SECTION 1 INTRODUCTION

THE OBJECTIVE OF THIS TRAINING PROGRAM

The National High Magnetic Field Laboratory's (NHMFL) Environmental, Health and Safety (EHS) program goal is to ensure that the laboratory is a safe and healthful place to work. The Laboratory and it's employees are required to comply with federal and state safety and health standards. These are defined by the Occupational Safety and Health Administration (OSHA), as found in the Code of Federal Regulations (CFR) and in the Florida Administrative Code (FAC).

You must have the knowledge, skills, and abilities to carry out your work safely and efficiently. The information in this manual will provide you with the training you will need to make your contributions to the NHMFL in a safe and productive manner.

TRAINING NEEDS

In the past there was no guarantee that you would be told of the chemical and physical hazards you might encounter while doing your job. That is why the OSHA standards pertaining to work place hazardous chemicals and hazardous operations are so important.

In order to ensure that you are working in a safe environment, there are responsibilities which must be fulfilled by the NHMFL and its employees:

THE NHMFL'S RESPONSIBILITIES

The NHMFL, being the employer, is responsible for:

- Complying with occupational safety and health standards and regulations.

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Fact: In 1992, there were over 60,000 cases of skin disorders/ diseases and 23,500 respiratory illnesses that were work related.

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Workers at the laboratory include:

Permanent staff
Users
Students
FSU Maintenance
Administrative Staff
Contractors
Professors

- Developing safety and health programs.
- Keeping records of all monitoring data.
- Correcting safety and health hazards.
- Informing workers of their rights and responsibilities related to occupational safety and health.

YOUR RESPONSIBILITIES

You, as a worker of the NHMFL, are responsible for:

- Observing and complying with safety and health standards and regulations that apply to your work.
- Reporting hazardous conditions promptly.
- Responding to warning signals that may be activated in the event of fire, cryogen release, high magnetic levels, or other emergency situations.
- Reporting emergencies using proper procedures.
- Participating in the safety improvement process at the NHMFL.

YOUR RIGHTS AS A WORKER

Because you are a worker, OSHA gives you the following rights:

- Know what hazards and hazardous chemicals are present in your workplace.

- Receive all important information pertaining to hazardous chemicals in the work place.
- Know what to do in the case of an emergency such as a hazardous material spill, fire, hurricane, flood, etc.
- See the records of work place monitoring.
- Receive prompt notification if you have been exposed to hazardous materials or harmful physical agents in excess of permissible limits.

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SECTION 2INTRODUCTION TO THE NHMFL HEALTH AND SAFETY PROGRAM AND POLICIES

SECTION OBJECTIVES

At the completion of this section, the attendee will be able to:

- Define the mission of the NHMFL and how magnet research present hazards that must be prevented.
- Discuss the laboratory Environmental, Health and Safety (EHS) policies and the objectives of the NHMFL EHS Program.
- Identify the organization of the NHMFL and FSU EHS Departments and who the key EHS contacts are at the NHMFL.
- Describe the organization and operation of the NHMFL Safety Committee.
- List the three types of training offered at the NHMFL and explain why each type of training is offered.

LABORATORY MISSION

The mission of the NHMFL is to become the preeminent user facility in the United States for magnet related research using some of the most powerful magnets ever assembled. The laboratory's high magnetic field research has and will continue to yield enormous benefits to society in areas of materials science, physics, engineering, biology, and chemistry.

There are many factors that contribute to the achievement of the laboratory's mission, but none more important than safety. Magnet development, fabrication, research, and the

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supporting activities all present hazards which put each of us at risk of injury. Implementing an EHS program can benefit the laboratory by:

- Reducing the frequency and severity of injuries and property damage.
- Describe the organization and operation of the NHMFL Safety Committee.
- Preventing damage to the property damage.
- Reducing worker's compensation costs, insurance premiums, and financial penalties for regulatory violations.

LABORATORY EHS POLICY

Therefore, a functional, progressive, and effective EHS program is necessary for the achievement of the laboratory's mission.

The NHMFL believes that providing a safe work environment for it's employees and users is first and foremost a moral obligation. It is the policy of the NHMFL that people who may be exposed to workplace hazards shall be knowledgeable of them and be trained to protect themselves and users from these hazards.

As an educational and research institution, the NHMFL has a special obligation and opportunity. Our students will soon move into professions from which society expects responsible behavior in handling risks. Therefore, we should actively use laboratories and classrooms opportunities in our own to teach students about hazards and how to avoid them.

In addition to moral reasons, there are, of course many legal requirements concerning safety and environmental health in federal, state, and local regulations. It is essential that work practices and equipment used to protect people from various hazards fully conform to the requirements of all federal, state, and local laws or regulations.

Faculty, administration, and research supervisory personnel are responsible for promoting safe work practices and providing safe equipment and facilities for members of the staff, students, users, and visitors. Each person using the equipment and facilities of the laboratory is expected to follow proper and safe procedures, to report accidents promptly, and to bring to the attention of supervisors and faculty members any unsafe conditions or practices. Individuals working in laboratories or shops should be informed about safety in connection with that particular laboratory or shop and the work being conducted. Safety in the laboratory can be achieved only by the exercise of good judgment and proper use of resources and facilities by informed, responsible individuals.

EHS PROGRAM OBJECTIVES

Several objectives have been established for the Environmental Health and Safety Program which support the mission of the laboratory. Those objectives are:

- Inform staff, users, and visitors of the hazards present at the laboratory and appropriate protective measures.
- Provide training necessary for personnel to safely perform their work functions.

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- Eliminate hazards through the safe design of equipment, systems, and processes.
- Reduce the risk of injury or property damage through the implementation of accident prevention techniques.
- Provide on the job instruction to student employees and volunteers, and graduate student researchers on how to work safely in a laboratory environment.

The laboratory EHS program objectives can help to achieve the laboratory mission in the following ways:

- An effective EHS Program provides a safe work environment and will attract users, researchers, and prospective employees to the laboratory.
- Organizations and agencies which provide support and funding require safety programs and review their effectiveness when considering a facility for funding.
- Employee productivity and moral will generally be higher when an effective EHS Program is in place.
- Accidents, injuries, and property damage cost money. By implementing an accident prevention program as part of the EHS Program, the laboratory can reduce the costs associated with accidents and have additional funds for facility upgrades and additional research.

NHMFL/FSU EHS ORGANIZATIONS

Two organizations have joint responsibility for implementing the EHS Program at the NHMFL. Florida State University (FSU) Department of Environmental Health and Safety has the responsibility for the campus wide development and implementation of EHS programs.

The NHMFL Safety Department is responsible for the implementation of both FSU safety policies, and the development and implementation of the NHMFL EHS Program.

FSU and the NHMFL are expected to work together to meet the EHS objectives of the laboratory. Both organizations have technical resources which can be drawn upon by the other to resolve EHS issues.

KEY PERSONNEL

In many instances, personnel at the NHMFL may require technical assistance from an EHS professional to resolve an issue. Knowing who to contact ensures that the issue will be addressed quickly.

Table 2-1 provides the contacts at the NHMFL for EHS issues.

TABLE 2-1
EHS CONTACTS AT THE NHMFL

TECHNICAL AREA	TELEPHONE #
Health, Safety, & Security	(904) 644-0233 (W)
Hazardous Materials	(904) 644-6955 (W)

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EMERGENCY CONTACTS

In the event of an injury requiring an ambulance, or an accident requiring fire or police response, workers should make the following calls:

1. Call 9-911 and inform the dispatcher of your location and the nature of your emergency.

2. Call the FSU Campus Police at (904) 644-1234. Inform them of your location and the nature of your emergency.

3. Call the NHMFL safety Department at the telephone numbers listed in Table 2-1. If there is no answer, you can page them at the following telephone numbers:

   Safety Coordinator: 657-8278

   Hazardous Materials Manager: 657-8279

If the emergency does not require the assistance of police, fire, or ambulance, contact Kyle Orth or Todd Wegenast directly.

SAFETY COMMITTEE AT THE NHMFL

The NHMFL has a safety committee made up of faculty, technicians, and other staff members to provide a mechanism for discussion, information, problem solving, and educational activities. This committee is the focal point for discussion of safety issues because of the varied and specific nature of potential problems. This is essential for any department or laboratory with significant hazards.

The committee identifies new environmental health and safety matters which may emerge as new activities are undertaken and as new technologies

develop or old ones change direction. The committee also works to resolve EHS issues associated with existing operations.

TRAINING

There are three types of safety training conducted at the NHMFL. The first type, General Safety Training, includes training required by regulations, standards, or good management practices. This training includes topics such as electrical safety, materials handling, cryogens, confined space entry, lockout/tagout, lasers, radiation, etc. This training is developed and presented by the NHMFL Safety Department. The supervisor in your work area will be able to assist you with determining which general safety training courses are required for your position.

The second type of safety training at the NHMFL is designed for supervisors. Supervisor Safety Training includes:

- Implementing accident prevention programs.
- Communication with workers.
- Supervisor safety responsibilities.
- Promoting interest in safety.
- Job safety training.
- Recordkeeping.

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NOTE: Although a safety department exists at the NHMFL, laboratory management believes that the EHS program will be enhanced by the active participation of the laboratory staff. A committee approach to EHS issues allows for the presentation of diverse viewpoints and constructive discussion of the issues.

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The third type of training provided at the NHMFL is Job Safety Training. Job Safety Training is a method for teaching workers about the hazards associated with a specific job, task, or operation. This is done by reviewing each step of the process and identifying the hazards present in that step. This training will be provided by your supervisor.

SECTION OBJECTIVES

This section will present general housekeeping practices. At the completion of this section, the attendee will be able to:

- Explain why good housekeeping is important.
- Discuss how to prevent some of the housekeeping hazards, such as slips, trips and falls.
- Identify general housekeeping tips.

HOUSEKEEPING PRACTICES

According to the National Safety Council, workers are injured from slips, trips, and falls more than any other occupational injury. These can be usually be avoided if proper housekeeping procedures are used. Workers usually end up tripping on a piece of equipment, or tool that they themselves forgot to put away.

One way to control hazards is through good housekeeping. The concept includes picking up, wiping up, and cleaning up. It includes removal of scrap and waste. It includes the adage "having a place for everything and putting everything in its place". Sometimes housekeeping is delegated to janitorial services, but everyone should share in the responsibility of cleaning up.

If objects such as tools, waste and other items are left lying around on an elevated surface, there is a good chance that they will fall onto the surface below and there is a good chance that someone will be struck by the item or trip over these materials.

N O T E S:

Did You Know???

In 1993 there were 2.25 million nonfatal injuries/illnesses that occurred. The biggest culprits: overexertion, falls, and being struck by a falling object account for over half of the cases.

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Housekeeping also includes the rapid cleanup of spilled materials by workers wearing protective equipment. Otherwise the material can become airborne and pose greater danger.

HAZARD PREVENTION

Good housekeeping plays a key role in accident prevention and it only requires a little effort to cleanup after yourself. Good housekeeping can be achieved by establishing 3 easy steps:

- Plan ahead.
- Assign responsibilities. A person should be specifically detailed to cleanup. Ideally, each individual should pick up after themselves and keep their work area neat.
- Implement a program. Housekeeping should be part of the daily routine, with cleanup being a continuous procedure.

HOUSEKEEPING TIPS

The following practices should help eliminate accidental injuries and prevent fires;

- Keep aisles and stairwells clearly marked and free of clutter.
- Clean up spills and leaks promptly.
- Properly dispose of oily and greasy rags.
- Keep all filing cabinets and drawers closed when not used.

- Keep tools and equipment clean and properly store tools.
- Neatly stack storage racks and bins.
- Smoke in designated areas only.
- Make sure work areas are well lighted.
- Clean up after yourself.
- Keep fire exits, extinguishers, and sprinklers marked and free of obstructions.
- Rope off maintenance areas to minimize personnel traffic.
- Close all drawers, cabinents, etc. when not in use.

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SECTION OBJECTIVES

This section will present the student with a basic understanding of Hazard Communication (HAZCOM). After completing this section, the attendee will be able to:

- Explain the OSHA HAZCOM Standard, 29 CFR 1910.1200.
- Explain the Florida Toxic Substances in the Workplace law.
- Identify what is on a product label.
- Discuss the information presented in the 8 sections of the MSDS.
- Identify where MSDSs are located at the NHMFL.
- Identify what is included in the NHMFL HAZCOM Program.
- Identify the training requirements under the HAZCOM Standard.
- Identify NHMFL Contractor Rights and Responsibilities when working at the Laboratory.

OSHA HAZARD COMMUNICATION STANDARD

The OSHA Hazard Communication (HAZCOM) standard requires employers to evaluate the potential hazards of materials and communicate those hazards to their workers.

The HAZCOM Standard requires all employers to:

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Remember, you have the RIGHT TO KNOW about the hazards in your workplace!!

- Identify hazardous materials in the workplace.
- Provide product warning labels.
- Provide material Safety Data Sheets (MSDSs).
- Establish a written HAZCOM Program.
- Train and notify workers of the hazards in the workplace.
- Notify contractors of workplace hazards.

The State of Florida has also developed a HAZCOM standard for public employers such as the NHMFL. The Toxic Substances in the Workplace Law requires public employers using chemicals found on the Florida Substance List to:

- Post a notice supplied by the State Department of Labor and Employment Security.
- Provide MSDS to employees upon request.
- Provide training to employees handling chemicals found on the Florida Substance List.

HAZCOM AND YOU

Some of you at the NHMFL do not have jobs that you would consider hazardous. Many of the chemicals you use at work are similar to the products you use at home for cleaning, home repairs, or for your hobby. However, chemical handling is very important because:

- At work you may handle a chemical 4 hours a day 5 days a week, while at home you may only handle the chemical 2 hours a week, increasing your exposure to the same chemical.

- The product you use at work may contain special additives or ingredients that are not used in the consumer products you buy at the supermarket.

- You may handle a hazardous chemical differently at work than at home. For example, you may not use chemical protective gloves and protective eyewear at home.

For these reasons, it is important that every worker know about the chemicals in the products they handle daily, and how to handle the chemicals safely.

IDENTIFYING HAZARDOUS MATERIALS

The HAZCOM standard requires chemical manufactures to determine if their products are hazardous. If their product is a mixture of several hazardous chemicals, each hazardous chemical must be identified by the manufacturer. At the NHMFL, the Safety Coordinator and Hazardous Materials Manager have generated a list of all hazardous materials used in each lab and work area. The list for each area will be updated whenever a new hazardous material is brought into the lab. Workers at the NHMFL must notify the Safety Officer whenever bringing hazardous materials on-site from another site. A master list of hazardous materials used at NHMFL is available at the Safety Office.

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PRODUCT WARNING LABELS

The HAZCOM standard requires that every container that holds a hazardous chemical must be labeled in English with the following information:

- Name of the product.
- Appropriate hazard warnings.
- The manufacturer's name and address.

Workers should never remove or deface a label on a container. The Safety Coordinator, Hazardous Materials Manager, and Work Area Supervisors will ensure that all hazardous materials in your area are properly labeled and that labels are not defaced. Any containers that are shipped from the NHMFL will be checked by the Hazardous Materials Manager to make sure all containers are properly labeled.

Temporary use containers must also be labeled if they are used by someone other than the person dispensing the material, or on more than one workshift. At the NHMFL, this typically includes squeeze bottles containing acids, bases, or solvents.

MATERIAL SAFETY DATA SHEETS (MSDSS)

MSDSs are provided for each hazardous chemical found in your work area. MSDSs provide you with specific information on the hazardous chemicals you use. The MSDS is typically broken up into 8 Sections which provide you with the following basic information:

Section 1: identifies the name, address, and phone number of the manufacturer of the product.

Section 2: provides information about the ingredients of a product including the airborne permissible exposure limits (PELs) and threshold limit values (TLVs) for ingredients of the product.

Section 3: identifies physical characteristics about the product, including; color, odor, boiling point, vapor pressure, vapor density, etc.

Sections 4: identifies fire and explosion information about the product, including; flash point, auto-ignition temperature, lower and upper explosion limits.

Section 5: identifies how the chemical reacts with air, water, and other chemicals.

Section 6: identifies some of the chemical's health effects including; how the product may enter your body and acute and chronic effects.

Section 7: identifies protective measures that can be used when handling the product, including PPE and engineering controls.

Section 8: describes techniques used to clean up spills and first aid procedures to use if the product is inhaled, gets on your skin, gets in your eyes, or is swallowed.

The Safety Coordinator and Hazardous Materials Manager will maintain a master binder of MSDSs in their offices. Also, each lab and work area will maintain an updated and current MSDS for each chemical in that area.

N O T E S :

An example of an MSDS for a chemical used at the NHMFL is shown on pages 4-6 and 4-7.

Sample MSDS

Sample MSDS

N O T E S:

Each worker has a right to access and review MSDS. If you would like a copy of an MSDS contact your supervisor or the NHMFL Safety Department. If you cannot find an MSDS in your work area MSDS notebook, contact the NHMFL Safety Department. They will check their master file for the MSDS and provide one to you. If the Safety Department does not have the MSDS on file, they will immediately request a copy from the manufacturer.

NHMFL HAZCOM PROGRAM

The HAZCOM Standard requires that employers develop and implement a written HAZCOM Program for any facility that contains hazardous materials. The HAZCOM Program serves as an awareness tool and resource guide to help employers identify and train workers on chemical hazards found in the workplace. The following is included in the program:

- A list of hazardous chemicals or products at the facility.
- Methods used to inform workers of hazards on non-routine tasks (e.g., cleaning storage tanks).
- An explanation of labeling systems found at the NHMFL.
- An explanation of MSDS Management at the NHMFL and how to obtain MSDS.
- Training of workers on the written HAZCOM Program.

NHMFL has developed a written HAZCOM Program which can be found in the Hazardous Material Information Center or the NHMFL Safety Office. The Safety Coordinator and Hazardous Materials

Manager are responsible for reviewing and updating the program as necessary.

WORKER TRAINING

Everyone who works with or is potentially exposed to hazardous materials at the NHMFL will receive training on the HAZCOM Standard and the written HAZCOM program. The HAZCOM Program's objective is to communicate information concerning potential hazards to workers who may handle hazardous chemicals. In addition to this general training on HAZCOM, training will be given to a worker when the worker is initially assigned to a work area or lab, and whenever a new hazard is introduced into the work area by the work area supervisor.

The Safety Coordinator and/or Hazardous Materials Manager will review the NHMFL training program and advise managers/supervisors on training or retraining needs in each work area or lab.

NHMFL CONTRACTOR RIGHTS AND RESPONSIBILITIES

The Safety Coordinator and/or Hazardous Materials Manager, upon notification by the responsible supervisor, will advise outside contractors of any hazardous materials that may be encountered in the normal course of their work at the NHMFL. The contractor will be:

- Shown the location of the MSDSs for the hazardous chemicals.
- The labeling system in use.
- The protective measures.

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- Safe handling procedures to be used for the hazardous chemicals in their work area.

Each contractor bringing hazardous materials to the NHMFL must provide MSDSs for those chemicals and appropriate hazard information on the hazardous materials. The contractor should not start work until copies of the MSDSs for the hazardous chemicals being used is given to the Safety Coordinator and/or Hazardous Materials Manager.

SECTION OBJECTIVES

This section will provide the attendee with a basic understanding of industrial hygiene concepts. After completion of this section the attendee will be able to:

- Explain what industrial hygiene evaluations entail.
- Distinguish between qualitative and quantitative exposure assessments.
- Describe types of toxicants encountered at the workplace.
- Describe adverse health effects caused by exposure to hazardous materials
- List factors affecting severity of exposure to hazardous materials.
- Discuss methods used to minimize exposure to hazardous materials.

DEFINITION

Industrial hygiene is the anticipation, recognition, evaluation, and control of health hazards in the workplace that may cause illness, discomfort, or lack of well-being among workers or among members of the community.

Industrial hygienists support you and your managers to make sure that the Laboratory is a healthful and safe place to work.

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TYPES OF INDUSTRIAL HYGIENE HAZARDS

The four types of industrial hygiene hazards to which you could be exposed at work are:

- Chemical hazards: liquids, solids, fibers, mist and dust, fumes and smoke, gases and vapors.
- Physical hazards: noise, vibration, temperature extremes, and nonionizing radiation such as infrared and ultraviolet radiation from lasers, microwaves, or radio frequency generated during the operation of accelerators.
- Biological hazards: insects, molds, bacteria, viruses, and yeasts.
- Ergonomic factors: video display terminals (VDTs) and repetitive motion.

INDUSTRIAL HYGIENE EVALUATIONS

We identify employee exposure through Industrial Hygiene evaluations. The four principles of Industrial Hygiene are:

- Anticipation: planning ahead by identifying hazards and the control of hazards before a new operation begins.

- Recognition: identifying the hazards as they exist.

- Evaluation: determining the extent or degree of the hazards.

- Control: identifying ways to reduce or eliminate the hazards.

AGENCIES THAT GOVERN INDUSTRIAL HYGIENE

There are several agencies that establish regulations, standards, and guidelines that industrial hygienists use to evaluate hazards:

- OSHA: Occupational Safety and Health Administration - issues mandatory regulations and establishes permissible exposure limits (PELs) that have the power of law.

- ANSI: American National Standards Institute - establishes guidelines that are used by industry for developing comprehensive health and safety programs. Many ANSI standards are used by OSHA when developing regulations.

- NIOSH: National Institute for Occupational Safety and Health - approves respiratory protection devices and establishes recommended exposure limits (RELs) for air contaminants.

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- ACGIH: American Conference of Governmental Industrial Hygienists - establishes threshold limit values (TLVs) used by industrial hygienists as guidelines or recommendations in the control of potential health hazards.

HAZARD EVALUATION

Hazards in your workplace are evaluated by the job supervisors with assistance form the Safety Officer. Hazards are evaluated qualitatively and quantitatively;

- Qualitative evaluations are done by smelling, seeing, hearing, and by noticing body signs and symptoms (e.g., rash, headaches, nausea, etc.)

- Quantitative evaluations are done by taking physical measurements in the workplace. This typically includes sampling a specific contaminant in the air that the worker is breathing using air monitoring instruments or measuring noise and radiation levels using noise dosimeters and radiation meters. Quantitative evaluations are more specific because an actual measurement of the hazard is performed.

TYPES OF TOXICANTS

Toxicants are classified according to how they affect the body. They are classified as:

- **Asphyxiants:** Gases that deprive the body of oxygen:

  - Simple Aspyxiants are gases that at high concentrations can displace enough air to cause suffocation. Examples include nitrogen, helium, and argon.

  - Chemical Asphyxiates are gases that prevent the lung tissues from getting enough oxygen. Examples include: carbon monoxide and cyanide. Carbon monoxide binds with hemoglobin 200 times more readily then oxygen. Cyanide prevents the transfer of oxygen from blood to tissues by inhibiting the necessary transfer enzymes.

- **Irritants:** Chemicals that irritate the air passages, causing constriction of the airways and possibly leading to edema (liquid in lungs) and infection. Examples include chlorine, ammonia, sulfur dioxide, and ozone.

- **Fibrosis Producers:** Chemicals that produce fibrotic tissue which, if massive, blocks airways and decreases lung capacity. Examples include silica, asbestos and fiberglass.

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- **Carcinogens:** Chemicals that cause cancer. Examples include, benzene, asbestos, carbon tetrachloride, etc.

- **Corrosives:** Chemicals that damage your skin. Some exposures to corrosives can result in permanent damage to the skin or eyes. Corrosive chemicals includes both acids and bases (caustics). Some examples of corrosives include, Hydrochloric Acid, Sodium Hydroxide, Potassium Hydroxide, and Ammonium Hydroxide.

HEALTH EFFECTS

The extent of effect from an exposure to a hazardous chemical depends on several variables:

- Route of entry (i.e., inhalation, absorption, ingestion, injection).

- Concentration of exposure.

- Frequency of exposure.

- Duration of exposure.

- Personal susceptibility (i.e., gender, age, health, etc.).

Duration and Frequency of exposure effect toxicity in two ways:

- Acute: Effects are adverse effects that occur immediately following a one-time exposure lasting less than 24 hours. Some examples of acute toxic effects are burning or itchy eyes, nausea, dermatitis, and dizziness.

- Chronic: Effects are adverse effects that occur after a long period of time following many exposures. Some examples of chronic toxic effects are cancer, liver damage, and kidney damage. Worker health monitoring is key in identifying these types of conditions, because many show no visible symptoms.

EXPOSURE CONTROL METHODS

We control our exposure to hazardous materials by using:

- **Engineering Controls** are mechanical systems which include; local ventilation systems, remote handling, laboratory hoods, material containment, and acoustical absorption.

- **Administrative Controls** are safety procedures that the worker is trained to do and they include; proper work practices, limiting exposure time, following standard operating procedures, and proper hygiene (washing up before eating lunch).

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Personal Protective Equipment (PPE) is safety equipment that can be worn to minimize exposure to the hazardous material and includes; respirators, hearing protection, chemical protective coveralls, goggles, gloves, etc. PPE must be worn if engineering and administrative controls do not eliminate the hazard.

SECTION OBJECTIVES

The following section will enable the attendee to:

- Discuss the OSHA requirements for Personal Protective Equipment.
- Identify different types of PPE used at the NHMFL.
- Identify disposal procedures for PPE.
- Provide proper care, maintenance, useful life and disposal of PPE.

DETERMINATION OF PPE

Chemicals enter the body and cause harm by three major routes of entry -- inhalation, absorption (contact), and ingestion. Personal protective equipment (PPE) is designed to protect workers against chemical hazards as well as physical hazards such as flying particles, electrical hazards, and case hazards. Whenever personal protective equipment is given to workers, the employer must comply with requirements established by OSHA 29CFR1910.131-29CFR1910.138 and:

- Determine when PPE is necessary.
- Determine what PPE is necessary.
- Train workers on how to don, doff, and properly wear PPE.
- Explain the limitations of PPE.
- Establish a written program.

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Depending on the job task and work area hazards, PPE required for each area at the NHMFL may be different. For example cryogenic fluids, namely liquid helium and nitrogen, are used in some areas of the NHMFL. Direct exposure of a worker's body to cryogenic liquids or gases can freeze the skin and cause severe tissue damage. Special insulated gloves, aprons, and faceshields, as well as other PPE, must be worn by all personnel handling these materials.

In addition to handling cryogenic liquids, laboratory personnel, as well as other NHMFL employees, may be required to handle chemicals such as acids, caustics, or solvents. Each chemical may require special PPE such as protective coveralls, lab coats, gloves, safety glasses, goggles, faceshields, or even respirators. The MSDS for the materials you handle will identify the specific PPE that should be worn when handling these materials. The employee should always read the MSDS before handling hazardous chemicals. The NHMFL Safety Coordinator and Hazardous Materials Manager can provide assistance in selecting the appropriate PPE.

Protection from non-chemical hazards such as flying particles and sharp edges may also be necessary. The machine shop, lathes, milling machines, drills, and saws may generate projectiles that can injure the eyes. Goggles or a faceshield are necessary to protect the eyes. Handling sharp objects such as sheet metal requires the use of leather work gloves to protect the hands from cuts.

TYPES OF PPE

PPE should be identified for each operation and each work area at NHMFL and may include:

- **Head Protection:** Hardhats should be worn in areas where overhead hazards or the risk of head injury exits.

- **Eyes and Face Protection:** Safety glasses, goggles, or splash shields should be worn in all areas where hazards from liquid splash, dust, flying objects, radiation, or cryogens exist.

- **Hand Protection:** Specially designed gloves should be worn when handling sharp objects, hot materials, acids, solvents, and cryogenic liquids.

- **Foot Protection:** A sturdy work shoe or boot should be worn in areas where drop or slip hazards exist and when cryogens are handled. Open toe shoes or sandals should not be worn at the NHMFL.

- **Respiratory Protection:** Respirators should be worn in areas where dust, fumes, gases or vapors may present a respiratory hazard. Workers at the NHMFL must complete training, a medical examination, and respirator fit test prior to wearing a respirator.

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- **Hearing Protection:** OSHA defines an area requiring hearing protection as one that has noise levels at 90 decibels (DBA) or greater. Generally, the rule of thumb requiring hearing protection is that if you have to speak above normal talking levels at arms length in order to be heard, then you probably are in an area requiring some type of hearing protection. Foam ear plugs are the simplest form of hearing protection and if worn properly they can provide excellent protection.

Areas of the NHMFL requiring hearing protection include:

- Physical plant.
- Machine shop (depends on the equipment being used).
- Deburring Room located in the Resistive Magnet Assembly Shop.

DECONTAMINATION AND DISPOSAL OF PPE

PPE may need to be decontaminated prior to reuse. Respirators, gloves, faceshields, goggles, and aprons may be contaminated by hazardous chemicals in your work area. Soap and water is typically used for decontamination, although you should consult the MSDS and the NHMFL Safety Department for additional guidance.

PPE which is contaminated by hazardous materials must not be placed into regular trash containers. Contaminated PPE may need to be disposed of as hazardous waste, and therefore be segregated from regular trash. Contact the NHMFL Safety Department for guidance on disposal of contaminated PPE.

NOTES:

SECTION OBJECTIVES

In this section, the attendee will be able to:

- Define ergonomics.
- Identify the three major concepts of ergonomics.
- Identify steps that can be taken to prevent ergonomic disorders.

DEFINITION

Ergonomics is the study of the relationship of people and their work environment, including machines, tools, computer work stations, and general work areas and conditions. The study of ergonomics tries to reduce hazards such as repetitive motion disorders (RMDs) and cumulative trauma disorders (CTDs). The most common disorder being Carpal Tunnel Syndrome.

There are three major concepts in an ergonomic program.

- **Satisfaction:** Design work stations, tools, and equipment that people judge as comfortable, desirable, convenient, and pleasing.
- **Health and Safety:** Attempt to minimize accidents and injuries resulting from human limitations.
- **Performance:** Attempt to extend the abilities of a person by improving output and reducing errors.

NOTES:

Fact: About one third of all worker compensation claims involve repetitive motion or cumulative trauma disorders.

NOTES:

The following steps can be taken to prevent ergonomic disorders:

- Identify the tasks to be performed.
- Properly design work stations.
- Design the job to fit the worker.
- Work Smart, not hard.
- Properly use tools and equipment to complete the task.
- Know the early signs of CTDs such as, pain and numbness of the fingers, etc.

The NHMFL Safety Coordinator can assist you with evaluating your work station or tools to improve the ergonomic conditions of your job. Figure 7-1 provides tips on how to arrange your work station to avoid ergonomic injuries.

HAZARD PREVENTION

FIGURE 7-1 WORKSTATION SET-UP TIPS

SECTION OBJECTIVES

In this section, the attendee will be able to:

- Identify different materials handling techniques and safety tips for each.
- Demonstrate how to manually lift materials properly.
- Identify safety tips used when mechanically handling hazardous materials via:
  - Non-powered hand trucks
  - Powered hand trucks
  - Fork trucks
  - Overhead cranes
- Identify for truck hazards.
- Identify safety tips used in planning material storage areas.

MATERIALS HANDLING

Materials handling is the lifting, moving and placing of anything used by people. It may be done manually or with some type of lifting equipment, such as hand trucks and fork trucks. Materials handling is one of the leading causes of disabling occupational injuries.

The majority of materials at NHMFL will be handled:

- Manually.
- Using nonpowered or powered hand trucks.

NOTES:

According to the National Safety Council, 20-25% of all disabling occupational injuries result from materials handling.

N O T E S:

Lower back injuries account for about one-quarter of all workers' compensation claims with an average claim of over $5,000.

Four out of every five Americans will suffer at least one episode of lower back pain.

- Using powered industrial trucks. (i.e., a fork truck).
- Overhead cranes.

MANUAL MATERIALS HANDLING

Manual materials handling involves the moving of materials by lifting the material by hand and carrying it to a desired location.

Manual materials handling accidents result in a variety of injuries. Objects and loads may fall and injure hands, feet and legs. Lifting may cause muscle strains and joint injuries. Back injuries, often from poor lifting techniques, are the most common type of occupational injury.

The reason back injuries are so common is **that we lift things all the time**, at home and on the job, and we don't always use proper lifting techniques. Safe lifting is a commitment to lifting correctly, every time you pick up or move something.

YOUR BACK

The fact is, your back supports your whole body. Your spinal column, an S-shaped stack of bones called vertebrae, literally holds you up. Ligaments connect the vertebrae, and between the vertebrae are soft discs that cushion and protect the bones. Nerves run through the spine and go to the rest of your body.

Your back is supported by muscles that run along the spinal column, working closely with the muscles in the stomach. Someone who is overweight may have more back problems because the extra

weight around the stomach puts a lot of extra strain on the back muscles.

PLAN YOUR LIFT

Safe lifting starts before you even pick up the load. That is, you should always plan your lift.

- Choose the flattest, straightest, and clearest route, even if it's a little farther.
- Move any objects that may be in your way and cause you to trip, prior to making the lift.
- Identify places where you can stop and rest.
- Make sure that the unloading area is clear.

CARRYING THE LOAD

After you plan your lift, your next step is to properly lift the load to be moved and move the load.

- Check and make sure that the weight of the load is stable and distributed evenly and that you are able to lift it yourself. If not, GET HELP!
- When picking up the load, bend your knees not your back and grip the load firmly with your hands, not just your fingers.

NOTES:

NOTES:

- Bring the load close to your body, keeping your arms and elbows tucked in for more power. Keep the weight centered.

- USE YOUR LEGS, not your back. Lift your head and shoulders first, then let your legs push your body up slowly. Remember, your back is only meant to hold your body and if you use your back instead of your legs, you'll get hurt sooner or later.

- Make sure you can see were you are walking. Take small steps and move slowly. **Don't twist your body!!** If you have to change direction, move your feet first.

- When unloading the object, use the same steps as you did to lift the load. Bend your knees, slowly lowering the object. Keep your fingers from the bottom of the load and place the load on the edge of the surface, then slide it to the desired location.

NONPOWERED HAND TRUCKS

Drums, barrels, and cylinders present special problems because they are too heavy to lift manually. In these cases, we use such things as hand trucks or dollies.

GENERAL RULES FOR NONPOWERED HAND TRUCKS

When using a hand truck, dolly, or other non-powered material handling equipment, follow these simple tips:

- Properly secure the load on the hand truck. This may mean using a strap to hold it in place.
- Push the load, don't pull. You can get twice the power by pushing and there is less chance of the load falling on you.
- Make sure you have a firm grip on the hand truck.
- Keep your knees bent, back straight, and lean in the direction of the movement of the load.
- Let you legs and body weight do the work.

If you are moving a gas cylinder, ensure that the cap is in place. Drums should not be moved without the bung caps in place.

POWERED HAND TRUCKS

Electric powered hand trucks which allow the operator to walk behind are being used more and more. Some of the hazards associated with these vehicles, include; catching the operator between the truck and another object, and collisions with other objects or people.

NOTES:

N O T E S:

GENERAL RULES FOR POWERED HAND TRUCKS

Anyone who operates a powered hand truck should be properly trained and the training should include the manufacturer's operating instructions. Some of the general operating procedures may include:

- Do not operate the truck with wet or greasy hands.
- Never operate the truck faster than normal walking pace.
- Always face the direction the truck is moving and always have at least one hand on the handle of the truck.
- Give pedestrians the right of way.
- Observe and stop at all blind corners, doorways, and intersections to prevent collisions.
- Make sure that the chemicals you are transporting are in proper containers.
- Make sure the load is stable before you move it.
- Never ride on the truck, unless it is specifically designed for a driver to ride. Never permit others to ride on the truck.

These general rules should be followed by operators who handle any type of powered materials handling equipment including industrial fork trucks.

FORK TRUCKS

There are many different powered vehicles for materials handling. Many are included in the term industrial trucks with the most common being forklift trucks. Industrial fork trucks are either electrically powered or combustion powered.

Combustion powered fork trucks emit gaseous by-products such as carbon monoxide. Caution should be taken when using these types of trucks in enclosed spaces, to prevent carbon monoxide poisoning. Ensure there is adequate ventilation in the work area.

Fork trucks should have safety belts. It is safer for the operator to be sitting in the seat if the truck tips over than attempting to jump clear. A driver jumping clear could be struck by some part of the truck body or overhead guard and be seriously injured or killed.

In order to comply with OSHA, anyone who operates a powered fork truck must be properly trained and the training must be documented. The training shall include safe driving practices and hands-on driving supervised by an experienced fork truck driver. The training should also be specific to the chemicals or materials that will be handled.

GENERAL RULES FOR FORK TRUCKS

Some of the general rules for driving a fork truck include:

N O T E S:

NOTES:

- Follow the Operator's and Owner's Manual and the NHMFL Operation Procedure, OP-5, Industrial Truck Operations.
- Obey NHMFL facility speed limits.
- Maintain a safe distance between moving trucks, at least three truck lengths, to allow time to stop.
- Drivers are required to slow down at intersections and crosswalks and sound the horn to notify other drivers and pedestrians.
- Only stable or safely balanced loads should be handled and the load should not exceed the specifications of the fork truck.
- Whenever fork trucks are parked the forks should be lowered to the ground and the parking brake should be set.
- A fork truck should never be used to elevate employees unless a safety platform, meeting OSHA requirements, with standard railing and toe boards, is fastened securely to the forks.
- Workers should not be permitted to pass beneath an elevated load.

OVERHEAD CRANES

The NHMFL has overhead cranes located in the OP/MD Highbay, the Magnet Cell Area, and the Hybrid Magnet Cell Area. The laboratory has established Operations Procedure OP-6 "Cranes and Crane Operations" and Maintenance Procedure MP-1 "Overhead Crane Periodic Checks" to ensure that proper guidance is available on the operation and maintenance of overhead cranes.

Anyone working at the NHMFL that needs to use a crane, must complete an extensive training program prior to using a crane. This program includes a training class, hands-on operation of an overhead crane while under the direct supervision of an experienced crane operator, and a written examination. Workers will only be qualified to operate a crane after successfully completing this three step process.

MATERIALS STORAGE

Both temporary and permanent storage of all materials must be neat and orderly. Materials piled haphazardly or strewn about increase the possibility of accidents. Properly planning material storage areas will reduce the time the material must be handled when bringing it into production and will remove hazardous chemicals from areas where they are not used.

Materials storage is facilitated and hazards are reduced by using bins and racks. Materials stored on racks, pallets, or skids can be moved easily and quickly from one work station to another. Additionally, cross-tying materials on skid will make them more secured during handling.

N O T E S:

Crane Training includes:

Training Objectives
Equipment Descriptions
Rigging Practices
Overhead Crane Safety
Overhead Crane Operation
Skill Demonstration
Written Examination

NOTES:

MATERIALS STORAGE AREAS

Here are some general safety tips you should keep in mind when planning a materials storage area:

- Flammable and combustible materials should be stored in labeled flammable storage cabinets. These cabinets are usually suitable for storage of 5 gallon capacity containers.

- Flammable and combustible materials should not be stored near oxygen or oxidizing materials (materials that give up oxygen). When oxidizers are mixed with flammable, the fire danger is greatly increased. If a fire does occur, it is much more rapid and violent because the needed oxygen is more readily available.

- All hazardous materials must be properly labeled, even when hazardous liquids are placed in portable containers.

- Compressed gas cylinders should be stored upright on a smooth floor. All cylinders should be chained and fastened firmly against a wall, post, or other solid object. The protective cap should be kept on the cylinder when not in use. Cylinders should be moved using a cylinder cart.

SECTION OBJECTIVES

In this section, the attendee will be able to:

- Identify hazards associated with hand tools, portable power tools, and stationary power tools.
- Identify different types of portable power tools.
- Explain safety tips which should be utilized when using hand and power tools.

GENERAL

The misuse of hand tools and power tools is a source of injury to workers. In many cases injury results because it is assumed that the worker knows how to use the tool or the worker does not pay attention to what he/she is doing. Here are three practices that minimize accidents:

- Train workers to select the right tools for each job.
- Train and supervise workers in the correct use of tools.
- Set up regular tool inspection procedures, and provide good tool repair procedures insuring that tools are being maintained in safe condition.

NOTES:

N O T E S:

Fact: The National Safety Council estimates that 118,000 injuries occurred in 1991 as a result of using hand tools ... at home!

HAND TOOLS

When you are using hand tools, such as hammers, chisels, wrenches, etc., there are individual practices that apply to particular tools. References on hand tools and manufacturer publications give particular practices. Below are some general user and safety practices you should be aware of:

- Select the right tool for the job. Every hand tool has a purpose and proper selection will prevent misuse.
- Do not wear jewelry.
- Know the hazards of the tool. For example, the tip of a screwdriver is hardened, and when it is used for chiseling or prying, it can fragment easily, whereas the struck end of a chisel is intentionally soft so that it will not fragment easily.
- Use tools correctly. Always wear eye protection when using any manual or powered tool. Leather work gloves may also be appropriate.
- Maintain tools. Inspect tools regularly to be sure that they are in good condition and repair or discard broken, worn or damaged tools. Broken handles on hammers may cause the head to fly off and hit someone.

PORTABLE POWER TOOLS

Users of portable power tools need training to use them safely and properly. Users need to understand the hazards of the tool, its action and power supply. They need to know what protection is built in and how to protect themselves from hazards during use, and how to maintain the tools. Eye and hand protection should always be worn when operating power tools.

Portable power tools are divided into five primary groups according to the power source;

- Electric.
- Pneumatic.
- Gasoline.

ELECTRIC TOOLS

- Hydraulic.

Electric tools are the most common type of powered tool and include such tools as drills, power saws, etc. The chief hazard from electrically powered tools is electric shock. To reduce the chance of shock, several safety features are included in many electric power tools:

- **Low voltage tools** are available. Portable transformers are installed which reduce the voltage to 32, 24, 12, and even 6 volts which will reduce the shock hazard in wet locations.
- **Double insulated tools.** Double insulated tools provide more reliable shock protection without third-wire grounding. Conventional electric

N O T E S:

NOTES:

tools have a single layer of functional insulation and are metal encased. Double insulation can be provided by encasing the entire tool, or at least the part of the tool which is handled, in a nonconductive material, such as plastic, which is also shatterproof.

- **Grounding** of portable electric tools and the use of ground-fault circuit interrupters (GFCIs) provide the most convenient way of safeguarding the operator. If there is any defect or short circuit inside the tool, the current is drained from the metal frame through a ground wire and does not pass through the operator's body. When a GFCI is used the current is shut off before a serious shock can occur. Remember, a GFCI should always be used with electric tools. The third-wire ground of the tool will not totally protect the worker from shock.

PNEUMATIC TOOLS

Pneumatic tools are tools powered by compressed air at pressures of up to 90 psi. The NHMFL uses nail guns operated by compressed air during construction activities. Pneumatic impact tools have three major hazards:

- In the use of most pneumatic tools there is a hazard from flying concrete or wood chips, and nails. Operators should wear safety goggles, and, if other employees must be in the vicinity, they should be similarly protected.

- Never point a nail gun at yourself or another person. Being struck by a nail can cause death or serious bodily harm.

- Noise levels from pneumatic tools are usually elevated and should be evaluated to determine if hearing protection is required. OSHA says; at 85 decibels, hearing protection should be offered to the employees, and at 90 decibels, hearing protection is required.

GASOLINE POWER TOOLS

Laboratory workers do use gasoline powered tools. The laboratory currently uses a gasoline powered-power spray washer to clean the water storage tank and the outside of the NHMFL building.

Operators of gasoline power tools must be trained in their proper use according to manufacturer's instructions. Operators should be familiar with fuel hazards as well as other hazards associated with the tool.

HYDRAULIC POWER TOOLS

Hydraulically powered aerial lift devices are used at the NHMFL. A hazard associated with the use of this equipment is small leaks in a hydraulic hose or around fittings. Care must be taken to always use hose designed for the appropriate working pressure. There have been instances where workmen have put a hand over a pinhole leak and had oil forced into a finger by the high pressure.

NOTES:

N O T E S:

Note: A lathe is used in the Cryo Lab to shape brass and phenolic plastic material. Always ensure the chuck key is removed from the chuck prior to starting the lathe. Keys weigh several pounds and can be thrown by the lathe if not removed prior to starting.

STATIONARY POWER TOOLS

Stationary power tools used at the NHMFL include the lathes, table saws, band saws, and drill presses. These tools can be found in the Machine Shop and the Cryo Lab. The hazards and safety precautions associated with stationary power tools are similar to those of portable power tools. Below are some additional safety practices:

- Read the manufactures instructions or manual before operating the machine.
- Always wear safety goggles and proper foot protection.
- Make sure all guards are in place and never remove or tie up a guard because it is in your way. Never attempt to modify the machine.
- Make sure the machine is properly grounded and never touch any electrical equipment with wet hands or feet.
- Do not wear loose fitting jewelry or clothing when operating these machines. Long hair should be tied up in a net or cap.
- Know where all stop or kill switches and safety devices are located in case of an emergency. BE SMART AND WORK SAFELY.

SECTION OBJECTIVES

In this section, the attendee will be able to:

- Explain the concept of a fire triangle and fire tetrahedron.
- Explain why fire burns.
- Identify the 4 classes of fires.
- Identify major causes of fires.
- Discuss methods of fire protection.
- Identify fire protection equipment found here at NHMFL.
- Identify fire fighting techniques.
- Demonstrate how to use a fire extinguisher.
- Discuss the limitations of fire extinguishers.
- Describe the NHMFL emergency evacuation procedure.

BACKGROUND

Each year, fire-related losses in the United States are considerable. There are about 1 million fires involving structures, about 8,000 deaths each year and the total annual property loss is about $7 billion. Only about one-fourth of the deaths are due to burns. Nearly two-thirds of all fire related deaths result from inhalation of carbon monoxide, smoke, toxic gases and asphyxiation.

The primary requirements for a successful fire prevention program include continuous training in fire-safe work practices, regular inspections of work areas, and proper evacuation procedures.

N O T E S:

N O T E S:

ANATOMY OF A FIRE

Fire is a chemical reaction of organic matter with atmospheric oxygen at a high temperature. In this reaction, great energy is released in the form of heat and light. Such reactions are said to be exothermic. Every ordinary fire results when a substance (fuel) in the presence of air (oxygen) is heated to a critical temperature, called its "ignition temperature".

In the early days of fire fighting, the mechanisms of a fire were best depicted by the **fire triangle**. The three sides of the triangle represent the three components of a fire; heat, fuel, and oxygen. If these three components exist in their proper concentrations, then the fire will continue to burn. Take one of the components away, and the fire can be extinguished.

When scientists began to answer questions about the very high efficiency of chemical extinguishing agents, it was evident that a fourth side to the triangle needed to be added. This fourth side represents the chemical reaction needed to keep the fire burning. What was developed was a triangular pyramid, or a **fire tetrahedron**. So now the four components needed to keep a fire burning include; heat (ignition source), oxygen (oxidizer), fuel, and a chemical reaction.

CAUSES OF FIRES

If the right amount of fuel, oxygen, and heat exist, there is a great chance that a fire will start. Below are some of the more common causes of fires in an industrial setting:

- Faulty electrical equipment.

- Friction between mechanical parts.
- Flammable liquids and gases.
- Explosive dusts.
- Plastics.
- Paper and wood products.
- Welding, cutting, and other types of hot work.
- Hot surfaces (such as hot plates).
- Static electricity.

FIRE PREVENTION

Good housekeeping is one of the main ways we can prevent fires from happening. We can prevent fires from happening if we observe the following:

- Ensure that all electrical equipment is properly grounded, insulated, and maintained.
- Store flammable and combustible materials in their proper cabinets or areas. When using flammable materials, only remove quantities required for the job.
- Keep stored flammable materials away from ignition sources.
- Control ignition sources to reduce possibility of fire. Only smoke in designated areas.

NOTES:

N O T E S :

Did you know?

Twenty-three percent of industrial fires are the result of faulty wiring or poor maintenance of equipment.

- Make sure that fire protection equipment is operational. Do not block automatic sprinkler systems or fire extinguishers.
- Reduce the use of portable heaters. If they must be used, make sure they are turned off at the end of the day.
- Make sure all emergency doors, aisles, and stairwells are clear and unobstructed.

FIRE PROTECTION EQUIPMENT

Fires can be extinguished by exhausting the fuel source, by manual fire fighting, or by fixed fire-fighting systems. Fire protection equipment can consists of the following:

- Automatic sprinkler systems.
- Fire alarms.
- Fire extinguishers.

AUTOMATIC SPRINKLER SYSTEMS

Automatic sprinkler systems are present at the laboratory. The sprinkler systems are actuated by fire detection systems. The fire detection systems are heat and smoke

FIRE ALARMS

detectors.

Obviously, a good fire protection program includes fire extinguishment. Whenever a fire breaks out, there should be a sequence of procedures used by everyone:

- Sound the fire alarm right away, no matter how small the fire is.
- If you are able, attempt to extinguish or control the fire using appropriate fire extinguishing equipment.
- Relay all pertinent information to fire fighting personnel when they arrive.

The laboratory's fire alarm system is directly connected to the local fire department for immediate response.

Whenever alarm systems are use, building occupants should be instructed on how, when, and where to report a fire. Also, building evacuation routes should be established and building evacuations should be practiced periodically.

CLASSES OF FIRES

The characteristics of a fire can vary depending on the material being burned. The type of material being burned also impacts the selection of a fire extinguishing media.

There are four classes of fires including:

Class A include fires in combustible materials such as paper, wood, cloth, and many plastics.

Class B include fires in flammable liquids, oil, grease, tars, lacquers, and similar materials. The extinguishing media usually includes a dry chemical which smothers the fire by reducing the oxygen or interrupts the chemical reaction.

N O T E S:

Note: The laboratory's fire alarm is a low pitch, electronic beep. The alarm is a steady beep at a rate of about one beep per second.

N O T E S :

Note: Easy way to remember the four classes of fires:

A - Paper
B - Oils
C - Electric
D - Metal

Class C include fires in electrical wires or equipment. The extinguishing media is a non-conductive material. Sometimes with Class C fires, Class A and B materials may also be burning because of insulating or conductive materials associated with electrical equipment.

Class D includes fires that occur in combustible metals, such as magnesium, lithium, and sodium. Special extinguishing agents are needed for these types of fires.

FIRE EXTINGUISHERS

There are fire extinguishers for class A, B, and C fires at the laboratory. The laboratory does not have fire extinguishers for Class D fires. If you are involved in a project using combustible metals, contact the NHMFL Safety Department to obtain a Class D extinguisher. Fire extinguishers should be selected based on the potential fire hazards in your work area.

The laboratory has available dry chemical and Halon fire extinguishers. The dry chemical extinguishers are designed for class A, B, and C fires. Halon fire extinguishers dispense a non-combustible gas that smothers the fire. Halon should be used on class C electrical fires. Using Halon on electrical systems fires allows the fire to be extinguished without the extinguishing agent causing any damage to the system. Using dry chemical extinguishers on an electrical fire will result in a significant effort to remove the powder.

Fire extinguishers are placed in areas that are readily accessible and are visually inspected monthly. They should never be obstructed.

FIRE FIGHTING TECHNIQUES

According to the fire tetrahedron there are four ways to extinguish a fire:

- Reduce or remove the oxygen source by smothering (for example, by shutting the lid over a tank of burning solvent or by covering it with foam).
- Remove or seal off the fuel source (i.e., shut off the valve to a leaking pipe).
- Cool the fire source below its ignition temperature with a suitable cooling agent (water).
- Interrupt the chemical reaction of the fire by using dry chemical or halon agents.

USING PORTABLE FIRE EXTINGUISHERS

When using a fire extinguisher, the following word may help you remember how to operate the extinguisher - P.A.S.S:

- ***P***ull the safety pin on the extinguisher before use. Most extinguishers require you to pull a pin which allows you to depress the handle. Make sure the extinguisher is on the ground before pulling pin to avoid static discharge.
  - Aim low at the base of the fire.
  - Squeeze the handle and release the extinguishing material.

N O T E S:

UNLESS YOU HAVE BEEN
Note: DO NOT FIGHT A
FIRE TRAINED TO DO SO!!!

NOTES:

- Sweep from side to side and keep spraying a continuous flow of extinguishing agent at the base of the fire.

EMERGENCY EVACUATION

Every worker at the NHMFL must be familiar with the evacuation route from their work area. Familiarize yourself with the locations of exits from your work area. Once you have left your work area, follow the route to the nearest building exit. Always have an alternate route in the event your primary evacuation route is blocked.

Use the following guidelines when evacuating the laboratory:

- Never open a door without feeling it first. Use the back of your hand to determine if the door is hot. Never open a hot door.
- After leaving a room, close the door but do not lock it.
- Do not use elevators.
- Find the nearest exit.
- If there is smoke in the building, stay low and even crawl along the floor if you have to. There should be less smoke near the floor.

After exiting the building, everyone should meet in the front parking lot outside the main entrance to the General Science Building. A “sweeper” has been assigned to each floor to perform a visual check of each floor. When the sweeper is confident that the floor has been vacated, they will notify the Safety Coordinator by radio.

SECTION OBJECTIVES

In this section, the attendee will be able to:

- Understand the importance of first aid.
- Describe actions taken during a medical emergency
- Define what Bloodborne Pathogens (BBP) are and give examples.
- Define Hepatitis B virus (HBV) and Human Immunodeficiency virus (HIV).
- Identify how HBV and HIV are transmitted.
- Define "Universal Precautions."
- Identify personal protective measures to prevent BBP infections.

FIRST AID

First aid is the immediate care given in case of injury and illness. The majority of first aid cases are minor and require minimal treatment. However, sometimes prompt treatment by a medical professional will be needed after immediate first aid is given.

THE IMPORTANCE OF FIRST AID

There are approximately 50 people trained in first aid/CPR at the NHMFL. If an employee is severely injured, unconscious, bleeding severely, or has a bad fracture, immediate first aid can reduce the possibility of shock, unnecessary loss of blood, aggravation of injury, and may even save a worker's life. Proper first aid must be given

N O T E S:

N O T E S:

Contact the Safety Officer to become trained in First Aid/CPR.

quickly and effectively or the victim's condition may become more serious by the time further help arrives.

MEDICAL EMERGENCIES

In the excitement of an emergency, it is important to stop for a moment and clear your head and think before you act. When responding to an emergency situation, remain calm and apply the three emergency action principles.

- Survey the area. Try to figure out what happened, so it won't happen to you if you attempt to help. For example, if someone was electrocuted, make sure it is safe for you to enter the area and help.
- Survey the victim. Try to find out what is wrong, so you can relay it to the emergency personnel. Do not try to perform first aid unless you are properly protected and trained.
- Call for help. Depending on the extent of the emergency, you may be required to call the local emergency medical provider.

The name and phone number of the emergency contact personnel is posted in accessible areas throughout the NHMFL. Specifically, the emergency numbers are posted next to the nearest telephone.

BLOODBORNE PATHOGENS (BBP)

In the past, you could come to the rescue of a fellow worker who is bleeding without giving much thought to your own safety. However, today it's not that easy. There are deadly diseases which can stand between you and acts of heroism. Diseases like the HBV and the HIV.

HEPATITIS B VIRUS (HBV)

HBV is a virus which causes liver disease which may eventually lead to cirrhosis and even death. The symptoms of HBV are similar to the flu and include fatigue, nausea, loss of appetite, stomach pain and perhaps yellowing of the skin. The symptoms can be seen within two weeks to six months following exposure. Some people are carriers of the disease and show no symptoms. Treatment before exposure or immediately after exposure may prevent infection from developing.

HUMAN IMMUNODEFICIENCY VIRUS (HIV)

Today, almost everyone knows that HIV eventually leads to AIDS. This disease interferes with the bodies ability to fight off other diseases. There are many people in the U.S. who are infected with HIV, but show no symptoms. These people are just as contagious as the ones who are showing signs of AIDS. Unlike HBV, there is no preventive treatment for HIV and it can not be cured.

N O T E S:

Each year as many as 300,000 people are infected with HBV.

N O T E S:

Universal Precautions

- ***Avoid contacting blood/body fluids.***
- ***Wear PPE.***
- ***Wash exposed skin with soap and water.***

TRANSMITTING THE DISEASES

HIV and HBV are usually transmitted, or passed on, when disease organisms enter the body through mucous membranes or through breaks in the skin. Outside of work, the two diseases are typically transmitted from:

- Sexual contact.
- An infected mother to her unborn child.
- Intravenous drug users sharing needles.

At work, HIV and HBV can be spread when a worker has an open cut or sore and is in contact with infectious materials, or when a worker is not wearing proper personal protective equipment (PPE) when administering first aid or cleaning up infectious materials such as blood, human tissue or other body fluids that contain blood.

UNIVERSAL PRECAUTIONS

The only way we can be sure that we are not exposed to HIV and HBV when handling infectious materials is to use Universal Precautions. That is, assume that any blood you may come in contact with contains BBP. You can't identify every person who is infected with the viruses, therefore you can't take any chances.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Anyone who may be exposed to bloodborne pathogens should protect themselves by wearing personal protective equipment such as

gloves, a splash gown or apron, protective goggles and a mask or face shield.

At a minimum, surgical gloves and goggles should be worn whenever administering first aid or cleaning up blood residue or blood stained clothing. Any disposable items that are contaminated with blood should be placed in a special container tagged with the biohazard label and symbol. Non disposable items or other permanent surfaces which have become contaminated should be cleaned with a disinfecting agent, such as diluted bleach solution.

PERSONAL HYGIENE

Personal hygiene practices focus on protecting the worker. If you've been exposed to blood or bodily fluid:

- Remove your gloves and wash the effected area immediately with soap and water.
- Use a towel to turn on the spigot so you don't contaminate others.
- Flush your eves, nose or other mucous membranes with water if they have been exposed.

Immediately report any exposure to your supervisor so vaccinations or treatments can begin as soon as possible.

NOTES:

SECTION OBJECTIVES

In this section, the attendee will be able to:

- Identify high voltage areas at the NHMFL and who is permitted access to these areas.
- Define electrical safety tips to be used by everyone at the laboratory.
- Define what a GFCI is.
- Identify the importance of lockout/ tagout.
- Give examples of equipment which may be locked or tagged at the NHMFL.

BACKGROUND

One of the biggest misconceptions of electrical safety is that it takes high voltage to kill you. The reality is that it is current, not voltage, that causes electrical shock. Electric shock occurs when current flows through your body. Studies have shown that 1 milliamp of current, under worst case conditions of resistance, can cause electrical shock. Typically body resistance, which is mainly based on skin resistance, is approximately 1,000 megohms. Studies have shown that worse case body resistance can be as low as 300 ohms. This means that system voltage as low as 30 volts AC can supply enough current to shock or possibly even kill you.

OSHA defines high voltage systems as those systems over 600 volts. High voltage areas must be locked or secured to prevent access by unauthorized personnel. Qualified personnel are permitted to enter high voltage areas. OSHA

N O T E S:

Examples of electrical hazards at NHMFL:

10,000 Amp Pulsed Power Supply in the Cryo Lab.

Electrical Bus - tunnel

Exposure to these sources would be lethal.

Underwriters Laboratory (UL) is a nonprofit organization that conducts scientific investigations, studies, experiements, and tests related to hazards of life and property. As a part of its function it publishes standards, classifications, and specifications for electrical equipment as well as other products.

NOTES:

defines a qualified person as an individual familiar with the construction, operation, and hazards associated with the equipment being maintained or operated. High voltage areas at the NHMFL include:

- OP/MD Distrubution Substation.
- OP/MD Electrical Switchgear Room.
- OP/MD Power Supply Transformer Rooms.
- General Science Building Switchgear Room.

Although rated less than 600 volts, the magnet power supplies located in the OP/MD mezzanine and the DC electrical bus tunnel are also prohibited areas for non-qualified personnel.

SAFETY TIPS

Below are some general electrical safety tips that are very easy to use and will reduce your potential for electric shock:

- Make sure all equipment is grounded. Ground fault circuit interrupters (GFCIs) should be used in areas where workers are exposed to wet or humid conditions.
- Do not touch exposed surface connectors.
- A GFCI is a fast acting device that monitors the current flow of a circuit. In the event of leakage of 5 milliamps or more, the GFCI, in a fraction of a second, shuts off the current to the appliance. GFCIs do not stop shock, but limit the duration.

- Never reverse the polarity when plugging in equipment. That is, do not reverse the plug and put the small prong into the larger socket hole and the large prong into the smaller hole. When you reverse the polarity, in many instances, the voltage will still be present in the piece of equipment when it is turned off. If that piece of equipment is dropped into water, shock may occur.

- Do not use extension cords that are damaged or have cuts in the insulation. Only use extension cords which have a ground wire (i.e., three pronged).

- Never break off the ground prong of a three prong plug to allow you to use it in a two prong outlet. Any cord with the prong missing should be put out of service. If the ground prong is removed the piece of equipment is no longer grounded.

- Whenever you have to work on a piece of equipment, lockout and tag the electrical source to that piece of equipment to make sure that it is de-energized.

- Routinely inspect all cords, plugs, and electrical equipment for damage.

NOTES:

N O T E S:

LOCKOUT/TAGOUT

Lockout/Tagout is a method of keeping equipment from being set in motion and endangering workers. The OSHA lockout/tagout standard is designed to prevent needless deaths and serious injuries to service and maintenance workers.

Before any maintenance is performed on equipment all sources of electricity as well as process lines (i.e. steam line, cryogen feed lines, etc.) shall be locked-out and tagged-out.

LOCKOUT/TAGOUT TECHNIQUES

Lockout/tagout procedures usually include:

- Identifying all energy sources to the piece of equipment.
- Turning off and shutting down all appropriate valves, switches, and circuit breakers.
- Locking out the piece of equipment by applying a lockable device over the energy-isolating mechanism to hold it in the safe or off position. Every worker who will be working on the equipment should attach his personal lock to the isolating device.
- Applying a tag to the isolation source identifying the work to be done and the person who applied it.

After the piece of equipment is locked and tagged out, it should be checked to make sure that energy sources were not missed.

Examples of equipment at the <u>NHMFL requiring Lockout/Tagout</u>

Vacuum Pumps
Overhead Cranes
Physical Plant Power Supply
Uninterruptable Power Supply
Centrifugal Pumps
Cryogenics System
Acid/Caustic Resin Regenerator
Motors

- Verify the main disconnect switch or circuit breaker can't be moved to the on position.
- Use a voltmeter or other equipment to check the switch.
- Press all start buttons and other activating controls on the equipment itself.

REMOVING LOCKOUT/TAGOUT EQUIPMENT

Lockout/tagout equipment should only be removed when the maintenance work is complete and the equipment has been determined ready for operation by qualified personnel. Except in emergencies, the removal of lockout/tagout devices should only be done by the person who put it on.

LOCKOUT/TAGOUT TRAINING

If your job involves working with equipment or machinery requiring locking and tagging, you are required to attend Lockout/Tagout Training and read and follow the NHMFL's Lockout/Tagout procedures SP-1 and SP-2. Contact the NHMFL Safety Department to schedule training.

NOTES:

SECTION OBJECTIVES

In this section, the attendee will be able to:

- Explain the major components of OSHA's Laboratory Standard.
- List several laboratory safe work practices.

OSHA'S LABORATORY STANDARD

In 1990, OSHA issued a laboratory safety standard designed to protect employees involved in the laboratory use of hazardous chemicals. This standard focused on the following issues:

- Employee Exposure Monitoring

  This section of the standard requires air monitoring of worker exposures if there is reason to believe they are exposed to the chemicals in excess of the OSHA Permissible Exposure Limits (PEL).

- Chemical Hygiene Plans

  Employers are required to develop and implement a written plan designed to protect workers from chemical hazards. The NHMFL has developed a Chemical Hygiene Plan and a copy can be obtained through the NHMFL Safety Department.

- Employee Information and Training

  The laboratory is required to provide training for those employees involved in the laboratory use of hazardous chemicals. The NHMFL has developed a training course specifically designed for chemists

N O T E S:

NOTES:

and other workers involved in the laboratory use of chemicals.

- Medical Consultation and Examination

  The laboratory is required to provide workers with an opportunity for medical attention whenever the worker develops signs or symptoms of a chemical exposure or the worker is exposed during a spill or leak. All exposures should be reported to your supervisor and the NHMFL Safety Department immediately. The NHMFL has arrangements with the FSU Infirmary, and local clinics and hospitals to provide the appropriate level of attention.

- Hazard Identification

  The requirements for labeling containers are the same as those found in the HAZCOM Standard. The Safety Department and your supervisors will periodically check containers for proper labeling.

- Use of Respirators

  Use of respirators in the laboratory must comply with OSHA requirements. If your job requires the use of a respirator, and you have not received training, fit-testing, and a medical examination, contact the NHMFL Safety Department for guidance.

OSHA's Laboratory Standard is similar to the HAZCOM standard in that the purpose is to communicate the chemical hazards found in the laboratory to the chemists and inform them of appropriate protective measures. If you work in a laboratory handling hazardous chemicals, you will need to attend additional training on laboratory safety and the NHMFL Chemical Hygiene Plan.

LABORATORY SAFE WORK PRACTICES

There are many laboratory safe work practices that could affect your safety. This list provides a summary of the most common recommended practices.

- Avoid working alone when handling chemicals.
- Clean up your laboratory work area at the end of each day as a minimum.
- Never store food or drinks in laboratory refrigerators.
- Never remove chemicals from the laboratory. Do not transport chemicals in your personal vehicle.
- Do not store hazardous chemicals at heights above your head.
- Chemicals which react together should be stored separately.
- Keep volatile liquids away from heat or sources of ignition.
- Place safety ridges along the front edges of shelves to prevent bottles from rolling or sliding off.
- Fume hoods should be used whenever a chemical has the potential to give off harmful vapors. The fume hood sash should be pulled down whenever a chemical reaction has the potential to splash or explode.
- Never dispose of chemicals down the drain or in the trash.

N O T E S:

Example: Peroxides are very dangerous in laboratory situations because they pose a serious explosion hazard. For example, a chemist concentrated an aqueous solution of hydrogen peroxide following an oxidation. He then took the flask to balance to weigh, and noticed it "popping". He tried to get it to a hood "to protect other chemists" but it exploded in his hands before he took two steps.

N O T E S:

- Never pipette by mouth.
- Label ether and other peroxide forming chemicals with the date received and opened. Peroxides are explosive and are a cause of many laboratory explosions.
- Avoid eating, smoking, drinking, chewing gum, etc. in chemical laboratories.
- Do not handle or use chipped, cracked or broken glassware. Glassware cuts are one of the leading causes of laboratory injuries.
- Wear heavy leather gloves when inserting glass tubing into a stopper.
- Do not wear contact lenses when working with chemicals.

SECTION OBJECTIVES

This section will provide the attendee with a overview of magnetic field safety. In this section, the attendee will be able to:

- Determine the electrical and magnetic hazards associated with high magnetic fields and magnet use.
- Identify general safety procedures required when inside a magnet cell.

  Identify how safety procedures are required.
- Identify emergency procedures established inside the magnet cells.

BACKGROUND MAGNETIC INFORMATION

The magnets used at the NHMFL produce strong magnetic fields. Lines are drawn on the floor of each magnet cell indicating 10 gauss (G) and 100 G levels. A Blue Line on the floor indicates 10 (G) levels and a white line indicates 100 (G) levels. Credit cards should not be brought inside the 10 G line. Steel and other magnetic objects should not be brought within the 100 G line.

ELECTRICAL HAZARDS

The laboratory's magnets are powered approximately 500 volts, 20,000 amps of electricity. This is enough electricity to kill you instantly. Although the power lines are well insulated and grounded, any contact with the magnet housing should be avoided.

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Note: Tools such as screw drivers and wrenches can become airborne if brought inside the 100G line.

N O T E S:

Additionally, be aware that there are exposed electrical conductors in each cell located against the wall, behind the magnets above the platform. Make sure that you nor your tools come in contact with this dangerous power source.

GENERAL SAFETY PROCEDURES

Anyone entering a high magnet cell are required to follow special safety procedures. The magnet cell safety procedure (SP-16) must be read and signed before entering the area. Some of the information emphasized in the safety procedure includes:

- Proper footwear must be worn and shall provide secure footing on stairs and ladders and shall protect against spilled cryogens.
- Because the magnet cells use a lot of energy to operate, two workers should enter cells to perform work. Two people work more efficiently, solve problems quickly, do experimental procedures quicker, and generally use the magnets' time more efficiently.
- Be aware of the strong magnetic fields around the magnet.
- Whenever maintenance is performed in the cell, proper lockout and tagout procedures should be followed.
- Use proper protective clothing, as identified in the NHMFL Safety Procedure SP-4 "Cryogenic Safety for Laboratory Users" when handling cryogens (also see Section 15).

- Access behind magnet barriers is not permitted.
- Maintain open communication with control room personnel.
- Operation of overhead cranes must be in accordance with Operating Procedure (OP)-6, Cranes and Crane Operations.

EMERGENCIES

There is a red "Emergency Off" button located on the wall, at eye level, near the exit in each cell. In case of Emergency, it will shut off power to all the magnets if it is pressed.

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SECTION OBJECTIVES

In this section, the attendee will be able to:

- Define Cryogen.
- Determine what and how cryogenic liquids are used at NHMFL.
- Identify the hazards associated with cryogens.
- Identify safe cryogen handling practices.

DEFINITION

A cryogen is an extremely cold material. Cryogens have temperatures typically below -238°F. Most cryogens are liquefied gases. The two cryogens found at NHMFL are liquid helium and liquid nitrogen.

Cryogens are used in the physical testing or cooling of various materials. AT NHMFL, cryogens are used to cool the large magnets. Liquid nitrogen and helium are used in sub-cooling samples for high magnetic research and in cooling super conducting magnets.

CRYOGEN HAZARDS

Liquefied cryogens pose a health hazard to anyone who handles them because they are extremely cold materials. Typically, liquid nitrogen is less than -320°F and liquefied helium is less than -452°F. If these materials contact unprotected skin they can cause serious internal and external skin damage.

N O T E S:

N O T E S:

Because cryogenic liquids are at such cold temperatures, they will rapidly boil at room temperature and convert from liquid to a gas. This may cause an asphyxiation hazard if the room is not ventilated or is a confined space.

Clothing saturated with oxygen from air condensed by cryogenic liquids readily ignites and will burn vigorously. Workers exposed to this situation should leave the area immediately and avoid all sources of ignition.

CRYOGEN HANDLING AND SAFETY

The transport of cryogenic liquids is done by using containers called DEWARS. DEWARS are typically hand held containment systems consisting of a vacuum jacket for insulation and pressure relief devices to vent excess pressure. Although the DEWARS are designed to protect the worker from contacting the cryogenic material, proper handling procedures should be followed:

- Face shields, protective gloves, aprons, and safety goggles should be worn while handling cryogens or working around pressurized piping systems containing cryogens.
- Never allow physical contact with cryogenic fluids or uninsulated pipes containing cryogenic fluids.
- Use tongs to lift objects in and out of cryogenic fluids.
- Do not use liquid helium dewars for liquid nitrogen and vice versa.

- Do not empty cryostats in pedestrian areas or in confined spaces.

- Use caution when using cryogenic materials indoors. The vapors given off are colorless, odorless, tasteless, and can cause rapid asphyxiation or death if released in confined, poorly ventilated areas.

- Anyone who enters a confined space that is suspected to contain vapors from cryogenic materials shall wear supplied air respiratory protection, either in the form of self-contained breathing apparatus (SCBA) or an airline type respirator.

Liquid nitrogen and helium are dispenses at the OP/MD Dewar Filling Station. Magnet users and others needing cryogens should schedule their request in advance to ensure availability. If you need liquid nitrogen or helium, contact the Control Room Operator. The operator will assist you with locating the Dewar Filling Station Attendant. Only the attendant is permitted to fill dewars.

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SECTION OBJECTIVES

In this section the attendee will be able to:

- Define ionizing and non-ionizing radiation.
- Give examples of ionizing and non-ionizing radiation.
- Explain the concept of ALARA, (i.e., time, distance, and shielding).
- Identify locations of radioactive materials at the Laboratory.
- Define what a laser is.
- Identify and define the 4 classes of lasers.

IONIZING RADIATION

Ionizing radiation is any electromagnetic or particle radiation capable of producing ions when it interacts with atoms and molecules. That is, ionizing radiation gives enough energy to an atom to remove electrons, creating a charged atom called an ion. Ions can cause chemical changes in our bodies. Types of ionizing radiation include alpha, beta, gamma, neutrons, and x-rays. Alpha, beta, and neutrons are particle radiation. Gamma and x-rays are electromagnetic radiation in the form of high energy waves.

PREVENTION

Radioactive materials can enter the body in several ways:

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- Ingestion (through the mouth).
- Inhalation (through the lungs).
- Absorption (through the skin).

To reduce our exposure to radiation, the concept of ALARA is practiced. ALARA means keeping exposure to radiation As Low As Reasonably Achievable. The exposure controls used to achieve this include:

- **Minimizing Time**. - Decreasing the time spent near a radioactive source decreases the exposure.
- **Maximizing Distance**. - Increasing the distance between the radioactive source and the worker reduces exposure.
- **Using Shielding**. - A shielding material, such as lead, is placed between the worker and the source, reducing exposure.

The type of shielding will depend on the type of radiation. For example something as simple as paper will shield alpha radiation, but you may need six inches of lead to shield against gamma radiation.

RADIATION AREAS

Radioactive materials should have appropriate radiation labels and symbols. Any radiation area should be posted with warning signs to alert workers to the type of level of radiation present and restricting admittance of untrained workers. The signs are usually yellow with black or magenta lettering and the trefoil (or propeller) symbol for radiation.

NON-IONIZING RADIATION

Non-ionizing radiation is a form of electromagnetic energy that does not have enough energy to ionize atoms. Non-ionizing radiation includes:

- Ultraviolet (UV) radiation.
- High energy visible light.
- Infrared (IR) radiation.
- Microwave radiation.
- Radio frequency (RF) radiation.
- Lasers.

LASERS

A laser is a source of intense, monodirectional optical radiation. Lasers are used for many applications including welding, machinery, measuring distances, and aligning equipment. Because of the small diameter of the laser beam, the eye is very vulnerable to injury from lasers, as well as the skin.

The NHMFL currently has 17 lasers and that number is expected to increase as lasers become part of other operations.

CLASSES OF LASERS

The hazard associated with lasers depends on the intensity and wavelength of the light beams, duration of exposure, means of exposure, and part of the body exposed. Lasers are generally grouped into 4 Classes, depending on the energy and hazard.

- **Class I** - Low powered laser. No damage to the eye.

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N O T E S :

Facilities that use lasers are required by the State of Florida Department of Health and Rehabilitative Services (HRS) to register all Class III, IIIb, and IV lasers within 30 days of aquiring the laser device per Florida Administrative Code 10-D-89.

- **Class II and IIa** - Low powered laser. Little potential for damage to the eye, blinking will preclude injury.
- **Class III, IIIa, and IIIb** - Medium powered laser. Direct beam viewing may damage eye.
- **Class IV** - High powered laser. Most dangerous. Direct and reflected beam will damage eye and skin.

The NHMFL has 12 lasers with at least one in each of these classes.

ENGINEERING CONTROLS

To contain the light from the laser beam, the laser equipment must be shielded. A laser should only be installed in an enclosed area or partitioned-off zone with proper warning signs posted. No mirrors or reflective surfaces should be in the area with the laser

PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment, such as eyewear and protective clothing should be made available to workers in the laser area.

- Protective eyewear designed for the specific laser being used must be worn by all workers having access to Class IIIa, IIIb, or IV Laser controlled areas.
- Protective gloves and clothing must be worn during the operation of Class IV Lasers, where the possibility exists for laser injury to parts of the body other than the eyes.

SECTION OBJECTIVES

In this section, the attendee will be able to:

- Define what a confined space is.
- Give examples of confined spaces.
- Identify hazards associated with entry into a confined space.
- Describe responsibilities of the person entering a confined space, the attendant, and the supervisor.

DEFINITION

The OSHA standard presents requirements for work in confined spaces. As defined by OSHA a confined space has the following characteristic:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit.
- Is not designed for continuous employee occupancy.

They can be:

- Storage tanks.
- Millikelvin pits.
- Pressure vessels.
- Boilers.
- Building C120 pit.
- Physical plant sumps.
- Underground utilities.
- Storm sewers.

NOTES:

N O T E S:

PERMIT REQUIRED VS. NON-PERMIT REQUIRED

OSHA further defines spaces as "permit" required or "non-permit" required based on their potential to present a hazardous condition to workers. A space is considered "permit" required when it presents one or more of the following hazards:

- Contains or has a potential to contain a hazardous atmosphere. Examples of hazardous atmospheres include an oxygen-deficient or oxygen-rich environment; the presence of an unacceptable concentration of a flammable gas; or the presence of an unacceptable concentration of a toxic material.
- Contains a material that has the potential for engulfing an entrant, for example, grain or sand.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized serious safety or health hazard.

This definition for a "permit" required space compares with that for a "non permit" confined space which is one that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard that can cause death or serious physical harm.

Confined spaces require special procedures to ensure that they are safe before people enter or

work in them. OSHA requires that a sign must be posted at every permit required confined space and should state "Danger - Permit-Required Confined Space, Do Not Enter". Additionally, a "Confined Space Entry Permit" must be filled out before any work can enter a permit required confined space.

ATMOSPHERIC HAZARDS

There are three main hazards that are identified on the confined space entry permit that need to be determined before entry. These hazards must be determined prior to entry using special air monitoring devices.

- **Oxygen Deficiency:** Oxygen levels are measured using an Oxygen Meter. OSHA says that a confined space must have at least 19.5% in order to enter without respiratory protection. If there is less than 19.5% oxygen, supplied air respirators must be worn.

- **Flammable and Combustible Gases**: Flammable and combustible gases are measured with a Combustible Gas Indicator or Explosion Meter and concentrations are given in percent of the Lower Explosive Limit (%LEL). OSHA says that you can not enter a confined space if flammable levels are 10% LEL or greater.

- **Toxic Gases**: The type of toxic gas will depend on what is in the confined space. Typically the toxic gases inside a confined space can be measured with a specific meter (H2S, CO, etc.).

N O T E S:

NOTES:

OSHA says that you can enter a confined space if the levels of the toxic gas are less than the PEL. If the toxic gas levels exceed the PEL, the space must be ventilated or appropriate respiratory protection and PPE must be used.

PURGING THE SPACE

If air monitoring results conclude that the atmospheric condition of the confined space is unacceptable, entry is prohibited until such conditions are brought into acceptable limits. This may be done by purging, cleaning, and/or ventilating the space. Purging refers to methods by which gases, vapors, or other airborne impurities are displaced from a confined space, using ventilation equipment such as large blowers. The confined space may also be made non-flammable, non-explosive, or otherwise chemically non-reactive by displacing or diluting the original atmosphere with steam or a gas that is non-reactive with respect to that space, a process referred to as “inerting.”

OTHER HAZARDS

Other hazards found in a confined space which should be eliminated before entry include:

- Moving parts inside the space.
- Electrical equipment.
- Process lines feeding the space.
- Pressurized atmospheres.
- Noise.
- Heat or cold.

The lockout/tagout procedures described earlier should be followed, and all electrical equipment, moving parts, and process lines should be locked and tagged out prior to entry into the confined space. Secure mechanical moving parts within a confined space with latches, chains, chocks, blocks, or other devices. Disconnect belt, chain drives, and mechanical linkages on shaft-driven equipment. Depressurize and disconnect contaminant/process supply lines and provide a blank or blind in the line.

OTHER CONSIDERATIONS

Certain work being performed in a permit required confined space could cause the atmosphere in the space to change. Examples of this are welding, drilling, grinding, or sludge removed. Air monitoring of the confined space should be conducted on a continuous basis throughout the period of entry.

Additionally, if workers leave the confined space for a significant period of time, such as for lunch or other breaks, the atmosphere of the confined space should be retested before any reentry into the space.

CONFINED SPACE TRAINING

Training is required for all personnel entering a confined space.

If your job requires entry into a confined space, contact the NHMFL Safety Department to schedule training.

NOTES:

N O T E S:

ROLES AND RESPONSIBILITIES

OSHA has established duties for those people authorized to enter a confined space, the attendants or safety watch, and the entry supervisors.

The person entering the space must:

- Know the hazards.
- Properly use equipment.
- Communicate with the attendant.
- Alert the attendant if problems arise.
- Exit the space when appropriate.

The attendant must:

- Know the hazards.
- Be aware of behavioral changes in entrant.
- Maintain communication with all entrants in the confined space.
- Maintain a count of entrants.
- Remain outside the confined space.
- Maintain communication with entrants.
- Monitor activities inside and outside the space.
- Summon rescue services.
- Prevent unauthorized personnel from entering space.
- Perform non-entry rescue.

The supervisor's duties include:

- Know the hazards.
- Verify entry permit.
- Terminate entry and cancel permit as needed.
- Verify rescue services are available.
- Remove unauthorized individuals.
- Ensure entry operations are consistent with the permit.

EMERGENCIES

In case of emergencies, any residue equipment must be readily available. This may include:

- Communication equipment including emergency telephone numbers and contact names.
- NIOSH approved positive pressure self-contained breathing apparatus (SCBA), or airline systems.

Retrieval equipment such as a tripod with wrench, canards, body harnesses, and rope.

NOTES:

SECTION OBJECTIVES

This training course has provided you with an introduction to the NHMFL EHS Program and the hazards encountered at the laboratory. Additional hazards may exist in the laboratory that have not been discussed in this training course. We all must consistently make the effort to analyze every task we perform to identify potential safety hazards before they cause an accident or injury. The laboratory and FSU have EHS professionals available to provide technical assistance and answer your health and safety questions. You should utilize these resources whenever there is a question about the safety of a specific activity, or when you need a second opinion to confirm your evaluation of the hazards.

Please remember, the first and foremost person responsible for your health and safety while working at the NHMFL is **you!**

NOTES:

ATTACHMENT A

GLOSSARY

GLOSSARY

Acute Effect: Adverse effects that occur immediately following a one-time exposure. Examples are itchy eyes, nausea, dermatitis, and dizziness.

ACGIH: American Conference of Governmental Industrial Hygenisist.

ALARA: As low as reasonably achievable.

ANSI: American National Standards Institute.

Asphyxiant: Gases that deprive the body of oxygen. There are two types of asphyxiants; simple asphixiants and chemical asphyxiants.

Autoignition Temperature: The minimum temperature required to ignite a gas or vapor without a spark of flame being present.

BBP: Bloodborne pathogens; diseases that are transferred through blood and other bodily fluids.

Boiling Point: Minimum temperature at which a liquid changes to a vapor.

Carcinogen: A material that can cause cancer in an organism.

Carpal Tunnel Syndrome: A common affliction of assembly workers caused by compression of the median nerve. Often associated with tingling, pain, or numbness, in the thumb and first three fingers.

Chronic Affect: Adverse effect, such as liver damage, that can result from a low-level exposure over a long period of time.

Confined Space: An enclosure, such as a tank, vessel, etc., that has limited access, poor ventilation, and is not meant for normal human occupancy.

Corrosive: A chemical that has the ability to chemically degrade human tissue or steel. Includes both acids and caustics.

Cryogen: A super cold liquid having a boiling point of less than -238°F.

Ergonomics: The study of the relationship between man and his work environment.

Flammable Liquid: Any liquid having a flash point below 140°F.

Flash Point: The minimum temperature at which a flammable liquid gives off enough vapor to ignite or flash in the presence of an ignition source.

GLOSSARY

(Continued)

GFCI: Ground Fault Circuit Interupter; a device that protects people from electrical shock. It is designed to quickly shut off for current changes of as little as 2 milliamps.

Hazcom: OSHA's Hazard Communication Standard 29 CFR 1910.1200.

HBV: Hepatitis B virus; a disease that causes liver damage.

HIV: Human Immunodeficiency Virus; a disease that effects the immune system, usually resulting in AIDS.

Ionizing Radiation: Electromagnetic or partial radiation capable of producing ions when it interacts with atoms and molecules. Examples include Alpha, Beta, and Gamma.

Irritants: Chemicals that irritate the air passages, causing constriction of the airways.

LEL: Lower explosive limit; refers to the lowest concentration of gas or vapor that will burn or explode if an ignition source is present.

Lockout/Tagout: Process of de-energizing equipment through a series of locks and tags.

MSDS: Material Safety Data Sheet; sheet(s) supplied by manufacturer that give information and details about chemicals or compounds and applicable health hazard information.

NIOSH: National Institute for Occupational Safety and Health.

Non-Ionizing Radiation: Electromagnetic radiation such as ultraviolet, infrared, microwaves, lasers, etc. capable of changing energy levels in tissue molecules, often producing heat.

OSHA: Occupational Safety and Health Administration.

Oxidizer: Chemical capable of producing oxygen that will support combustion.

PELs: Permissible Exposure Limits; 8 hour time weighted average air concentrations established by OSHA. PELs are law enforceable.

GLOSSARY

(Continued)

PPE: Personal Protective Equipment; equipment worn by workers to protect against chemical and physical hazards. Examples include protective clothing, gloves, respirator, etc.

SCBA: Self Contained Breathing Apparatus.

TLVs: Threshold Limit Valves; 8 hour time weighted average air concentrations recommended by the ACGIH.

UEL: Upper Explosive Limit; highest concentration of a flammable vapor that will produce a fire. Above this concentration the atmosphere is considered too rich to burn.

Vapor Pressure: Pressure exerted by a vapor against the sides of a container. The lower the boiling point, the higher the vapor pressure.

Vapor Density: Density (mass per unit volume) of a gas or vapor compared to the density of air (=1). A vapor with a vapor density less than 1 will rise and a vapor density greater than 1 will sink.