

MST

Materials Science & Technology Division

Lab Safety and
Personal Protective Equipment
Training

Presented by the MSTD

Office of Environmental Safety and Health

Objectives

- Understand the requirements of the OSHA Laboratory Standard
- Apply the use of the RSS to ensure research safety
- Understand your role in Integrated Safety Management
- Assess the needs and proper use of PPE



Case Study – Researcher Fatality

(Dr. Karen Wetterhahn, 1948 -1997)

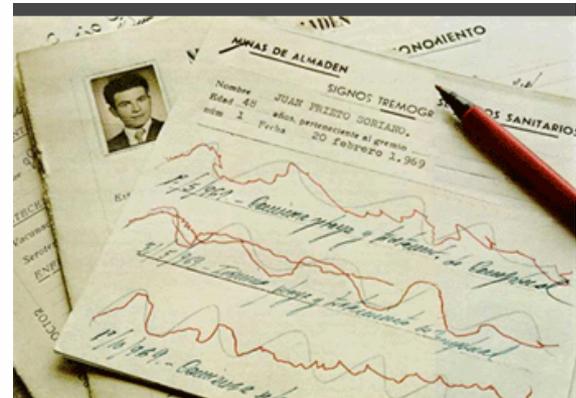


Dr. Wetterhahn died at age 48. She was a chemistry professor at Dartmouth University. She wore her PPE, but it was the wrong choice.

- Conducting heavy metals research at Dartmouth in 1997 – spilled a tiny drop of a common metal on a gloved hand.
- Symptoms: tingling in hands, nausea, weight loss, stumbling, gradual loss of sight and hearing
- Six months later she slipped into a coma
- In ten months she was gone....

Case Study – Researcher Fatality

- What heavy metal caused this fatality?
 - One drop of dimethyl mercury, which was absorbed through her latex glove and intact skin



Case Study – Researcher Fatality

What could the researcher do to work in a safe manner?

- Review Material Safety Data Sheet (MSDS)
- Plan out work and account for likely hazards
 - Research Safety Summary (RSS) at ORNL
- Ensure adequate controls
 - Isolation, ventilation
- Training
- Personal protective equipment



OSHA

Occupational Safety & Health Administration
U.S. Department of Labor

OSHA Required Training and Information:

- o What's in the *OSHA Laboratory Standard* & where to get a copy;
- o *ORNL Chemical Hygiene Plan* ;
- o Location and availability of MSDS (material safety data sheets) & other ESH references;
- o Awareness of the hazards of the chemicals present in the work area;
- o Permissible exposure limits for air contaminants;
- o Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and
- o How to detect a release of a chemical
- o Physical & health hazards
- o Protective measures, equipment, & controls.





OSHA

Occupational Safety & Health Administration
U.S. Department of Labor



U.S. Department of Labor
Occupational Safety & Health Administration



www.osha.gov

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Safety and Health Topics: **Laboratories**

The Occupational Safety and Health Administration, recognizing the unique characteristics of the laboratory workplace, tailored a standard for occupational exposure to hazardous chemicals in laboratories. This standard is often referred to as the "Laboratory Standard". Under this standard a laboratory is required to produce a Chemical Hygiene Plan which addresses the specific hazards found in its location, and its approach to them. The following questions link to resources that provide safety and health information relevant to laboratories.



[What standards apply?](#)

[OSHA Standards](#) | [NFPA](#) | [ICC](#) | [OSHA Interpretations and Compliance Letters](#)



[How do I recognize and evaluate hazards in the laboratory?](#)

[Hazard Recognition](#) | [Exposure Evaluation](#)

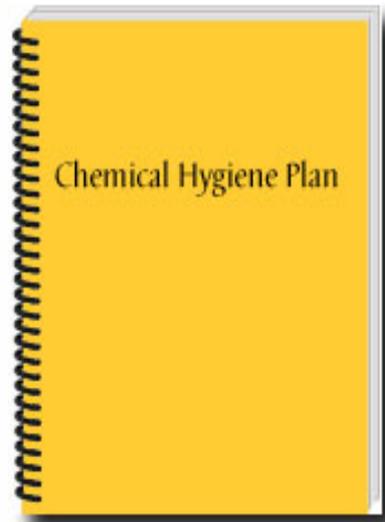
Safety and Health Topics

Laboratories

- [Standards](#)
- [Hazard Recognition](#)
- [Possible Solutions](#)
- [Additional Information](#)
- [Credits](#)



How does ORNL comply?



Who has already taken the Chemical Hygiene Plan training?

What was in it?

How does it pertain to your work here?

How does ORNL comply?

- Integrated Safety Management
 - Define work
 - Analyze hazards
 - Develop controls
 - Perform work
 - Provide feedback



Integrated Safety Management

- First step, complete a Research Safety Summary (RSS)
- *Has anyone participated in writing a RSS? What did you do?*
- *Has anyone read an RSS? What was in it? Why was it important?*



RSS

- Backbone of Safety & Health and Environmental Protection
- Ensures compliance with OSHA Lab Standard, and other regulations
- Researcher Driven
 - Cooperative effort between ESH and researcher
- Establishes laboratory safety control
- Describes limits and safe use



RSS - Elements

- Title and description of research
- List of hazards involved in study
- Hazard controls to be utilized
- Regulatory requirements
 - For safety
 - For environmental protection
- List of hazard training



RSS Logic



- Anticipation and Planning
- Define hazards before R&D starts
- Review of equipment manuals and manufacturer instructions
- Alternative processes or materials
- Minimize quantity of chemicals and exposure time
- Ventilation (glove boxes, snorkels, lab hoods)
- Work practices
- Personal Protective Equipment

**STOP WORK AND GET HELP IF YOU PERCEIVE
HAZARDS TO BE UNCONTROLLED!**

[Example of RSS](#)

MSDS

- Material Safety Data Sheets (MSDS) are a source of information needed for RSS
- Available from HMMS

The screenshot shows the HMMS website interface. At the top left is the ORNL logo (Oak Ridge National Laboratory). At the top right is the HMMS logo. Below the logos is a dark blue header with the text "Hazardous Material Management System" and an image of laboratory glassware. A navigation bar below the header contains five tabs: "Reporting", "MSDS", "HMMS Reps", "Useful Links", and "Help".

On the left side, there is a "Help Desk" button and a "Reports:" section with a list of links: "Inventory", "Regulated Material", "Materials Exchange", "Facility Safety", "Transactions", and "Management Reports*".

The main content area is titled "Inventory Reporting:" and contains the following text and links:

New Inventory Reports (*Open site-wide access to all ORNL chemical inventory data*) **NEW**

- [My Inventory Report](#)
- [Search Inventory by Custodian UID](#)
- [Chemical Locator \(Name/Synonym Search\)](#)
- [Select Criteria Filter](#)
- [Regulated Materials Inventory Report](#)
- [Search Inventory by Physical State and Location](#)

Below this list, it says "Previous Reports, Instructions and Utilities (*Limited access*)" and there is a "Previous Reports" button.

MSDS

- Advantages

- Provide physical characteristics, health hazards, and regulatory information

- Limitations

- Rely on the manufacturers' expertise
- Not necessarily updated
- Non-specific recommendations (wear appropriate personal protective equipment)

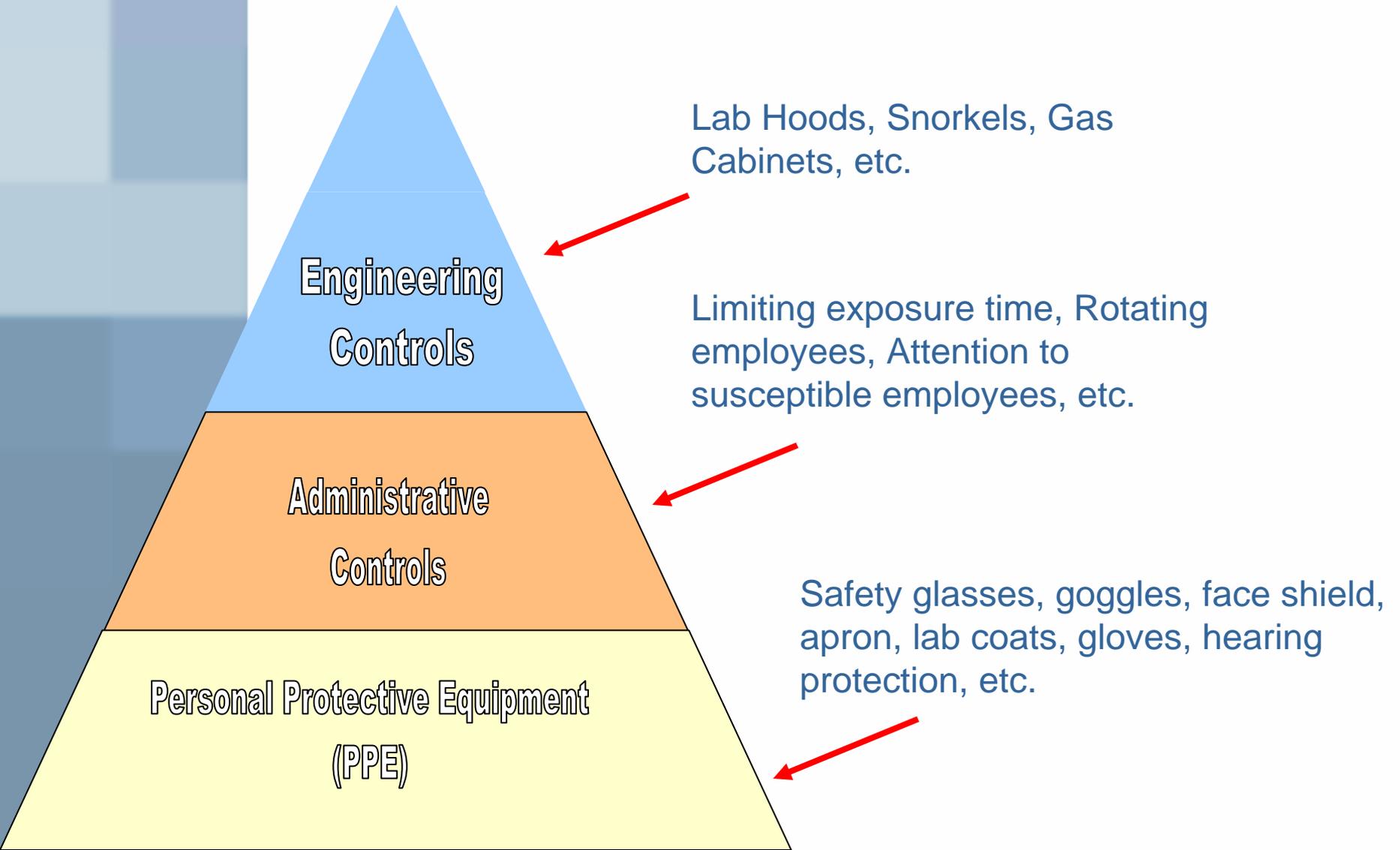


RSS

- Now that we have defined work and analyzed hazards, how do we develop controls?



Hierarchy of Controls



PPE - Last Line of Defense



- Institute **engineering controls first** to take the hazard out of the work areas – example: ventilation hoods and gas cabinets
- Then, consider **administrative controls** – example: limit the amount of time an individual is allowed to work with a given hazard.
- Last, **personal protective equipment**. Since PPE can fail, and relies on the worker to use properly, and leaves the hazard in the workplace, PPE is our **last line of defense** against workplace contaminants.

Examples of Hazard Controls

- Solvents: minimize use, polymer gloves, safety glasses and no use around sources of ignition;
- Acids: polymer gloves & eye protection, chemical splash goggles, use of hoods and sash
- Metals: gloves, eye protection, hoods/snorkels, personal hygiene



Typical Lab Entrance

NOTICE
AUTHORIZED PERSONNEL ONLY

LABORATORY	BLDG/RM
Materials Joining and Acid Hood	4508, 227

ACCESS REQUIREMENTS
PPE Required, Safety Glasses With Side Shields

HAZARD WARNINGS

HAZARD	CONTROL	HAZARD	CONTROL	HAZARD	CONTROL
 CORROSIVE MATERIALS		 EYE PROTECTION REQUIRED		 FLAMMABLE MATERIALS	

CONTACTS	NAME	PHONE	OFFICE
Lab Space Manager	ALAN FREDERICK	574-4809	4508/220
Group Leader	STAN DAVID	574-4804	4508/208
Division Director	EVERETT BLOOM	574-4065	4500S/5164
R&D Division Operations Manager	RON BALDWIN	574-8603	4508/272

ORNL-899-A LAST REVISION: 12/14/04

NOTICE
SAFE FLOOR
LOAD LIMIT
NOT TO EXCEED
150 LBS.
PER SQUARE FOOT

Research Safety
Summary (RSS)

Laboratory
Hazard Posting

Laboratory Posting Document
(ES&H Hazard/Controls Summary)

Summary for Building 4508 - Lab Room 227 - 02 project

Lab Title: Polymer Chemistry and Control of Polymer Materials (R&D # 0208-01)
Principal Investigator: Dr. Everett Bloom
Lab Director: Stan David
Start Date: November 20, 2002
End Date: December 31, 2004
Last Revision: Thursday Mar 14, 2008 02:19:00 PM by Stan David
Group Leader(s): Stan David (0208)

Responsible Officer: Stan David (0208)
Responsible Officer: Stan David (0208)
Responsible Officer: Stan David (0208)

RSS

PPE

- Once you have developed an RSS, and determined PPE may be the only way to control certain hazards, you need training!!
- *Why are we so meticulous about PPE?*



What Corrosives Can Do...

- Has anyone used HCl?
- How about NaOH?
- Sulfuric acid?
- Cryogenics (LN₂)?



A collection of various personal protective equipment (PPE) items including a hard hat, safety glasses, gloves, boots, and a respirator.

Personal Protective Equipment (PPE)

Selection and Applications

Proper Use

Proper Storage

OSHA's PPE Requirements

- Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained ...
- The *employer shall assess the workplace* to determine if hazards are present, ... which necessitate the use of PPE ... the employer shall:
 - Select, and have each affected employee use, the types of PPE...
 - Communicate selection decisions...
 - Select PPE that properly fits...
- Defective equipment shall not be used...



OSHA's PPE Requirements

- Each such employee shall be trained to know at least the following:
 - **When PPE is necessary;**
 - **What PPE is necessary;**
 - **How to properly don, doff, adjust, and wear PPE;**
 - **The limitations of the PPE; and,**
 - **The proper care, maintenance, useful life and disposal of the PPE.**
- Each affected employee shall demonstrate an understanding ... and the ability to use PPE properly, before being allowed to perform work Retraining required if improper use, changes in hazards, changes in PPE...

The screenshot shows the OSHA eTool interface for Eye and Face Protection. The header includes the title "Eye and Face Protection eTool" and navigation links: "Home", "PPE Selection", "OSHA Requirements", "Scope", "FAQ's", "Glossary", "Additional References", "Viewing/Printing Instructions", and "Credits". Below the header is a row of six circular images showing workers wearing various types of eye and face protection, including safety glasses, goggles, and face shields.



When do we use PPE?

- When engineering controls (e.g. ventilation) are not adequate to control exposures
- Emergency and clean-up procedures
- To supplement engineering and administrative controls
- Comfort

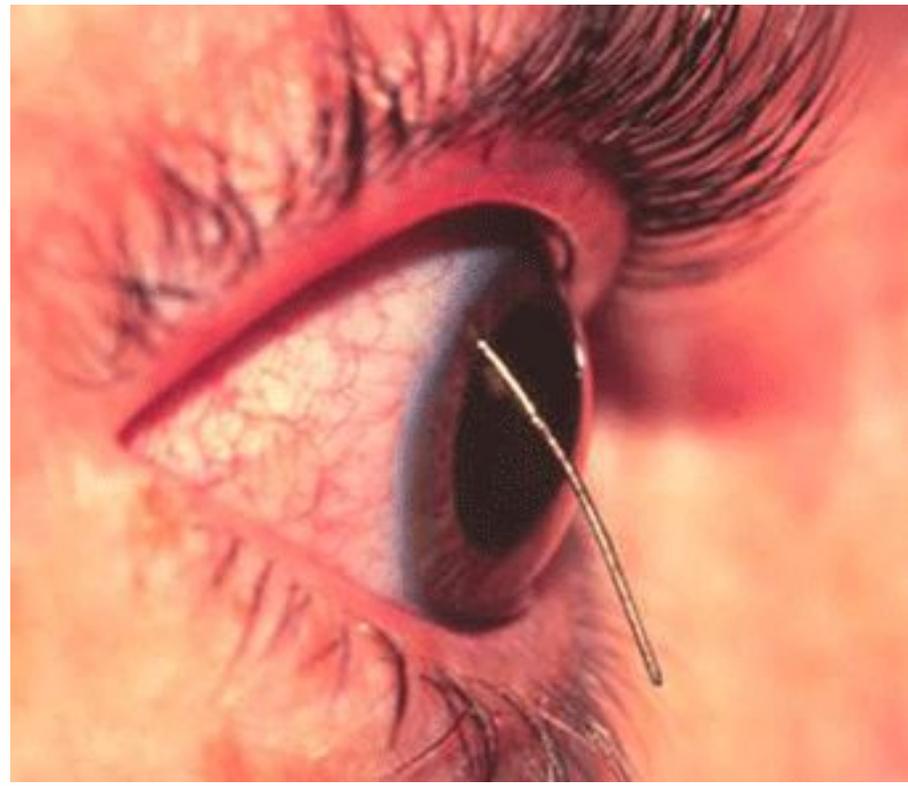
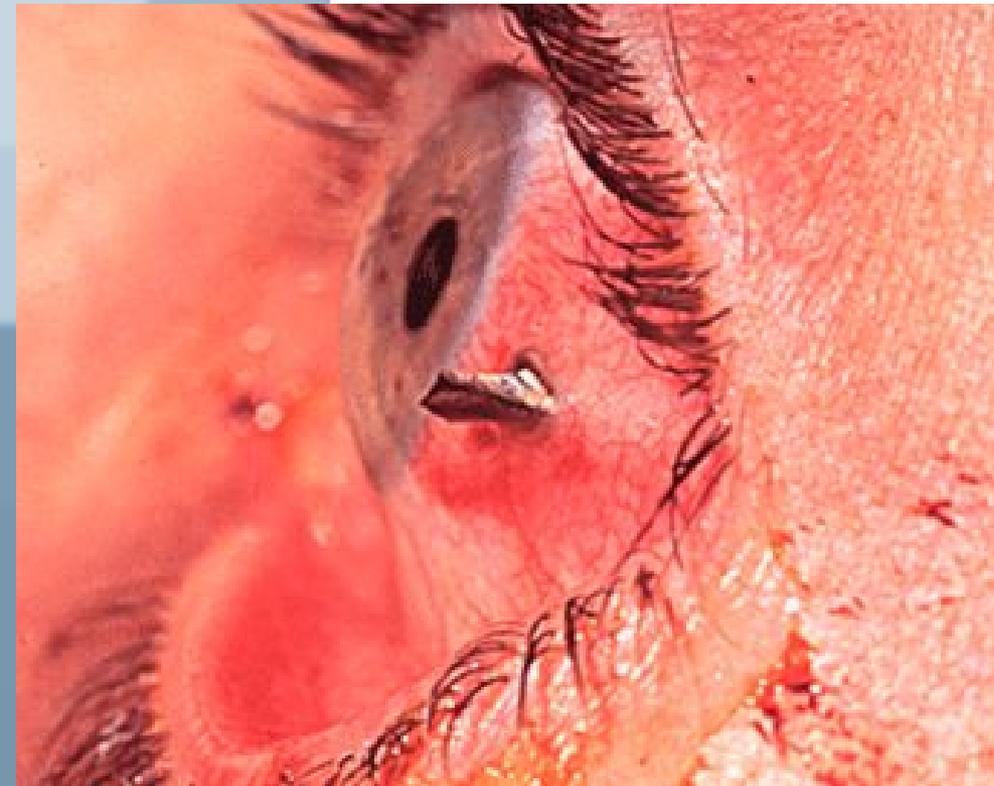


Why do we use PPE?

- It's the law!
- Experience - we can prevent most workplace injuries with the help of properly worn PPE.
- **All MSD employees are REQUIRED to wear at least safety glasses in our labs** – most labs also require gloves and lab coats, plus other unique PPE.
- Thousands of people are blinded each year from work-related eye injuries that could have been prevented with eye protection. Eye injuries alone cost more than \$300 million per year in lost production time, medical expenses, and worker compensation. (OSHA)



SAFETY GLASSES ARE
REQUIRED!





What we want you to remember....

- Types
- Selection
- Use/Limitations
- Storage
- Donning/Doffing



Selecting Proper PPE

- Choose the correct PPE for the hazard
 - Example: use disposable nitrile gloves for most substances, but for.....
 - Sharp Objects: Performance Fiber or Steel
 - High Heat: Heat Resistant Glove
 - Chemicals: PVA, PVC, Nitrile, Latex, Rubber
- Let ESH help you choose

Storage of PPE

- All of our labs are considered “contaminated”
- Do not leave PPE exposed to the lab environment when not in use
- Store all PPE in convenient, clean, storage containers (may be zip lock bag)



Eye Protection



If you need prescription eyewear – be sure to obtain prescription safety glasses or safety glasses with bifocals.

Face Protection



What is wrong with this use of a face shield?

A face shield is secondary eye protection. Safety glasses must be worn in addition to the face shield.

Hand Protection



Kevlar



Disposable Nitrile



Cryogenic Gloves (must be loose-fitting)



Heavy
Leather

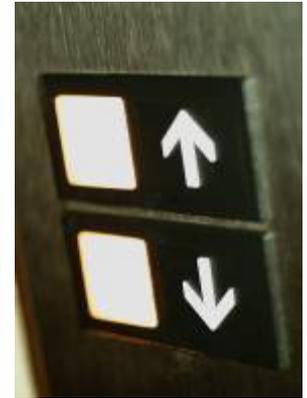
Hand Protection



What is wrong with this use of PPE?

Glove Use

- Work from “clean to dirty”
- Limit opportunities for “touch contamination”
 - Protect yourself, others, your research, and the environment
 - Don’t touch your face or adjust PPE with contaminated gloves
 - Don’t touch environmental surfaces except as necessary



Donning/Doffing

- Don PPE in “clean area”
- Always adjust PPE immediately after donning.
- Don't wear poorly fitting PPE.
- Roll gloves off to prevent skin contamination.





Donning/Doffing

- Removing gloves

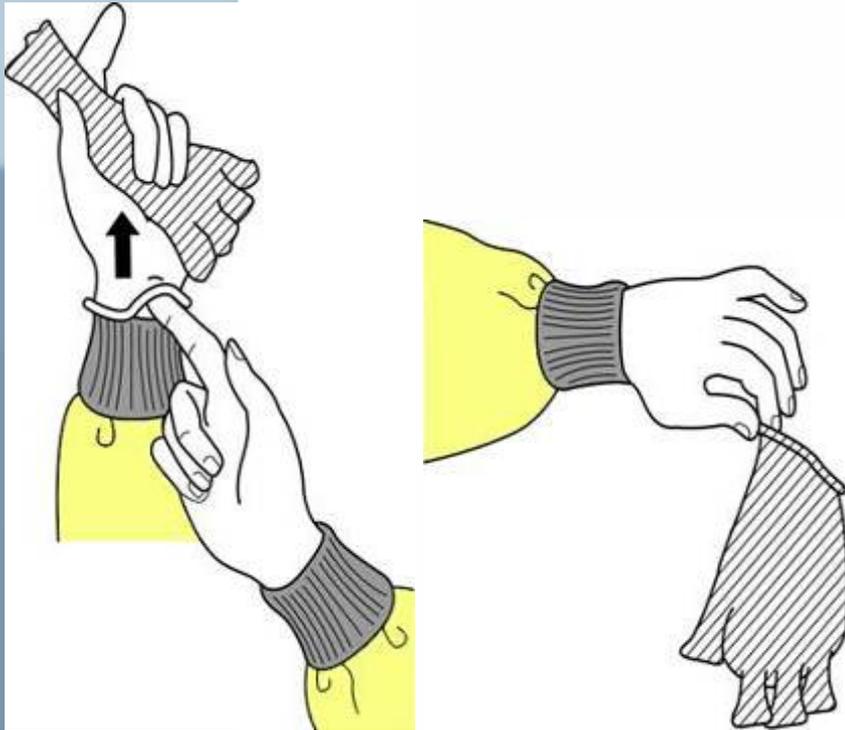


- Grasp outside edge near wrist
- Peel away from hand, turning glove inside-out
- Hold in opposite gloved hand



Donning/Doffing

- Removing gloves



- Slide ungloved finger under the wrist of the remaining glove
- Peel off from inside, creating a bag for both gloves
- Discard

Chemical Resistant Gloves



- Chemical-resistant gloves are specific to the type of chemical used. There is NO all-purpose chemically resistant glove.
- Chemicals will eventually penetrate and swell, crack or weaken the gloves over time.
- Contact ESH to choose appropriate chemical resistant gloves.



Hearing Protection



What is the correct way to don ear plugs?

Can you wear your safety glasses and ear muffs together?

Respiratory Protection



Respiratory protection requires medical evaluation, additional training and certification.

Do not use respiratory protection without guidance from EHS.

Foot Protection



Impact Injuries



Spills & Splashes



Compression Injuries



Electrical Shocks



Slipping



**Temperature
Extremes**

Protective Clothing



Using this picture, consider the following:

- What activities are being done?
- What controls are in place?
- What PPE is being used?
- Is it being used properly?
- What could be improved?

What PPE is necessary?

Safety glasses, lab coats and solvent resistant gloves are required during use of chemicals or when working near energetic processes (furnaces, welding, presses, grinding, Instron testing, pressurized systems, etc.,).

Gloves & safety glasses are required when handling open containers of solvents (exposure is brief), oils, metal powders, liquid nitrogen.

Laser eye wear is required for laser work (areas marked Class 3b or 4 laser)

Thermal protection is required when working with (or near) hot items or cryogenics (LN₂).

Foot protection is required for work with heavy (or sharp edged) items;

Nitrile and butyl gloves are approved for work with large quantities (> mL) of solvents.

Hearing Protection may be required for certain operations.

Top 5 Reasons PPE Is Not Worn

5. It doesn't match my outfit!
4. It makes me look dorky.
3. It is uncomfortable.
2. I can't perform with this on.
1. It won't happen to me.



Dead before their time

Preventable young worker deaths....

Steven Burke, killed aged 17, fall from scaffold.

Craig Gowans, killed aged 17, electrocuted.

Lewis Murphy, killed aged 18, burned in a fireball.



Check out Raiseyourhand.com for LOTS of other workplace injury stories – It can happen to you!!

Injuries at ORNL

- Student caught hair in rotating part and hair was ripped out of scalp.
 - Rotating parts can easily pull hair, clothes, gloves into machine.
- Follow your RSS carefully to avoid injury!
- Other injury data and statistics can be found at: <http://safetyfirst.ornl.gov/>

SAFETY FIRST

SPONSORED BY



Wearing PPE

- Wear it when required.
- Wear it correctly.
- Disciplinary action can be taken for failure to comply with safety rules.
- Wear it to protect yourself, and your future.

PPE For Radiological Work

- Radiation exposures/work is done through the Radiation Worker Training and Radiation Work Permit briefings.
- It is very important that you report damage or defects in PPE immediately (e.g., holes in gloves used for hazardous chemicals, cracks in safety glasses, and etc.). They must **not** be worn.
- Radiation workers and those assigned to work requiring respiratory protection will receive additional training.

PPE Final Thoughts...

- If PPE is to be reused, after use, then inspect, clean, and store the items.
- Store all PPE in areas where they will not be physically or chemically damaged (clean areas).
- Do not leave PPE on benches and in lab hoods.
- Look for deterioration, color changes, pin holes, cracks.
- Discard (immediately) items that are defective.

Integrated Safety Management

- What can happen if the RSS is not followed or work is done in an unapproved manner or location?
- The next slides depict a recent accident at the lab.

CAUTION ✖
NO DISPOSAL OF
OIL, PETROLEUM
PRODUCTS, HAZARDOUS,
RADIOACTIVE, TOXIC
OR CARCINOGENIC
MATERIALS
IN THIS DRAIN!
CALL 4-6874
For Chemical Waste Disposal

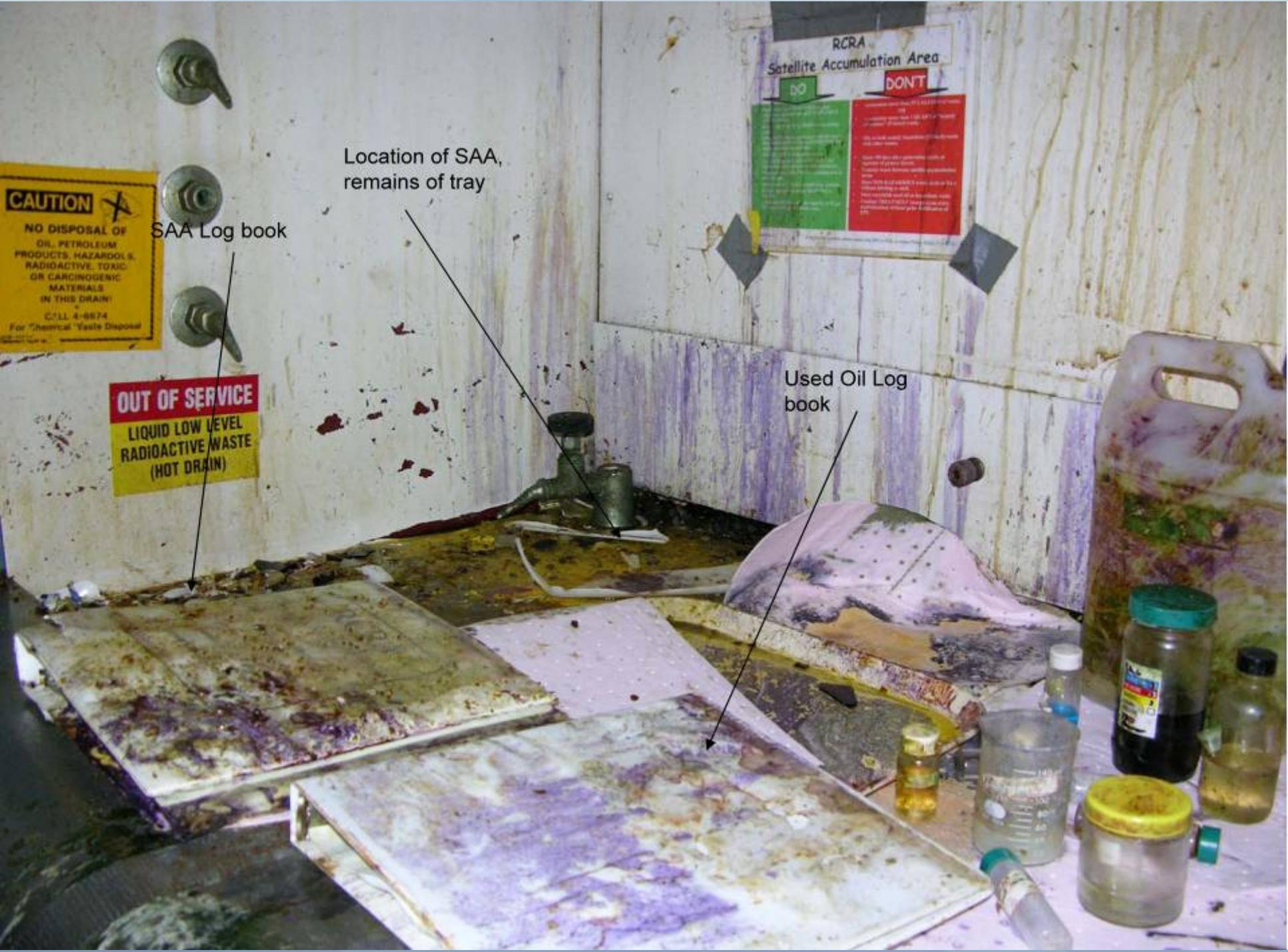
OUT OF SERVICE
LIQUID LOW LEVEL
RADIOACTIVE WASTE
(HOT DRAIN)

RCRA
Satellite Accumulation Area
DO
DONT

Location of SAA,
remains of tray

SAA Log book

Used Oil Log
book



Cracks in glass

NO FILTER

NO FILTER

RCRA Satellite Accumulation Area
14

Used Oil Collection Point
231



RCRA
Satellite Accumulation Area

Used Oil Area Sign

Process Drain location





Integrated Safety Management

- Define scope of work
- Analyze hazards
- Provide feedback



Integrated Safety Management

- Working in a different division and location
- Tried different methods to speed up process that were not in RSS
 - Did not consult with GL / LSM
- Tried different cleaning agents
- Placed incompatible waste in a Satellite Accumulation Area (SAA)
- Not familiar with waste procedures
 - Did not take training course

Personal Protective Equipment

- You will receive additional training in individual labs regarding PPE-use and expectations,
- Your Group Leader and the ESH Group can provide PPE and can answer questions,
- Your Group Leader and the ESH Group will monitor use and provide further training, as the need arises.
- When in doubt or concern, stop and ask questions.

Questions?

PPE Review Questions

- At ORNL, what tool is used before research begins to assess safety hazards?
- Research Safety Summary (RSS)

PPE Review Questions

- What OSHA standard must researchers at ORNL comply with?
- OSHA Laboratory Standard

PPE Review Questions

- What web-based training must everyone complete prior to working in a lab at ORNL?
- Chemical Hygiene Plan training

PPE Review Questions

- What document contains chemical / physical properties, health hazard information but may not be specific or updated regularly? Where can you find this document?
- Material Safety Data Sheets (MSDS), HMMS

PPE Review Questions

- Why is personal protective equipment the last line of defense when protecting employees from hazards?
- PPE relies on the worker to wear it every time, don it correctly, understand limitations, and ultimately PPE can fail unknown to the user. It leaves the hazard in the workplace, rather than eliminating it.

PPE Review Questions

- What type of personal protective equipment is **REQUIRED** in all MSD laboratories?
- Safety glasses

PPE Review Questions

- What glove material is resistant to all chemicals?
- There is no such glove. Gloves are chosen according to the chemicals being used, and the amount of exposure that is anticipated.

PPE Review Questions

- What is the correct way to doff (remove) disposable gloves?
- Roll them down off the hand, so they are inside out, and one inside of the other for disposal.

PPE Review Questions

- How should reusable PPE be stored?
- Reusable PPE should be stored so it is not exposed to the “contaminated” laboratory environment. This could be a clean container or plastic zip lock bag.

PPE Review Questions

- Where can you get additional information about hazard control in your laboratory?
- Group Leader and/or EHS

Conclusion

- Please ensure you have signed the attendance roster to receive credit for this training.
- Thank you for your attention and contact EHS with any additional questions about hazard control.