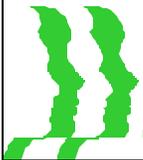
“My concern is that we take care of men and women who were harmed as a result of loyal service to their country.”

Elaine Chao, Secretary of Labor, May 2001



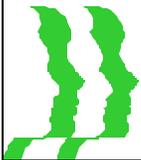
### **DOE and other industries expect to continue using beryllium.**

- Beryllium has unique properties.
- Beryllium is used in weapons production.
- Beryllium is used in defense and energy research.
- Beryllium has other industrial and consumer uses.



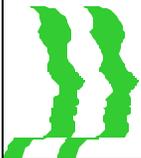
### **Beryllium wastes must be cleaned up at former weapons production and research sites.**

- DOE has buildings, equipment, and storage areas contaminated with beryllium.
- Decontamination and decommissioning (D&D) of beryllium contamination areas will continue for many years.



### **Understanding beryllium's health risks and how to protect yourself is important.**

- Current and former DOE site workers may have been exposed to beryllium.
- Current workers need to know how to protect themselves now and in the future.
- Under the Beryllium Rule (10 CFR 850), DOE is implementing a stronger program to protect workers on DOE sites from beryllium hazards.



## Why Are We Here?



**The purpose of the DOE beryllium rule is to reduce the occurrence of CBD among workers in DOE facilities.**

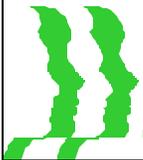
Requirements include:

- Limiting access to beryllium.
  - Preventing beryllium release and capturing particles before they can be inhaled.
  - Conducting medical surveillance of exposed and potentially exposed workers.
  - Monitoring the effectiveness of the new programs in preventing CBD.
- 

### Goals for today's session

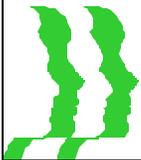
To assure that you know:

- The health risks associated with exposure to beryllium particles.
- The program required by the Beryllium Rule to protect you, your co-workers, and your families from beryllium exposure.
- Steps you can take to reduce beryllium exposure.



### **Message to remember**

- Beryllium is a hazardous material that will continue to be used and handled in DOE operations.
- DOE site employees who currently work with or around beryllium-containing materials or did so in the past need to learn about their personal risks of beryllium disease.
- Employees working with or around beryllium need to know how to protect themselves from exposure.



# WHAT IS BERYLLIUM?

## Background Information for Health Risk Course Participants

### Beryllium Is a Silver-Gray Metallic Element That Occurs Naturally in About 30 Minerals.

Beryllium was discovered in 1798, but it was not widely used in industry until the 1940s and 1950s. In industrial applications beryllium can be:

- used as pure metal
- mixed with other metals to form alloys
- processed to make salts that dissolve in water
- processed to form oxides and ceramic materials

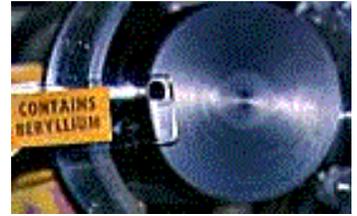


Figure 1 Courtesy of Lawrence Livermore National Laboratory

### Beryllium-Containing Minerals Are Found in Rocks, Coal and Oil, Soil, and Volcanic Dust.

From these sources, beryllium is emitted into the air and water by natural processes like erosion and by the burning of coal and oil. According to data collected by the Environmental Protection Agency (EPA), the average concentration of airborne beryllium in the United States is very small (0.03 nanogram/cubic meter--a nanogram is one-billionth of a gram). However, all of us probably breathe or swallow trace amounts of beryllium each day from the air around us, from water, and from some foods. EPA studies have found that beryllium occurs in tobacco leaf and in cigarette smoke.

Beryllium used in industry begins as a silicate ( $\text{BeSiO}_3$ ) in beryl and bertrandite ores. In a very pure crystalline form, beryl is known to us as gems such as blue-green aquamarine and green emerald.



Figure 2 Courtesy of Lawrence Livermore National Laboratory

Bertrandite is mined in Utah, but other ores and scrap are imported into the United States, which is the world's leading producer, processor, and consumer of beryllium products. According to U.S. Geological Survey reports, total U.S. use of all forms of beryllium in 1999 was about 240 metric tons.

<b>Lighter than Aluminum, Stiffer than Steel--Properties That Make Beryllium Useful</b>	
<b>Light weight</b>	<ul style="list-style-type: none"> <li>• atomic weight is 9.0122</li> <li>• second lightest of the metals (only 1/3 as heavy as aluminum)</li> <li>• density is 1.85 grams per cubic centimeter (similar to magnesium)</li> </ul>
<b>Stiffness or rigidity</b>	<ul style="list-style-type: none"> <li>• about 6 times stiffer than steel</li> <li>• can withstand great force before bending</li> </ul>
<b>High melting point</b>	<ul style="list-style-type: none"> <li>• 1285°C, which is high compared to other light metals</li> <li>• holds its shape over a wide temperature range</li> </ul>
<b>High heat-absorption capacity</b>	<ul style="list-style-type: none"> <li>• a pound will absorb as much heat as 5 pounds of copper</li> </ul>
<b>Nonmagnetic</b>	
<b>Dimensional stability</b>	
<b>Good corrosion resistance</b>	
<b>Lowest thermal neutron absorption cross-section of any metal</b>	
<b>High permeability (transparency) to X-rays</b>	
<b>Can be machined to close tolerances</b>	

## Many Products and Processes Use Beryllium's Properties.

**Beryllium metal has been produced for various industrial uses since the late 1950s.**

Both structural and instrument grade materials are manufactured, especially for use in aerospace and defense:

- Windshield frames and other structures in high-speed aircraft and space vehicles
- Aircraft and space shuttle brakes
- Satellite mirrors and space telescopes
- Inertial guidance systems and gyroscopes
- Neutron moderator or reflector in nuclear reactors
- X-ray windows
- Nuclear weapons components



Figure 3 Courtesy of NASA

## Other Beryllium Materials Include Soluble Salts, Alloys, and Oxide.

*Soluble salts*, such as beryllium fluoride, chloride, and sulfate, are used in nuclear reactors, in glass manufacture, and as catalysts for certain chemical reactions.

*Beryllium-copper (BeCu) alloys* usually contain about 2 percent beryllium, but vary greatly in composition to meet different industrial and consumer needs. Beryllium contributes hardness, strength, high electrical and thermal conductivity, and resistance to corrosion, wear, and fatigue. For example, BeCu springs "bounce back" to their original shape again and again.

BeCu alloys are used for:

- Springs, switches, relays, and connectors in automobiles, computers, radar and telecommunications equipment, and other instruments
- High-strength nonsparking tools including some tools sold for use in the home
- Molds or casts to make metal, glass, and plastic items
- Sports equipment such as golf clubs and bicycle frames
- Dental bridges and related applications

Beryllium is also added to aluminum, nickel, zinc, and zirconium for some applications. Beryllium-nickel alloys are used in automobile air bags. A relatively new beryllium-aluminum alloy (the registered trademark is "Beralcast") is being used in fighter planes, helicopters, and missile systems.

## Beryllium Oxide (BeO) Is Used To Make Ceramics For Electronics, Electrical, And Other Equipment.

BeO contributes hardness, strength, excellent heat conductivity, and good electrical insulation. In closely packed circuitry (like that in the electronic ignition systems of automobiles), beryllium ceramic layers can draw heat away from other circuit components. Because BeO is transparent to microwaves, it has also been used in microwave ovens.

### Despite Its Usefulness, Beryllium Is Not an Ideal Material.

It is expensive and too brittle to work with in some applications.

***The most significant disadvantage of beryllium as an industrial material is the toxicity of its dust, fumes, and soluble salts.***

Beryllium's brittleness is the down side of its advantageous stiffness. Brittleness also increases the hazards associated with beryllium's toxicity. Unless ventilation and other controls are used, small particles and chips of insoluble beryllium-containing materials break off during machining and other processes and spread through the air in the work area. Inhalation of these tiny particles is the type of exposure that can lead to chronic beryllium disease.

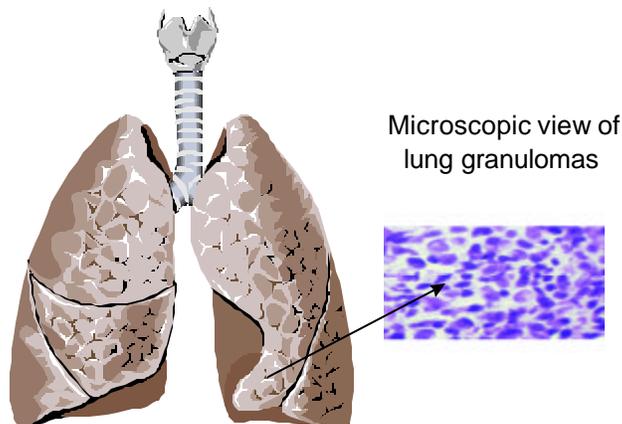


Figure 4 Micrograph Courtesy of Dr. Lee Newman, National Jewish Medical and Research Center

### Information Sources

- Information on beryllium's production and use can be found in U.S. Geologic Survey (USGS) publications. Two annual USGS publications, the Minerals Yearbook and the Mineral Commodity Summaries, include articles on beryllium. These documents are available in the reference rooms of many public and university libraries or on-line at: <http://minerals.usgs.gov/minerals/pubs>. They can also be ordered from:

U.S. Government Printing Office  
Superintendent of Documents  
P.O. Box 371954  
Pittsburgh, PA 15250-7954  
Phone: 202-512-1800; Fax: 202-512-2250

- Many types of information on beryllium's health and safety hazards are available from federal agencies. In 2000, the Agency for Toxic Substances and Disease Registry updated its *Toxicological Profile for Beryllium*, with a draft now in review. The draft can be found on the following web site: <http://www.atsdr.cdc.gov/toxprofiles/tp4.pdf>. For more information on this or other ATSDR publications, call 1-888-42-ATSDR (1-888-422-8737) or email [atsdric@cdc.gov](mailto:atsdric@cdc.gov).
- Because beryllium and its compounds are regulated under environmental laws, the Environmental Protection Agency's Integrated Risk Information System (IRIS) includes data on beryllium health effects in its databases and publishes a toxicological review of beryllium and its compounds. The

*Toxicological Review of Beryllium and Compounds (CAS No. 7440-41-7)*, published in 1998, can be downloaded from <http://www.epa.gov/iris/toxreviews/0012-tr.pdf>.

To request a paper copy, call the EPA's Risk Information Hotline at 513-569-7254.

- The National Institute of Occupational Safety and Health (NIOSH) has information on a number of beryllium compounds in the form of International Chemical Safety Cards (online at <http://www.cdc.gov/niosh/ipcsneng/nengsynb.html>). You can reach NIOSH to request a publication at:

NIOSH Publications  
4676 Columbia Parkway, Mail Stop C-13  
Cincinnati, OH 45226-1998  
Phone: 1-800-356-4674; fax: 513-533-8573  
Internet e-mail address: [pubstaft@cdc.gov](mailto:pubstaft@cdc.gov)

- Manufacturers of beryllium alloys and compounds provide Material Safety Data Sheets (MSDSs) with detailed information on the health and safety hazards. Brush Wellman, the major U.S. manufacturer, has beryllium health and safety information (including MSDSs) online at: <http://www.brushwellman.com/ehs/msdsweb.nsf/wtoc>. Address requests for Brush Wellman MSDSs to:

Brush Wellman, Inc.  
17876 St. Clair Avenue  
Cleveland, OH 44110  
Phone: 1-800-862-4118

- Environmental Defense's Scorecard information system has chemical profiles on beryllium and some beryllium compounds. Go to <http://www.scorecard.org> to locate them. The profiles include information on waste generation and environmental releases by state or locality and by industry type.



**HEALTH RISK COMMUNICATION ON BERYLLIUM  
PARTICIPANTS' PRE-COURSE SURVEY**

**NOTE:** This pre-course survey is optional and will only be used by the facilitator in presenting the appropriate content to participants.

1. Today's date: Mo \_\_\_\_ Day \_\_\_\_ Yr \_\_\_\_

2. Site or facility: \_\_\_\_\_

3. Brief work history with beryllium, or in buildings where beryllium operations were present:

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4. Current job title \_\_\_\_\_

5. Are you currently working as one of the following?

5.1 \_\_\_\_\_ Project or work team leader

5.2 \_\_\_\_\_ Union representative

5.3 \_\_\_\_\_ Supervisor

5.4 \_\_\_\_\_ Manager

6. Which of the following describes your current work?

6.1 \_\_\_\_\_ I no longer work with beryllium or go into areas where beryllium is present.

6.2 \_\_\_\_\_ Most of my work is elsewhere, but I occasionally enter a beryllium work area.

6.3 \_\_\_\_\_ Much of my work is performed in a beryllium work area.

7. Which of the following describes your current job responsibilities (check all that apply)?

7.1 \_\_\_\_\_ Weapons production or dismantling operations

7.2 \_\_\_\_\_ Weapons or energy research and design

7.3 \_\_\_\_\_ Environmental cleanup/restoration

7.4 \_\_\_\_\_ Waste management

7.5 \_\_\_\_\_ Packaging and transportation

7.6 \_\_\_\_\_ Design of facilities

7.7 \_\_\_\_\_ Maintenance of building, facility, or equipment

7.8 \_\_\_\_\_ Construction or demolition of site facilities

7.9 \_\_\_\_\_ Janitorial or laundry services

7.10 \_\_\_\_\_ Other (please state): \_\_\_\_\_





10. Other concerns?

10.1. \_\_\_\_\_

10.2. \_\_\_\_\_

10.3. \_\_\_\_\_



In this module you will learn about:

- How beryllium enters your body.
- The health effects of exposure to beryllium.
- How chronic beryllium disease (CBD) can affect you.
- The question of whether any levels of airborne beryllium are safe for everyone.
- What you can do to reduce the risk of getting CBD.
- Medical monitoring and surveillance programs at this facility.
- How sensitization to beryllium is diagnosed.
- How CBD is diagnosed and treated.
- Worker compensation, counseling, and other services.
- How CBD or beryllium sensitization may affect your job assignment.
- Your rights to your medical records.

## I. HEALTH EFFECTS

### A. How Beryllium Enters and Affects Your Body

*Beryllium can enter your body by four different routes:*

- Breathing (inhalation)
- Skin contact with soluble beryllium compounds
- Cuts and skin wounds
- Swallowing (ingestion)

*Breathing (inhalation):* Most of the serious health effects of beryllium occur when beryllium enters your body from breathing in airborne insoluble particles that are small enough to travel deep into your lungs.

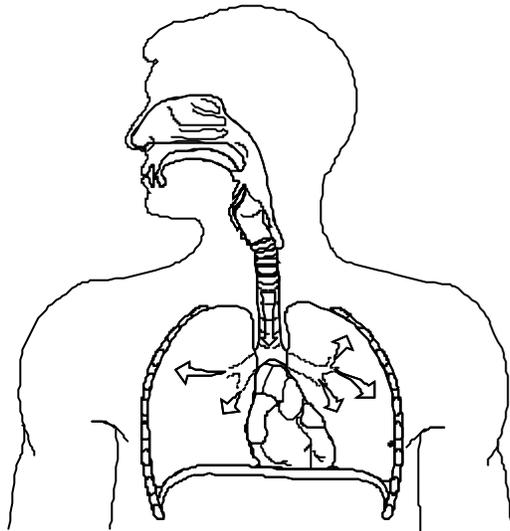
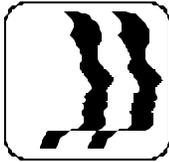
Some operations at this facility generate or have the potential to generate tiny airborne beryllium particles that you could breath into your lungs.

Note: You may wish to have the site occupational medicine director or another health professional who is knowledgeable about CBD and about the medical surveillance program join the group to answer questions or explain the policies and procedures at your site. At a minimum, be prepared to refer participants to the occupational medicine department for more information on the topics addressed in this module.

Review module objectives.  
Show Overheads 2-1 and 2-2.

Show Overhead 2-3 and discuss routes of entry. Participants may have had encounters at work or in the home with exposure to hazards by one or more of these routes. Emphasize that serious health effects are associated with **inhaling** beryllium.

Note specific forms of beryllium that employees could be exposed to at your facility. Note forms that are *not* present at your facility.



*Skin contact with soluble beryllium compounds:* Skin contact with beryllium compounds that dissolve in water, such as most beryllium salts, can produce rashes and other types of skin reactions (*dermatitis*).

Some studies in progress also suggest that very small insoluble particles may also get through intact skin and contribute to beryllium sensitization.

Dust and fumes of non-dissolving (insoluble) forms of beryllium, such as beryllium metal, alloys, or beryllium oxide ceramics can irritate your eyes.

*Cuts and skin wounds:* Beryllium can enter your body through a cut, abrasion, or other wound on your skin. If particles of insoluble beryllium, such as beryllium ceramics, become lodged under your skin, they can cause a rash or the formation of hard lumps of inflamed tissue (*granuloma*). The wound will fester as long as the particles are present, but once the beryllium is removed, the wound will usually heal soon afterwards. A wound that does not heal readily should be examined by a physician.

Health studies of beryllium alloy workers suggest that cuts and skin wounds may also be a means of becoming sensitized to beryllium.

Sally Tinkle at NIOSH has reported the possibility of penetration of intact skin by ultrafine beryllium particles, but



*Swallowing (ingestion):* Beryllium can get inside your body if you swallow particles by eating or drinking beryllium-contaminated foods or using hands or utensils contaminated with beryllium. Studies to date have not found adverse health effects from ingested beryllium. However, remember that beryllium particles on hands, food, or tobacco products could also be inhaled.

*Inhaling airborne beryllium particles can cause SERIOUS ILLNESS.*

Inhaling a large number of particles can cause a form of *chemical pneumonia*, which occurs very soon after the exposure. Exposure to much smaller amounts of beryllium can cause individuals who are sensitized to beryllium to develop chronic beryllium disease, even many years after the exposure happened.

Understanding how beryllium enters and affects your body will help you understand *why* you must follow all the practices and procedures your site has established to protect you, your co-workers, and your family from beryllium exposure.

Working safely around beryllium may reduce your chances of becoming sick or possibly even dying from beryllium disease.

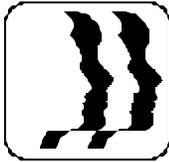
Procedures to prevent exposure to beryllium particles are described in Modules 3 and 4. Failing to observe these preventive measures may put you and others at risk of exposure.

*Get medical attention if you believe you have been exposed to beryllium by any route.*

If beryllium particles appear to have been released via an emergency or other incident in your work area, you should seek medical attention immediately through your site occupational medical facility.

You should also report and seek medical attention after any possible exposure to particles through cuts, abrasions, and similar injuries in a beryllium work area.

Show Overhead 2-4. Stress the seriousness of inhalation of beryllium particles of the right size to penetrate deep into the lungs.



**You should avoid exposure to beryllium by ALL routes of entry.**

Exposure to beryllium can affect your health in various ways. Some of these effects have obvious symptoms, such as persistent coughing. However, CBD may not cause any symptoms that you or your doctor would notice until it has reached an advanced stage.

### **B. Chemical Pneumonia: A Short-Term Health Effect**

In the 1930s, 1940s, and 1950s, doctors and researchers found that workers who inhaled airborne concentrations of beryllium particles of 100 micrograms per cubic meter or (these measurements will be explained in Module 3) were developing serious lung irritation that led to a disease called “chemical pneumonia” or “chemical pneumonitis.” Symptoms included coughing, burning and pain in the chest, and shortness of breath.

Chemical pneumonia was mainly seen in workers who had inhaled soluble forms of beryllium (beryllium salts). The disease is called a short-term, or *acute*, effect of beryllium exposure because the delay time between the exposure and the symptoms is only days or weeks.

Improved engineering controls and workplace practices make it unlikely that anyone working in beryllium operations today will be exposed to concentrations high enough to cause chemical pneumonia. Nevertheless, accidents happen. You should be aware of the hazard.

### **C. Chronic Beryllium Disease: A Long-Term Health Effect**

Long-term, or *chronic*, health effects can take years to develop after the first exposure to beryllium and can affect people who were exposed to very small amounts of beryllium. In some cases, CBD has been diagnosed in former office workers and others who had only brief, incidental exposure to beryllium.

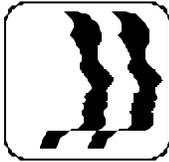
Show Overhead 2-5.

Note that there are uncertainties about the beryllium dose associated with chemical pneumonia. In the early 1950s, some cases of acute disease were reported to have occurred at even lower concentrations.

Chemical pneumonia due to beryllium exposure is very rare today. The primary risk for a current DOE site employee would be as a result of some type of accident.

Show Overhead 2-6 and play the video module “Taking It In.”

Note that very small amounts of beryllium can lead to CBD. Note the progression: exposure to sensitization to disease.



This long-term effect of beryllium exposure is called *chronic beryllium disease*, or CBD. This disease is sometimes called by an older name, “berylliosis.”

CBD is primarily a lung disease, but it may also affect other organs, particularly the lymph nodes, skin, spleen, liver, kidneys, and heart.

CBD is seen in individuals who are sensitized to beryllium.

CBD occurs in individuals who have become “allergic” or sensitized to beryllium upon exposure. Although DOE medical surveillance programs are now identifying more people who are only sensitized and not sick with CBD, some individuals had already developed CBD by the time they were evaluated for beryllium sensitization or lung symptoms.

Recent research suggests that beryllium sensitization may have a genetic basis. Researchers have found some of the genetic risk factors for CBD, and studies are in progress to identify others.

Small differences in certain genes can affect the way the immune system handles beryllium. People with one form of a particular gene may be more susceptible to CBD than those with a slightly different form.

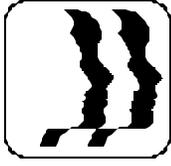
However, some individuals without any of the known genetic risk factors have developed CBD. At present, there is no way to predict whether a given individual is likely to get CBD following exposure to beryllium particles. The best policy continues to be preventing exposure to beryllium.

DOE and other agencies continue to fund research on the genetic factors associated with CBD.

First cases of CBD were described in 1946 in a study of 17 workers in the fluorescent lamp industry, whose symptoms developed 6 months after first exposure (H.L. Hardy and I.R. Tabershaw. 1946. Delayed chemical pneumonitis occurring in workers exposed to beryllium compounds. *J. Industrial Hygiene and Toxicology* 28:197-211).

Small variations in the genes responsible for some of the immune response proteins appear to be associated with CBD susceptibility. A change in the shape of one of these proteins could determine whether or not immune system cells recognize and react to beryllium.

Although some labs can test for genetic markers, there is still no standard genetic test for CBD susceptibility. Some current and former workers are participating in studies to help refine the tests. There is no approved test to detect a genetic basis for beryllium sensitization. Many ethical issues surround genetic tests and their use in the workplace.



### CBD can take many years to develop.

The average time from first beryllium exposure to the development of symptoms (*latency period*) of CBD is 10 to 15 years. This means you can be exposed to beryllium today and not suffer any health effects for many years. Health effects have appeared a few months after exposure in some people, but not for as long as 30 years in others.

Doctors and researchers believe that some individuals who have had CBD lived with the disease and died from other causes without even knowing they had CBD.

### CBD symptoms resemble those of other lung diseases.

The symptoms of CBD are very similar to those of several other diseases, particularly a disease called *sarcoidosis* that affects the lungs and sometimes organs. On occasion, doctors have diagnosed what turned out to be CBD as sarcoidosis or another disease.

In some cases, the physician did not know that the patient could have been exposed to beryllium. In other cases, the physician did not know about the effects of beryllium exposure. Tests that show beryllium sensitization are one of the few ways doctors have to tell CBD from sarcoidosis.

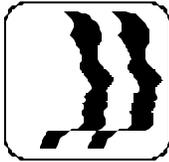
### Symptoms of CBD may include the following:

1. Persistent coughing
2. Shortness of breath with physical exertion
3. Fatigue
4. Chest and joint pain
5. Blood in the sputum (*sputum* is saliva, mucus, and other discharges that can be "coughed up" from the respiratory system)
6. Rapid heart rate
7. Loss of appetite
8. Fevers and night sweats

In addition to sarcoidosis, many other kinds of chronic lung disease also cause scarring or fibrosis and resemble CBD. Some of these diseases (such as silicosis) are also caused by occupational or environmental exposures. The American Lung Association and the National Jewish Medical and Research Center are two good sources for more information about lung diseases.

### Show Overhead 2-7.

These symptoms may not appear until the disease is quite advanced. Anyone who has pulmonary symptoms that persist for two weeks should get a medical evaluation. CBD is only one of several serious diseases that can be associated with these symptoms.



If you have any of these symptoms, report the symptoms to the occupational medical staff at your facility immediately, *and* see your doctor.

***Do NOT wait until your next annual exam to report symptoms.***

### D. How Chronic Beryllium Disease (CBD) Can Affect You

The course of CBD is unpredictable and varies from person to person.

The course of CBD can vary dramatically from person to person. Some individuals experience periods of flare-ups followed by periods of improvement. Others are stable for many years and then experience a rapid decline.

How does CBD develop?

Once particles enter the air spaces of the lungs, some insoluble forms of beryllium remain there. The immune system defenses the lung typically uses to get rid of foreign matter are not effective against these particles.

In one of these mechanisms, *cell-mediated immune response*, various kinds of immune cells recognize specific components (called *antigens*) of foreign bodies. They bind to the invaders, and signal other cells to attack them. These immune cells spot and destroy harmful agents like viruses and bacteria, but, in some individuals, they also respond to antigens of substances like pollen or certain foods that are harmless to most people.

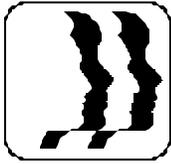
In a beryllium-sensitized person, immune cells recognize beryllium particles as a foreign invaders. Small clusters of the cells that do the lung's clean-up work gather around particles deposited in the air sacs and attempt to wall them off or destroy them.

Show Overhead 2-8.

Stress that individual variation in all aspects of CBD makes it hard to predict the experience a particular individual is likely to have with the disease.

Note that cell-mediated immune response is a complex process, but the important point is that this "hypersensitivity" to beryllium is the starting point for the damage done to the lungs as CBD progresses.

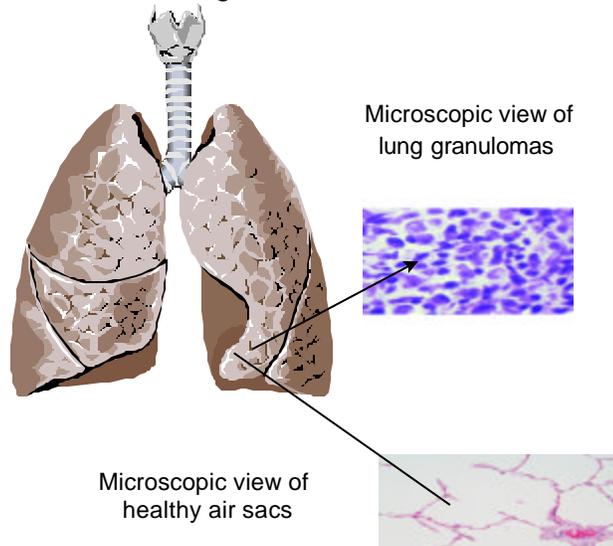
Since the damage does not happen immediately, this type of response is called "delayed hypersensitivity."



Although the cells cannot destroy or remove beryllium particles deposited in the lungs (or other organs), they keep trying to. As a result, the cell cluster around a beryllium particle may persist and even grow larger as more cells join the battle. The immune cells' attacks also damage nearby lung tissue.

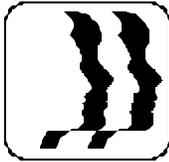
This ongoing response leads to a chronic state of *inflammation*, the same process that causes redness and swelling around a skin wound.

The persistent cluster of various types of immune cells forms a nodule, or *granuloma*.



Microscopic slides of healthy lungs show the thin, delicate walls of the air sacs, which have to fill and empty many times each hour. Granulomas produce stiff, thickened areas, which no longer have the elasticity needed to expand and contract and which interfere with exchange of oxygen and carbon dioxide between the air sacs and the blood vessels that surround them.

In time, fibrous scar tissue forms in the granuloma and in the surrounding lung cells that have been repeatedly damaged and repaired. These areas of inflammation and scarring interfere with the ability of the lungs to expand to take in oxygen, and the body begins to experience oxygen starvation.



CBD is treatable, but not curable.

If loss of lung function is detected, treatment may involve taking *corticosteroids* (often just called “steroids”), a medicine that reduces inflammation. The most common type of corticosteroid prescribed for CBD is prednisone.

If successful, treatment with steroids can slow the progress of CBD by reducing the buildup of scar tissue and delaying permanent lung damage. However, many individuals do not respond well to treatment. Others cannot tolerate the side effects of long-term steroid treatment.

The side effects of taking steroids for long periods of time are serious and can become worse with long-term treatment. They include:

- slower healing of infections
- loss of bone mass (osteoporosis)
- higher blood cholesterol
- fluid and salt retention, which can make heart or kidney disease worse

The right treatment for an individual must be considered in light of that person’s overall health and medical history.

Individuals with insufficient levels of oxygen in their blood as a result of CBD may also need supplemental oxygen to help improve oxygen delivery to the body and to protect the heart from the damage that can be done by low oxygen levels.

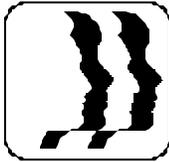
Individuals who cannot take steroids may continue to lose lung function. As a result they are likely to experience poorer quality of life, becoming invalids in some cases. Their life span may also be shorter.

On the other hand, some people diagnosed with CBD may never become sick enough to require treatment.

Note that studies of the effectiveness of prednisone in patients with CBD are not possible because they would require withholding treatment from some individuals.

Emphasize the serious side effects of long-term use of steroids.

Although the use of corticosteroids is the standard treatment for CBD, some research is in progress on other drugs that may eventually reduce the need for high doses of steroids.



### E. “Safe Levels” Are Not Known for Everyone Working Around Beryllium.

The health effects of beryllium exposure depends on at least three factors:

1. Concentration of beryllium particles in the inhaled air,
2. Length of exposure, and
3. Whether an individual has become sensitized to beryllium.

Exposure ⇒ Sensitization ⇒ Disease

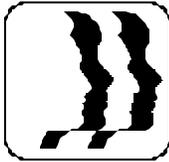
The story of CBD remains puzzling. Most people who are exposed to low levels of beryllium do not become sensitized or develop the disease. This is true even for people who had continuous, direct exposure. Still others get the disease from intermittent, incidental exposure.

The amount of airborne breathable beryllium required to cause the disease varies for different individuals. The exposure limit set by the Occupational Safety and Health Administration (OSHA), or the lower action level at DOE facilities (see Module 3) may be good enough for many workers. However, none of the studies published so far have established a level that is clearly safe for everyone.

The studies of individuals employed at DOE plants do show that workers in certain jobs where exposure to airborne particles may have been the greatest have been at greater risk for CBD.

These workers include machinists, lab analysts, and laundry workers (who routinely handled beryllium-contaminated coveralls).

Because levels that are safe for all people are not known keeping airborne beryllium levels as low as possible is important.



Beryllium Sensitization and CBD Among DOE Facility Employees: Data From Medical Surveillance Studies					
Job Title	No. Tested	No. Sensitized	Percent Sensitized	No. With CBD	Percent With CBD
Y-12 machinists	650	36	5.5	15	2.3
Y-12 cleaners	162	7	4.3	4	2.5
Y-12 electricians	208	7	3.4	1	0.5
Y-12 lab analysts/ technicians	88	10	11.4	4	4.5
Y-12 supervisors	310	11	3.5	4	1.3
RF Be machinists	201	24	11.9	17	8.5
RF chemical technicians	859	41	4.8	20	2.3
RF administrative staff	2,254	98	4.4	29	1.3
Y-12 overall	2,913	104	3.6	36	1.2
RF overall	8,413	303	3.6	119	1.4

Note that numbers and percents of CBD cases are included within numbers and percents of sensitized.

(Rocky Flats and Y-12 data as of April 2001. The ORISE Center for Epidemiologic Research collects these data for the DOE Office of Health Programs.)

### Many questions about beryllium disease need further study.

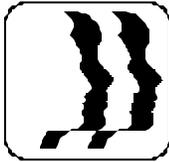
Issues where researchers need to know more include:

1. The development or "natural history" of CBD
2. How time and dose affect the disease
3. The relationship of specific chemical and physical forms of beryllium to the disease
4. The relationship of particle size to CBD
5. How well animal models can apply to humans
6. The genetic basis for sensitization to beryllium

The data for Rocky Flats and Y-12 include workers employed at various times and for various lengths of time in each plant's history, including periods when the level of control may have been less effective than it is now. The data do suggest that the greater the exposure (as in the case of machinists working directly with beryllium), the greater the risk of disease.

Note that medical surveillance studies concerned with beryllium are in process at many DOE sites. Participants may have completed questionnaires or attended meetings about these studies.

Show Overhead 2-9. Stress that research is continuing on all these topics. Note that a good source of more scientific information is the *Environmental Health Perspectives* supplement of October 1996. Articles from this issue (cited in Modules 1 and 2 references) can be downloaded <http://ehpnet1.niehs.nih.gov/doc/1996/Suppl-5/toc.html>.



### Is particle size an important factor?

The size of beryllium particles released during machining or other operations varies with the process and the type of beryllium compound or alloy being used.

Research is currently underway to understand how the type, number, and size of beryllium particles (not just the total amount or concentration) may affect whether inhalation (or possibly even skin contact) will lead to sensitization and disease.

Preliminary results from this research suggest that exposure to very small, or “ultrafine,” particles (under 1 micrometer in diameter) may be associated with the greatest risk of disease.

### **F. Another Possible Long-Term Health Effect: Is Beryllium a Carcinogen?**

Evidence from animal and human studies suggests significantly elevated risks of lung cancer from beryllium exposure. The International Agency for Research on Cancer (IARC), the cancer agency of the World Health Organization, has concluded that exposure to beryllium can cause lung cancer in humans.

An aerosol of beryllium may include particles of different sizes. When the particles are mostly small, a given mass will have many more particles than the same total mass of larger particles. These smaller particles appear to be harder for the lungs to clear. Many small particles deposited in the lungs also offer more total surface area to immune cell attack compared to fewer large particles.

See M. McCawley et al. 2001. Ultrafine beryllium number concentration as a possible metric for chronic beryllium disease risk. *Applied Occupational and Industrial Hygiene* 16(5):631-638.



### G. What You Can Do to Reduce the Risk of Getting Acute and Chronic Beryllium Disease

First of all, tell your personal doctor and your site occupational physician if you believe that you may be at risk for CBD. Remember that:

*Anyone who has CBD symptoms should get medical attention to find out the cause of those symptoms.*

If you work with beryllium, you have a higher risk of being exposed to beryllium particles. You need to do as much as possible to reduce that risk.

Here are some things you can do on the job:

1. Wear the personal protective equipment required for your work area and operation.
2. Follow safe work practices.
3. Follow established work procedures.
4. Be aware of exposure monitoring results for your work area.
5. Follow established personal hygiene practices for your work area.
6. Inform your site medical department if you develop any signs of beryllium disease.
7. Get the recommended medical exams.
8. Be aware of your right to a safe work area.

If you believe that the procedures and work practices are **not** adequate then you should notify your supervisor immediately. We will discuss these precautions in greater detail in Modules 3 and 4.

Show Overhead 2-10. Stress that good practices can reduce the disease risk.



## II. MEDICAL SURVEILLANCE

### A. Surveillance, Monitoring, or Screening?

The terms “medical monitoring” or “screening” and “medical surveillance” are often used interchangeably, but occupational health professionals and agencies, such as OSHA, use these terms for different activities:

- *Monitoring* and *screening* typically describe examinations and tests to learn about the health status of an individual, often to identify problems before symptoms are apparent in a person at risk.
- *Surveillance* is the collection and analysis of information on health events and exposures to identify hazards that can be controlled and prevented. Occupational health surveillance usually studies groups of workers who have had similar workplace risks.

Both monitoring and surveillance take place at DOE facilities, and both require feedback to workers. The individual should always receive his or her monitoring or screening results and any personal surveillance results. All workers in a group being studied (as well as managers, unions, and others) should receive reports on medical surveillance findings.

Medical monitoring and surveillance are also available to individuals formerly employed at certain DOE sites. These programs screen for the health effects of various kinds of occupational exposures, including beryllium. Sites where former employees may be eligible for these programs and program contact information appear in Appendix B.

### B. DOE Requirements for Medical Surveillance of Beryllium Workers

DOE sites with beryllium-associated workers must maintain a medical surveillance program. Components of this surveillance program include:

Discuss medical monitoring and surveillance policies and practices at your site. If brochures or fact sheets from your occupational medicine department or other services are available, bring them to the session.

For more on OSHA definitions and requirements for screening and surveillance, see:

<http://www.osha.gov/SLTC/medicalsurveillance/index.html>

Point out Appendix B.

Show Overhead 2-11. The applicable section of the rule is 850.34.



1. Keeping an updated roster of workers at risk for CBD.
2. Collecting detailed work and medical histories with emphasis on beryllium exposure.
3. Conducting baseline and periodic medical evaluations of beryllium-associated workers who voluntarily participate in the program. These exams must emphasize the respiratory system and include a chest x-ray, lung function tests, and tests for sensitization to beryllium.
4. Providing each worker who has been examined with the results of all tests or procedures, an explanation of any abnormal findings, and a recommendation, if appropriate, for any additional testing for CBD.
5. Analyzing medical, job, and exposure data to identify additional workers who may be at risk for CBD.

### C. How Sensitization to Beryllium Is Diagnosed

Beryllium is like many other substances that people have an allergy-like reaction to. You may not know that you are sensitized to beryllium until you have taken one or more screening test.

At the present time, doctors and researchers use the beryllium lymphocyte proliferation test (BeLPT) to diagnose beryllium sensitization in people with no symptoms of illness.

Remind participants that beryllium-associated workers include anyone regularly working in a DOE beryllium activity and other current workers who:

- May have been exposed in an earlier job at a DOE site,
- Have signs or symptoms of beryllium exposure, or
- Have been removed from beryllium work on the advice of the site occupational medicine director.



The beryllium lymphocyte proliferation test (BeLPT) can help identify beryllium-sensitized individuals.

The BeLPT is used to identify individuals with beryllium sensitization. It can also help to identify CBD before symptoms become severe and to differentiate CBD from other, similar diseases.

The BeLPT is a *voluntary* test. Not everyone at risk for beryllium disease will choose to take it. The DOE brochure entitled “Beryllium Testing for Research and Beyond: The ABCs of the LPT” is a good resource to help you learn more about the test and decide whether you should take the BeLPT.

You may obtain this brochure from DOE’s Office of Science website at:

[http://www.er.doe.gov/production/ober/HELSSRD\\_top.html](http://www.er.doe.gov/production/ober/HELSSRD_top.html)

The BeLPT requires special laboratory procedures. The test uses *lymphocytes* (a type of cells involved in the cell-mediated immune response), which are obtained in one of two ways:

1. From a blood sample.
2. From the lungs in a process called *bronchoalveolar lavage (BAL)*. This test can be used in making a definitive diagnosis of CBD.

The cells are grown in the laboratory. Samples of the cells are then exposed to different concentrations of a beryllium salt and their rate of growth is measured. Cells from a person who has been sensitized to beryllium will usually show rapid growth (“proliferation”) in response to the beryllium salt. This is called an “abnormal,” or positive, BeLPT result.

Cells from a person with no beryllium sensitization will grow the same way whether or not beryllium salts are present. This result is called a “normal,” or negative, BeLPT.

Show Overhead 2-12 and play the “Beryllium LPT” module of the video.

Some participants may have heard of the BeLPT as the “lymphocyte transformation test” (LTT). The name has changed, but the test is the same.

Participation in beryllium medical surveillance must be *voluntary* (10 CFR 850.24). DOE does not require that workers take the test because the medical benefit to the individual is not certain and because there could be some risks to the individual’s well-being.

Sites that have made participation in beryllium medical surveillance (including a BeLPT) mandatory for anyone employed in beryllium work areas will have to change that practice.

Check the current policies at your site and be prepared for questions on this issue.

Anyone taking the test will be asked to read and sign an informed consent statement. The statement appears as Appendix A to the Beryllium Rule.



### How often are workers tested?

Because one out of four people who have one positive (abnormal) test do *not* have a positive result on a second test, two positive tests are required to indicate that a person is sensitized to beryllium.

If your first BeLPT is negative (normal) and you are a current beryllium worker, you will be offered the test every year as part of routine monitoring. Other beryllium-associated workers are offered the test every three years after a negative test.

If the first test is positive, you will be offered another BeLPT test to confirm the results of the first test.

If the second test is also positive, you are considered sensitized to beryllium.

If the second test does not confirm the first test's results, a third test may be offered.

### Interpreting BeLPT results

When a person has at least two positive blood BeLPTs, but never develops CBD, the person is sensitized to beryllium but is not viewed as having the disease.

The BeLPT test is not always easy to interpret. Some tests have to be redone because the results were "borderline" or difficult to read. Also, BeLPTs can result in both "false positives" and "false negatives."

A "false negative" occurs when a person has a normal BeLPT, but actually is sensitized to beryllium or has CBD.

A "false positive" occurs when a person has an abnormal BeLPT, but actually is not sensitized or does not have CBD.

Some individuals who are confirmed as beryllium sensitized, but do not have CBD at the time they are tested, eventually do develop CBD. Others may never develop the disease.

Note the policies and schedules for testing and re-testing used at your site.

Participants may have many questions about the interpretation of the BeLPT. It is important to capture questions that you cannot answer on the "parking lot" and convey them to the site occupational medicine department if an occupational physician or other health professional cannot attend the session.



### E. How CBD Is Diagnosed

#### BeLPT results can help diagnose CBD.

An abnormal (positive) BeLPT is often the first sign of CBD. It can help the doctor distinguish CBD from other diseases that could be causing the symptoms.

Remember that an abnormal blood BeLPT alone does not mean that the individual has CBD. Additional tests are required to definitely diagnose CBD.

#### Other tests can help to identify CBD.

When beryllium particles are inhaled, they may go deep into your lungs where granulomas can then develop around them. After many small granulomas develop, the best current method for detecting them is *biopsy*. Biopsy is the removal and examination of small samples of tissue and cells, in this case, of lung tissue.

Unfortunately, obtaining samples of tissue from the lungs is an invasive process, which is often unpleasant for the patient.

At more advanced stages of CBD, the granulomas will have begun affecting breathing. At these stages, they can usually be detected by more traditional or less invasive medical tests:

- As the granulomas increase in size and number, pulmonary function tests are likely to show decreased lung function.
- The doctor can also hear their effects by listening through a stethoscope for abnormal breathing sounds (called "*rales*").
- The granulomas can sometimes be seen in a chest x-ray.

Show Overhead 2-13.



A history of exposure to beryllium helps to distinguish CBD from sarcoidosis (which also causes granulomas) and from the other diseases CBD resembles.

At some point, screening tests for the underlying genetic basis for sensitization may become widely available, but they are currently not available, except to participants in some research programs.

### What is the value of a definitive diagnosis?

A definitive diagnosis of any medical condition provides:

1. Information on the disease's cause and progress.
2. A reason to consider treatment.
3. Data to establish eligibility for workers' compensation benefits.
4. The basis for work restrictions.

Beryllium-sensitized individuals should continue to receive medical monitoring so that any symptoms of CBD can be detected as early as possible.

Early treatment appears to slow down the progress of the disease in some people, but remember: *CBD is treatable but not curable.*



### III. WORKER COMPENSATION AND OTHER JOB ISSUES

#### A. The Energy Employees Occupational Illness Compensation Act of 2000 (EEOICPA)

A new program compensates workers and former workers who are ill because of exposures on the job at DOE sites.

In the past, DOE contractor workers have been eligible for workers' compensation only through state programs. However, state programs vary in eligibility requirements.

In 2000, Congress passed the Energy Employees Occupational Illness Compensation Program Act (EEOICPA; Public Law 106-398) to offer the uniform benefits to these workers.

The U.S. Department of Labor (DOL) administers an Energy Employees Occupational Illness Compensation Program (EEOICP) under this law. The program serves workers who have beryllium disease, certain radiation-related cancers, or silicosis as a result of on-the-job exposures while they were working at specific DOE facilities or at some other weapons and beryllium plants.

A copy of the regulations and the claims forms are available online at:

<http://www.dol.gov/dol/esa/public/regs/compliance/owcp/eoicp/law/EECAregs.pdf>

A list of the DOE and contractor sites may be found at:

<http://www.dol.gov/dol/esa/public/regs/compliance/owcp/eoicp/law/SitesListUpdate.pdf>

Workers and former workers who have CBD (and eligible survivors) may receive monetary compensation. Those who are beryllium sensitized are provided with ongoing medical monitoring.

Show Overhead 2-14.

Provide information, such as claim forms or brochures from the local resource center, on the Energy Workers' Compensation Program.

The DOL interim final rule for administering this program was published in the *Federal Register* on May 25, 2001 (vol. 66, no. 102, pp. 28948-29003).

Note that the program may also reimburse certain survivors of covered workers. In 2001 Congress extended survivor benefits to adult children.



The DOE Office of Worker Advocacy works with the Department of Labor on the EEOICPA program, and also helps workers with compensation claims in state programs for occupational illnesses not covered by the federal law.

EEOICP has district offices and 10 resource centers, jointly operated by DOL and DOE. The resource centers locate possible applicants, give them information about the programs and the claims process, and help workers and their families to file claims. Locations and contact information for these centers and offices appear in Appendix B.

As of April 2002, over 25,000 claims had been filed, and more than 2500 individuals were receiving cash compensation or payment of medical bills.

For more information on this program from DOL, call the DOL toll-free number: **1-866-888-332**  
or go to:

<http://www.dol.gov/dol/esa/public/regs/compliance/owcp/eoicp/main.htm>

The DOE Office of Worker Advocacy also has a toll-free Workers' Compensation Helpline: **1-877-447-9756**

and a web site:

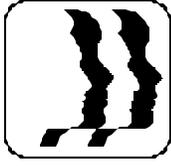
<http://www.eh.doe.gov/advocacy>

You may obtain claims forms and other program information from a resource center or from DOE and DOL web sites:

<http://tis.eh.doe.gov/advocacy/laws/dolfrtoc.html>

<http://www.dol.gov/dol/esa/public/regs/compliance/owcp/eoicp/claimsforms.htm>

Note Appendix B



### C. Using All Appropriate Sources of Medical Help

To determine if you are eligible for a compensation program, you will need to work with your site occupational medicine physician, your personal physician, and other specialists to obtain a diagnosis.

You should give all of the doctors involved in your care information about your work history so that they understand that beryllium disease is a possible risk to you.

You should have a medical exam each year. When you see your personal physician, tell him or her:

- That you have been exposed to beryllium on the job.
- What you have learned about how beryllium affects the body.
- Where to get more information on CBD (your site medical director or federal agencies such as the Centers for Disease Control and the Agency for Toxic Substances and Disease Registry).

Ask your doctor to examine you for health effects that exposure to beryllium may have caused.

By working together, occupational and personal physicians can help assure that patients receive appropriate medical care.

**Note:** The facilitator will present site-specific policy and procedures on medical surveillance programs available to you, covering such information as:

- Tests conducted on the site
- Tests that need to be conducted off-site
- Availability of physicians to discuss test results and diagnosis

### C. Counseling Services

Counseling and other support services should be available in your area.

Supplement this discussion with any brochures, policy statements, or other materials your site provides to explain these programs.



The course facilitator will provide information that will answer such questions as:

- Is there a beryllium support group?
- Where do you call to find out more about it?
- Where should you go for the counseling available to beryllium sensitized workers and to those diagnosed with CBD?
- Is counseling available for employees' families?

### D. How Your Job Can Be Affected by Beryllium Sensitization or by Having CBD

Once you have been identified as sensitized to beryllium or diagnosed with CBD, your site occupational medicine director will recommend that you no longer work around beryllium. This work restriction can affect where you work and what you do at the site in the future.

Under the Beryllium Rule, if the occupational medicine director recommends that you should no longer work around beryllium, you will be offered *medical removal protection benefits*. Medical removal is voluntary.

Benefits include the offer of a comparable job for which you are qualified (or for which you could be trained in a short time). The risk of exposure to beryllium in this job should be as low as possible.

If no comparable job is available, your employer must maintain your normal earnings, benefits, seniority, and other worker rights for up to two years.

**Note:** The facilitator will introduce your site's policies and recommendations on work assignments for beryllium-sensitive employees and those with CBD.

### E. Your Rights to Access Your Medical Records

Ask for a copy of your records each time you have a medical exam or BeLPT.

Keep a copy of your medical records.

Provide brochures, fact sheets, or contact information for the counseling services and support groups at your site.

Recognize that this may be a topic on which some participants have very strong views. Be prepared to record comments or concerns from the discussion to assist participants in identifying questions they need to have answered or to help pinpoint areas that need better explanation by human resources and occupational medicine staff.

Applicable section of 10 CFR is 850.35.

Note that the medical removal protection benefits can end at two years.

Explain the procedures at your site for obtaining a copy of the medical records.



Bring these records with you when you visit your personal physician.

Your employer is required to keep a copy of your medical records on file for as long as you are employed there.

DOE also requires that individual health case files for DOE contractor employees be retained for 75 years after the person retires or leaves employment (for any reason) at the DOE facility.

Access to medical records is a right of both current and former employees.

DOE has adopted the OSHA standard on “Access to Employee Exposure and Medical Records” (29 CFR 1910.20). Under this standard you have a right to:

- See and copy your medical records whether they are kept by your employer or by outside contractors.
- Have your medical records sent to anyone you choose, such as a family doctor.
- Have a doctor explain your medical records to you.
- Allow your union representative access to your medical records.
- The following individuals and groups may have direct access to your medically confidential data on a need-to-know basis:
  - Clinic staff members
  - Medical specialists who will provide or arrange for additional medical treatment or tests
  - Some DOE staff
  - Officials of the Centers for Disease Control and Prevention (CDC) and the National Institute for Occupational Safety and Health

**Note:** Your facilitator will provide site-specific guidance on the offices and individuals you, as a current or as a former worker, should contact about obtaining your medical records or having them sent to a doctor.

Participants who have worked in other industries may know that the OSHA requirement for occupational medical and exposure record retention is 30 years. DOE has a longer retention requirement.



#### IV. SUMMARY

The major route of entry for exposure to beryllium is by breathing.

Inhaling even small amounts of beryllium particles can cause some individuals to become sensitized to beryllium and later to acquire CBD, a serious lung disease.

Understanding the hazards of beryllium will help you avoid exposure to yourself and others.

The course of CBD varies among individuals.

CBD is treatable but not curable.

DOE sites have medical monitoring and surveillance programs to identify and help employees who have experienced beryllium exposure.

A new federal worker compensation program provides benefits to individuals who are experiencing the effects of on-the-job exposure to beryllium in DOE facilities.

You have the right to see and obtain the medical records kept by your DOE site employer.

Show Overheads 2-15 and 2-16.

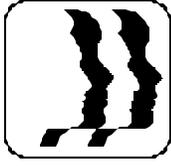


**V. REVIEW QUESTIONS FOR MODULE 2**

1. Beryllium can enter you body by any of these routes:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  
2. Get \_\_\_\_\_ if you have been exposed to beryllium by any route.
  
3. Chronic beryllium disease occurs in individuals who have become allergic or \_\_\_\_\_ to beryllium upon exposure.
  
4. The average time from first beryllium exposure to the development of symptoms (latency period) of chronic beryllium disease is \_\_\_\_\_.
  
5. List at least 6 symptoms of chronic beryllium disease.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  
6. The \_\_\_\_\_ Test can help identify beryllium-sensitive individuals
  
7. A federal compensation program is available to workers who are ill with CBD. TRUE or FALSE?
  
8. Former DOE site employees have the right to have access to their medical record. TRUE or FALSE?

Possible answers:

1. Breathing (inhalation) skin contact with soluble beryllium compounds, cuts and skin wounds, swallowing (ingestion). Of these four routes, breathing (inhalation) of beryllium is the most serious.
  
2. Medical attention
  
3. Sensitized
  
4. 10 to 15 years
  
5. Possible answers:  
Persistent coughing  
Shortness of breath with physical exertion  
Fatigue  
Chest and joint pain  
Blood in the sputum  
Rapid heart rate  
Loss of appetite  
Fevers and night sweats
  
6. Lymphocyte proliferation, or Beryllium lymphocyte proliferation test, or BeLPT
  
7. TRUE
  
8. TRUE



## VI. SUPPLEMENTAL REFERENCE MATERIALS

The following is a list of some research activities on beryllium health effects currently in progress:

### A. Epidemiologic Studies

1. Studies completed in the 1990s are those conducted by the National Jewish Medical and Research Center (NJC) in Denver at Rocky Flats, a ceramics plant, a ceramic plant in the Southwest, and a production plant in the Midwest.

Kreiss, K., Mroz, M.M., Newman, L.S., Martyny, J., Zhen, B. 1996. Machining Risk of Beryllium Disease and Sensitization with Exposure Below 2 Micrograms/m<sup>3</sup>. *American Journal of Industrial Medicine* 30(1): 16-25.

Kreiss, K., Mroz, M.M., Zhen, B., Martyny, J., Newman, L.S. 1993. Epidemiology of Beryllium Sensitization and Disease in Nuclear Workers. *American Review of Respiratory Diseases* 148(4 Part 1): 985-991.

Kreiss, K., Wasserman, S., Mroz, M.M., Newman, L.S. 1993. Beryllium Screening in the Ceramics Industry: Blood Lymphocyte Test Performance and Exposure-Disease Relations. *Journal of Occupational Medicine* 35(3): 267-274.

Kreiss, K., Mroz, M.M., Boguang, Z., Wiedemann, H., Barna, B. 1997. Risks of Beryllium Disease Related to Work Processes at a Metal, Alloy, and Oxide Production Plant. *Occupational and Environmental Medicine* 54: 605-612.

2. Data analysis is in progress for a study of Oak Ridge Y-12 Plant, conducted by the Center for Epidemiological Research at Oak Ridge Institute for Science and Education (ORISE). The latest report from that study is entitled "Examination of Workplace Characteristics of Workers Sensitized to Beryllium at the Y-12 Plant," January 1998.
3. Studies managed by NIOSH are in the second of four years at a metal alloy fabrication plant (the study is being conducted by National Jewish) and at a production and fabrication plant in Pennsylvania (the study is being conducted by Michigan State and University of Pennsylvania).
4. Continuing medical surveillance, conducted by Oak Ridge Institute for Science and Education, has collected analyzable data on an additional 6,000 Rocky Flats Plant beryllium workers. National Jewish has more than 100 individuals enrolled in a NIOSH-funded study of the progression of CBD from sensitization to disease and disability. This is the first study of the natural history of CBD since treatment of the disease began in the late 1950s.

Stange, A.W., Hilmas, D.E., Furman, F.J. 1996. Possible Health Risks from Low Level Exposure to Beryllium. *Toxicology* 111(1-3): 213-224.



Barnard, A.E., Torma-Krajewski J., Viet, S.M. 1996. Retrospective Beryllium Exposure Assessment at the Rocky Flats Environmental Technology Site. *American Industrial Hygiene Association Journal* 57(9): 804-808.

### B. Molecular and Cellular Studies

1. Studies at National Jewish and the Hospitals of the University of Pennsylvania are aimed at understanding the cellular and molecular mechanisms of CBD.

Stubbs, J., Argyris, E., Lee, C.W., Monos, D., Rossman, M.D. 1996. Genetic Markers in Beryllium Hypersensitivity. *Chest* 109 (3 Suppl): 45S.

Kreiss, K., Miller, F., Newman, L.S., Ojo-Amaize, E.A., Rossman, M.D., Saltini, C. 1994. Chronic Beryllium Disease--from the Workplace to Cellular Immunology, Molecular Immunogenetics, and Back. *Clinical Immunology and Immunopathology* 71(2): 123-129.

Harris, J., Bartelson, B.B., Barker, E., Balkissoon, R., Kreiss, K., Newman, L.S. 1997. Serum Neopterin In Chronic Beryllium Disease. *American Journal of Industrial Medicine* 32(1): 21-26.

Tinkle, S.S., Kittle, L.A., Schumacher, B.A., Newman, L.S. 1997. Beryllium Induces IL-2 and IFN-Gamma in Berylliosis. *Journal of Immunology* 258(1):518-526.

Tinkle, S.S., Kittle, L.A., Schwitters, P.W., Addison, J.R., Newman, L.S. 1996 Beryllium Stimulates Release of T Helper 1 Cytokines Interleukin-2 and Interferon Gamma from BAL Cells in Chronic Beryllium Disease. *Chest* 109 (3 Suppl):5S-6S.

Inoue, Y., Cornebise, M., Daniloff, E., Lloyd, J., Tinkle, S., King, T.E., Jr, Newman, L.S. 1996. Mast Cell-Associated Basic Fibroblast Growth Factor in the Fibrotic Response to Environmental Toxins: The Beryllium Model. *Chest* 109 (3 Suppl):43S-44S.

Newman, L.S., Bobka, C., Schumacher, B., Daniloff, E., Zhen, B., Mroz, M.M., King, T.E. Jr,. 1994. Compartmentalized Immune Response Reflects Clinical Severity of Beryllium Disease. *American Journal of Respiratory and Critical Care Medicine* 150(1): 135-142.

Bost, T.W., Riches, D.W., Schumacher, B., Carre, P.C., Khan, T.Z., Martinez, J.A., Newman, L.S. 1994. Alveolar Macrophages from Patients with Beryllium Disease and Sarcoidosis Express Increased Levels of mRNA for Tumor Necrosis Factor-Alpha and Interleukin-6 but Not Interleukin-1 Beta. *American Journal of Respiratory Cell and Molecular Biology* 10(5): 506-513.

2. Research at the University of Modena in Italy on a genetic marker for CBD susceptibility has recently resulted in a second publication. Four cohorts have now been screened for the genetic marker.



Newman, L. S. 1993. To Be <sup>2+</sup> or Not To Be <sup>2+</sup>: Immunogenetics and Occupational Exposure. *Science* 262(5131): 197-198.

Richeldi, L., Kreiss, K., Mroz, M.M., Zhen, B., Tartoni, P., Saltini, C. 1997. Interaction of Genetic and Exposure Factors in the Prevalence of Berylliosis. *American Journal of Industrial Medicine* 32(4): 337-340.

Richeldi, L., Sorrentino, R., Saltini, C. 1993. HLA-DPB1 Glutamate 69: A Genetic Marker of Beryllium Disease. *Science* 262(5131): 242-244.

3. A project at Los Alamos National Laboratory is using flow cytometry to gain an understanding of the biological variables affecting the Beryllium-LPT. NJC is collaborating in this research.
4. In a project led by Dr. Richard J. Albertini, the University of Vermont in collaboration with ORISE, is using CBD as a model for studying immune system-mediated diseases. The hypothesis is that a characteristic mutation occurring in lymphocytes due to a replication error will be a useful biomarker of early disease. One goal of the project is to develop a new and sensitive biomarker for identifying sensitization to beryllium at an early stage.

### C. Animal Model Studies

1. Researchers at the Lovelace Respiratory Research Institute (LRRI) formerly worked to develop a CBD animal model. Development of an animal model would allow researchers to answer dose response questions that are not possible to answer in epidemiologic studies and to explore new treatments that are not possible to test in humans.

Nikula, K.J., Swafford, D.S., Hoover, M.D., Tohulka, M.D., Finch, G.L. 1997. Chronic Granulomatous Pneumonia and Lymphocytic Response Induced by Inhaled Beryllium Metal In A/J and C3H/Heij Mice. *Toxicology and Pathology* 25(1): 2-12.

Finch, G.L., Hoover, M.D., Hahn, F.F., Nikula, K.J., Belinsky, S.A., Haley, P.J., Griffith, W.C. 1996. Animal Models of Beryllium-Induced Lung Disease. *Environmental Health Perspectives* 104, Suppl 5: 973-979.

Haley, P.J., Pavia K.F., Swafford, D.S., Davila, D.R., Hoover, M.D., Finch, G.L. 1994. The Comparative Pulmonary Toxicity of Beryllium Metal and Beryllium Oxide in Cynomolgus Monkeys. *Immunopharmacology and Immunotoxicology* 16(4): 627-644.

Haley, P.J., Finch, G.L., Mewhinney, J.A., Harmsen, A.G, Hahn, F.F., Hoover, M.D., Muggenburg, B.A., Bice, D.E. 1989. A Canine Model of Beryllium-Induced Granulomatous Lung Disease. *Laboratory Investigation* 61(2): 219-227.

2. University of Wisconsin researchers reported limited success in inducing granuloma in A/J mice with a beryllium salt.



Huang, H., Meyer, K.C., Kubai, L., Auerbach, R. 1992. An Immune Model of Beryllium-Induced Pulmonary Granulomata in Mice. Histopathology, Immune Reactivity, and Flow-Cytometric Analysis of Bronchoalveolar Lavage-Derived Cells. *Laboratory Investigation* 67(1): 138-146.

### **D. Measurement/Monitoring Technology**

1. The Los Alamos National Laboratory developed Laser-Induced Breakdown Spectroscopy (LIBS) as a real-time beryllium-specific aerosol monitor. This method also has possible applications as a surface monitor and as a rapid method of analyzing beryllium collected on filters.



## Module 2

### Health Effects and Medical Monitoring and Surveillance

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2. National Jewish and LRRRI are characterizing the physical and chemical characteristics of aerosols in an attempt to better understand the relationship between beryllium exposure and risk of getting CBD. This work is aimed at developing monitoring methods that are better correlated with risk of CBD. It is being conducted at a metal alloy fabrication plant.

## Objectives

### **In this module you will learn about:**

- How beryllium enters your body.
- Health effects of exposure to beryllium.
- How chronic beryllium disease (CBD) can affect you.
- Whether there are levels of airborne beryllium that are safe for everyone.
- Ways to reduce the risk of getting CBD.

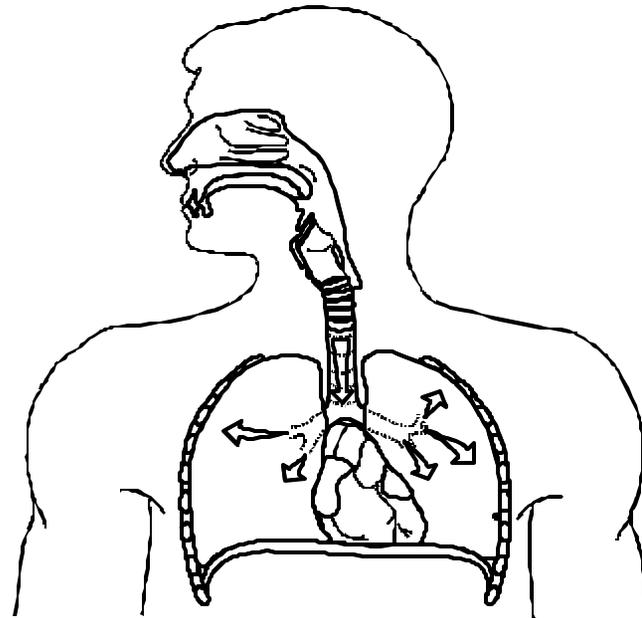
## Objectives

### In this module you will learn about:

- Medical monitoring and surveillance programs at this facility.
  - How beryllium sensitization is diagnosed.
  - How CBD is diagnosed and treated.
  - Worker compensation, counseling, and other services.
  - How CBD or beryllium sensitization may affect your job assignment.
- 
- Your rights to your medical records.

## Entry routes for beryllium

- Breathing
- Skin contact
- Skin wounds
- Swallowing



**Inhaling airborne beryllium particles  
can cause **SERIOUS ILLNESS.****

- Work safely around beryllium to reduce exposure.
- Recognize how beryllium enters and affects the body.
- Seek medical attention if you believe you have been exposed.
- Avoid exposure to beryllium.

## **Short-term (days/weeks) health effects of inhaling beryllium**

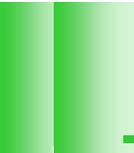
- High airborne levels of airborne particles have caused “chemical pneumonia” or “chemical pneumonitis.”
- Improved controls have reduced potential for exposure.
- Current risk would primarily be from an accident.
- Get medical attention if you have any symptoms.

## **Long-term (months/years) health effects of inhaling beryllium**

- CBD can develop months or many years after exposure.
  - CBD is usually seen in sensitized individuals.
  - Sensitization may have some genetic basis.
  - CBD is primarily a lung disease.
  - Symptoms of CBD can look like other diseases.
- 

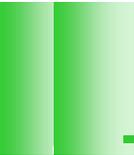
## Symptoms of CBD

- Persistent coughing
- Shortness of breath with physical exertion
- Fatigue
- Chest and joint pain
- Blood in the sputum
- Rapid heart rate
- Loss of appetite
- Fevers and night sweats



**Do NOT wait until your next annual exam  
to report these symptoms!**

## **CBD affects people differently.**

- Difficult to predict the progression of CBD.
  - Begins with immune system effort to destroy or get rid of beryllium particles.
  - Inflammation leads to scarring/loss of lung elasticity.
  - CBD can be treated but not cured.
  - There is NO known exposure level that is safe for everyone.
- 

## **Questions about beryllium health effects that need further study**

- “Natural history” of CBD
- Effects of time and dose
- Relationship of chemical/physical forms of beryllium to CBD
- Relationship of particle size to CBD
- Use of animal models to study human experience
- Genetic basis for beryllium sensitization

## How you can reduce your risk of beryllium disease

- Wear PPE required for area and job.
- Follow safe work practices/procedures.
- Follow personal hygiene practices.
- Inform your supervisor/site medical department of any symptoms.
- Get the recommended medical exams.
- Know that you have a right to a safe work area.

**Medical monitoring and surveillance  
DOE facilities must:**

- Keep an updated roster of workers at risk for CBD.
- Collect work and medical histories.
- Conduct medical evaluations.
- Provide each worker examined with test results, an explanation of findings, and a medical opinion on the need for more testing.
- Analyze medical, job, and exposure data to identify other workers at risk for CBD.

## Diagnosing beryllium sensitization

- Beryllium lymphocyte proliferation test (BeLPT) can help identify beryllium-sensitized individuals.
- An “abnormal” or positive blood BeLPT may indicate beryllium sensitization.
- It is possible to have an abnormal BeLPT and no symptoms of CBD.

## Diagnosing beryllium disease

- The BeLPT can help the doctor make a diagnosis.
- Other tests may be needed for definitive diagnosis.
- Beryllium-sensitized individuals should be monitored for early detection of CBD.

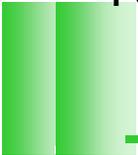
## **Programs for workers with health effects of beryllium exposure**

- Benefits under the Energy Employees Occupational Illness Compensation Program
- Role of the DOE Office of Worker Advocacy
- Using all appropriate sources of medical help
- Access to counseling services and support groups
- Medical removal protection benefits
- Access to medical records

## Message to remember

- Major route of beryllium entry is by breathing.
- Inhaling small amounts can cause health effects in some individuals.
- Knowing the health effects raises awareness and can help you avoid exposure.
- Development of CBD varies among individuals.

## Message to remember

- CBD is treatable but not curable.
  - DOE sites have medical monitoring and surveillance programs.
  - A federal worker compensation program offers benefits to those experiencing the effects of occupational exposure to beryllium in DOE facilities.
  - You have a right to your medical records.
- 



In this module you will learn about:

- The DOE Beryllium Rule.
- Where and how you may be exposed to beryllium in the workplace.
- Regulations limiting airborne beryllium in the workplace.
- How workplace exposures are determined.
- How potential exposures can be minimized.

## **I. THE DOE BERYLLIUM RULE**

DOE's 1999 Beryllium Rule (Title 10, Part 850 of the Code of Federal Regulations, or 10 CFR 850 describes DOE's Chronic Beryllium Disease Prevention Program (CBDPP).

In order to reduce worker exposure to beryllium and to reduce the number of cases of CBD, the Beryllium Rule requires DOE facilities to:

- Limit access to beryllium locations and operations.
- Implement engineering and work practice controls to prevent the release of beryllium to the air and capture or contain particles before they can be inhaled.
- Establish medical surveillance to monitor the health of exposed workers and to ensure early detection of disease.
- Monitor the effectiveness of the program in preventing CBD and make any changes needed to improve the program.

CBD Prevention Programs at DOE facilities must include the following elements:

1. Conducting a baseline beryllium inventory
2. Conducting hazard assessment
3. Conducting exposure monitoring
4. Using controls and other practices to reduce and minimize exposures
5. Conducting medical surveillance
6. Offering medical removal protection to sick or sensitized workers
7. Keeping accurate records
8. Providing performance feedback

Show Overhead 3.1. Review and discuss objectives with class. Remember to incorporate site-specific data (from sampling, job safety analyses, and other sources) throughout the discussion in this module.

Show Overhead 3.2. Have available copies of the Beryllium Rule, the DOE Implementation Guide, and site-specific CBDPP plans and documents.

The overall purpose of the CBDPP is summarized in the preamble to the rule (*Federal Register* vol. 64, no. 235, p. 68862, December 8, 1999).

Show Overhead 3.3. The sections of 10 CFR requiring these elements are as follows:

1. 850.20
2. 850.21
3. 850.24
4. 850.25
  
5. 850.34
6. 850.35
  
7. 850.39
8. 850.40



The Beryllium Rule and the CBDPP are part of DOE's commitment to providing its employees and contractors with a safe workplace.

DOE has developed an implementation guide for the rule to assist facility managers in meeting their requirements. The guide provides:

- Information concerning lessons learned
- Best practices for controlling beryllium exposure
- References to other sources of information

The *Implementation Guide for Use with 10 CFR 850, Chronic Beryllium Disease Prevention Program*, DOE G 440.1-7A, published in January 2001, may be found online on two DOE web pages:

<http://www.directives.doe.gov/pdfs/doe/doetext/neword/440/g4401-7a.html> or

<http://tis.eh.doe.gov/be/docs/beguide/beguide.html>

Specific new requirements of the rule are included in this course. Your facilitator will lead discussions of progress at your site in implementing these requirements.

## **II. ACTIVITIES THAT MAY EXPOSE WORKERS TO BERYLLIUM**

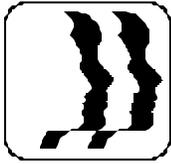
### **A. Where You May Be Exposed in the Workplace**

Exposure to beryllium may occur in the workplace where beryllium or beryllium-containing material is processed, machined, or converted into metal, alloys, ceramics, or other materials.

Some of the processes and operations that may generate beryllium particles are:

Note that workers, line management, and site health and safety professionals all have responsibilities for components of the CBDPP

Show Overhead 3.4.



- Grinding, sanding, polishing, or buffing
- Machining
- Melting or casting
- Abrasive blasting or sawing
- Welding
- Hot rolling or slab milling
- Pickling

Other industrial activities with the potential for exposure include:

- extraction processing,
- metallic beryllium operations,
- beryllia ceramic manufacturing, and
- alloy processing.

Maintenance and housekeeping activities and exposure monitoring around any of these operations may result in exposure to beryllium.

Activities that may abrade beryllium items can also result in beryllium exposure. For example, tossing beryllium-containing spark-proof tools into a tool chest or bin may release beryllium particles into the air.

Environmental cleanup or decontamination and decommissioning (D&D) of former beryllium facilities may also result in exposure to beryllium.

Beryllium can also be transferred to other individuals from workers' hands, tools, or clothing.

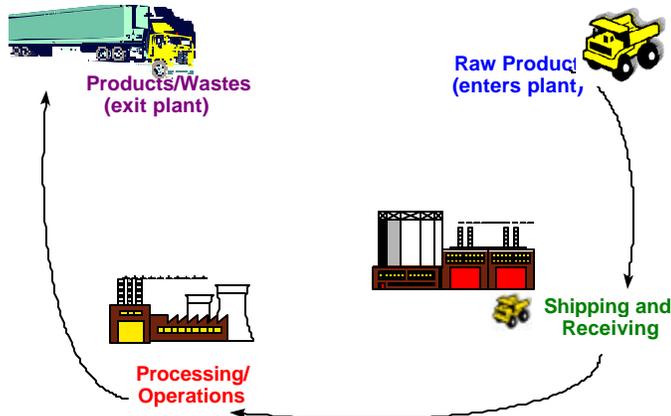
#### **E. Potential Exposures at R&D Facilities**

Some research and development (R&D) activities at DOE laboratories and other facilities use beryllium or beryllium compounds and alloys. Workers in and near these activities may have a risk of exposure to beryllium.

In these small-scale, non-production R&D activities, the Occupational Safety and Health Administration (OSHA) Laboratory Standard (29 CFR 1450) may be used in place of the DOE Beryllium Rule.



### F. How Beryllium Travels in the Workplace



Show Overhead 3.5 or revise the overhead to reflect the movement of beryllium in your facility.

Lead a brief discussion of where and how beryllium-containing materials enter and move around your site. Emphasize the risks of exposure to beryllium associated with these steps.

### G. Potential Exposures from Past Operations

One goal of the CBDPP is to locate areas of former operations and facilities where beryllium has been used, stored, or handled.

This activity is important because any beryllium that is still present in these areas could be the source of potential exposure to current workers at that location.

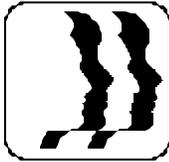
The records used to track down these areas may not be complete. For this reason, if you know of any place where beryllium may have been used or stored, please notify environment, safety and health (ES&H) personnel at your facility.

Your contribution to this effort is important. **Properly identifying all beryllium areas** assures that you and your co-workers have accurate information about current and past locations of beryllium in your workplace.

### H. Potential for Exposing People Outside the Workplace

In a 1997 study at one plant (not a DOE facility), the National Institute for Occupational Safety and Health (NIOSH) found that people working on precision machining of beryllium metal products were sometimes carrying beryllium dust out of the workplace.

Show Overhead 3.6 and discuss the findings of the NIOSH study of the spread of beryllium contamination outside the workplace.



During the study, wipe samples were taken from 61 workers' hands and from surfaces in their vehicles over a one-week period. The samples were then tested for beryllium.

The study found that many of the workers had beryllium particles on their hands when they left work. The largest amounts were on the hands of operators in milling, machining, and similar processes.

Workers' vehicles were also found to have beryllium contamination. Although there was a lot of variation in the samples, the highest levels were found on the driver's side of the vehicle.

As the following data show, the floors on the driver's side had the heaviest contamination:

Location	Mean Level of Beryllium ( $\mu\text{g}/100\text{cm}^2$ )	Maximum Be Level ( $\mu\text{g}/100\text{cm}^2$ )
Driver's seat	0.26	15.9
Driver's floor	2.1	76.9
Passenger's seat	0.18	7.5
Passenger's floor	0.53	25.2

Source: Data from Table II of W.T. Sanderson et al. 1999. Beryllium contamination inside vehicles of machine shop workers. *Applied Occupational and Environmental Hygiene* 14: 223-230. Data converted from  $\mu\text{g}/\text{ft}^2$  to  $\mu\text{g}/100\text{ cm}^2$ .

The findings that beryllium was carried from the plant on workers' clothes, shoes, and hands show the importance of following housekeeping, personal hygiene, and other procedures to limit the release of particles.

The efforts you, your employer, and your co-workers make to limit exposure *inside* the workplace may also protect family and friends from hazards that can be carried *outside* the work area.

### III. DETERMINING POTENTIAL BERYLLIUM EXPOSURES

According to the Beryllium Rule, your employer must take two steps to begin determining potential beryllium exposures in your workplace. These first steps are:

Show Overhead 3.7. The applicable rule sections are 850.20-21.



1. Conducting a *baseline beryllium inventory* of areas with possible beryllium contamination. The inventory includes identifying workers who may be exposed to beryllium at these locations.
2. Conducting a *hazard assessment* when the inventory identifies the presence of beryllium.

Qualified safety and health personnel should manage both of these steps. However, their success depends on input from workers who know the operations and the facilities.

### A. Hazard Assessment

The hazard assessment includes analyzing:

- The nature of beryllium in the work area
- Existing conditions in the work area
- Exposure data
- Medical surveillance trends
- Exposure potential of planned activities

The analysis of existing conditions must include descriptions of the types and forms of beryllium as well as the total amounts. This information is important because some forms of beryllium appear to be more hazardous than others. For example, the most hazardous airborne beryllium particles are those small enough to easily become airborne and to be drawn deep into the lungs.

A hazard assessment indicates which areas are or may be contaminated and which activities or events create the greatest risk of exposure. The results are used to identify the best methods of protecting workers from exposures.

### B. Measuring the Amount of Beryllium in Workplace Air

Where the inventory and hazard assessment indicate the possibility of airborne beryllium, your employer must monitor the air in that work area for the presence of beryllium particles. Monitoring of areas where there may be beryllium contamination must be conducted according to an *exposure monitoring plan*.

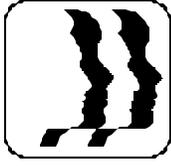
Note that hazard assessment is a process used to identify all kinds of hazards, not just beryllium.

Reference your site's specific procedures, and note that inventories and assessments are part of your site's overall effort to protect worker safety and health.

Note that these steps are consistent with DOE's Integrated Safety Management program. Stress the value of each participant contributing his or her own site knowledge to the hazard assessment process.

Show Overhead 3.8. The applicable rule section is 850.24.

Bring to the meeting room and exhibit the specific monitoring devices such as a personal air



The plan should state which workers will be monitored and how frequently monitoring will take place. It must also describe the analytical and statistical methods that will be used to assure that the results accurately describe the potential exposures of workers who enter the area.

### Personal air (or breathing zone) monitoring

Exposure monitoring is conducted by measuring the amount of beryllium in air samples taken near a worker's mouth and nose, or "breathing zone."

These *personal air samples* are required because they show how much beryllium is in the air that you are most likely to inhale.

To collect a personal air sample, a worker wears a pump that pulls air from the breathing zone through a collecting filter. The pump operates for a set amount of time and draws air through the filter at a set flow rate. In this way, the total volume of air passing through the filter can be calculated. The amount of beryllium captured on the filter is then determined by spectroscopic analysis.

The air volume that flowed through the filter is described in cubic meters. A cubic meter ( $m^3$ ) is about the size of a box that is a little more than one yard wide, deep, and high.

The mass of the beryllium captured by the filter is measured in micrograms, or  $\mu g$ . One microgram is one-millionth of a gram.

### Area air and source monitoring

Industrial hygiene personnel may also conduct air monitoring of work areas to help evaluate the effectiveness of controls, show sources of potential exposure, or measure variations in exposure over a work shift.

monitor and sampling pump, filter cassettes, a swipe template, and other sampling equipment used at your site so that participants can become more familiar with them.

Describe the breathing zone concept and how it is defined.

Demonstrate (or ask an experienced participant to demonstrate) the operation of a monitor and sampling pump.

The volume of air is directly measure in liters (1 liter  $\approx$  1 quart) and converted to  $m^3$  (1  $m^3$  = 1000 liters)

To understand how small a microgram is, consider that a penny weighs about two grams. If a penny were cut into 2 million pieces of equal size, each piece would have a mass of 1  $\mu g$ . Be prepared for questions participants may have about such related issues as airflow and sources of make-up air in the work area or about stack sampling and environmental sampling.



### Surface sampling of beryllium

*Surface (or swipe or smear) sampling* helps to find beryllium particles on containers, equipment, and other surfaces. Under the Beryllium Rule, routine surface sampling is required in operational areas where beryllium is present.

Surface samples are measured in micrograms per 100 square centimeters (100 cm<sup>2</sup>). An area of 100 cm<sup>2</sup> is about the size of a square 4 inches on each side.

### How monitoring data are used

The information collected from sampling helps to answer the following questions:

- What jobs have potential for exposure to beryllium?
- What are workers' exposure levels?
- How well are safety standards and rules being met?
- Where are opportunities to reduce exposures?
- What level of respiratory protection does the job require?

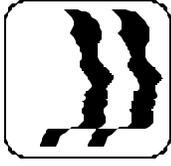
Industrial hygiene personnel also use the information to:

- Monitor the effectiveness of exposure control
- Evaluate the cleanliness of work areas
- Track beryllium movement through work areas.
- Ensure that beryllium contamination has not spread to previously clean areas.

Sampling results are usually available to industrial hygiene personnel within 24 hours of collection. However, this delay means that results cannot be used for immediate protection. You should always follow procedures to keep beryllium dust levels at a minimum.

Copies of personal sampling results must be provided to the worker. Results that exceed the permissible exposure level must be posted (without identifying the individual worker). You have a right to this information.

Discuss the turn-around time for analysis of samples taken at your site. Describe your facility's procedures for notifying employees of monitoring results. Show examples.



### C. Regulations Limiting Airborne Beryllium in the Workplace

To reduce worker exposures, the DOE Beryllium Rule sets an *action level* for airborne beryllium particles.

This action level is 0.2 micrograms of beryllium per cubic meter of air ( $0.2 \mu\text{g}/\text{m}^3$ ) in the work area, averaged over an 8-hour work shift.

**If monitoring shows that beryllium levels have reached  $0.2 \mu\text{g}/\text{m}^3$ , your employer must take actions to reduce exposures.**

These actions include assuring that workers have and use approved respirators, implementing other controls, and performing periodic personal monitoring.

Any area where the beryllium at or above the action limit has been detected must also be regulated by:

- Limiting access to the area
- Defining the boundaries of the area
- Keeping records of who enters the area

Your site may have an *administrative action level* for airborne beryllium that is lower than  $0.2 \mu\text{g}/\text{m}^3$ . Use of respirators, other controls, and additional actions will be triggered at this lower administrative action level.

DOE requires facilities to take actions to protect workers at a level ten times lower than the Occupational Safety and Health Administration (OSHA) *permissible exposure limit* (PEL), which is currently  $2.0 \mu\text{g}/\text{m}^3$  averaged over an 8-hour work shift.

Your employer must ensure that no worker is exposed to airborne beryllium levels at or above the PEL.

You can play the video module “How Much” here.

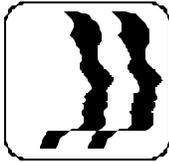
The applicable section of the rule is 850.23.

Show Overhead 3.9. Beryllium standards and limits set by other organizations include the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV), currently  $2.0 \mu\text{g}/\text{m}^3$  for beryllium.

Note that the Environmental Protection Agency sets standards to protect the public and the environment while OSHA, NIOSH, and ACGIH are concerned with standards to protect the worker. OSHA is considering reducing the PEL. In *Preventing Adverse Health Effects from Exposure to Beryllium on the Job* (September 2, 1999), OSHA noted that its current PEL of  $2.0 \mu\text{g}/\text{m}^3$  “may not be adequate” to prevent CBD. ACGIH is also considering lowering its TLV for beryllium to  $0.2 \mu\text{g}/\text{m}^3$ .

Describe the beryllium work areas defined by your site. Exhibit the signs and labels used to alert personnel to beryllium hazards.

Discuss administrative action levels specific to your facility.



#### Removable beryllium contamination levels

The Beryllium Rule also sets limits on the allowable levels of beryllium contamination on equipment and surfaces in beryllium work areas.

During non-operational periods the level of beryllium dust or other waste that can be removed from these surfaces must not exceed  $3 \mu\text{g}/100 \text{ cm}^2$ .

Before equipment or other items are moved outside a beryllium work area, your employer must assure that the removable surface contamination is below  $0.2 \mu\text{g}/100 \text{ cm}^2$ .

#### **D. Minimizing Potential Exposures in Your Workplace**

The amount of beryllium in the air at the DOE action level or the OSHA PEL cannot be seen, smelled, or tasted. But you can still inhale these beryllium particles, and inhaling particles can set the stage for beryllium disease.

The action level and the permissible exposure limit are mandatory, but, given the uncertainties about safe levels of beryllium particles in workplace air, DOE policy is to keep exposures below the action level.

Your employer is responsible for measuring how much beryllium is in the air in your work area and for taking steps to reduce the possibility of beryllium exposure to the lowest level practical.

Each DOE facility must consider many factors in developing and carrying out its plan to minimize worker exposure to hazards under the Beryllium Rule.

Your employer is expected to minimize beryllium exposures based on the level of risk of employees' developing CBD. The most hazardous work areas and conditions should be given the highest priority.

You and everyone else concerned at your site should contribute to job safety analyses, baseline inventories, hazard assessments, and other activities designed to determine potential exposures to beryllium.

Relevant section is 850.30.

Note that this limit does not apply to surfaces on the interior of closed systems such as glove boxes, ventilation systems, and other enclosures.

Show Overhead 3.10.



You should also follow all requirements and procedures designed to prevent or reduce beryllium exposure. You have the right to a safe workplace.

#### **IV. SUMMARY**

To help protect you, and ensure your exposure to beryllium is as low as practical, DOE has a Beryllium Rule that establishes the Chronic Beryllium Disease Prevention Program (CBDPP).

Exposure to beryllium can occur at various locations in DOE facilities. It is important to know about both current and past operations involving beryllium.

Through monitoring, industrial hygiene personnel can determine the amount of beryllium to which you are being exposed.

You must wear respirators and other protection if monitoring shows that levels of beryllium particles in the work area are at or above the action level. You should not be exposed to any amount of beryllium that exceeds the OSHA PEL, which is  $2.0\mu\text{g}/\text{m}^3$  averaged over an 8-hour shift.

Remember that beryllium is not the only hazard in your workplace. Control of beryllium exposure must be integrated with an overall program of safety analysis, work planning, monitoring, controls, and other efforts to prevent exposure to many types of hazards and to injury.



**V. REVIEW QUESTIONS FOR MODULE 3**

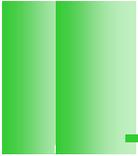
1. 10 CFR Part 850 establishes a \_\_\_\_\_  
to reduce the number of workers currently exposed to beryllium in their work at DOE facilities.
2. A \_\_\_\_\_ must be completed for each location and task involving beryllium that may become airborne.
3. a. DOE's action level for airborne beryllium is \_\_\_\_\_  
b. The OSHA permissible exposure limit (PEL) is \_\_\_\_\_  
c. At this facility, the administrative action level is \_\_\_\_\_
4. Air monitoring done near the mouth and nose of the worker is called:  
\_\_\_\_\_.
5. DOE policy is to keep exposure to beryllium as low as possible because there is no level of exposure that is known to be \_\_\_\_\_ for everyone.

Possible answers to the review questions:

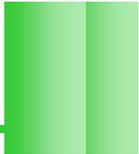
1. Chronic Beryllium Disease Protection Program (or CBDPP)
2. hazard assessment
3. a.  $0.2 \mu\text{g}/\text{m}^3$   
b.  $2.0 \mu\text{g}/\text{m}^3$   
c. Participants should know the administrative action level at your site.
4. personal air monitoring (or breathing zone monitoring)
5. safe (or healthy)

### **Objectives**

**In this module you will learn about:**

- The DOE Beryllium Rule.
  - Where and how you may be exposed to beryllium in the workplace.
  - Regulations limiting airborne beryllium in the workplace.
  - How workplace exposures are determined.
  - How potential exposures can be minimized.
- 

## Beryllium in the Workplace



**To reduce worker exposure and prevent CBD, the Beryllium Rule requires DOE facilities to:**

- Limit access to beryllium locations and operations.
- Implement engineering and workplace controls.
- Establish medical surveillance.
- Monitor program effectiveness in preventing CBD.

### **Elements of a CBD Prevention Program:**

1. Baseline beryllium inventory
2. Hazard assessment
3. Exposure monitoring
4. Controls and other practices to reduce and minimize exposures
5. Medical surveillance
6. Medical removal protection
7. Accurate recordkeeping
8. Performance feedback

### **You may be exposed to beryllium by:**

- Working in or around operations and processes that use beryllium-containing materials.
- Working in environmental cleanup or D&D of facilities where beryllium operations previously occurred.
- Conducting research and development activities that use beryllium.
- Coming into contact with clothing, tools, or other objects that have been in beryllium work areas.

# Beryllium in the Workplace

## How beryllium travels in the workplace

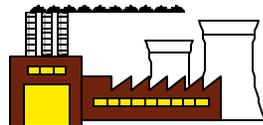
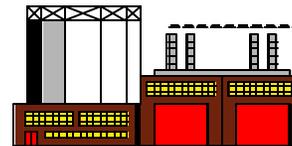
(Revise to reflect how beryllium travels through your facility)



**Finished Product or Wastes  
(exit plant)**



**Raw Product  
(enters plant)**



**Processing/  
Operations**



**Shipping and  
Receiving**

### **Family and friends can be exposed to beryllium tracked outside the workplace.**

#### Beryllium Contamination Found in Workers' Vehicles at One Industrial Facility

Location	Mean Level of Beryllium ( $\mu\text{g}/100\text{cm}^2$ )	Maximum Be Level ( $\mu\text{g}/100\text{cm}^2$ )
Driver's seat	0.26	15.9
Driver's floor	2.1	76.9
Passenger's seat	0.18	7.5
Passenger's floor	0.53	25.2

Source: From Table II of W.T. Sanderson et al. 1999. Beryllium contamination inside vehicles of machine shop workers. *Applied Occupational and Environmental Hygiene* 14: 223-230.

### **Your potential exposure to beryllium is determined through:**

- Baseline beryllium inventory
- Hazard assessment
- Monitoring
  - personal, or breathing zone
  - area air and source
  - surface sampling

### **The Beryllium Rule requires personal air, or breathing zone, monitoring.**

- Monitoring air near the mouth and nose shows how much beryllium is in the air you are likely to inhale.
- Monitoring results are measured in micrograms of beryllium per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ).
- Area air monitoring and surface (swipe/smear) sampling may supplement personal monitoring.

**The DOE action level for airborne beryllium is 0.2 micrograms per cubic meter (0.2  $\mu\text{g}/\text{m}^3$ ).**

If monitoring shows that airborne levels have reached or exceeded this amount, your employer must “take action” by:

- assuring that workers have and use approved respirators
- performing additional personal monitoring
- implementing other workplace controls

### **Minimizing beryllium exposure and potential for exposure is an important goal for DOE and for this facility.**

- Exposure to beryllium is a health hazard.
- There is NO known exposure level that is “safe” for everyone.
- DOE policy is to keep exposures as low as possible.
- Workers, managers, and safety and health staff all have responsibilities for keeping the workplace safe.



In this module you will learn about:

- How your workplace is made safe through engineering controls, administrative controls, and personal protective equipment.
- How to reduce the risks of potential exposure to beryllium in maintenance activities.
- How to reduce potential exposure through performance feedback and continuous improvement.

### I. MAKING YOUR WORKPLACE SAFE

Three kinds of controls are used to make working with beryllium as safe as practicable. These controls are applied in order listed below:

- Engineering controls
- Administrative controls
- Personal protective equipment

#### A. Engineering Controls

- *Engineering controls* are processes and equipment used to help reduce the risk of exposure in the workplace. These controls can help reduce the possibility of workers being exposed to airborne beryllium by minimizing the number of ways workers can be exposed.

Engineering controls include:

- Substitution
- Ventilation
- Wet methods
- Enclosure of processes
- Isolation (process and people)

#### Substitution

*Substitution* is the use of a less hazardous material in place of a more hazardous one.

Show Overhead 4.1. Review objectives.

You can play the “Controls” module of the video here.

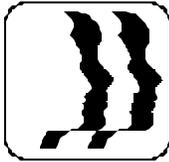
Show Overhead 4.2. The applicable section of the rule is 850.25c. Define and explain:

- Engineering controls
- Administrative controls
- Personal protective equipment

Discuss the concept of “hierarchy of control” and how it is applied at your facility.

Show Overhead 4.3. Define and review the following terms:

- Substitution
- Ventilation
- Wet methods
- Enclosure
- Isolation



In most weapons operations, there may not be a substitute for beryllium. In cleanup and decontamination and decommissioning (D&D), substitution is obviously not possible.

### Ventilation

*Ventilation* is used to control the amount of airborne beryllium in such operations as:

- Grinding, sanding, polishing, or buffing
- Machining
- Melting or casting
- Abrasive blasting or sawing
- Welding
- Hot rolling or slab milling
- Pickling

Pickling is a procedure that removes the oxide layer that forms on metal after heat treating or casting by putting the newly formed beryllium-containing part in an acid bath. Ventilation is usually necessary because of the mist the acid bath may release.

Ventilation devices draw in air that contains the beryllium particles. They must create adequate airflow to do their job of capturing the particles at their source and drawing them into the ventilation system. A meter measures the airflow on some devices.

Ventilation devices are inspected regularly to make sure an adequate flow of air is maintained.

Check that the ventilation system is working properly before beginning work in areas where beryllium is routinely processed.

If you see that a ventilation device is not drawing air properly, tell your supervisor immediately.

Cooling fans should not be used in beryllium work areas. They can spread airborne particles and interfere with the capture of particles by the ventilation system. If heat is a problem, consult with industrial hygiene or ventilation engineers.

Discuss the ventilation systems workers will encounter on the job at your site. Note any special features of the systems (e.g., types of meters, alarms) your site uses. Emphasize the importance of airflow rate, clean sources of make-up air, and similar critical features of systems at your site.

Some participants may know the airflow meter as a “velometer.”

Stress that workers should follow appropriate work procedures for assuring adequate ventilation.



### **Never try to modify ventilation equipment.**

Unauthorized modification can upset the balance of ventilation throughout the plant and can result in high exposures to airborne beryllium for you and for co-workers in non-beryllium areas.

Do not use ventilation systems to remove scrap paper or trash. These materials will clog them and restrict the airflow. If the airflow is restricted, the system is less effective in controlling airborne particles.

Proper operation and maintenance of ventilation systems/equipment is essential for providing a safe and healthy environment for everyone.

If you have questions about proper flow rates or other ventilation operations, ask your supervisor.

### Wet methods

For some types of work with beryllium, the use of cutting and lubricating liquids may help trap beryllium particles and thus reduce the number of particles that become airborne. Wetting beryllium-contaminated dusty surfaces helps to keep particles from becoming airborne when the surface is disturbed by wiping off the dust or when maintenance is conducted near the surface.

Wet methods should be used when it is practical to do so and when analysis of the job shows that they do increase protection. However, beryllium can be suspended in aerosols. Spraying and breaking of the liquid droplets can still release particles that are breathable.

Also, liquids drying on surfaces can leave behind beryllium particles that could later become airborne.

Be sure to use the correct wetting solution. For example, some beryllium machining operations may require the use of oil.

Dr. Mark Hoover of NIOSH provided information on the release of respirable beryllium particles from liquid droplets.

Note that pickling has some of the same concerns associated with other wet methods. Bubbles bursting from gases formed in acid tanks can be a significant source of aerosols of dissolved beryllium

General information on the potential for exposure from spraying and splashing liquids in work operations may also be found in W. A. Burgess. 1995. *Recognition of Health Hazards in*



Wet methods are not effective in all operations in controlling airborne beryllium particles. If you have questions about when wet methods can be effectively used, contact your supervisor.

### Isolation and Enclosure

*Isolation* of a process limits the number of people exposed to the hazards and controls the spread of contamination.

*Enclosure*, which is the total or near total containment of the work operation, is one way to isolate an activity.

Some enclosed operations, like nuclear hot cells, are designed for remote operation so that no worker enters the enclosure while hazards are present. In other cases, access to the enclosed area is restricted to essential personnel wearing respirators and other PPE.

Enclosure used with ventilation is the most effective way to control airborne beryllium particles.

Routine beryllium operations that can be enclosed include:

- Machining
- Grinding, buffing, and polishing
- Casting
- Melting

Glove bags or temporary negative pressure enclosures can be used to isolate non-routine activities, such as maintenance and D&D.

Operations can also be isolated in *time*. For example, maintenance that may release beryllium particles can be scheduled at times when few workers are in the building.

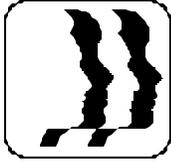
### **B. Administrative Controls**

Administrative controls include a variety of work practices designed to minimize exposure to airborne beryllium. These controls include:

*Industry: A Review of Materials and Processes*, 2<sup>nd</sup> ed. New York: John Wiley and Sons.

Discuss examples of isolation and enclosure of beryllium operations at your site.

Discuss various kinds of administrative controls with reference to the ways they are applied at your site.



- Written procedures
- Regulated areas
- Warning signs and labels
- Housekeeping practices
- Personal hygiene
- Material Safety Data Sheets
- Handling and storing beryllium practices
- Appropriate waste disposal
- Training and counseling
- Emergency response

### Procedures

Written procedures describe approved processes that must be followed step-by-step, exactly as written, to ensure that a task is always performed the same way, regardless of who performs it.

Procedures are especially important for tasks that:

- Pose a hazard to worker safety and health
- Are complicated to carry out
- Are performed infrequently

In the DOE system, procedures are developed using job safety analysis findings and the enhanced work planning process to assure that appropriate safe practices are integrated into the procedure.

Your employer should ensure that procedures are written and enforced.

You and your co-workers should always follow procedures to ensure your safety in the workplace.

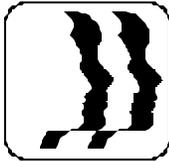
You have a right to stop work if a procedure is not being followed, or if you feel the procedure is not adequate to protect the worker.

### Regulated Areas

The Beryllium Rule requires your employer to establish *regulated areas* wherever airborne beryllium concentrations are found to be at or above the action level.

Show Overhead 4.4.

Explain that administrative controls are considered less reliable than engineering controls because there is more possibility of human error in applying them.

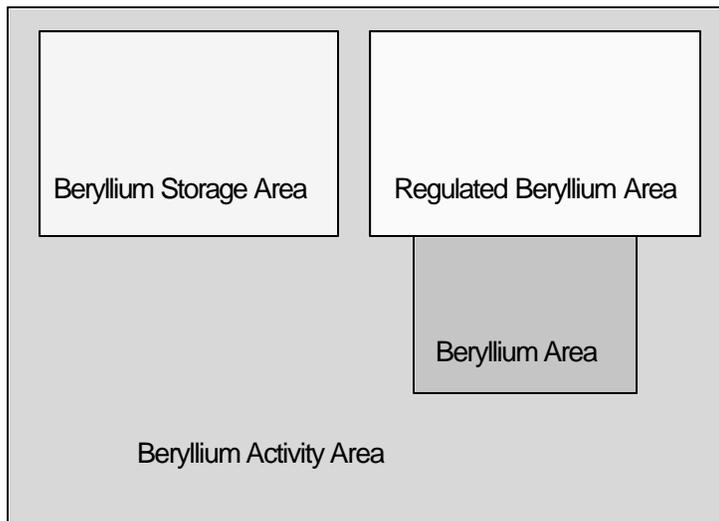


Regulated areas serve to:

- Limit the number of individuals exposed and potentially exposed to beryllium.
- Limit the spread of beryllium to uncontrolled areas.

Procedures are also provided for personnel who enter these locations.

Your site may have several types of areas that are regulated because of the potential for beryllium exposure, such as those shown in this example.



### Warning Signs and Labels

Signs and labels must be posted at all entries to beryllium-regulated areas and at other locations to alert workers and visitors of the possible presence of beryllium.

The applicable section of the rule is 850.26. Include a site-specific drawing of your facility's beryllium work areas in place of the one presented here as an example.

Display and discuss beryllium warning signs and labels used at your facility. The applicable section of the rule is 850.38.



The following information must be in the warning sign:

**DANGER**  
**BERYLLIUM CAN CAUSE LUNG DISEASE**  
**CANCER HAZARD**  
**AUTHORIZED PERSONNEL ONLY**

Warning labels must also be placed on containers of:

- Beryllium and beryllium compounds
- Items contaminated with beryllium
- Waste, scrap, or debris contaminated with beryllium

The following information must be in the warning label:

**DANGER**  
**CONTAMINATED WITH BERYLLIUM**  
**DO NOT REMOVE DUST BY**  
**BLOWING OR SHAKING**  
**CANCER AND LUNG DISEASE HAZARD**

These signs and labels are meant to protect and remind you and others of the potential hazards.

Warning signs must also be posted on areas temporarily regulated for maintenance, D&D, or emergency response. These postings help prevent entry by persons who have not had proper training on beryllium hazards and their control.

### Housekeeping Practices

Housekeeping and cleanliness are part of your facility's program to reduce exposure to beryllium. Housekeeping practices include:

- Using wet methods, vacuums, or methods that control the spread of dust contaminated with beryllium to clean surfaces and floors
- Equipping vacuums with *high efficiency particulate air* (HEPA) filters
- Labeling and controlling cleaning equipment used in beryllium areas to assure that it's not used elsewhere

Alert the participants that additional information about signs and labels may be provided in training they will receive on site-specific procedures.

The applicable section of the rule is 850.30.



To test the effectiveness of housekeeping, your employer must also conduct routine surface sampling in beryllium work areas.

### Personal Hygiene

Good personal hygiene goes with good housekeeping in contamination control and exposure reduction.

In facilities where workers can be exposed to the action level or above, the employer must provide:

- Change rooms or areas
- Showers and hand-washing facilities
- A lunchroom free of beryllium contamination

You should follow good personal hygiene practices such as the following:

- Wash your hands several times during a work shift.
- Wash thoroughly immediately after working with beryllium.
- Be especially careful to wash your hands before placing them near your face after you have been in a beryllium work area.
- Be especially careful not to bring beryllium-contaminated sleeves near your face.
- Remove protective clothing and equipment before entering clean areas or leaving the facility.
- When you are required to shower, wash from head to toe, using plenty of soap, to prevent taking beryllium particles outside the work area.
- Do not eat, drink, smoke, or apply cosmetics in work areas.

The applicable section of the rule is 850.27. Note that good hygiene practices in the use and handling of protective clothing and procedures for changing rooms will be addressed in the section on PPE.

Discuss site policies and procedures. Note the consequences of ignoring or violating these and other safety and health requirements.



### Material Safety Data Sheets (MSDSs)

MSDSs are always available to you to provide information on how to work safely with beryllium.

Although procedures and other site information may cover the same or more specific information, you may also want to read the MSDS.

Consult the MSDS, your supervisor, or site safety and health personnel with questions you may have.

**You have a right to have access to MSDSs.**

### Handling and Storage

You must be trained in the proper handling and storage of beryllium before you work with it.

Safe handling and storage practices will depend on the types and forms of beryllium in use at your facility.

The major concern in DOE operations is release of beryllium particles to the air and the health hazards of inhaling them.

Information on safe handling and storage of specific beryllium-containing materials is also available in the Material Safety Data Sheets for the materials.

### Waste Disposal

The waste management organization at your site can provide you and your co-workers with guidance on waste disposal issues.

Follow your site's procedures for disposing of beryllium-containing materials, scraps, dust, and other wastes according to DOE, EPA, and state requirements.

Consult your supervisor if you have questions about proper disposal methods.

Describe how and where MSDSs are maintained at your site. Note that MSDSs and related information is also available from online sources noted in the fact sheet in this manual.

The applicable section of the rule is 850.32. The MSDS for specific materials will also contain waste disposal information.



### Training and Counseling

*Training* is required for current and new beryllium-associated workers and for everyone who works at a site where beryllium activities are conducted.

Training for beryllium-associated workers, like this session, must be provided before or at the time of a worker's assignment and at least every two years afterwards.

Training must cover:

- The health risk of exposure to beryllium
- The facility's CBDPP
- Workplace beryllium hazards and their controls

*Counseling* must also be offered to those beryllium-associated workers who are diagnosed as sensitized to beryllium or as having CBD.

### Emergency Response

Emergency procedures have been established in your work area. Response to beryllium emergencies at DOE sites must follow requirements in the OSHA Hazardous Waste Operations and Emergency Response Rule.

You should know how to respond to beryllium-related emergencies by following the emergency plan and evacuation procedure for your work area.

In the event of a spill, fire, power outage, ventilation loss, or other emergency, you may be required to leave and isolate the area immediately. You must not reenter the area until you have been authorized to do so.

### **C. Personal Protective Equipment (PPE)**

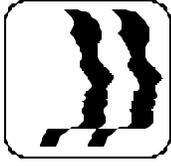
Engineering and administrative controls may not be enough to protect you from beryllium exposure. You may also need to use personal protective equipment (PPE).

The applicable section of the rule is 850.37. Explain the training program at your facility. Remind participants of the categories included in "beryllium-associated workers." Note that retraining may be necessary if a worker appears to lack the skills and knowledge needed for the work he or she performs with beryllium. Retraining may also be necessary if there are changes in operations or procedures or if new types of controls are introduced.

Describe counseling services offered to workers at your facility. Give out information about support group meetings and contacts.

Include site-specific information here about the applicable procedures at your site and sources of guidance. The OSHA rule is 29 CFR 1910.120. Paragraph (l) applies to D&D; paragraph (q) applies to beryllium emergencies in all other operations.

Show Overhead 4.5. The applicable section of the rule is 850.29.



PPE includes:

- Respirators
- Safety glasses
- Gloves
- Hardhats and other headgear
- Safety shoes, shoe covers, or booties
- Hearing protection
- Coveralls
- Lab coats

Because there is no known level of exposure to beryllium that is safe for everyone, it is important to use PPE correctly to protect yourself and others from potential exposures.

All protective clothing and equipment must remain at the plant site. It must be handled and cleaned according to procedures to limit the spread of beryllium particles.

Your job may require PPE that protects you against exposure to other hazards in addition to beryllium.

### Clothing

Wear the protective clothing, gloves, shoe covers, and other equipment specified in site procedures to avoid skin contact with beryllium and contamination of your personal clothing with beryllium particles.

Protective clothing and equipment *are required where:*

- Airborne levels of beryllium are at the action level or above, or
- Surface contamination is at or above 3  $\mu\text{g}/100\text{ cm}^2$ .

Even if measured levels are lower, your employer must provide you with protective clothing and equipment if you request it for beryllium work.

All protective clothing and equipment should be clean, available each day, and put on before you begin work.

Throughout this section, discuss specific PPE used at your facility, showing examples and referencing site procedures for use.



If you have questions about the best protective clothing material for specific operations, consult your supervisor or site safety and health personnel.

### Handling Used Clothing

*Disposable clothing* must be disposed of as hazardous waste, following your site's procedure.

*Reusable clothing* must be labeled and handled in ways that prevent exposure to beryllium particles. Handling and laundering practices must be part of the CBDPP plan.

Reusable clothing is placed in laundry containers before leaving the work area. The containers should be properly labeled and should not be used for other clothing.

Your site also has procedures to protect those who handle and launder the clothing. For example, soiled clothes can sometimes be placed in water-soluble bags so that laundry workers can put the closed bags directly into the washer and avoid exposure to beryllium dust on the clothes.

### Change Area Procedures

Facilities that require and provide protective clothing must also have lockers, showers, and laundry facilities.

Change areas are separated into a:

- *Personal side* (where you leave your personal clothes at the start of the shift), and
- *Work side* (where you deposit dirty clothes for laundering at the end of the shift).

Keep all beryllium-contaminated clothing on the work side. Never put anything that may be contaminated with beryllium on the personal side.

Do not wear jewelry while working with beryllium. Beryllium particles can be carried home on jewelry if it is worn while working in a beryllium work area.

Display examples of labels used on laundry containers.



At the end of your work shift, place (don't throw!) work clothing into the clothes hamper before showering and entering the personal side.

This procedure helps prevent beryllium exposure to family members and others.

### Respiratory Protection

The CBDPP plan at your site will specify the tasks for which respirator use is required. Under the Beryllium Rule, respirators must be provided and properly used when:

- Airborne beryllium levels are at or above the action level,
- Task analysis indicates a risk of exposure, or
- The beryllium-associated worker requests a respirator.

Use of the right type of respirator may be necessary to protect your lungs from beryllium particles.

Procedures or work instructions will specify the type of respirator required and how long the respirator should be worn. All respirators used must be NIOSH-approved or accepted under the DOE Respiratory Protection Acceptance Program. They must be the type specified for protection against the airborne levels of beryllium measured or expected and other work conditions.

Your respirator must fit properly to protect you, but you cannot tell if a respirator fits you by looking at it. A respirator that does not fit can look just like one that does.

Always perform the *fit checks* you learned in respirator training to help ensure your respirator fits properly.

There are serious disadvantages to wearing a respirator:

- Respirators can be uncomfortable, hot, and heavy.
- Respirators can block your sight.
- Respirators may make it harder to breathe.
- Improper use of respirators can be dangerous.

Show overhead 4.6.

Briefly describe the respirator program at your site. The applicable section of the rule is 850.28. Your site program must meet the OSHA requirements (29 CFR 1910.134, last revised in 1998).

Anyone using a respirator must have a medical examination, pass training in respirator use, and be fit tested for the type and size of respirator he or she will use. The site health and safety personnel or work supervisor can provide more information on the respirator program.

Point out that the protection factors for respirators are currently under review at OSHA.

Although a respirator approved for a higher concentration of particles can be worn when levels are lower, a respirator cannot be used at levels *higher* than the level for which it is approved.



Nevertheless, wearing an approved, properly fitting respirator is your last line of defense against beryllium exposure.

### II. MAINTENANCE

Maintenance personnel have a high risk of being exposed to beryllium. They often perform non-routine tasks where it is difficult to predict exposure potential in advance and difficult to use engineering controls to minimize exposure.

Because they move around the plant, maintenance personnel may spread beryllium contamination outside a regulated area and into other locations in your facility.

Respiratory protection and PPE should be worn during most maintenance activities as required by your site's CBDPP.

#### A. Housekeeping

Proper housekeeping procedures during and after maintenance activities are important to reduce the spread of beryllium dust from one work area to another.

Housekeeping should be performed at the end of each maintenance task or at the end of the shift.

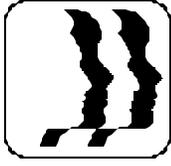
You are responsible for cleaning up your work area.

Good housekeeping might include:

- Wiping surfaces with wet cloths or cleaning surfaces with sticky tack cloths to reduce the amount of beryllium-containing dust in the area.
- Using a HEPA-filtered vacuum (not brooms, regular vacuums, or compressed air, which can cause beryllium-containing dust to become airborne).

Be careful with cleaning cloths. Do not wipe a contaminated surface, put the cloth back in your pocket, and then shake or snap it when you take it out next, thus flicking beryllium particles into the air.

The applicable section of the rule is 850.30.  
Show Overhead 4.7.



Following proper housekeeping procedures to maintain a clean work area can protect you from exposure to airborne beryllium.

*You have a right to a clean work area.*

### **B. Decontamination**

Clean every item before you remove it from a beryllium work area. This will help prevent the spread of beryllium dust to other facility areas.

Decontamination of an area might include:

- Thorough cleaning of all surfaces in the area with HEPA-filtered vacuums and wet methods, and
- Repainting the area to seal any residual beryllium dust after cleaning.

Contact industrial hygiene personnel any time you have questions about cleanliness in a beryllium work area.

### **C. Ventilation and Air Cleaning Systems**

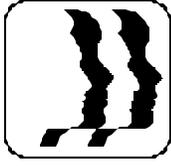
Maintenance or repair of ventilation and air cleaning systems, including HEPA-filtered vacuums, used in beryllium work areas can result in the release of high levels of beryllium particles.

Activities with the potential for exposing the maintenance worker and others to beryllium include:

- Changing and testing filters
- Replacing gaskets
- Cleaning ductwork
- Inspecting

To avoid releasing beryllium to the air, conduct these activities according to specified procedures and work plans and using respirators and other required controls.

Remember to handle used filters and other debris as beryllium waste.



### D. Equipment

Maintenance of equipment used in beryllium areas or maintenance of the areas themselves can result in high levels of airborne beryllium particles. Activities that can disturb and spread beryllium particles include:

- Furnace rebuilding
- Repair, rebuilding, or welding of beryllium-contaminated equipment or structures
- Structural renovation

You must follow procedures and work instructions for maintenance of equipment used in a beryllium work area.

Required work practices and controls typically include the combined use of:

- Portable enclosures
- Wet methods or vacuums with high-efficiency particulate air (HEPA) filters
- Respiratory protection
- Protective clothing
- Restricted work zones

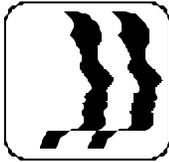
Clean equipment, tools, and enclosures frequently, using wet wiping, wet scrubbing or HEPA-filtered vacuuming.

You may need to clean the equipment **before** maintenance begins and **after** the job is complete.

If equipment must be sent offsite for repair, maintenance and safety and health personnel should do the following:

- Label the equipment and notify repair personnel that the equipment was used in a beryllium area.
- Provide a description of the steps taken or not taken to clean both internal and external surfaces.
- Provide information on the surface contamination levels, the hazards associated with beryllium exposure, and appropriate protective measures.

For answers to questions or clarification of specific procedures, contact your supervisor.



### E. Used PPE and Tools

Respirators and protective clothing that could be contaminated must be bagged or handled according to applicable procedures or work instructions.

Laundry workers and personnel who are responsible for the cleaning and maintenance of respirators have a high potential for being exposed to airborne beryllium dust.

These individuals need to be aware of how to protect themselves from exposure to beryllium.

It is important to clean all tools used in a beryllium work area to prevent exposing your family, friends, and co-workers.

Display labels used for bagged respirators and PPE.

### III. CONTINUOUS IMPROVEMENT AND PERFORMANCE FEEDBACK

The Beryllium Rule requires your employer to analyze and assess the effectiveness of monitoring, exposure reduction, medical surveillance, and other elements of the CBDPP. The results must be given to workers, managers, labor organizations, and others who request them.

The information gathered through this analysis can be used for continuous improvement of worker protection at your site.

If you know ways to help reduce the potential for exposure by changes to the work instructions and procedures, notify your supervisor.

Your input is important to the continuous improvement process.

The applicable section of the rule is 850.40. Lead a discussion of the performance feedback and continuous improvement processes being used at your facility. Participants may be members of teams to review or develop work instructions. Note the methods used at your facility to identify and communicate performance data, lessons learned, and good practices.

### IV. PROTECTING YOURSELF AND YOUR FAMILY

Employees are the key to protecting family and friends from exposure to beryllium.

Show Overhead 4.7.



Knowing the safe levels is one thing, but it is important for you to know *how* to protect yourself.

You are responsible for ensuring that beryllium dust is not carried with you when you leave your work area.

Beryllium workers can help ensure a safe work environment by following four simple guidelines:

- Be smart
- Be clean
- Be aware
- Be safe

### *Be Smart*

Remember, CBD is caused by inhaling beryllium particles. Use the controls and equipment available to you to keep beryllium dust and fumes from reaching your lungs. Wear PPE, including the approved respirator, and use work practices to limit the release of particles to the air.

### *Be Clean*

Follow good housekeeping and hygiene practices in your work and when you leave the work area. Wash several times during the work shift. Shower or wash thoroughly before eating, drinking, smoking, or putting on cosmetics. If your hands, arms, or face have beryllium dust on them, you can inhale it.

### *Be Aware*

Know the symptoms of CBD and know the health and safety hazards of beryllium-containing materials you work with. Participate in the medical surveillance program and talk with your site occupational medicine physician and your personal physician about your work history and symptoms you may have. Remember that, although CBD is not curable, it is treatable.



### Be Safe

You are the key to a safe work environment. If you have questions and concerns about possible beryllium problems, talk with your supervisor or with your site safety and health personnel.

## V. SUMMARY

DOE facilities use engineering controls, administrative controls, and personal protective equipment to reduce and minimize worker exposure to beryllium.

You play a key role in controlling your exposure. To help protect yourself, you should follow the requirements and the recommendations of your site CBDPP and related procedures and instructions.

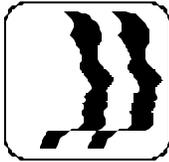
Pay special attention to the worker protection requirements in maintenance activities where infrequent or non-routine jobs may lead to high levels of beryllium in the air or on exposed surfaces.

Participate in activities to identify areas for improvement. If you have questions or concerns about current procedures or suggestions for making beryllium work safer, talk with your supervisor or with facility safety and health personnel.

Use the resources available to you, such as your site's medical surveillance program, counseling services, and the information offered in this course and other sessions.

***You have a right to, and a responsibility for, a safe work environment.***

Show Overhead 4.8.



**VI. REVIEW QUESTIONS FOR MODULE 4**

1. \_\_\_\_\_ are processes/equipment used to help reduce the risk of exposure in the workplace.
  
2. Two examples of processes and equipment to control exposure to airborne beryllium are:  
\_\_\_\_\_  
\_\_\_\_\_
  
3. \_\_\_\_\_ and \_\_\_\_\_  
\_\_\_\_\_ must be worn for work where the beryllium concentration is at or above the action level.
  
4. Employees should not \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, or apply \_\_\_\_\_ while working in any beryllium work area.

Possible answers:

1. Engineering controls
  
2. Any two: substitution, ventilation, wet methods, enclosure, and isolation
  
3. Respirators, or respiratory protection, and personal protective equipment, or PPE
  
4. Eat, drink, smoke, or [apply] cosmetics

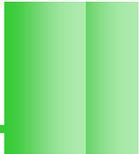
### **Objectives**

#### **In this module you will learn about:**

- How your workplace is made safe through engineering controls, administrative controls, and personal protective equipment.
  - How to reduce the risks of exposure in maintenance activities.
  - How to reduce potential exposure through performance feedback and continuous improvement.
- 

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## Controlling Beryllium Exposure and Contamination

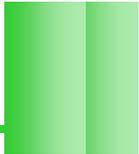


### **How to make your workplace safe**

- Engineering controls
- Administrative controls
- Personal protective equipment (PPE)

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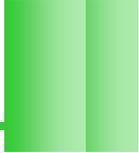
## Controlling Beryllium Exposure and Contamination



### **Engineering controls**

- Substitution
- Ventilation
- Wet methods
- Enclosure
- Isolation

## Controlling Beryllium Exposure and Contamination



### **Administrative controls**

- Written procedures
- Regulated areas
- Warning signs and labels
- Housekeeping practices
- Personal hygiene
- Material Safety Data Sheets
- Handling and storage
- Waste disposal
- Training and counseling
- Emergency response

## **Personal protective equipment (PPE)**

- Types of PPE
  - Requirements for use
  - Handling used protective clothing
  - Following change area procedures
  - Respiratory protection
- 

**Respiratory protection must be provided  
and properly used when:**

- Airborne beryllium levels are at or above the action level
- The task analysis indicates exposure risk.
- The beryllium worker requests a respirator.

## Controlling Beryllium Exposure and Contamination

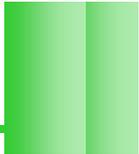


### **Maintenance personnel have high risks of beryllium exposure.**

- Wear respiratory protection and PPE.
- Follow proper housekeeping procedures.
- Clean every item before removing it from a beryllium work area.
- Work carefully on equipment with a high potential for release of beryllium particles.
- Clean and handle all used PPE and tools to avoid spreading particles.

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## Controlling Beryllium Exposure and Contamination



### **Simple guidelines to protect yourself and your family:**

Be smart

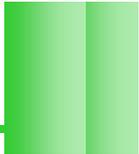
Be clean

Be aware

Be safe

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## Controlling Beryllium Exposure and Contamination



**You have a right to and  
a responsibility for a  
safe work environment.**



As you talk with others in your workplace, your family, and your community about health risks, you will communicate more successfully if you use a few of the basic principles and tips described in this appendix.

Throughout the course, your facilitator will lead the group in several role-playing scenarios designed to practice your skill in communicating as well as to reinforce the course content.

Following and applying these principles outside the classroom—in casual conversation as well as in formal meetings—can help you “get across” your ideas, questions, and concerns about beryllium health effects and about other topics that are important to you and your co-workers.

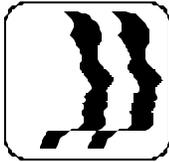
### **I. YOUR COMMUNICATION IS IMPORTANT**

- Communication is important because health and safety issues are complex.
- Communication is open, organizes thoughts and words, and uses clear and concise language.
- “Communication” comes from the Latin word “communis” which means commonness or sharing of meaning.
- Communication is enhanced when conversation/discussion occurs between you, your supervisor, and your organization.
- Communication is common sense and keeps everyone in the information loop.
- Informed choices require effective communication.

#### **A. Seven Cardinal Rules of Risk Communication**

Risk communication is defined as any communication that informs individuals about the existence, nature, form, severity, or acceptability of risks.

The term “risk communication” also refers to low-trust, high-concern communication issues.



In your communication dealing with risk in the workplace, the following will help to keep the lines of communication open:

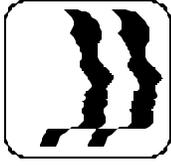
1. Accept and involve interested parties as a legitimate partner.
2. Plan and evaluate your efforts.
3. Listen to the issues.
4. Be honest, frank, and open.
5. Coordinate and collaborate with other credible sources.
6. Meet the information needs of internal and external advocacy groups.
7. Speak clearly and with compassion.

### **B. Communication Tips**

Listed below are tips for improving your communication.

1. Ask about workplace issues and interests (this will provide you with information regarding attitudes, perceptions, skills, etc.).
2. Seek other viewpoints from your co-workers; medical, human resources, and legal offices; and supervisors.
3. Provide several avenues for communication (focus groups, brainstorming, one-on-one conversations, suggestion boxes, e-mail, and staff meetings).
4. Ask questions of everyone involved in the process such as: What are the most reasonable steps? When and how can this be accomplished? Where do we go from here?
5. Attend meetings or read publications to increase your knowledge of the issues.
6. Work to improve your communication skills by learning how to:
  - Listen.
  - Develop questioning techniques.
  - Be consistent with your communication.

Communication is a skill. It requires practice, patience, and tolerance.



### C. Communication Principles to Remember

When communicating, remember the following:

1. Perception equals reality.
2. Be perceived as a trustworthy and credible source of information.
3. Communication is a skill.
4. Learn to listen and identify issues.
5. Practice self-management. Remove emotions from your statements. Speak with confidence. Avoid becoming defensive.
6. Develop key points to communicate and emphasize them often.
7. Follow up on requests for information and action.
8. Take responsibility by asking questions and seeking solutions.

## II. SUGGESTIONS FOR IMPROVING YOUR COMMUNICATION SKILLS

Open communication provides opportunities for everyone to:

- Express their opinions.
- Ask questions and seek answers.
- Provide input into the decision-making process.
- Earn trust and build credibility.

### A. Maximize Your Communication Skills

You must be **perceived** as trustworthy and credible.

To maximize your communication skills and be perceived as trustworthy and credible, consider the four building blocks of earning trust and building credibility:

1. Empathy and caring
2. Competence and expertise
3. Commitment and dedication
4. Honesty and openness



### B. Show Empathy and Caring

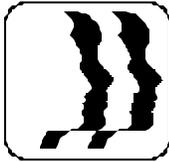
A good communicator uses empathy and caring to open the ears of the listeners by establishing commonality with them.

We tend to listen to others who have similar interests, values, and experiences.

1. Approximately 50 percent of establishing trust and credibility is your ability to project empathy and caring.

One important way to build trust is to identify what you have in common with your listeners. Your ideas will be better heard if you can establish commonality within the first 30 seconds of the conversation by using the pronoun “I”, “my”, or “mine.”

2. Here are some phrases you can use to establish commonality:
  - I want to share with you information about
  - My goal is to keep you informed with the latest information regarding
  - I know you are interested in
  - It appears that we are both interested in health and safety issues
  - Looking as this situation from your perspective, I also feel
  - I work here too and am interested in
  - I am/have been in contact with (medical, industrial hygiene, human resources)...attempting to get answers to this question
  - I am interested in the safety and well being of our co-workers and their families
  - I am here to share with you the knowledge and confidence I have in our ability to protect
  - As a friend of many of the people who work here, I want to let you know how important it is that we work together to (resolve, find a solution, to get back to our daily routines, etc.)
  - I agree that ...is important
  - If I were in your shoes and reading/hearing/ seeing the things you have been reading/ hearing/seeing, I would be asking the same questions



- If it is an important question to you, then it is an important question to me
- The issue(s) you have raised is/are at the top of my priority list
- I also care about
- Looking at the issue from your point of view, I can see why you are interested in
- In listening to your question, I can sense your (frustration, deep feelings, concerns) about
- I have asked myself the very same question

Other ways to show that you care about those you are speaking with include:

3. Use open body language (for example, don't fold your arms across your chest).
4. Listen.

### **C. Project Competency and Expertise**

A good communicator knows the subject matter and is prepared to address related issues.

People want to talk to the “person(s) in the know.”

Approximately 15 to 20 percent of establishing trust and credibility is based on your ability to project competence and expertise.

When speaking about a technical area, use the following techniques:

1. Define terms that may be unfamiliar.
2. Use data selectively to make important points rather than for the sake of using them.
3. State your credentials as needed (“I have 15 years experience in this operation.” “I was part of the team testing the new procedure.” etc.) .
4. Use relevant comparisons (apples to apples).

### **D. Project Commitment and Dedication**

A good communicator demonstrates commitment and dedication by actions that lead to resolution.



Approximately 15 to 20 percent of establishing trust and credibility is your ability to project commitment and dedication.

When demonstrating commitment and dedication, use the following techniques:

1. Make statements that show organizational commitment throughout the process.
2. Be accessible to all interested parties.
3. Follow up with information.

### **E. Be Honest and Open**

A good communicator must be honest and open during the communication process.

Approximately 15 to 20 percent of establishing trust and credibility is your ability to project honesty and openness.

When projecting honesty and openness, use the following techniques:

1. Always tell the truth.
2. Have open body language.
3. Establish eye contact.
4. Avoid jargon/technical language and excessive use of numbers.
5. Avoid using lecterns/tables as a barrier.
6. Be willing to say "I don't know but will find out. . ."

### **F. Strive to Improve Your Verbal Skills**

Well-developed verbal skills are essential in communication.

Communication is a skill.

You must practice your communication skills to keep them sharp.



Tips for improving your verbal communication skills:

1. Practice in front of a mirror or co-workers.
2. Speak with confidence.
3. Emphasize important materials by speaking at a slower rate, or pause before or after an important word or statement.
4. Select the most appropriate time and place for the communication.

### **G. Use Positive Language**

Body language is important in low-trust, high-concern communication settings.

When communicating low-trust, high-concern issues, your body language:

1. Provides up to 50 to 75 percent of the message content
2. Is intensely noticed
3. Can be interpreted negatively
4. Overrides verbal communication

Establish eye contact when answering questions. Eye contact communicates:

1. Honesty and openness
2. Competence and expertise
3. Commitment and dedication
4. Empathy and caring
5. Belief in your message

Keep your hands above your waist and visible at all times.



### III. ANSWERING QUESTIONS

#### A. Anticipate Questions

The key to answering questions is anticipation.

If you get the same question several times, consider incorporating the answer into the routine training or expanding the area concerning the question.

Ninety-five percent of all questions can be anticipated, meaning that ninety-five percent of all responses can be developed.

Questions should be answered within two minutes.

#### B. Use Guidelines for Answering Questions

To answer questions, use the following guidelines:

1. Develop key messages, 5 to 20 words in length, and stick to them.
2. Use easy-to-recognize language.
3. Evaluate your response.
4. Examine your choice of words.

When you cannot answer a question, your response should be honest and open. For example:

- If the answer to a question is unknown say, "The issue is still being researched..."
- I am prepared to speak on another issue but if you would like more information..."
- I will get back to you by...with the answer..."
- "If you would you be kind enough to give me your name and where you can be reached, I will research the issue and get back to you by...."

"That's a great question and I will need to do additional research to find out, but I'll be glad to find out for both of us."

Be sure that follow-up occurs, either over the phone or in writing, within the time frame specified.



### **C. Support Key Message With Facts**

Support your key message with two supporting facts.

The supporting facts can be conveyed by:

1. Relating a story/experience
2. Analogies
3. Quoting a credible agency that agrees with your position.

### **D. Transition to Conclusion**

Transition to a conclusion.

The conclusion is the same as the key message previously delivered.

Repeat your key message verbatim.

Studies indicate that important information needs to be heard at least two times.

Changing the words in your conclusion can send conflicting messages and confuse your listener.

### **E. Include Future Action in Your Closing Remarks**

This statement informs the audience of the long- and short-term actions to follow.

This statement should ALWAYS include a location, phone number/fax/voice mail, or address where your listener can obtain additional information.

### **F. Be Prepared**

Preparation is the key to delivering concise, focused, and well-planned answers to questions.

Listed below are steps that should be taken prior to answering questions:

1. Develop good communication skills.
2. Answer questions that are in your area of expertise.



3. Refer other questions to the appropriate person or internal/external agency.
4. Plan ahead. The way you answer questions may influence others' perceptions about you and the organization.

Preparation may include the following steps:

- Role play question and answer sessions.
- Anticipate questions and develop responses.
- Practice “keeping your cool.”
- Concentrate on verbal and nonverbal communication skills.
- View your preparation time as an investment. (The return on this investment can be high.)

#### IV. SUMMARY

1. Always be prepared. Lack of preparation can be seen through verbal and nonverbal communication skills.
2. “Presentation is a skill where preparation and attitude are recognized almost immediately.”
3. Respond to all questions properly.
4. Know knowable information. Prepare, prepare, prepare. It is your responsibility to gather, review, and communicate, as clearly as possible, all information relevant to the issue being discussed.
5. Establish rapport. Chemistry between you and the listener is important. Rapport links you and/or the organization psychologically to the audience.
6. Be organized. To maintain credibility, appear organized. It speaks volumes about your work habits and how tasks are accomplished within the organization.
7. Provide the appropriate content – the “need-to-knows” rather than “nice-to-knows.”



The following scenarios are designed to stimulate discussions about individual roles and responsibilities for communicating beryllium health and safety issues in the workplace. These can be used in class to illustrate the importance of communication. Ask participants to read the scenarios and then lead the discussion with the questions provided. Ask if they have seen or experienced similar occurrences in their workplace. Ask if, now that they have taken this class and participated in this exercise, they would be willing to speak with others about beryllium health and safety issues. Explore reasons why they would not be willing to speak about these issues with their co-workers. The goal is to raise awareness of how individual behavior in the workplace can affect everyone.

### Scenario 1. Management to Worker - Communications

Lucy and Eddie are getting ready to enter a beryllium work area.

**Eddie:** Let's get this job over with. I've got other things to do today and besides I don't think it is safe working in here.

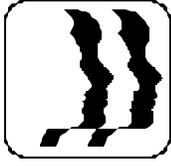
**Lucy:** What makes you think it's not safe? We've been to training on this and you know it is safe. I'm your supervisor and if I say it is safe then it is safe.

**Eddie:** You'll say anything to anyone in order to get this job completed. No one here cares if we are safe. They just want the work done.

**Lucy:** Do you think that I would go into an area that is unsafe? I know more about this than you do. That's my job. I'm responsible for all you people and it's my head on the chopping block if anything happens to you.

#### Discussion Questions:

1. If you were Lucy, what risk communication techniques would you use to show Eddie you are interested in his health? *Use empathy and caring.*
2. If you were Eddie, what risk communication techniques would you use to communicate with Lucy? *Use honesty and openness.*
3. Using risk communication techniques, rewrite the above scenario. *Lucy should take the time to listen and then treat his concern seriously. She should try to make him feel that his concerns are important. Eddie should state his concerns openly and honestly, without placing blame.*
4. Be ready to present and discuss your changes with other participants.



## Scenario 2. Worker to Worker – Administrative Controls

Phil has talked with Dr. Al, from Occupational Medicine, about possible health effects of working with beryllium. Phil wants to warn Denise and Chris about the health effects.

**Phil:** You guys should not be eating in here. You *have* to go to the break room. The signs that are posted say no eating, drinking, or smoking in a beryllium area.

**Denise:** I don't have time to wash up every time I want to eat.

**Chris:** What's your problem? For the past few days you've been on a mission of some sort. In fact, since you went to see Dr. Al, you've become Mr. Safety Professional.

**Phil:** I think it is important you realize that what you do today can cause problems later.

**Denise:** Like eating in here is a real health concern. I've never felt better. In fact, eating here saves time and money. The company should appreciate the fact that I am saving them money.

**Chris:** I feel fine too.

**Phil:** That's the point. You may feel good today but health effects caused by beryllium may not surface for 10-15 years. You may be getting sick now and not know it for a long time.

### Discussion Questions:

1. If you were Phil, what risk communication techniques would you use to get Denise and Chris to comply with procedures? *Use competence and expertise.*
2. If you were Denise and Chris, what risk communication techniques would you use to communicate with Phil? *Use empathy and caring. Respect other employees' position and consider their point of view.*
3. Using risk communication techniques, rewrite the above scenario. *Phil should continue to show empathy and caring and demonstrate his commitment and dedication. Denise and Chris should take the time to listen and consider Phil's points.*
4. Be ready to present and discuss your changes with other participants.



### Scenario 3. Worker to Industrial Hygiene - Respirators

Scott, the company industrial hygienist, is walking through a beryllium work area when he notices that two workers, Bob and Linda, are not wearing their respirators.

**Scott:** Both of you get those respirators on and get them on now.

**Bob:** Who are you to tell us what to do?

**Scott:** I am the industrial hygienist for this company. My responsibility is to make sure that you abide by company policies. We don't want any lawsuits because you failed to follow procedures and wear your respirator.

**Linda:** Whoa! Wait a minute! These respirators are hot and they give me a headache. Anyway, look around. This place is pretty clean. There's hardly any dust floating around.

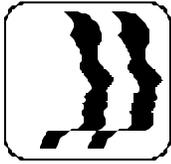
**Scott:** The site administrative action level for this area is  $0.5 \mu\text{g}/\text{m}^3$ . All of our air, smear, and personal air samplings indicate that anyone working in this area must wear a respirator.

**Bob:** I don't know about that sampling stuff. What does that mean?

**Scott:** That's technical stuff. Don't worry about it. Just put that respirator on.

#### Discussion Questions:

1. If you were Scott, what risk communication techniques would you use to get Linda and Bob to comply with procedures? *Show empathy for their position and demonstrate his competence and expertise by discussion that they can understand.*
2. If you were Linda and Bob, what risk communication techniques would you use to communicate with Scott? *Show commitment and dedication and try to find out more about the issue.*
3. Using risk communication techniques, rewrite the above scenario.
4. Be ready to present and discuss your changes with other participants.



### Scenario 4. Worker to Management - Procedures

Frank is a beryllium worker and Steve is the section head. Frank knows about the health effects caused by working with beryllium because two of his co-workers have been diagnosed with CBD.

**Frank:** I'm a little concerned about working with beryllium. Lately that's all we've heard. Why can't we use some other material?

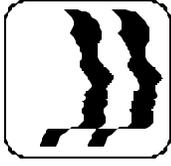
**Steve:** Well, it's not the material that caused the problem, it's the employee not following the procedures. The main thing to do is do what you are told. Besides there isn't a substitute for beryllium at this point.

**Frank:** I don't know. My two friends did what they were told, and now both of them have CBD. It seems to me that we need to make an effort to use something that is safer and just as effective.

**Steve:** I'm sure we will consider it if anything ever comes along.

#### Discussion Questions:

1. If you were Steve, what risk communication techniques would you use to address Frank's question? *Use empathy and caring to listen and discuss Frank's concern.*
2. If you were Frank, what risk communication techniques would you use to communicate with Steve? *Use competence and expertise to make his point more convincingly to Steve.*
3. Using risk communication techniques, rewrite the above scenario.
4. Be ready to present and discuss your changes with other participants.



### Scenario 5. Worker to Worker – Personal Protective Equipment

Juan and Harry are about to start working in a beryllium area.

**Juan:** We need to get this job started. Let's get our suits and masks on and get started.

**Harry:** This is such a small job, I don't think I'll suit up.

**Juan:** But we are going to be working with beryllium. We need to wear protective clothing to protect us from the beryllium dust.

**Harry:** Since it is such a small job, we shouldn't be generating much dust. All that gear slows me down and besides, it's hot in here.

**Juan:** I know it's hot but you need to protect yourself from inhaling beryllium dust.

**Harry:** You do what you want and I'll do what I want. I've already been in trouble for not meeting production deadlines. That will not happen again. I want to prove to management that I can do the work. All that equipment will just slow me down.

#### Discussion Questions:

1. If you were Juan, what risk communication techniques would you use to get Harry to follow company procedures? *Use competency and expertise to show Harry the reason for the procedures.*
2. If you were Harry, what risk communication techniques would you use to communicate with Juan? *Use empathy and caring and listen to Juan's point of view.*
3. Using risk communication techniques, rewrite the above scenario.
4. Be ready to present and discuss your changes with other participants.



### Scenario 6. Worker to Industrial Hygiene - Procedures

Jake and Ben, an industrial hygienist, are in a conversation regarding information about beryllium.

- Jake:** I'm a little concerned about working with beryllium. There's been a lot of talk around the plant about the dangers of working with beryllium.
- Ben:** It wouldn't be such a big deal if you and your coworkers followed the procedures such as washing your face and hands or wearing your respirator.
- Jake:** A lot of people don't like wearing respirators. They are uncomfortable and hot.
- Ben:** I don't care how uncomfortable or hot they are. The point is, they will help to protect you while working with beryllium. You people just won't listen until one of you gets sick! Then it's our fault for not enforcing the rules.
- Jake:** What do you want me to tell my co-workers, "You've got to follow the rules or else?"
- Ben:** I don't know. Just tell them they'd better do it.

#### Discussion Questions:

1. If you were Ben, what risk communication techniques would you use to get Jake to follow company procedures? *Empathy and caring for his situation and competency and expertise to convince Jake.*
2. If you were Jake, what risk communication techniques would you use to communicate with Ben? *Show commitment and dedication to demonstrate to Ben how important this issue is to everyone and the company.*
3. Using risk communication techniques, rewrite the above scenario.
4. Be ready to present and discuss your changes with other participants.



## Scenario 7. Worker to Doctor – Communications

Steve and Dr. Eric are discussing the results of Steve's physical.

**Steve:** I really don't understand what these test results mean.

**Dr. Eric:** Steve, these tests are telling us that there is a risk that you could develop CBD in the next 10-15 years.

**Steve:** What is CBD?

**Dr. Eric:** CBD is a pulmonary granulomatous disorder due to a cell-mediated reaction to beryllium.

**Steve:** I don't work with beryllium. I'm the HVAC guy. What is a pulmonary granular disorder. Are my cells dying?

**Dr. Eric:** You didn't let me finish! I'm attempting to explain this to you. You will really need to pay attention if you want to know more about your test results and CBD.

**Steve:** Today I'm healthy but you are saying that I might have this cell disorder thing?

**Dr. Eric:** CBD is hard to diagnose. We need to run some other tests.

**Steve:** If it is so hard to diagnose, how did I get it so easily?

**Dr. Eric:** A certain percentage of the population has a particular allele of a MHC gene ...

**Steve:** Allele? MHC? Look, Doc, you need to speak in English if you want me to understand this thing.

### Discussion Questions:

1. If you were Dr. Eric, what risk communication techniques would you use discuss Steve's test results? *Empathy and caring and competency and expertise to speak in terms that Steve can understand and show a genuine concern for his condition.*
2. If you were Steve, what risk communication techniques would you use to communicate with Dr. Eric? *Competency and expertise to be patient and open to learn more.*
3. Using risk communication techniques, rewrite the above scenario.
4. Be ready to present and discuss your changes with other participants.



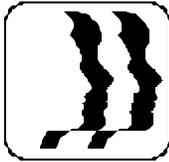
## FORMER WORKER MEDICAL MONITORING AND SURVEILLANCE PROGRAMS

Gaseous Diffusion Workers Portsmouth, Paducah, and Oak Ridge (K-25)	(888) 241-1199
Hanford Construction Workers	(800) 866-9663
Hanford Production Workers	(800) 419-9691
Idaho National Engineering and Environmental Laboratory	(888) 241-1199
Los Alamos National Laboratory	(877) 500-8615
Nevada Test Site	(888) 636-8161
Oak Ridge Building Trades	(888) 464-0009
Savannah River Construction Workers	(800) 866-9663

To inquire about other programs, call the site occupational medicine department where you worked, or call

Oak Ridge Institute for Science and Education (ORISE)

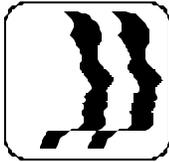
Colorado Office	(866) 812-6703
Tennessee Office	(866) 219-3442



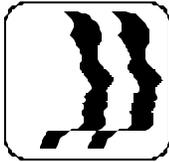
**ENERGY EMPLOYEES COMPENSATION PROGRAM  
RESOURCE CENTERS AND DISTRICT OFFICES**

**Resource Centers**

<b>Resource Center</b>	<b>Manager</b>	<b>Center Address/Phone</b>
Augusta, GA	Jim Kirr srs.center@eh.doe.gov	1708 Bunting Dr. North Augusta, SC 29841 Toll free (866) 666-4606 Main (803) 279-2728 Fax (803) 279-0146
Espanola, NM	Floyd Archuleta espanola.center@eh.doe.gov	412 Paseo De Odate, Suite "D" Espanola, NM 87532 Toll free (866) 272-3622 Main (505) 747-6766 Fax (505) 747-6765
Idaho Falls, ID	Larry Jones idaho.center@eh.doe.gov	Exchange Plaza 1820 East 17 <sup>th</sup> St., Suite 375 Idaho Falls, ID 83404 Toll free (800) 861-8608 Main (208) 523-0158 Fax (208) 557-0551
Las Vegas, NV	Robert Agonia vegas.center@eh.doe.gov	Flamingo Executive Park 1050 East Flamingo Rd., Suite W-156 Las Vegas, NV 89119 Toll free (866) 697-0841 Main (702) 697-0841 Fax (702) 617-0843
Oak Ridge, TN	Shirley White or.center@eh.doe.gov	Jackson Plaza Office Complex 800 Oak Ridge Turnpike, Suite C-103 Oak Ridge, TN 37830 Toll free (866) 481-0411 Main (865) 481-0411 Fax (865) 481-8832

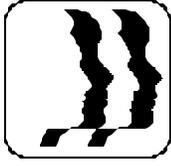


<b>Resource Center</b>	<b>Manager</b>	<b>Center Address/Phone</b>
Paducah, KY	Stewart Tolar paducah.center@eh.doe.gov	Barkley Center, Unit 125 125 Memorial Dr. Paducah, KY 42001 Toll free (866) 534-0599/(888) 654-9922 Main (270) 534-0599 Fax (270) 534-8723
Portsmouth, OH	Dan Charles portsmouth.center@eh.doe.gov	4320 Old Scioto Trail Portsmouth, OH 45662 Toll free (866) 363-6993 Main (740) 353-6993 Fax (740) 353-4707
Richland, WA	Eunice Godfrey hanford.center@eh.doe.gov	1029 N. Kellogg St. Kennewick, WA 99336 Toll free (888) 654-0014 Main (509) 783-1500 Fax (509) 783-0651
Anchorage, AK	John Landerfelt doecomp@acsalaska.net	2501 Commercial Dr. Anchorage, AK 99501 Toll free (888) 908-4070 Main (907) 258-4070 Fax (907) 258-4240
Rocky Flats, CO	Ray Malito denver.center@eh.doe.gov	8758 Wolff Court, Suite 201 Westminster, Colorado 80030 Toll free (866) 540-4977 Main (720) 540-4977 Fax (720) 540-4976



**District Offices**

<b>District Office</b>	<b>Directors</b>	<b>Office Address/Phone</b>
<p><u><i>District Office 1</i></u> <u><i>Jacksonville, FL</i></u> (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee)</p>	<p>Regional Director: Nancy Ricker</p> <p>District Director: William Franson</p>	<p>U. S. Department of Labor, DEEOIC 214 North Hogan St., Suite 910 Jacksonville, FL 32202 Toll free (877)-336-4272 Main (904) 357-4705 Fax (904) 357-4704</p>
<p><u><i>District Office 2</i></u> <u><i>Cleveland, OH</i></u> (Connecticut, Delaware, District of Columbia, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Puerto Rico, Rhode Island, Vermont, Virgin Islands, Virginia, West Virginia and Wisconsin)</p>	<p>Regional Director: Nancy Jenson</p> <p>District Director: Charles Ketcham, Jr.</p>	<p>U. S. Department of Labor, DEEOIC 1001 Lakeside Dr., Suite 350 Cleveland, OH 44114 Toll free (888)-859-7211 Main (216)-802-1300 Fax (216) 802-1308</p>
<p><u><i>District Office 3</i></u> <u><i>Denver, CO</i></u> (Arkansas, Colorado, Iowa, Kansas, Louisiana, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, Wyoming and all claims from RECA Section 5 awardees)</p>	<p>Regional/District Director: Robert Mansanares</p> <p>Assistant District Director: Kevin Peterson</p>	<p>U. S. Department of Labor, DEEOIC 1999 Broadway, Suite 1120 P.O. Box 46550 Denver, CO 80201-6550 Toll free (888)-805-3389 Main (720)-264-3060 Fax (720) 264-3089</p>
<p><u><i>District Office 4</i></u> <u><i>Seattle, Washington</i></u> (Alaska, Arizona, California, Idaho, Hawaii, Marshall Islands, Nevada, Oregon and Washington)</p>	<p>Regional Director: Ed Bounds</p> <p>District Director: Vardas Nathaniel</p>	<p>U.S. Department of Labor, DEEOIC 719 2nd Ave., 6th floor Suite 601 Seattle, WA 98104 Toll free (888)-805-3401 Main (206)-373-6750 Fax (206) 373-6798</p>

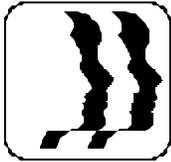


## USEFUL WEBSITES

DOE Chronic Beryllium Disease Prevention Program	<a href="http://tis.eh.doe.gov/be/index.html-ssi">http://tis.eh.doe.gov/be/index.html-ssi</a>
<i>Beryllium Rule</i>	<a href="http://tis.eh.doe.gov/be/berule.pdf">http://tis.eh.doe.gov/be/berule.pdf</a>
<i>Implementation Guide</i>	<a href="http://tis.eh.doe.gov/be/docs/beguide/beguide.html">http://tis.eh.doe.gov/be/docs/beguide/beguide.html</a>
DOE Office of Worker Advocacy	<a href="http://www.eh.doe.gov/advocacy">http://www.eh.doe.gov/advocacy</a>
DOE Human Subjects Protection Program	<a href="http://www.science.doe.gov/ober/humsubj/index.html">http://www.science.doe.gov/ober/humsubj/index.html</a>
Worker health-related studies	<a href="http://www.science.doe.gov/ober/humsubj/workrtop.html">http://www.science.doe.gov/ober/humsubj/workrtop.html</a>
DOL Energy Employees Compensation Program	<a href="http://www.dol.gov/dol/esa/public/regs/compliance/owcp/eeoicp/main.htm">http://www.dol.gov/dol/esa/public/regs/compliance/owcp/eeoicp/main.htm</a>
EEOICP claims forms and regulations	<a href="http://www.dol.gov/dol/esa/public/regs/compliance/owcp/eeoicp/law/EECAregs.pdf">http://www.dol.gov/dol/esa/public/regs/compliance/owcp/eeoicp/law/EECAregs.pdf</a> <a href="http://tis.eh.doe.gov/advocacy/laws/dolfrtoc.html">http://tis.eh.doe.gov/advocacy/laws/dolfrtoc.html</a>
DOL Occupational Safety and Health Administration (OSHA)	<a href="http://www.osha.gov">http://www.osha.gov</a>
DOE Medical Surveillance Program at ORISE	<a href="http://www.ornl.gov/cer/BMSP_pro/be-home.htm">http://www.ornl.gov/cer/BMSP_pro/be-home.htm</a>
DOE Former Workers Program	<a href="http://www.ornl.gov/cer/BMSP_pro/be-home.htm">http://www.ornl.gov/cer/BMSP_pro/be-home.htm</a>
Beryllium Support Group	<a href="http://www.dimensional.com/~mhj/">http://www.dimensional.com/~mhj/</a>
Environmental Protection Agency (EPA) <i>Toxicological Review of Beryllium</i>	<a href="http://www.epa.gov/iris/toxreviews/0012-tr.pdf">http://www.epa.gov/iris/toxreviews/0012-tr.pdf</a>



- Agency for Toxic Substances and Disease Registry (ATSDR)  
*Toxicological Profile for Beryllium* <http://www.atsdr.cdc.gov/toxprofiles/tp4.pdf>
- National Institute of Occupational Safety and Health (NIOSH),  
International Chemical Safety Cards <http://www.cdc.gov/niosh/ipcsneng/nengsynb.html>
- Brush Wellman MSDSs <http://www.brushwellman.com/ehs/msdsweb.nsf/wtoc>
- Environmental Defense's Scorecard <http://www.scorecard.org>
- Environmental Health Perspectives*, Oct. 1996  
supplement on beryllium <http://ehpnet1.niehs.nih.gov/doc/1996/Suppl-5/toc.html>
- U.S. Geologic Survey (USGS), Minerals  
Yearbook and Commodity Summaries <http://minerals.usgs.gov/minerals/pubs>
- National Jewish Medical and Research Center <http://nationaljewish.org/deoh/acr14.html>
- American Lung Association <http://www.lungusa.org/>
- Merck online manuals (medical information) <http://www.merck.com/pubs/>
- National Library of Medicine PubMed  
(medical research database) <http://www.ncbi.nlm.nih.gov/entrez/query.fcgi>

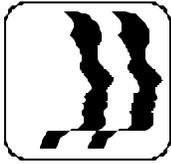


## ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
BAL	Bronchoalveolar lavage
BeLPT	Beryllium-induced lymphocyte proliferation test
CBD	Chronic beryllium disease
CBDPP	Chronic Beryllium Disease Prevention Program
CFR	Code of Federal Regulations
D&D	Decontamination and decommissioning
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ES&H	Environment, safety, and health
HEPA	High efficiency particulate air
IARC	International Agency for Research on Cancer
LPT	Lymphocyte proliferation test
MSDS	Material Safety Data Sheet
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	Permissible exposure limit
PPE	Personal protective equipment
R&D	Research and development
SOMD	Site Occupational Medical Director
TLV	Threshold limit value
TWA	Time-weighted average

## UNITS OF MEASURE

cm <sup>2</sup>	Square centimeter
m <sup>2</sup>	Square meter
m <sup>3</sup>	Cubic meter
µg	Microgram



## GLOSSARY

**Abnormal Beryllium Lymphocyte Proliferation Test (BeLPT):** The result of a BeLPT, which demonstrates the rapid growth of cells in response to a beryllium salt. Also known as a “positive” BeLPT.

**Action Level:** The level of airborne concentration of beryllium, that DOE facilities must set in their CBD prevention program (10 CFR 850.23) that, if met or exceeded, requires the implementation of specified worker protection provisions.

**Acute effects:** See Short-term health effects.

**Administrative Action Levels:** The levels of beryllium concentration (set for airborne and/or surface contamination) that DOE facilities may set and at which controls are implemented or actions are taken to prevent the occurrence of exposures above the occupational exposure limit.

**Administrative control:** Written policies and procedures prepared before work begins that remove or prevent exposure to physical, biological, or chemical hazards. Typical administrative controls include restricting access to hazardous areas and requiring workers to shower at the end of the work shift.

**Air sampling:** The sampling for and measuring of pollutants in the air.

**Antigen:** A substance that stimulates an immune response.

**Area air sampling:** Sampling the air in the work area. This is a diagnostic tool used in characterizing sources of beryllium exposure, checking the effectiveness of beryllium control systems, making an initial determination of the level of respiratory protection needed, and confirming acceptable air quality in general work areas.

**Authorized person:** A person formally identified by management as prepared to work safely.

**Baseline beryllium inventory:** An inventory of the locations of beryllium operations and other locations of potential beryllium contamination, including the identity of workers exposed or potentially exposed at these locations. Required of DOE facilities by 10 CFR 850.20.

**Berylliosis:** A term sometimes used for chronic beryllium disease. See *Chronic beryllium disease*.

**Beryllium:** A naturally occurring, silver-gray metal that has a low density, moderately high melting point, good stability, and good mechanical properties. The DOE Beryllium Rule defines beryllium as “elemental beryllium and any insoluble beryllium compound or alloy containing 0.1 percent beryllium or greater that may be released as an airborne particulate” (10 CFR 850.3).

**Beryllium activity:** Activity taken for, or by DOE at a DOE facility that can expose workers to airborne beryllium, including but not limited to design, construction, operation, maintenance, or decommissioning, and which may involve facilities or operations or a combination of facilities and operations.



**Beryllium article:** A manufactured item that is formed to a specific shape or design during manufacture, that has end-use functions that depend in whole or in part on its shape or design during end use, and that does not release beryllium or otherwise result in exposure to airborne concentrations of beryllium under normal conditions of use (10 CFR 850.3).

**Beryllium-associated worker:** A current worker who is or was exposed or potentially exposed to airborne concentrations of beryllium at a facility, including (1) a beryllium worker; (2) a current worker whose work history shows that the worker may have been exposed to airborne concentrations of beryllium at a DOE facility; (3) a current worker who exhibits signs or symptoms of beryllium exposure; and (4) a current worker who is receiving medical removal protection benefits (10 CFR 850.3).

**Beryllium-containing material:** Applies to any insoluble beryllium compound or alloy that contains at least 0.1 percent beryllium that may be released as an airborne particulate.

**Beryllium emergency:** Any occurrence such as, but not limited to, equipment failure, container rupture, or failure of control equipment of operations that results in an unexpected and significant release of beryllium at a facility (10 CFR 850.3).

**Beryllium lymphocyte proliferation test (BeLPT):** A laboratory test conducted on certain disease-fighting cells (lymphocytes) separated from a sample of blood or other tissue from an individual. The cells are tested with beryllium salts and other agents to determine if they react to beryllium as a foreign substance. Such a reaction indicates that the individual has become sensitized to beryllium following an earlier exposure.

**Beryllium sensitization:** A heightened immune response to beryllium following a previous exposure.

**Beryllium work (or operational) area:** See *Operational area*.

**Beryllium regulated area.** See *Regulated area*.

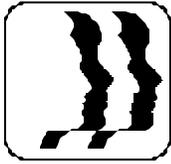
**Beryllium worker:** A current worker who is regularly employed in a DOE beryllium activity (10 CFR 850.3).

**Biopsy:** The careful removal of small bits of living tissue from the body for further study and examination, usually under a microscope.

**Breathing zone:** A hemisphere forward of the shoulders, centered on the mouth and nose, with a radius of 6 to 9 inches.

**Breathing zone sample:** An air sample collected in the breathing zone of workers to assess their exposure to airborne contaminants.

**Bronchoalveolar lavage (BAL):** A procedure for obtaining samples of tissue and cells from the airways and air sacs of the lungs. These samples can be used to make a definitive diagnosis of chronic beryllium disease.



**Carcinogen:** A substance that can cause cancer.

**Carcinogenicity:** The ability of a substance to cause cancer.

**Ceiling:** An airborne concentration of a substance in the work environment, which should never be exceeded.

**Cell-mediated immune response:** The natural process whereby the body recognizes and responds to an antigen (foreign body or material). In cell-mediated immunity, the response involves the binding of one type of lymphocyte (T cells) to the surface of other cells that display the antigen and trigger a response. The response may also involve other types of white blood cells.

**Chemical pneumonia (or chemical pneumonitis):** Inflammation of the lungs caused by inhaling material that is toxic to the lungs. Chemical pneumonia that occurs within hours or days after an individual inhales a large number of beryllium particles is considered acute, or short-term beryllium disease.

**Chronic beryllium disease (CBD):** A treatable, but not curable lung condition in which chronic inflammation of the air sacs leads to scarring and loss of lung function. CBD occurs in 1-6% of individuals who are exposed to beryllium dust or particles, usually in the workplace, and may take months or years to develop after exposure occurs.

**Chronic Beryllium Disease Prevention Program (CBDPP):** A program intended to reduce the number of workers exposed to beryllium and minimize their exposure. DOE and DOE contractors should supplement and integrate a CBDPP into existing worker protection programs. The requirements and criteria for a CBDPP are described in the Beryllium Rule (10 CFR 850).

**Chronic health effects:** See *Long-term health effects*.

**Concentration:** The amount of a given substance in a unit amount of another substance.

**Corticosteroid:** See *Steroid*.

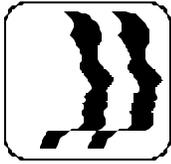
**Decontamination:** Removal of harmful substances.

**Dermatitis:** Inflammation of the skin. Can be caused by skin contact with irritating substances or substances to which an individual is allergic.

**Disposable clothing:** Work clothing that is disposed of by a specified procedure after one wearing.

**Engineering controls:** Changes that can be made in the work environment to reduce hazards on the job. The Occupational Safety and Health Administration (see *OSHA*) requires employers to make changes in the workplace environment whenever possible to protect worker health and safety.

**Exposure:** See *Worker exposure*.



**Exposure assessment:** The determination or estimation (qualitative or quantitative) of the magnitude, frequency, duration, and route of exposure.

**Exposure monitoring:** The act of collecting a sample from the environment for analysis to discover the concentration or intensity of a hazard (such as a hazardous substance, ionizing radiation, heat, or noise levels).

**False negative:** The term used when a person has a normal test result but actually has the condition the test is used to diagnose.

**False positive:** The term used when a person has an abnormal test result, but does not have the condition the test is used to diagnose.

**Fibrosis:** The development of scarring in tissue that has been inflamed. Fibrosis of the air sacs in the lungs decreases their ability to expand and contract in breathing, limiting the amount of oxygen they can take in.

**Granuloma:** A mass or nodule of chronically inflamed tissue. A granuloma contains many types of cells including those that can begin to form scar tissue.

**Hazard assessment:** The activity of determining and documenting the likelihood that individuals will be exposed to a known hazardous substance or condition. In the DOE requirements for a Chronic Beryllium Disease Prevention Program (10 CFR 850.21), the beryllium hazard assessment must include analysis of existing conditions, exposure data, medical surveillance trends, and the exposure potential of planned activities.

**Hazard Communication Standard:** An Occupational Safety and Health Administration (see *OSHA*) regulation (29 CFR 1910.1200) that requires employers to provide workers with information about the hazards of chemicals in their workplace and the means of protecting against them.

**Hazard:** A danger or a source of danger or harm.

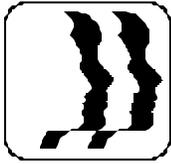
**Hazardous:** Capable of causing danger or harm.

**Hazardous waste:** Any waste that is considered dangerous to people or the environment by federal, state, or local laws or regulations.

**High efficiency particulate air filter:** Filter capable of trapping and retaining at least 99.97% of dispersed particles 0.3 micrometer in diameter.

**Immune response:** The series of cellular events by which the immune system reacts to challenge by an antigen.

**Industrial hygienist:** A person who is trained and experienced in anticipating, recognizing, evaluating, and controlling health hazards in the workplace.



**Inflammation:** A defensive reaction of body tissue to injury or irritants. An inflamed area is usually red, swollen, hot, and often painful.

**Ingestion:** The process of taking substances, such as food or drink, into the stomach.

**Insoluble:** Incapable of dissolving in a specific solvent (e.g., beryllium oxide does not dissolve in water).

**Latency period:** The time from exposure to a hazard to the development of symptoms of illness resulting from that exposure.

**Long-term health effects:** Symptoms that may develop weeks, months, or years after the exposure to the causative agent and may last over a long period of time. Also called chronic health effects.

**Lymphocyte proliferation test:** See *Beryllium lymphocyte proliferation test*.

**Lymphocytes:** Types of disease-fighting cells involved in the cell-mediated immune response.

**Medical monitoring:** See *Medical surveillance*.

**Medical removal protection benefits:** The employment rights established for beryllium-associated workers who voluntarily accept temporary or permanent medical removal from beryllium areas following a recommendation by the Site Occupational Medicine Director

**Medical surveillance:** The analysis of health information obtained by the systematic monitoring of health status and exposures in a population of workers in order to prevent and control occupational hazards and their associated diseases and injuries.

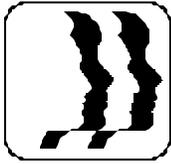
**MSDS:** Material Safety Data Sheet. MSDSs are fact sheets about hazardous chemicals used in workplaces. OSHA's Hazard Communication Standard requires that employers have an MSDS available to employees for each hazardous chemical used in the workplace.

**NIOSH:** National Institute for Occupational Safety and Health. A federal agency that does research on occupational conditions and hazards and recommends new occupational health and safety standards to OSHA.

**Normal BeLPT:** The result of a lymphocyte proliferation test, which demonstrates the same growth of cells whether or not beryllium salts are present. Also known as a "negative" BeLPT.

**Occupational exposure limits:** The concentration or amounts of hazards to which workers are permitted to be exposed in the workplace.

**Occupational:** Having to do with the workplace and working.



**Operational area:** An area where workers are routinely in the presence of beryllium as part of their work activity (10 CFR 850.3).

**OSHA:** Occupational Safety and Health Administration within the U.S. Department of Labor. OSHA is the main federal agency that issues workplace safety and health standards and enforces them in private industry.

**Permissible Exposure Limit (PEL):** The highest average amount of a toxic substance that OSHA permits workers to be exposed to. The average is calculated for exposure over an 8-hour period. The PEL for beryllium is 2.0 micrograms beryllium per cubic meter of workroom air, averaged over an 8-hour work shift.

**Personal air sampling:** Process that measures or estimates individual employee exposures.

**Personal side of the change area:** Where you leave your personal clothes at the start of the shift.

**Personal air samples:** Air samples collected from within the breathing zone of a worker, but outside the respirator.

**Personal protective equipment:** Devices worn by the worker to protect against hazards in the environment. Respirators, gloves, and hearing protectors are examples.

**Point sampling:** See *Process sampling*.

**Prednisone:** A commonly prescribed steroid used to help treat CBD.

**Procedures:** Approved practices that must be followed step by step, as they are written in order to help ensure that a task is always performed the same way, regardless of who does it.

**Process sampling:** Samples used to identify sources of exposure, to estimate potential worst-case exposures, and to evaluate or initiate engineering controls. Generally taken within inches of a potential source.

**Pulmonary:** Pertaining to the lungs.

**Rales:** Abnormal breathing sounds. Usually rales can only be heard through a stethoscope.

**Regulated area:** An area demarcated by the responsible employer in which the airborne concentration of beryllium exceeds, or can reasonably be expected to exceed, the action level.

**Removable contamination:** Beryllium contamination that can be removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or washing.

**Respirator:** A device to protect the wearer from inhalation of harmful contaminants.



**Responsible employer:** The DOE federal or contractor office that is directly responsible for the safety and health of its employees while they are performing a beryllium activity or other activity at a facility, and any person acting directly or indirectly for such office with respect to terms and conditions of employment of beryllium-associated workers.

**Reusable clothing:** Work clothing that can be laundered frequently to prevent the clothing from becoming a source of exposure to hazards.

**Sarcoidosis:** A chronic disease that involves the formation of granulomas or nodules in the lungs, skin, bones, or lymph nodes. When sarcoidosis affects the lungs, the symptoms are similar those of chronic beryllium disease.

**Short-term health effects:** Symptoms that occur within minutes, hours, days, or sometimes weeks, in response to a single, usually large, exposure to a hazard. Also called acute health effects.

**Site Occupational Medical Director (SOMD):** The physician responsible for the overall direction and operation of the occupational medicine program at a DOE site.

**Silicosis:** A fibrotic disease of the lungs caused by inhalation of dust of stone, sand, or flint containing silica.

**Smear sampling:** See *Surface sampling*.

**Soluble:** Able to dissolve in a specified solvent (e.g., beryllium salts dissolve in water).

**Sputum:** Saliva, mucus, and discharges from the throat and lungs that are expelled by coughing, hawking, or spitting.

**Steroid:** A medicine that helps reduce inflammation.

**Surface (smear, swipe, wipe) sampling:** Obtaining and analyzing contamination on a surface by wiping the surface with a wipe made of a specific material and analyzing the contaminant level on the wipe. Used to monitor the effectiveness of housekeeping effects in a workplace and to help diagnose the sources of beryllium contamination.

**Systemic disease:** A condition that affects the body as a whole, not just one area or organ.

**Threshold Limit Value (TLV):** An airborne exposure value established by the American Conference of Governmental Industrial Hygienists intended to be used as a guideline or recommendation in the control of potential health hazards. The TLV for beryllium exposure is  $2.0 \mu\text{g}/\text{m}^3$  averaged over an 8-hour time period.

**Toxicity:** The quality of having a harmful effect on some biological mechanism and the condition under which this effect occurs.



**Unique identifier:** The part of a paired set of labels, used in records that contain confidential information, that does not identify individuals except by using the matching label.

**Wipe sample:** See *Surface sampling*.

**Worker:** A person who performs work for or on behalf of a facility. A worker may be an employee, independent contractor, subcontractor employee, or any other person who performs work at a facility.

**Worker exposure:** The exposure of a worker to a hazard that would occur if the worker were not using protective equipment.

**Work history:** A description of current and former occupations and activities a person has performed. Workers may be asked to provide a work history as part of their medical exams.

**Work side of change area:** Where employees deposit their dirty work clothes for laundering or disposal at the end of the shift.