

FOREWORD

Welcome to Fermilab, a U.S. Department of Energy research laboratory. Fermilab management has no higher priority than to perform research in a safe and healthful manner. We insist that every worker, experimenter, and sub-contractor make job safety and health a top priority as well.

This handbook is provided to give you an overview of Fermilab's Environment, Safety, and Health (ES&H) Program. It provides practical safety tips, and reviews general emergency procedures and actions. It is provided as an aid ...it is NOT a replacement for nor a supplement to the Fermilab ES&H Manual which contains "official policies and procedures". Please be aware that policies and procedures may change and this version of the handbook may not reflect those changes.

As a Fermilab worker – employee or user - you are required to follow Fermilab's ES&H policies and procedures. You can find more policy and procedure information in the Fermilab ES&H Manual which is posted on Fermilab's ES&H home page at <http://www-esh.fnal.gov/> or hard copy in the ES&H Section on the 7th floor of Wilson Hall. You must be aware of and adhere to all safety signs and postings at the Laboratory.

If you have questions regarding safety and health or the environment, please contact your supervisor, point of contact (POC), or the safety personnel within your division/section.

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POLICY AND ADMINISTRATION

Definitions

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ESH Responsibilities

POLICY AND ADMINISTRATION

DEFINITIONS

Integrated Safety Management (ISM) – The foundation of integrated safety management is line responsibility; i.e., the line organization must have the authority, responsibility, and be held accountable for integrating ES&H into, and as a part of, all of the work that they do. Line responsibility for safety is woven into the organizational structure, as well as all aspects of the ES&H program at Fermilab.

The Laboratory Director has ultimate responsibility for all aspects of ES&H for all work done under the FRA/DOE contract on the Fermilab site. The Director delegates the ES&H responsibility to the line managers (division/section heads) assigned to carry out the work. The responsibility is further delegated to line supervisors and ultimately to the workers.

Environmental Management Systems (EMS) - Is a defined and integrated system of managing activities, training and communication to achieve environmental goals/objectives and targets within its overall Integrated ES&H Management System (IESHMS).

The EMS describes the Laboratory's program for integrated execution and evaluation of programs for protecting the environment, assuring compliance with applicable environmental standards, and avoiding adverse environmental impacts through an effort of continual improvement.

The Fermilab Environment, Safety & Health Manual (FESHM) 8000 series further describes important program elements under the Fermilab EMS.

SAFETY RESPONSIBILITIES

The ultimate responsibility for safety at Fermilab rests with the Laboratory Director, and through him to your division/section head/spokesperson to your supervisor, point of contact, and finally, to you. Within your division/section, a senior safety officer is available to assist you in carrying out your safety responsibilities.

The Environment, Safety and Health (ES&H) Section is responsible for oversight of the Laboratory ES&H program and is available for technical support, special services, and consultation.

Employee/User Safety Responsibilities

- Conduct activities safely and in an environmentally sound manner.
- Notify his/her supervisor if he/she feels unqualified or insufficiently trained to do the task at hand.
- Be aware that telephone extension **x3131** from any Laboratory phone, from a pay phone or cellular phone dial **630-840-3131** is to be used to get emergency assistance.
- Immediately stop any of his/her activities that pose imminent hazards to personnel or the environment, and notify his/her supervisor
- Stop activities or conditions of others that pose imminent hazards to personnel or the environment and report them to his/her supervisor.
- Report occupationally incurred injuries and illnesses to his/her supervisor immediately.

Supervisor Safety Responsibilities

- Ensure that individuals under their supervision are trained or otherwise qualified to do their assigned activity safely.

- Ensure that individuals under their supervision are trained to recognize hazards they are reasonably expected to encounter in the performance of their duties. This is accomplished by completing an Individual Training Needs Assessment (ITNA) for each employee. An ITNA shall be performed when employee is first assigned to a supervisor or when job assignments change. It is highly recommended that ITNAs be performed annually. See FESHM 4010 for more information.
- Monitor activities under their supervision for safe operation and take action to enforce safety rules, when necessary.
- Stop work processes under their supervision involving imminent hazards to personnel or the environment when discovered and notify higher management.
- Describe the job activities of individuals under their supervision to the Medical Office. This is done by completing a Work Activity Analysis Form (WAAF), which can be found at <http://www-esh.fnal.gov/pls/default/WAAF.html>. The supervisor shall assure that the employee abides by the job restrictions provided by the Medical Office.
- Encourage reporting of ES&H concerns by those under their supervision. Immediately take action to address those concerns.
- Ensure that employees under their supervision report occupationally incurred injuries and illnesses to the Fermilab Medical Department at the first opportunity.
- Investigate all accidents and take all reasonable actions to prevent their recurrence.

Point of Contact (POC)

- Ensure individuals associated with each experiment receive ES&H training specified by Fermilab.
- Monitor their experimental activities for performance in accord with ES&H requirements.
- Request reasonable resources from the host division/section head to maintain a safe work environment which is in compliance with Fermilab ES&H standards.

Division/Section Head

- Implement the requirements of the Fermilab ESH Manual.
- Establish and maintain ES&H programs for appropriate aspects of environmental protection, industrial safety, industrial hygiene, radiation safety, emergency preparedness,

fire protection, waste management and transportation of hazardous materials.

- Advise the Directorate on implementation of Laboratory ES&H policies.
- Ensure that the division/section ES&H programs contain provisions for:
 - Identification and correction of potential safety and environmental hazards.
 - Procedures for correction of hazards found on inspection or upon occurrence of some incident or accident, and for following up on those corrections.
 - Identification of plans for dealing with credible emergencies.
 - ES&H review and hazard analysis of new & existing operations.
 - Training of personnel in safety procedures.
- Ensure that personnel within the division/section shall:
 - Assign sufficient resources to assure the implementation and maintenance of appropriate ES&H programs.
 - Comply with the provisions of the Fermilab Self Assessment Program (e.g., self-inspection).
 - Provide sufficient resources to carry out landlord/tenant responsibilities.
 - Ensure all operational procedures are consistent with Fermilab ES&H policies.
 - Ensure dissemination of ES&H directives and information to all appropriate personnel.
- For experiments for which it is the "host" division, assure that each user group carries out experiments in compliance with "The ES&H Review Procedure for Experiments."

Division/Section Senior Safety Officer

- Advise the division/section head on restarting an activity that has been stopped.
- On items of imminent ES&H peril, report directly to the division/section head, the Senior Laboratory Safety Officer, or the Director.
- Advise the division/section management on ES&H matters

GENERAL INFORMATION

EMERGENCY PREPAREDNESS

In any emergency, Dial x3131 from any Laboratory phone, from a pay phone or cellular phone dial **630-840-3131**. Be prepared to give the Emergency Operator the following information and remember to STAY ON THE LINE until the operator indicates that no more information is required and that help is on the way:

- The nature of the emergency
- The location
- Your name
- Other information the operator may require

You should become familiar with the alarms used on site. Ask your supervisor, point of contact, or ESH Representative for emergency evacuation and tornado shelter information.

ALARM SOUNDS

Location	Emergency	Sound	Actions
Indoors	Fire	Steady alarm	Exit building & meet at designated assembly point.
Indoors	Tornado or severe weather	Voice instructions	Go to designated shelter area.
Indoors	Hazardous atmosphere*	Whooper alarm	Evacuate the area.
Indoors	Other emergency	Voice instructions	Follow voice instructions
Outdoors	Tornado or national emergency	Steady siren	Go to designated shelter area.
Outdoors	National emergency	Warbling siren	Go to designated shelter area.

*Includes ODH and radiation.

HAZARD WARNING LIGHTS

COLOR	CONDITION	Action or status
Red	DANGER	Stop, Do not enter, or Do not touch.
Blue	CAUTION	Hydrogen may be present in the area or system. A red light used in conjunction with a blue light indicates

		DANGER.
Yellow or orange	CAUTION	Some hazard is present.

ACCIDENTS, NEAR MISSES AND ILLNESSES

Occupationally incurred injuries and illnesses must be reported to the Fermilab Medical Department and your supervisor or point of contact at the first opportunity.

All injuries, no matter how small, must receive medical attention. In the event a serious injury or illness occurs onsite, dial **x3131** from any Laboratory phone, from a pay phone or cellular phone dial **630-840-3131** for immediate medical assistance.

For less serious conditions, but still needing medical attention, report to the Fermilab Medical Department during regular work hours (7 a.m.- 3:30 p.m., Monday through Friday) or the Fermilab Fire Department at other times. The Medical Office is located in Wilson Hall, ground floor west. The Fermilab Fire Department is located at Site 38.

In addition to reporting accidents all personnel are required to report near misses to their supervisors and POC's. Reporting near misses will enable divisions and sections to perform accident investigations and take corrective measures before injuries or property damage occur.

TRAFFIC SAFETY

The driving and parking of motorized vehicles on the Fermilab property poses a serious safety risk to motorists as well as bicyclists and pedestrians. To reduce the risk to motorists, bicyclists and pedestrians, Fermilab has adopted the applicable portions of the State of Illinois Vehicle Code and the Rules of the Road publication into its Work Smart Standards. These are the same standards that motorists are legally obligated to observe when operating vehicles on public roadways in Illinois.

Because Fermilab roads are not "public roads" under state law, state and local law enforcement officials have no jurisdiction over traffic citations occurring on them and thus have no authority to issue traffic citations (except for driving under the influence). Traffic violations on Fermilab roads constitute "company rule" violations as opposed to

citations, which may subject the violator to fines and court appearances, and company disciplinary action, can and will be taken against offenders.

The Traffic Safety FESHM Chapter 9010 highlights the standards that Fermilab is contractually bound to enforce, assigns responsibilities, and defines a uniform progressive disciplinary program.

Bicyclists are permitted to use either roadways or bicycle/pedestrian paths in accordance with the Illinois Rules of the Road, and are required to follow the same traffic safety rules as the motorists. Individuals who ride a bicycle on loan from Fermilab, or ride a personal bicycle in the performance of their work duties, are required to wear a helmet certified by either CPSC (Consumer Product Safety Commission) or ASTM (American Society of Testing and Materials).

Pedestrians have the right of way. **Yield to anyone in a crosswalk.**

Disabled Vehicles: If your vehicle becomes disabled, make every attempt to clear the roadway and notify Security (x3414 from any Laboratory phone, from a pay phone or cellular phone dial **630-840-3431**) immediately to avoid creating a traffic hazard.

In Case of Accident: Anyone involved in a motor vehicle accident on the Laboratory site is required to notify Security immediately (x3414 from any Laboratory phone, from a pay phone or cellular phone dial **630-840-3431**). If there is personal injury as a result of the accident, dial x3131 from any Laboratory phone, from a pay phone or cellular phone dial **630-840-3131** to summon emergency help.

FIRE SAFETY

You can help prevent fires by following these rules:

- Maintain a neat and clean work area. Prevent rubbish and other combustible materials from accumulating. Don't hoard boxes or crates; instead store them in specified storage areas or, better yet, recycle them. Store flammable and combustible materials in approved containers.
- Before starting any operation involving welding, brazing, or flame cutting, obtain a "Burn Permit" by calling the Fermilab Fire Department at x3428 from any Laboratory phone, from a pay phone or cellular phone dial **630-840-3428**.
- Observe all "No Smoking" signs.
- Keep experimental areas neat.

- Keep flammable and combustible materials at least 18 inches away from appliances such as coffee makers, hot plates, space heaters, and other sources of ignition.
- Do NOT use highly flammable urethane foam or styrene without authorization by the ES&H Section. For installation of nonflammable foam for fire penetration sealing, call the Facilities Engineering Services Section at **x3035** from any Laboratory phone, from a pay phone or cellular phone dial **630-840-3035**.

If you see or smell a fire:

- Go to a safe place.
- If you pass a fire alarm box, pull the alarm.
- Call **x3131** from any Laboratory phone, from a pay phone or cellular phone dial **630-840-3131** to report the fire.
- Do NOT attempt to use a portable fire extinguisher unless you have been trained to do so at Fermilab.

For more fire safety information, see Chapter 6000 of the FESHM Manual.

ES&H TRAINING

Training is designed to help you develop skills, acquire knowledge and competencies. ES&H specific training is provided to help you develop the skills and knowledge needed for your own protection as well as for regulatory compliance.

In order to work safely, you must be able to recognize hazards in your work environment and to respond appropriately. ES&H training is intended to prepare you to recognize hazards in your work environment and to protect yourself by responding appropriately. New employee ES&H orientation is required of everyone working at the Laboratory in an unescorted capacity.

Other courses such as radiation safety training and ODH training are necessary to qualify for work in certain areas. The training you need depends on both your work activities and the work environment. This training can be identified by completing an Individual Training Needs Assessment Survey (either electronically or hard copy) and the preparation of an individual training plan. Your supervisor or point of contact will help insure you receive the ES&H training you need to work safely at Fermilab.

Other training appropriate to specific jobs should be arranged through your supervisor. See FESHM Chapter 4010 for further information.

SAFE LIFTING

Back injuries are one of the most costly types of injuries at the Laboratory and certainly from the individual's perspective, it is one of the most painful. It is vital that you do everything to prevent injuring your back. BackWorks training is available through TRAIN. When in doubt, get help. Techniques that may help:

- Consider the size the weight of the object to be lifted. Do not lift more than you can handle comfortably.
- Before lifting, plan your move. How will you lift the object? Where will you move the object? Is the path clear? How will you set the object down?
- When lifting, bend at the knees. Get a good hold on the object and lift by straightening your knees. Keep the object as close to your body as possible. And NEVER, NEVER twist while lifting or setting the object down.
- Never carry an object that you cannot see over or around.
- Do not carry objects up or down stairs if you are unable to hold onto the handrail.

HOUSEKEEPING

Good housekeeping means simply a place for everything and everything in its place. We must all do our part to keep our work areas clean and neat, not just for appearance but also to prevent accidents associated with slips, trips and falls; the prevention of fires, and for regulatory compliance. Suggestions for good housekeeping:

- Keep your work areas clean and all aiseways/exits clear of obstructions.
- Replace as needed all grating, toeboards, hole covers, guardrails, barricades, machine guards, and warning signs.
- Clean up your work area at the end of each shift or immediately after finishing a job.
- Do NOT leave equipment, tools, etc., in stairwells or on stairways as a trip hazard.
- Place waste materials in containers provided for such purposes. Never put chemical or regulated wastes into unmarked trash receptacles.
- Immediately clean up any spills which may cause a slip hazard or an environmental impact. If the spill is too large for

you to clean up or contain immediately, call **x3131** from any Laboratory phone, from a pay phone or cellular phone dial **630-840-3131**.

BLOODBORNE PATHOGENS

Human Immunodeficiency Virus (HIV) and Hepatitis B Virus (HBV) are two of the most serious bloodborne viruses. HIV and HBV are normally transmitted through contact with blood or other body fluids from an infected person.

To protect yourself against HIV and HBV, avoid direct contact or exposure to infectious blood or body fluids. The best way to do this is by not attempting to clean up other people's blood or other potentially infectious materials unless you have been trained to do so.

The most common scenario at the Laboratory is when a worker suffers a laceration or puncture wound and blood drips onto the floor or equipment. When possible the injured worker should clean up the blood or body fluid. This eliminates the risk of infection for others and no training is required to do this.

Kits containing gloves, eye protection, swabs, and labeled bags are provided by the Medical Department for this purpose. For additional information, see Chapter 5072 in the Fermilab ES&H Manual.

INDUSTRIAL SAFETY

RADIATION SAFETY

There are areas at Fermilab where exposure to man-made radiation can occur. These areas, designated as RADIATION AREA, HIGH RADIATION AREA, VERY HIGH RADIATION AREA, CONTROLLED AREA and RADIOACTIVE MATERIAL AREA, are posted with black (or magenta) and yellow signs indicating their boundaries.

Some areas of the Laboratory contain removable radioactivity, typically in the form of radioactive dust, rust, or grease, which could be picked up on shoes, hands, or clothing. Such areas are posted as CONTAMINATION AREAS. Contact your supervisor or point of contact for information on the training necessary to enter specific areas or work with specific materials.

Certain areas, as specified by the Radiation Safety Officers, also require the wearing of a dosimetry badge to measure the radiation received. Instruction on how to procure such a badge and how to properly wear it is incorporated into the special training for radiation workers.

Some areas, such as experimental enclosures or target areas are kept locked and interlocked. When the accelerator is operating, the radiation levels in these areas may be high enough to cause serious injury or even death. Do NOT attempt to circumvent this security system.

Call x3131 from any Laboratory phone, from a pay phone or cellular phone dial **630-840-3131** to report all incidents/accidents involving radiation.

The Fermilab Radiological Control Manual is part of the Fermilab ES&H Manual. For more information, refer to the Chapter 10000, Radiation Safety in the Fermilab ES&H Manual for a link to the Fermilab Radiation Control Manual.

ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

Fermilab is committed to maintaining or improving the quality of the environment by controlling the release of harmful materials and radiation, as well as by the conservation of natural resources located

on site. In addition, the Lab has an extensive monitoring program to assure that every potential environmental problem receives attention.

For further information, see Chapter 8010 (Environmental Protection Program) of the ES&H Manual.

The policy for environmental protection, as stated in the Director's Policy Manual, identifies the major goals under which the Laboratory's efforts are directed to meet the EMS program objective. The original documentation of the Fermilab EMS compared against DOE identified elements (policy, planning, implementation and operation, checking and corrective action, and management review) was performed in 2003 through the gap analysis process. It was performed as an independent audit to additionally meet an annual performance measure with the DOE Fermilab Site Office.

The Laboratory also sets measurable goals that are achieved through the development of Environmental Management Programs. The Laboratory will meet its final metric to demonstrate an EMS in place through the Self-Declaration mechanism.

FESHM 8000 series further describes important program elements under the Fermilab EMS.

WASTE DISPOSAL

Several different types of wastes, i.e., hazardous waste, radioactive waste, and special non-hazardous regulated chemical waste, are generated from activities on site which support Fermilab's operations. The waste generator (a.k.a. the person creating the waste) is responsible for packaging, labeling and characterizing his/her waste at the point of generation, and the ES&H Section is responsible for collection, temporary storage, and shipment for disposal.

To manage their waste, each division/section is responsible to train and assist waste generators. Ask your Waste Coordinator or contact ES&H Section staff for further information about identifying waste types and waste management procedures.

Never put hazardous, radioactive, or, special non-hazardous waste materials into trash receptacles or dumpsters. Whenever possible, non-hazardous, non-radioactive liquid waste should be disposed of in the sanitary sewer - NEVER in surface water.

Check with your Senior Safety Officer, your ES&H Department, or the ESH Section before disposing of any waste. Ignoring these

prohibitions is a violation of state and federal regulations which can result in serious environmental damage, expensive remediation, civil penalties, and criminal prosecution.

Additional information may be found in Chapter 8021 of the ES&H Manual.

HAZARD COMMUNICATION

The purpose of FESHM Chapter 5051 is to ensure that hazardous chemicals used at Fermilab are evaluated for their hazards and that this information, along with information about appropriate protective measures, is transmitted to employees

The Laboratory relies on chemical manufacturers and vendors for hazard information contained on Material Safety Data Sheets (MSDSs) and chemical labels. However, for those hazardous chemicals that are synthesized at the Laboratory, health and physical hazards of the chemicals must be determined and an MSDS must be prepared if they are shipped off-site. Secondary containers to which chemicals are transferred to must be labeled.

Uncharacterized chemicals should be labeled as toxic and handled accordingly. All routes of entry should be assumed. Other hazardous properties, such as flammability, corrosivity, and stability shall also be considered and appropriate precautions taken.

You should contact to your supervisor, point of contact, or Senior Safety Officer if you have questions regarding a chemical, how to work with it properly or what to do if you spill or it comes in contact with you.

NOISE

Fermilab has a variety of high noise sources such as compressors, pumps, and machine tools. Exposure to high noise levels is typically brief and sporadic. Occasionally, however, exposure can be above an 8-hour time weighted average of 85 dBA. At this noise level, verbal communication is difficult at a distance of one foot. At this level, hearing protection - earplugs or earmuffs - must be worn.

In many work areas, signs requiring hearing protection are posted. ALWAYS wear hearing protection in these areas. Some people mistakenly think that they will "get used to the noise". They have

been told that the human ear will "toughen up" and that the noise will not hurt. In reality, you will be permanently damaging your hearing.

Don't take chances, use your hearing protection. The Laboratory provides ear plugs and ear muffs to all employees and users.

To prevent occupationally related noise induced hearing loss from such exposures and comply with Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.95, the hearing conservation program, FESHM Chapter 5061 has been established.

ERGONOMICS PROGRAM

Work-related musculoskeletal disorders, such as sprains, strains and cumulative trauma disorders are the single most costly type of occupational injuries at Fermilab. The purpose of this chapter is to assist the line manager in preventing the occurrence of disorders such as tendonitis, low back pain, and carpal tunnel syndrome by controlling employee exposure to the workplace risk factors that can cause or aggravate these disorders.

An effective ergonomics program consists of four elements: workplace analysis, hazard prevention and control, medical case management, and training. These are discussed in detail in the Technical Appendix of the Ergonomics Program, FESHM Chapter 5084.

LASER SAFETY

There are many kinds of lasers and numerous applications. In addition, the relationships between emitted radiations and harmful effects can be complicated. In order to simplify the implementation of control measures, laser radiation hazards are rated on a scale from class 1 (safe) to class 4 (dangerous). It is unlikely that a hazard class 1, 2, or 3a laser would cause an inadvertent injury.

On the other hand, hazard class 3b and 4 lasers have a significant potential for causing accidental injuries. Not surprisingly, most control measures are associated with these higher class systems. Control measures include direct supervision by a qualified laser operator, warning signs, locking the laser when not in use and protective eyewear.

At Fermilab, class 3b and class 4 laser systems are primarily utilized in scientific applications. For example, class 3b nitrogen lasers are used as a source of pulsed ultraviolet radiation for calibrating scintillation detectors. Class 4 Nd:YAG (and similar) lasers are also used in material applications and for direct photon-particle interactions.

Lasers used in commonly encountered commercial applications such as bar code scanners, pointers, alignment systems, CD/DVD systems, and fiber optic communication systems tend to be class 2 or class 3a diode lasers.

See Chapter 5062.1 (Lasers) of the ES&H Manual for more information.

ELECTRICAL SAFETY

Electrical systems of all types, from high voltage power distribution systems to low voltage electronic circuits, are an integral part of the research and associated support work done at Fermilab. Electrical systems have the potential for causing shock and burn injuries to personnel and fires and explosions due to arcing and overheating.

FESHM Chapter 5040, Fermilab Electrical Safety Program, presents the basic policy, responsibilities, and description of the Fermilab Electrical Safety Program for control of the hazards presented by electrical systems and associated work activities.

Fermilab ES&H Manual Chapters 5041 through 5048 and 5120 contain additional requirements specific to Fermilab and its organization for implementing the Electrical Safety Program.

If you work on or around equipment with the potential of electrical shock, you must attend training about the hazards involved and actions which you should follow to prevent injury.

MAGNETIC FIELDS

The fields associated with most magnets used at Fermilab are constrained to their interiors and hence do not present an exposure hazard. The notable exceptions are fields from analyzing magnets which are employed extensively in the fixed target research program. The static magnetic fields from these devices may be as high as

several tesla and, though the intensity decreases rapidly with distance, may require many meters to drop to negligible levels.

The hazards of exposure to static magnetic fields include forces on ferrous objects and interference with various medical devices (especially cardiac pacemakers and ferrous implants/prostheses). Other effects have not been shown to be harmful. The FESHM Chapter 5062.2, Static Magnetic Fields, describes procedures to control the hazards associated with exposure to static magnetic fields.

MATERIAL HANDLING EQUIPMENT

OVERHEAD CRANES, HOISTS AND RIGGING

Cranes, hoists and rigging equipment are found in many buildings and experimental enclosures throughout Fermilab. The use of material handling equipment creates a significant potential for property loss and serious injury. FESHM Chapter 5021 contains procedures for proper design, testing, and safe operation of hoisting and rigging equipment.

BELOW-THE-HOOK LIFTING DEVICES

FESHM Chapter 5022 outlines the requirements for designing, fabricating, operating, testing, inspecting and documenting of Below-the-Hook lifting devices. It is the intent and purpose of this chapter to provide a means for governing the safety of Fermilab personnel and equipment.

POWERED INDUSTRIAL TRUCKS (PIT'S)

Forklifts, tow-motors and other powered material handling equipment are used throughout Fermilab to perform a variety of functions. Equipment of this type are often grouped together under the title "powered industrial trucks". The use of powered industrial trucks creates a potential for serious injury and property loss. FESHM Chapter 5023 contains procedures to ensure that the operation, inspection, and maintenance of powered industrial trucks is conducted in a safe manner and that operators are qualified to operate the truck safely.

Safe Work Practices:

- Lifting and moving of heavy objects should be done by mechanical devices whenever this is practical.
- The equipment used must be appropriate in size and design for the lifting and moving task.

- Heavy objects that require special handling or rigging must be moved by Fermilab contracted riggers or under the guidance of employees specifically trained to move such objects.
- The rated load capacity of the equipment must be displayed and must not be exceeded.
- Each lifting device must be inspected before lifting.
- Lift trucks, cranes and hoists are designed to move material not passengers.
- The operator is the only person permitted on the equipment.
- When loads are moved, they must never be moved over any personnel.
- Walking or working under a suspended load is strictly prohibited.

For additional safe work practices see FESHM Chapter 5020 or contact your supervisor, task manager or POC.

MACHINERY AND MACHINE TOOLS

Machinery and machine tools are by definition power driven equipment used to shape material by cutting or impact. Included in this category are lathes, mills, punches, presses, radial saws, planers, sanders, drills, and grinders.

Safe Work Practices:

- The operation, adjustment, or repair of any machinery or machine tool is restricted to experienced and trained personnel.
- All areas where machine tools are used should be placarded to indicate that eye protection is mandatory for all persons in the area whether operating the equipment or not.
- Never leave machinery running if you are not there to operate it.
- Materials such as metal stock or lumber must be removed from the machine and the power-down procedure carried out before leaving the area.
- Proper grounding and machine guards are required where applicable.
- Removing or circumventing machine guards which have been installed is strictly prohibited.

If you have any questions or concerns regarding the operation of machinery or machine tools contact your supervisor, task manager or POC.

LADDERS

All ladders used at Fermilab must meet the requirements set forth by the Occupation Safety & Health Administration (OSHA). Ladders must be appropriate for the job - proper length and type; e.g., metal ladders must never be used for electrical work or in areas where there is any probable contact with live electrical parts.

Arrangements must be made for transporting tools and materials up and down ladders (i.e., use canvas bag or tie into bundles, etc.) so that you will have both hands free for climbing.

Misuse of ladders and the use of improvised ladders are responsible for a large percentage of the injuries resulting from falls. When a ladder is to be used, the following basic safe practices should be observed:

- Never use a defective ladder.
- Straight ladders shall extend at least 3 feet above the highest landing to which access is intended.
- Climb no higher than the third rung from the top of a straight ladder, or the second step from the top of a step ladder.
- Work no more than an arm's length from the upright position. A good rule is to keep your belt buckle between the ladder side rails.
- Only one person at a time shall be on a ladder.
- Select firm footing. Place the feet of a straight ladder at least 1 foot out from the vertical plane for each 4 feet of height between the base and the support.
- Remove ladders at the end of your work. **Do not** climb or stand on improvised ladders such as chairs, barrels, drums, desks, or boxes.
- Select the right ladder for the job.
- Before use, visually inspect your ladder for obvious defects such as cracked or damaged side rails; missing, loose, or cracked rungs; loose, bent, or broken steps or spreaders; and worn or missing shoes.

If you have any questions or concerns regarding the use of ladders contact your supervisor, task manager or POC.

SCAFFOLDS

All scaffolds must conform to OSHA requirements. They are to be inspected and approved by a competent person prior to use. See your supervisor or point of contact for more information.

Use a secured ladder for entry. Climbing on handrails, midrails, or brace members as a means of access to the scaffold is forbidden unless the scaffold is designed with a built-in ladder.

Fall protection is required if you are unable to erect proper guardrails or need to work from the rails. Check with your supervisor or point of contact, to ensure your work plan is appropriate.

GAS AND VESSEL SAFETY

Pressure vessels, such as dewars and gas storage tanks containing substances under pressure, pose a potential hazard to equipment and personnel from rupture or explosion/implosion. FESHM Chapter 5030 Pressurized Gas Safety specifies the procedure to be followed in designing, fabricating, testing, and using pressurized vessels in order to reduce hazards. It also applies to any vessel used at Fermilab that falls within the scope of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII.

Whenever a gas is pressurized or liquefied, its intrinsic toxicity, flammability and reactivity hazards are enhanced. In addition, there is an added risk of violent energy release via flying materials, whipping pipes and high velocity gas flow. (Related oxygen deficiency considerations are discussed in the Oxygen Deficiency Hazard Section in this Handbook.) With large vacuum systems, damage can lead to a rapid influx of air and entrainment of nearby objects including people.

NEVER smoke in compressed gas storage areas such as hydrogen, acetylene, or oxygen storage areas.

Information about intrinsic gas hazards can be found on manufacturer provided material safety data sheets (MSDS's).

In general, compressed/liquefied gases should only be used in large well-ventilated areas.

Most liquefied gases also present a hazard of frostbite.

Special precautions such as personal protective equipment, gas detectors or detailed risk-analyses may be required for high hazard applications.

COMPRESSED AIR

One hazard of using compressed air in proximity to the human body involves the accidental injection of air under the skin.

Proper procedures for use of compressed air in industrial applications include inspection of all connections to make sure they are secure, reducing the pressure to less than 30 psi for cleaning machinery, and the mandatory use of eye protection.

Compressed air should never be used to clean personal attire or to direct against someone else in “horseplay”.

WELDING AND CUTTING OPERATIONS

Work done on site that involves weldingburningbrazing is regulated through the use of a Burn Permit obtained from the Fire Department, X3428. This system allows for risk evaluation, required controls, and approval by authorized personnel. FESHM Chapter 2021 Welding, Burning, and Brazing describes procedures for the issuance of permits for weldingburningbrazing (WBB) operations by Fermilab personnel as well as for all subcontracted work.

Safe Work Practices:

- Only experienced personnel will be allowed to perform welding and cutting operations.
- Welding goggles and hoods, gloves, and aprons must be worn while welding and cutting.
- Shields and screens constructed of approved materials must be used to contain sparks or hot slag that could start a fire, and to avoid exposing others to harmful light rays.
- When welding and cutting equipment is not in use, the valves must be shut off at the cylinders and the torch.
- Flashback arresters are required on oxyacetylene systems. Ventilation in the area must be adequate to exhaust any toxic fumes produced in the operation.

FERMILAB WORK PERMITS

A Work Permit and Notification Form (WPN) is a work planning tool intended to provide timely notification of a proposed construction project or work activity that will have impact beyond a particular organizational group and/or the specific system or area affected by the work. It lists (identifies) applicable permits, site-specific training

requirements, and organizations that need to be notified prior to the commencement of on-site work activities.

The use of this form will serve as a reminder and as a checklist to identify hazards or other aspects of the work activity that are controlled by practices or requirements specific to Fermilab, as well as documenting the authorization to commence work by the landlord division/section.

FESHM Chapter 2020 Work Permit and Notification Form is applicable to all projects performed by subcontractors that require permits listed on the Work Notification form and/or include any of the following activities: construction, remodeling, excavation activities, welding-brazing-burning operations, rigging activities, revisions to existing structural, mechanical, electrical, fire protection or other utility systems, entry into confined spaces or, environmental work, such as well drilling, soil borings or subsurface investigation.

CONFINED SPACES

A confined space is any enclosure for which entry and exits are limited and hazards may be present. Identifying characteristics include small opening(s) - ingress/egress is restricted, poor ventilation, infrequent access, isolation from help, and a relatively small volume. Typical confined spaces at the Lab include manholes, tanks, pipes, and sump pits. Some confined spaces require a permit before entering. You must complete a special training course to qualify to enter these spaces.

Working in confined spaces presents unique hazards because environmental conditions can change rapidly and it may be difficult to quickly exit the space. Some of the most common problems associated with confined spaces include hazardous atmospheres (e.g. reduced oxygen, flammable, toxic), slippery surfaces, electric shock, poor illumination, and flooding.

FESHM Chapter 5063, Confined Spaces, describes the procedures to be used for entry into these spaces. If an oxygen deficiency hazard (ODH) exists as identified by FESHM Chapter 5064 and is within a confined space, the confined space entry team is also expected to follow any training and monitoring requirements found within FESHM Chapter 5064.

HYDROGEN AREAS

Hydrogen is colorless, odorless, non-toxic, highly flammable and explosive in the presence of air or oxygen in the right concentration. It forms a flammable mixture when it exists at 4 to 74% in air or 4 to 94% in oxygen. If ignited, unconfined hydrogen/air mixtures usually burn, but confined mixtures can be expected to explode. While hydrogen is not toxic, it can displace the air in a confined, unventilated space and cause asphyxiation. In addition, hydrogen will tend to form pockets of gas along ceilings, which can lead to an explosion or fire hazard.

- In the design of experimental apparatus for use with hydrogen, special attention should be given to hydrogen embrittlement, a means of purging by vacuum or inert gas when necessary, a safe means of detecting leaks, the use of explosion-proof electrical equipment and proper ventilation to avoid the collection of pockets of gas.
- A flashing or rotating blue light is used at the Laboratory to indicate that hydrogen is present in experimental apparatus in the area.
- **Only trained personnel may be allowed to work in hydrogen areas.** Approval for incidental workers, i.e., maintenance personnel, janitorial and subcontractor personnel must be obtained from your supervisor or point of contact.
- Welding, cutting and the use of open flame for burning are PROHIBITED in hydrogen areas without the express, written authorization of a division/section safety officer and the issuance of a Welding, Cutting, and Brazing Permit.
- Hydrogen areas are designated NO SMOKING areas. Employees shall refrain from taking smoking materials (cigarettes, cigars, pipes, matches, and lighters) into hydrogen areas.

CRYOGENIC SAFETY

Cryogenics involves the use of gases which liquefy at low temperatures. These include:

- Liquid Hydrogen: for targets for physics experiments and for bubble chambers.
- Liquid Argon: for detectors used for physics experiments and as a source of argon gas.

- Liquid Helium: for cooling superconducting magnet coils to the very low temperatures they require for operation.
- Liquid Nitrogen: for cooling traps in vacuum systems, for precooling and shielding helium refrigerated systems, for cold shocking equipment to test its low temperature integrity, and as a source of nitrogen gas.
- Liquid Oxygen: for cutting and welding operations.

See Chapter 5032 for additional information.

OXYGEN DEFICIENCY HAZARDS (ODH)

The use of compressed and liquefied gases is commonplace at Fermilab. The introduction of these materials to the atmosphere can present a hazard. In particular, persons exposed to reduced-oxygen atmospheres may experience reduced abilities, unconsciousness, or death.

The purpose of FESHM Chapter 5064, Oxygen Deficiency Hazards, is to provide the requirements for assessing the potential for and controlling the associated hazards of a possible oxygen deficient environment. This chapter does not address the general topic of confined spaces (see Chapter 5063 and definition of "ODH operation" below) or working in areas where the environment is known to be below 19.5% oxygen.

Air normally contains 21% oxygen. If the concentration at normal atmospheric pressure falls below 19.5%, harmful effects can occur - such as reduced senses, poor reasoning ability, dizziness, loss of consciousness and even death. The nature of, and the time to, a particular effect depends on how far below 19.5% the oxygen concentration gets. For instance, at 13% it may take several hours before a person will pass out, while at 6% or less it will take less than 15 seconds.

Certain operations have the potential to expose you to atmospheres which are oxygen deficient. In particular, those occurring near liquefied gas (cryogenic) systems such as superconducting magnets and associated equipment. If there is a leak in these systems, the escaping liquefied gas will expand about 700 times and push out the oxygen near the system. **To enter or work in these areas requires special medical screening and training.** See Chapter 5064 for additional information.

SUBCONTRACTOR SAFETY

Fermilab subcontractors conducting work on site are required to take all precautions necessary to protect the environment, health, and safety of their employees, as well as that of other persons on and around the site. In part, this requires compliance with the Fermilab ES&H Manual and this Safety Handbook, the Illinois Rules of the Road and all DOE mandatory safety standards, especially OSHA, NEC and NFPA standards prescribed by DOE.

Subcontractors must provide any necessary safety training, medical surveillance, PPE, and other safety equipment required to perform their work. In cases where the potential hazards are not inherent to the subcontracted work activity, but rather a part of Fermilab activities (i.e., custodial subcontractors in radiation or ODH areas), the Laboratory may provide the appropriate training, medical surveillance, and safety equipment.

TRANSPORTING HAZARDOUS MATERIAL

ONSITE: Fermilab is a restricted-access site. Therefore, transportation of hazardous material on Fermilab roads is exempt from State and Federal Department of Transportation (DOT) regulations. Fermilab is committed to transporting hazardous material, including hazardous waste and hazardous substances, in a manner that ensures the protection of Laboratory personnel, the surrounding communities, and the environment. See ES&H Manual Chapter 9020 for more information.

OFFSITE: The offsite transportation of hazardous material, including hazardous waste and hazardous substances, shall be done in accordance with applicable Federal Department of Transportation regulations (49 Code of Federal Regulations).

Contact the ES&H Section **x3741** from any Laboratory phone, from a pay phone or cellular phone dial **630-840-3741** for additional information.

PERSONAL PROTECTIVE EQUIPMENT

Per OSHA 29 CFR 1910.132 personal protective equipment (PPE) shall be provided, maintained, and used whenever the workplace poses a hazard to the head, eyes, ears, respiratory system, hands or feet. To determine if these hazards exist, and what PPE is necessary,

a hazard assessment of the workplace shall be conducted and documented. In addition, each employee required to use PPE shall be trained in its use. Training shall be documented as well.

For PPE requirements against hazards not addressed in FESHM Chapter 5101, Personal Protective Equipment, refer to the FESHM chapters that deal with specific risks such as noise, respiratory, radiation and sources of ignition from electric arcs, welding, open flames, radiant heat and sparks. The referenced standards in those chapters will address the PPE requirement that matches the exposure.

If you need an item of PPE which is not maintained at the Lab, see your supervisor or point of contact.