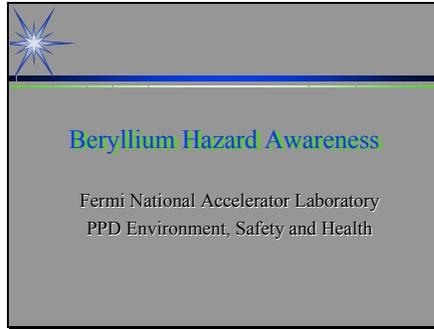


Slide 1

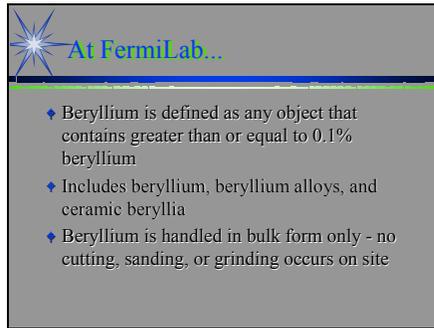


This video is designed to inform you of the hazards associated with beryllium.

Inhalation of beryllium particulate has been associated with short and long term adverse health effects to individuals with a hypersensitivity to the metal.

To assure that we never create a hazardous situation, you need to know that the safe handling procedures are and the reasons for these precautions.

Slide 2

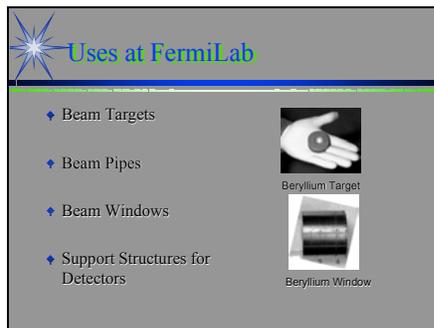


We define beryllium as any object that contains greater than or equal to 0.1 percent beryllium.

Fermilab uses beryllium, beryllium alloys, and ceramic beryllia.

These objects are not hazardous unless they are machined or used in a manner that creates a dust, fume, or mist.

Slide 3



Beryllium, beryllium alloys, and ceramic beryllia is used for such items as beam targets, beam pipes, beam windows, and support structures for particle detectors.

Slide 4

 Properties

- ◆ Silver-gray metal
- ◆ 1/3 lighter than aluminum
- ◆ 6 times stiffer than steel
- ◆ Good corrosion resistance
- ◆ High Melting Point
- ◆ Brittle
- ◆ Toxic



Beryllium is a silver-gray metal that is one third as light as aluminum and six times stiffer than steel.

It has good corrosion resistance and a high melting point.

These properties make beryllium a particularly attractive material for industrial applications.

Most of the beryllium ore mined is processed into beryllium hydroxide, which is further processed into beryllium metal, alloys, and oxide. Pure beryllium metal is used to make aircraft disc brakes, nuclear weapons and reactors, aircraft-satellite-space vehicle structures and instruments, X-ray transmission windows, missile parts, fuel containers, precision instruments, rocket propellants, navigational systems, heat shields, and mirrors.

Beryllium oxide is used to make specialty electrical and high-technology ceramics, electronic heat sinks, electrical insulators, microwave oven components, gyroscopes, military vehicle armor, rocket nozzles, and laser structural components. Beryllium alloys are used in electrical connectors and relays, springs, precision instruments, aircraft engine parts, nonsparking tools, submarine cable housings and pivots, wheels, and pinions.

Slide 5

Health Hazards

- Skin Disorders
- Lung Disease

There are a number of health concerns associated beryllium. These fall into two categories (1) skin disorders and (2) lung disease.

Let look at the ways beryllium can causes these effects.

Slide 6

Ingestion

- Beryllium is not intended for internal consumption
- Hands should be thoroughly washed after contact
- Eating and smoking are not allowed in beryllium areas

Slide 7

 Skin Contact

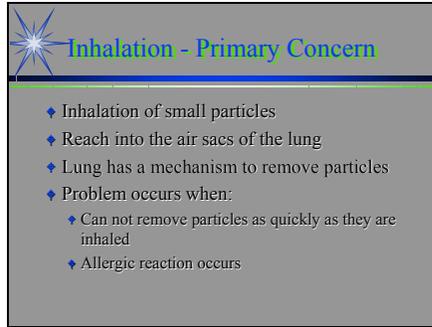
- ◆ Water soluble beryllium salts can cause skin irritation also called Dermatitis
- ◆ If beryllium is imbedded in the skin, ulcers and corn-like lesions can develop
- ◆ Skin disorders usually heal completely

A skin rash, also called dermatitis, can develop when there is contact with water soluble beryllium salts. We do not use these type materials at Fermilab.

If beryllium becomes imbedded in the skin, an ulcer or corn-like lesion can develop.

These disorders usually heal completely once the beryllium is removed.

Slide 8



Inhalation - Primary Concern

- ◆ Inhalation of small particles
- ◆ Reach into the air sacs of the lung
- ◆ Lung has a mechanism to remove particles
- ◆ Problem occurs when:
 - ◆ Can not remove particles as quickly as they are inhaled
 - ◆ Allergic reaction occurs

There are a number of health concerns associated with the inhalation of beryllium particulate. When very small particulates, less than 10 micrometers, are inhaled they reach the airsacs of the lung.

The lung has a mechanism to remove particulate, however, when that mechanism is overwhelmed or if there is an allergic reaction to beryllium, then lung disease can develop.

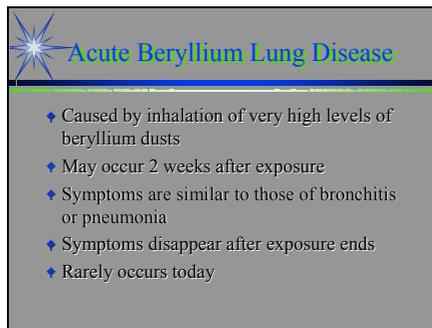
Slide 9



Inhalation - Primary Concern

- Exposure should be Kept As Low As Reasonably Achievable (ALARA)
- Minimize...
 - Number of workers
 - Time
 - Amount of Beryllium
- Currently, there are 0 employees at Fermi Lab trained as Beryllium Workers

Slide 10



Acute Beryllium Lung Disease

- ◆ Caused by inhalation of very high levels of beryllium dusts
- ◆ May occur 2 weeks after exposure
- ◆ Symptoms are similar to those of bronchitis or pneumonia
- ◆ Symptoms disappear after exposure ends
- ◆ Rarely occurs today

When very high concentrations of beryllium are inhaled for a short duration, pneumonia-like symptoms may occur.

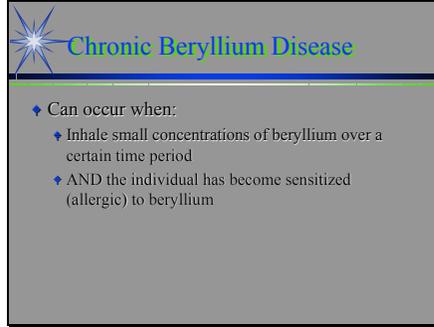
This is called Acute Beryllium Disease.

The symptoms may not occur for 2 weeks after the exposure.

Acute Beryllium Disease is treatable and is completely reversible.

Such large exposures occur very rarely today.

Slide 11

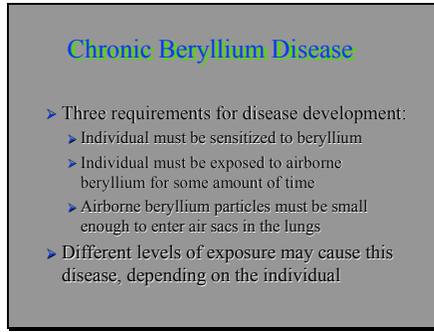


Chronic Beryllium Disease

- ◆ Can occur when:
 - ◆ Inhale small concentrations of beryllium over a certain time period
 - ◆ AND the individual has become sensitized (allergic) to beryllium

Chronic Beryllium Disease, however, is not reversible. It can occur when small concentrations of beryllium have been inhaled over a certain time period. It can only occur if the individual has become sensitized to beryllium.

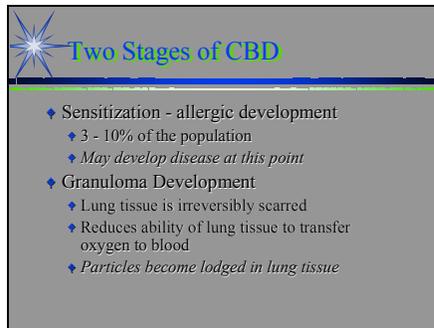
Slide 12



Chronic Beryllium Disease

- ▶ Three requirements for disease development:
 - ▶ Individual must be sensitized to beryllium
 - ▶ Individual must be exposed to airborne beryllium for some amount of time
 - ▶ Airborne beryllium particles must be small enough to enter air sacs in the lungs
 - ▶ Different levels of exposure may cause this disease, depending on the individual

Slide 13



Two Stages of CBD

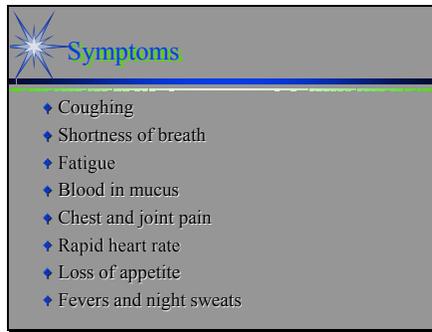
- ◆ Sensitization - allergic development
 - ◆ 3 - 10% of the population
 - ◆ *May develop disease at this point*
- ◆ Granuloma Development
 - ◆ Lung tissue is irreversibly scarred
 - ◆ Reduces ability of lung tissue to transfer oxygen to blood
 - ◆ *Particles become lodged in lung tissue*

It is estimated that three to ten percent of the population has the potential of hypersensitivity to beryllium.

When sensitized, it seems the lung's particle removal mechanisms don't work as they should. Instead of removing the beryllium particulate, scar tissue begins to form around the particles. The scar tissue, called granuloma, gradually increases in size, reducing the amount of healthy lung tissue.

As the disease progresses, it becomes more difficult to breath.

Slide 14



Slide 14 features a grey rectangular box with a black border. At the top left of the box is a blue starburst icon. To its right, the word "Symptoms" is written in a green, sans-serif font. Below this header, there is a list of seven symptoms, each preceded by a small blue diamond icon. The symptoms are: Coughing, Shortness of breath, Fatigue, Blood in mucus, Chest and joint pain, Rapid heart rate, Loss of appetite, and Fevers and night sweats.

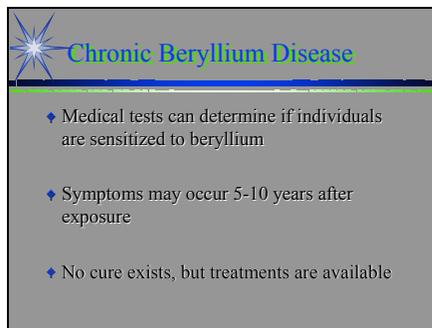
Symptoms

- ◆ Coughing
- ◆ Shortness of breath
- ◆ Fatigue
- ◆ Blood in mucus
- ◆ Chest and joint pain
- ◆ Rapid heart rate
- ◆ Loss of appetite
- ◆ Fevers and night sweats

Symptoms include persistent coughing, shortness of breath, fatigue, blood in mucus, chest and joint pain, loss of appetite, fever, and night sweats.

These symptoms may not occur for five to ten years. Some sensitized people never progress to the granuloma stage.

Slide 15



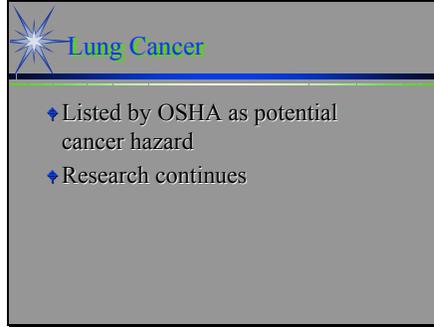
Slide 15 features a grey rectangular box with a black border. At the top left of the box is a blue starburst icon. To its right, the words "Chronic Beryllium Disease" are written in a green, sans-serif font. Below this header, there is a list of three points, each preceded by a small blue diamond icon. The points are: Medical tests can determine if individuals are sensitized to beryllium, Symptoms may occur 5-10 years after exposure, and No cure exists, but treatments are available.

Chronic Beryllium Disease

- ◆ Medical tests can determine if individuals are sensitized to beryllium
- ◆ Symptoms may occur 5-10 years after exposure
- ◆ No cure exists, but treatments are available

These symptoms occur for five to ten years. Some sensitized people never progress to the granuloma stage.

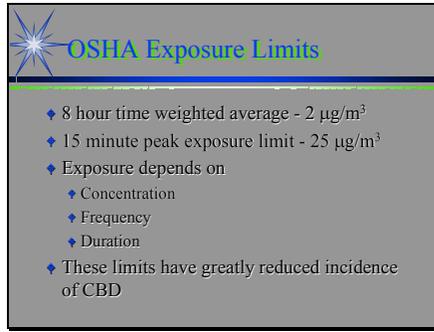
Slide 16



Lung Cancer

- ◆ Listed by OSHA as potential cancer hazard
- ◆ Research continues

Slide 17



OSHA Exposure Limits

- ◆ 8 hour time weighted average - $2 \mu\text{g}/\text{m}^3$
- ◆ 15 minute peak exposure limit - $25 \mu\text{g}/\text{m}^3$
- ◆ Exposure depends on
 - ◆ Concentration
 - ◆ Frequency
 - ◆ Duration
- ◆ These limits have greatly reduced incidence of CBD

OSHA has established a permissible exposure limit for beryllium of 2 micrograms per cubic meter of air.

This exposure limit is very small. If you evenly distributed an amount of beryllium metallic powder the size of a pencil tip into a box that is six feet high and as wide and long as a football field, that would be equal to two micrograms per cubic meter.

This is an eight hour time weighted average which takes into account the concentration, frequency of exposure, and duration of the exposure. While this Permissible Exposure Limit has greatly reduced the incidence of Chronic Beryllium Disease, this disease is still occurring.

Slide 18

To Minimize Your Exposure...

- ▶ Use Personal Protective Equipment (PPE)
- ▶ Follow Safe Work Guidelines
- ▶ Practice personal hygiene
- ▶ Contact the Medical Department if symptoms occur

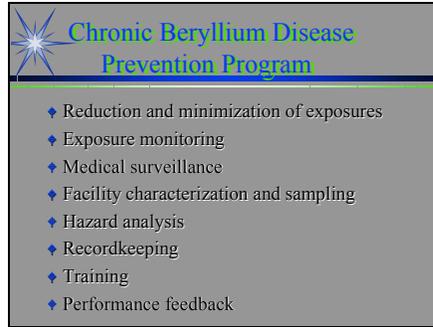
Slide 19

 Department of Energy

- ◆ All DOE contractors must have a Chronic Beryllium Disease Prevention Program to address this concern
- ◆ Many question the adequacy of OSHA's limits
 - ◆ Permissible Exposure Limit - $2 \mu\text{g}/\text{m}^3$
 - ◆ Action Limit - $5 \mu\text{g}/\text{m}^3$
 - ◆ Short term Exposure Limit - $10 \mu\text{g}/\text{m}^3$
- ◆ *These limits require medical surveillance and personal protection*

At Department of Energy facilities where beryllium is machined, a 1998 survey of 9000 workers showed that approximately 100 had Chronic Beryllium Disease and 200 had become sensitized. As a result, many people have questioned whether the OSHA Permissible Exposure Limit is protective enough. The Department of Energy, in response, has required its contractors to develop a Chronic Beryllium Disease Prevention Program to address these concerns.

Slide 20



Chronic Beryllium Disease Prevention Program

- ◆ Reduction and minimization of exposures
- ◆ Exposure monitoring
- ◆ Medical surveillance
- ◆ Facility characterization and sampling
- ◆ Hazard analysis
- ◆ Recordkeeping
- ◆ Training
- ◆ Performance feedback

The program must contain the following elements:

Reduction and minimization of exposures

Exposure monitoring

Medical surveillance

Facility characterization and sampling

Hazard analysis

Recordkeeping

Training

Performance feedback

Slide 21

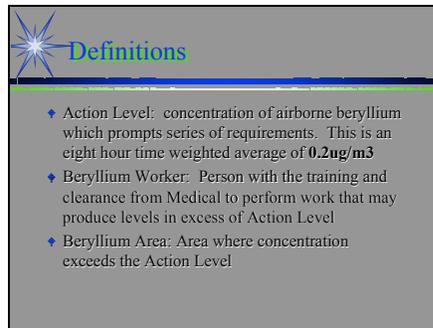


FermiLab's Program

- ◆ FermiLab Environment, Safety and Health Manual, Chapter 5052.5
- ◆ www-esh.fnal.gov/FESHM/5000/5052_5.html

FermiLab's Chronic Beryllium Disease Prevention Program is Chapter 5052.5 of the FermiLab Environment, Safety, and Health Manual. It can also be found at the website given.

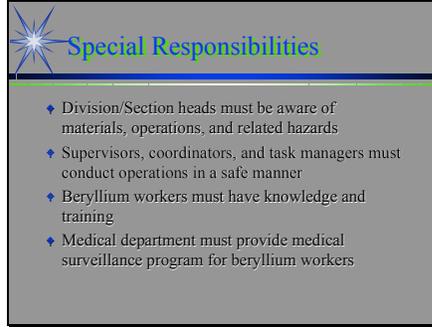
Slide 22



Definitions

- ◆ Action Level: concentration of airborne beryllium which prompts series of requirements. This is an eight hour time weighted average of **0.2ug/m³**
- ◆ Beryllium Worker: Person with the training and clearance from Medical to perform work that may produce levels in excess of Action Level
- ◆ Beryllium Area: Area where concentration exceeds the Action Level

Slide 23



Special Responsibilities

- ◆ Division/Section heads must be aware of materials, operations, and related hazards
- ◆ Supervisors, coordinators, and task managers must conduct operations in a safe manner
- ◆ Beryllium workers must have knowledge and training
- ◆ Medical department must provide medical surveillance program for beryllium workers

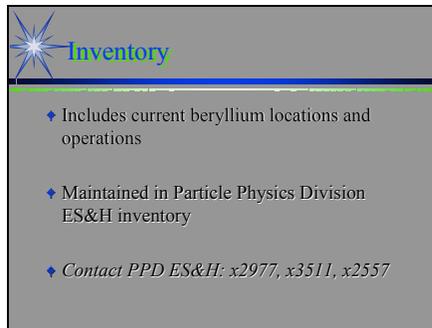
Division and Section heads shall be aware of the materials, operations, and related hazards with which their personnel may be involved. They shall assure the policies, procedures, and requirements as set forth in the Environment, Safety and Health chapter are followed.

Supervisors, construction coordinators, and task managers shall conduct their operations in a safe manner.

Individuals working with beryllium shall have sufficient knowledge and training to perform their work safely.

The Medical Department shall provide a medical surveillance program for beryllium workers.

Slide 24



Inventory

- ◆ Includes current beryllium locations and operations
- ◆ Maintained in Particle Physics Division ES&H inventory
- ◆ *Contact PPD ES&H: x2977, x3511, x2557*

Divisions and sections will utilize their records, process knowledge, employee interviews, and hazard assessment of beryllium locations to determine if they have beryllium or beryllium contamination areas. Locations where beryllium was previously used and residual contamination exist must be included in the inventory. An inventory of current beryllium locations and operations shall be maintained in the Particle Physics Division's Environmental, Safety, and Health Group's inventory. The inventory shall be reviewed and updated annually.

Slide 25



Storage and Labeling

- ◆ Label
 - ◆ Areas where exposure may exceed action level
 - ◆ Beryllium-containing materials
- ◆ Store in dry, designated storage areas
- ◆ Containers must be sealed and secured

Label beryllium to identify it from other less toxic metals. Individual pieces need not be labeled if they are stored in a labeled container and/or cabinet. Whenever possible, components used in experimental areas should be labeled. It is recognized that in some cases this is impossible due to the complex nature of the component.

Beryllium must be stored in designated storage areas. It must be stored in sealed containers, labeled, and secured in a dry location. Surplus beryllium should be stored in the locked storage facility maintained by the Particle Physics Division's Environmental, Safety and Health Group or the Railhead (if above Class 1).

Slide 26

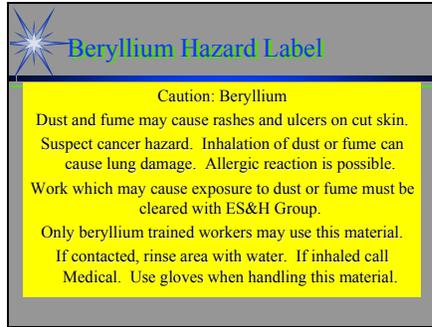


Beryllium Area Label

RESTRICTED AREA - NO ENTRY
DANGER
BERYLLIUM WORK AREA
INHALATION OF DUST OR FUME MAY CAUSE
SERIOUS LUNG DISEASE
POTENTIAL CANCER HAZARD
NO SMOKING OR EATING
CONTACT _____ PRIOR TO ENTRY

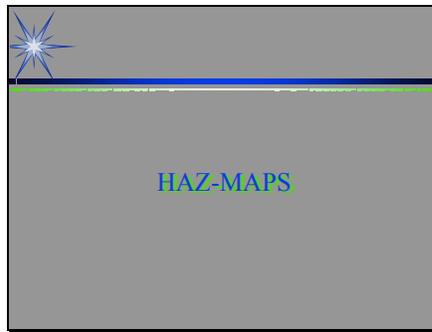
Areas where employee exposure to beryllium is at or above the Action Level shall be posted with a warning sign, which resembles the sign shown on this slide.

Slide 27

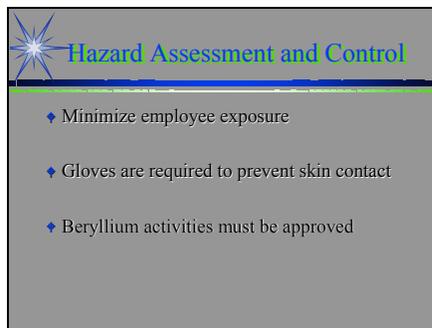


Containers of beryllium, beryllium compounds, beryllium-contaminated clothing, equipment, waste, scrap, or debris shall be posted with a warning sign, which looks like the sign shown on this slide.

Slide 28



Slide 29

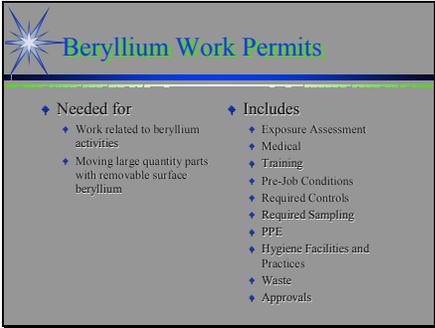


Every effort shall be made to minimize employee exposure to beryllium. Whenever handling beryllium, gloves are required to prevent direct skin contact. There may be removable beryllium on the surface due to oxidation. All beryllium activities that are performed at FermiLab must be reviewed by the division or section's Environmental, Safety, and Health Group and approved by the division or section head.

Whenever there is a potential to expose employees to beryllium

in excess of the Action Level, control measures must be implemented. The division or section shall assess the situation, determine the needed controls, and document the requirements on a beryllium work permit. The following are situations where a permit would be required

Slide 30

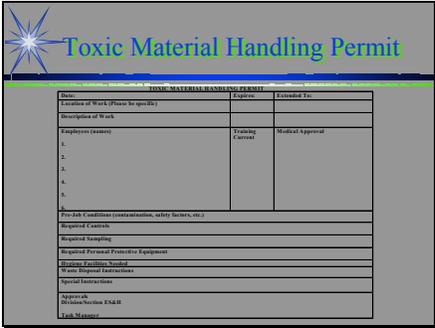


Beryllium Work Permits

- ◆ **Needed for**
 - ◆ Work related to beryllium activities
 - ◆ Moving large quantity parts with removable surface beryllium
- ◆ **Includes**
 - ◆ Exposure Assessment
 - ◆ Medical
 - ◆ Training
 - ◆ Pre-Job Conditions
 - ◆ Required Controls
 - ◆ Required Sampling
 - ◆ PPE
 - ◆ Hygiene Facilities and Practices
 - ◆ Waste
 - ◆ Approvals

The following are situations where a permit would be required: work related to beryllium activities, and moving a significant quantity of parts with surface beryllium concentration levels in excess of the Action Level Standard.

Slide 31



Toxic Material Handling Permit

Date	Location	Exposure	Controlled To
Description of Work (Please be specific)			
Description of Work		Exposure	Medical Approval
1.			
2.			
3.			
4.			
5.			
Pre-Job Conditions (contaminants, safety factors, etc.)			
Required Controls			
Required Sampling			
Required Personal Protective Equipment			
Hygiene Facilities Needed			
Work Required Instructions			
Special Instructions			
Approved: <input type="checkbox"/> Division Section 6548			
Each Manager: <input type="checkbox"/>			

Slide 32

Exposure Assessment

- ▶ Conducted by an ES&H professional
- ▶ Exposure during activities are assumed over the Action Level unless data from similar procedures document exposures below the Action Level

Slide 33

Medical

- ▶ Must be notified prior to any job that requires a permit
- ▶ Must approve each worker assigned to the job

Slide 34

Training

- ▶ Beryllium Awareness Training
- ▶ Respiratory Protection Training
- ▶ Beryllium Worker Training

Slide 35

Pre-Job Conditions (Permit)

- Work area analysis
 - Wipe Samples
 - Beryllium Component analysis
- Job safety Analysis
 - Ergonomic concerns
 - Safety concerns

Slide 36

 **Required Controls (Permit)**

- Engineering, work practice, and administrative controls
 - Exhaust ventilation
 - Hygiene practices
 - Enclosing the work area
 - Restricting work area access

Slide 37

Required Sampling (Permit)

- Permit indicates number and frequency of
 - Personal and area air samples
 - Surface wipe samples

Slide 38

**Personal Protective Equipment
(Permit)**

- Respirators
- Coveralls
- Gloves
- Hoods
- Disposable shoe covers

Slide 39

Hygiene Practices

- Keep work area free of beryllium accumulation
- Food, beverages, and tobacco may not be stored or consumed in beryllium areas
- Maintain low beryllium levels at all times

Slide 40

Waste

- Beryllium-contaminated residues must be contained, collected and packaged for disposal
- Dispose of waste in accordance with Fermi Lab's regulated chemical disposal program

Slide 41

Approvals

- ▶ Permit must be signed by
 - ▶ ES&H Group of the division or section overseeing the project
 - ▶ Task manager

Slide 42

Decontamination

- ▶ Use Soap and water
- ▶ Consult the Medical Department

Slide 43

 **PPD Requirements**

- ◆ Always wear gloves when handling beryllium
- ◆ Determine concentration of removable beryllium on new parts before use and clean if necessary
- ◆ Beryllium contaminated materials are classified as Special Waste
- ◆ If part breaks, call PPD ES&H for clean-up or x3131

Slide 44



Questions?

Contact PPD ES&H Group
x2977
x3511
x2557