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MP-Division Health and Safety Reference Handbook

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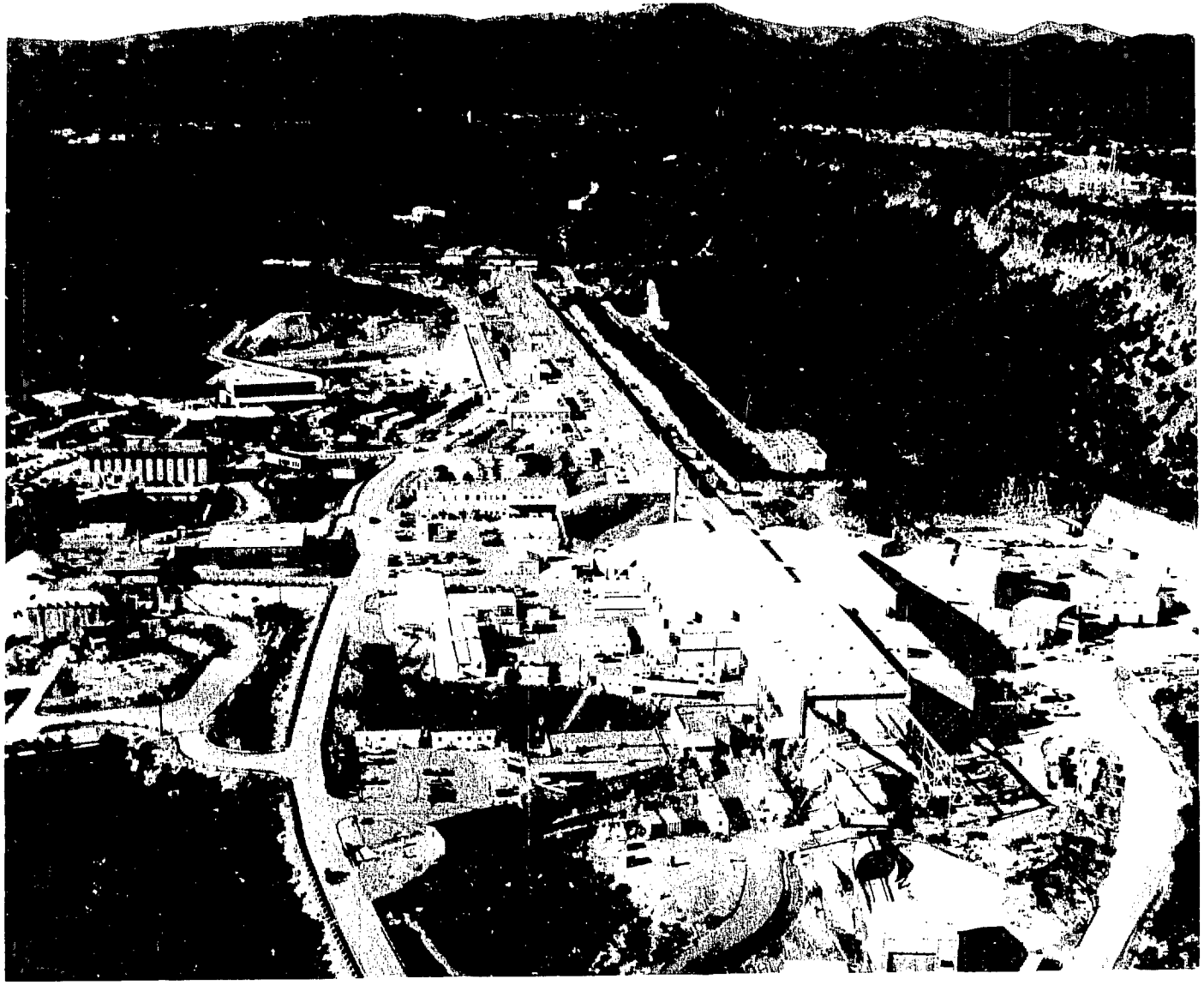

TA-53 site with Jemez Mountains in the background.

Foreword

The MP-Division Health and Safety Reference Handbook presents the objectives, organization, policies, and essential rules and procedures that have been adopted by MP Division and that form the basis of the Health and Safety Program of the Clinton P. Anderson Meson Physics Facility (LAMPF). The facility includes the beam-delivery systems for the Los Alamos Neutron Scattering Center and the Weapons Neutron Research Facility (LANSCE/WNR). The program is designed not only to assure the health and safety of all personnel, including users, in their work at LAMPF, and of MP-Division staff in their work on the LANSCE/WNR beam lines, but also to protect the facility (buildings and equipment) and the environment.

The purpose of the Handbook is to provide a convenient compilation of the essential information MP-Division personnel might need to perform their work in a safe manner. The Los Alamos National Laboratory Manual Chapter 1 Health and Safety (H&S manual) is the ultimate safety reference for everyone; its safety requirements are mandatory.

The LAMPF Health and Safety Reference Handbook is a revised and expanded version of the LAMPF Safety Handbook first published in July 1981. Based on the requirements of the Laboratory H&S manual, this Handbook also includes the special safety rules and procedures that are unique to MP Division.

Contributions to the Handbook by the many interested persons from HSE and MP Divisions are gratefully acknowledged.

Donald R. F. Cochran

Donald R. F. Cochran
MP-Division Safety Officer

Safety Policy Statement

In today's highly technological society, health and safety are essential ingredients of any program, and thus are an integral part of the MP-Division programs. These programs present a diverse and highly complex array of safety considerations that must be continually monitored and reevaluated to maintain a working environment properly protective of the health and safety of employees, the many LAMPF users, and the public. In all operations jeopardy to government property and the environment also must be avoided.

MP-Division policy is to scrupulously follow the health and safety rules, regulations, and general practices that govern operations throughout the Los Alamos National Laboratory. To implement this policy, MP-Division has established a safety office, a safety management organization, and a safety program that permeates all areas of Division responsibility. Further, the Division emphasizes this policy by making safety practices an integral part of the performance appraisal of each employee.

The following basic premises should guide all MP-Division/LAMPF operations:

- ***No activity is considered so urgent that safety may be compromised.***
  We therefore will not start any operation unless it can be done safely. Further, if an employee cannot perform a task effectively and safely because of illness or fatigue, that task shall be performed by another employee or the task shall be delayed.
- Safety must start with the individual carrying out a given operation. That individual may not proceed with the operation until all safety aspects are understood and are properly covered. For team efforts, including teams working on experiments, the senior on-site member is responsible for the health and safety of the team and for protecting government equipment.
- Line supervisors must make sure that all employees under their supervision understand the safety responsibilities and safety aspects of their assigned tasks.

Finally, MP-Division policy gives high priority to the timely correction of significant equipment or environmental safety deficiencies whenever such are identified.

Donald C. Hagerman

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MP-Division Leader

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ABSTRACT

The MP-Division Health and Safety Reference Handbook presents the objectives, organization, policies, and essential rules and procedures that have been adopted by MP Division and that form the basis of the Health and Safety Program of the Clinton P. Anderson Meson Physics Facility (LAMPF). The facility includes the beam-delivery systems for the Los Alamos Neutron Scattering Center and the Weapons Neutron Research Facility (LANSCE/WNR). The program is designed not only to assure the health and safety of all personnel, including users, in their work at LAMPF, and of MP-Division staff in their work on the LANSCE/WNR beam lines, but also to protect the facility (buildings and equipment) and the environment.

Safety Program

I. Program Objectives

The objectives of the MP-Division Safety Program are

- to assure a safe and healthful working environment for the staff and users;
- to assure the safe functioning of the MP-Division programs without undue burden on the operation, maintenance, or development of the facility or the experiments;
- to assure the highest levels of health and safety in operation of the facility and in all experiments;
- to facilitate the identification, evaluation, and control of hazards and potential hazards throughout the MP-Division areas;
- to minimize the possibility of accidents that could result in injury to personnel or damage to government equipment and facilities or that could have an adverse impact on the environment;
- to develop safety rules and procedures that are based on national standards and federal and state legislation in accordance with Laboratory and Department of Energy directives and to apply and interpret these with understanding and a reasonable approach to their intent;
- to assist MP-Division line management in understanding and exercising its responsibilities for the health and safety of its operations and personnel;
- to assist MP-Division line management in the safety training of its personnel and in job safety analysis and appraisal of job risks;
- to assure that employees and users observe the health and safety procedures and requirements specified by their supervisors in accordance with MP-Division, Laboratory, and DOE safety policies and directives;
- to assure the coordination of regular safety appraisals and inspections of all MP-Division facilities, with participation by members of the responsible groups in each area;
- to encourage all personnel to develop safe attitudes and habits in their work; and
- to assure a continuing overview of health and safety activities, as well as a means of logging and recording such activities, and to form a system to appraise the progress of the safety program toward meeting its objectives.

II. Management and Organization

A. Safety Management Policy

The Laboratory H&S manual states in part that the highest levels of safety are to be provided for employees, the public, government property, and the environment in order to protect them from harm that could arise from Laboratory operations. To accomplish this objective, MP Division has established a Health and Safety Program. Line management is responsible for implementing and maintaining this program for all facilities and activities under its control.

The primary responsibility for assuring the health and safety of Laboratory employees and guests rests with line management; this responsibility is given the highest priority in the performance of Laboratory operations. Line management is responsible for conducting only those activities and operations that can be done safely. Further, it is fundamental to accident prevention that supervisory responsibilities for health and safety rank equally in importance with other duties.

All Laboratory personnel and users are responsible for keeping the risks of their activities at the lowest levels technically and economically achievable and for observing the Laboratory's health and safety requirements in the conduct of their work. Careful, prudent behavior in the work place and strict observance of prescribed safety procedures and regulations are conditions of employment by the Laboratory, and this policy must be enforced by supervisors.

B. MP-Division Health and Safety Office (HSO)

Because of the nature of MP-Division operations, a Health and Safety Office (HSO) has been established in MP Division to manage the Safety Program. The personnel in this office provide day-to-day support for line supervisors in promoting the health and safety of personnel and in protecting equipment involved in the operation, maintenance, development, and use of LAMPF and the LANSCE/WNR beam-delivery systems. The HSO coordinates all aspects of operational health and safety for personnel at the facilities and is the focal point for assistance and staff support in all safety matters; it is located in the Laboratory-Office Building (MPF-1, Room A-236, 7-6176). Safety questions should be addressed to the personnel in this office; they are always ready to help.

C. MP-Division Safety Officer

The MP-Division Safety Officer is appointed by the MP-Division Leader to manage and promote the Safety Program and its associated activities, to provide staff support to the Division Office, and to assist MP-Division group leaders and their line supervisors with safety responsibilities.

D. LAMPF Users Safety Officer

The LAMPF Users Safety Officer provides a point of contact to assist users with safety problems. He is appointed by the MP-Division Leader and works with the MP-Division Safety Officer in promoting all aspects of user safety.

E. MP-Division Safety Organization

The MP-Division Safety Organization (Fig. 1) includes MP-Division leaders and group leaders, numerous staff and first-line supervisors, and HSE-Division support personnel. The functions and responsibilities of the various safety committees follow:

1. MP-Division Safety Committee. This committee consists of the MP-Division Leader as chairman, all MP-Division Deputy, Associate, and Assistant Division Leaders, all MP-Division Group Leaders, senior representatives of associated Laboratory groups, HSE-Division site representatives, and the chairmen of special MP-Division safety committees. The committee determines general health and safety policies, reviews special problems, and establishes procedures for all phases of the Safety Program. The MP-Division Safety Officer serves as secretary of this committee.

2. Electrical Safety Committee. The nature of the LAMPF accelerator and its varied research activities, and of the LANSCE/WNR beam-delivery systems, exposes personnel to many combinations of electrical equipment and to some unique applications. Consequently, extra efforts are required to minimize risks to personnel by assuring that adequate safety measures are developed and followed in the design, construction, installation, operation, and maintenance of the vast amounts of electrical equipment involved. The Electrical Safety Committee was established to review the adequacy of electrical safety measures throughout any project. It is responsible for reviewing and recommending changes in electrical safety procedures as needed and for advising on the electrical safety aspects of the programs.

3. Group Safety Officers (GSO) Committee. Each group in MP Division and each Laboratory group with a significant program at LAMPF appoint Group Safety Officers to assist group leaders in safety matters. Their typical duties are

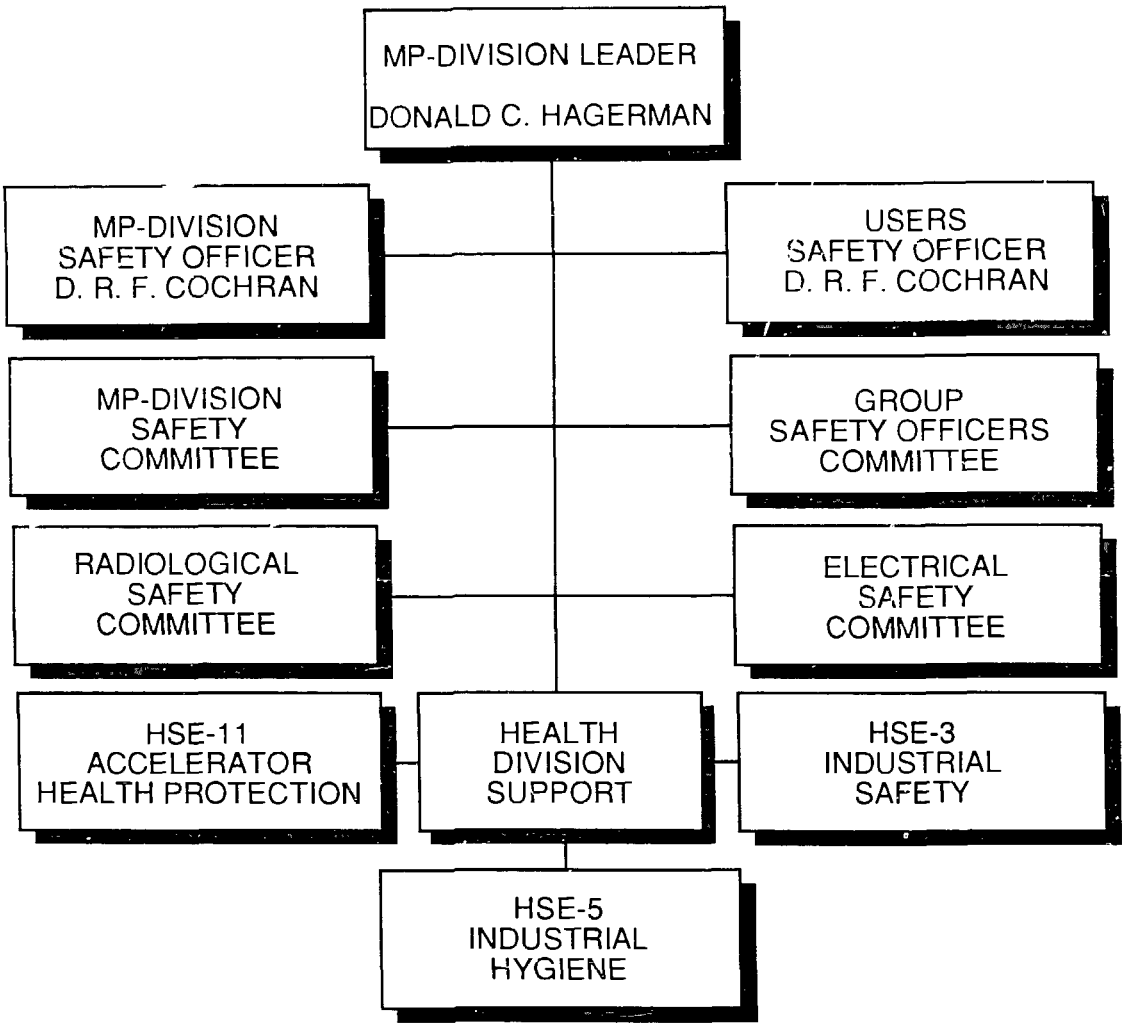


Fig. 1. MP-Division safety organization.

- to assist the group leader in carrying out responsibilities for safety within the group's operations,
- to assist in promoting and maintaining a high degree of safety practices and safety consciousness among the group's personnel,
- to assist in the safety training of new personnel,
- to assist with safety inspections of areas for which the group is responsible, and
- to bring to the attention of the group leader and the HSO those potentially hazardous or unsafe conditions that cannot be corrected on the spot by the GSO or other members of the group.

The GSO Committee has been established to further strengthen the Safety Program, to provide safety training for the Group Safety Officers on specific topics, and to encourage discussions of safety-related problems. The MP-Division Safety Officer serves as chairman of this committee and takes its recommendations to the MP-Division Safety Committee.

4. Radiological Safety Committee. The Radiological Safety Committee is responsible for reviewing

radiation-control procedures and for recommending changes when necessary to the Accelerator Health-Protection Group (HSE-11) or to the MP-Division Safety Committee. Typically, committee members provide individual input to HSE-11 or the HSO on routine matters. The committee may meet formally to address special circumstances should the need arise.

5. ***Ad Hoc Committees.*** When necessary, special safety review committees are formed to address particular problems. For example, experiments that use tritium have required special review.

6. ***Health and Safety Resources.*** Health and safety specialists from the Laboratory's Health, Safety, and Environment (HSE) Division have been assigned to advise and assist MP Division in promoting the Safety Program. The Safety Group (HSE-3) has a full-time industrial safety engineer at the site, the Accelerator Health-Protection Group (HSE-11) is concerned with radiological safety matters, and the Industrial Hygiene Group (HSE-5) has representatives on call who are concerned with health-related items such as ventilation, solvents, work in confined spaces, and toxic materials. The HSE-11 group leader coordinates the work of all HSE groups at TA-53.

If you have questions or suggestions or need help with problems about health or safety matters, consult any of the following:

MP-Division Safety Office	7-6176
Users Safety Officer	7-5763
HSE-Division Representatives	
HSE-3, TA-53 Industrial Safety	7-1384
HSE-5, Industrial Hygiene	7-7189
HSE-11	
Accelerator Health Protection	7-5890
Area A Health Physics Office	7-7069

Safety information is available to all MP-Division and associated personnel through safety orientations, the "MP-Division Health and Safety Guidelines," the "MP-Division Health and Safety Reference Handbook," the Laboratory H&S manual, the LAMPF Users Newsletter, special bulletins and memos, and safety meetings. The MP-Division branch library has a shelf in the reading room reserved for safety-related material, and references for pertinent safety books and articles, as well as specific MP-Division safety information, are listed in the back of this Handbook (Appendixes A–E). All personnel are responsible for reading all safety material published by MP Division or circulated by the HSO that is pertinent to their activities. Attendance at safety meetings is mandatory.

III. General Safety Policies

A. Safety Program Coverage

The MP-Division Safety Program covers all activities involving MP-Division personnel, related Laboratory personnel, visiting scientists (users), and contract personnel either working for MP Division or doing construction or maintenance work. The rules and procedures set forth in the Laboratory H&S manual and in the MP-Division Health and Safety Reference Handbook apply to everyone listed above. Each person working at, or using, MP-Division facilities is required to become familiar with the general safety policies, rules, and procedures set forth in these documents.

B. Individual Safety Responsibilities

Safety must start whenever an individual performs a task of any kind. That individual shall assume responsibility for the safety of any activity in which he or she is involved. All personnel must perform their activities so as to protect their own safety as well as that of their colleagues. If there is any doubt about the safety of an activity, the persons involved must resolve that doubt before performing the activity.

C. The "MP-Division Health and Safety Guidelines"

The "MP-Division Health and Safety Guidelines" contains a brief compilation of the most pertinent health and safety information people need in their activities, including references to the "MP-Division Health and Safety Reference Handbook" and the Laboratory H&S manual. The information in the Guidelines is essential for the safety of personnel and the smooth functioning of MP-Division programs. Therefore, all personnel in MP Division and all persons associated with MP-Division activities are to read the Guidelines on a yearly basis and to certify that they have done so.

D. *The "MP-Division Health and Safety Reference Handbook"*

The "MP-Division Health and Safety Reference Handbook" (MP H&S Handbook) is a general compilation of the basic safety rules and procedures that apply to all activities at MP-Division facilities. All staff and users, and visitors assisting with any technical work or experiments, must be familiar with the Handbook, especially the sections that are applicable to their work.

E. *Familiarity with the Laboratory H&S manual*

The Los Alamos National Laboratory Manual Chapter 1 Health and Safety (H&S manual) is the ultimate reference for safety questions at the Laboratory. All MP-Division personnel are required to be familiar with it and to use it whenever there are safety questions related to experiments or other activities at LAMPF that the MP-Division H&S Handbook does not cover. The rules and procedures contained in the manual apply to all personnel, including users, working in MP Division. Copies are available in MP Division at the Visitors Center, the MP-Division Library, the MP-Division Office and all group offices, all shops and counting houses, and many of the trailers.

F. *Safety Orientation for New Personnel*

All personnel who are new to LAMPF or MP Division are required to attend a Health and Safety orientation, held biweekly, as soon after arriving as possible. At the orientation, personnel from the Laboratory Health, Safety, and Environment (HSE) Division shall review industrial safety, industrial hygiene, and radiological safety matters, as well as special health and safety items that are unique to LAMPF and MP-Division activities.

G. *Safety Review of Experiments*

In each research proposal submitted to LAMPF the spokesman is required to identify and discuss any potential health and safety problems. Experiments that are comparatively routine, such as many of those at EPICS and HRS, may be exempted from this requirement. All other experiments to be scheduled at LAMPF must be reviewed and approved for operational safety by the MP-division Health and Safety Office (HSO). Before the LAMPF Scheduling Committee (LSC) Engineering Review, the experiment spokesman must appoint an on-site member of the team to serve as safety representative and as the primary contact for safety matters.

At the Experiment Engineering Review the various safety aspects of the experiment shall be evaluated to determine the need for any special safety measures. The review also covers fire hazards and protection, physical hazards, chemical hazards, electrical safety, radiological safety, and operating procedures. In special cases, written operating procedures may be required, particularly where hydrogen or cryogenic systems are involved, where the use of large quantities of flammable or toxic materials is proposed, or where hazardous quantities of radioactive material may be used in a target. For the more complex experiments, an on-site review (walk-through) of the installation may be required before the experiment begins operation.

H. *Reporting Accidents and Incidents*

The primary goal of a safety program is to prevent accidents that could result in injury to personnel and damage to government property. An essential ingredient in this effort is the analysis of each accident and incident so that similar events can be avoided in the future and so that any safety deficiencies discovered can be promptly corrected. Accordingly, the Laboratory Health and Safety Program requires prompt, accurate, and complete reporting of job-related accidents and incidents.

Specific reporting procedures for different cases are given below. For more details, refer to the Laboratory H&S manual, Sec. AR 1-1.

1. Reporting Fires. The fire-alarm boxes located throughout the facility may be used to summon the Fire Department. All fire alarms are transmitted directly to the Central Alarm Station (CAS) and are received simultaneously in the Central Control Room (CCR). To assure that an alarm has been properly received, you should also call the emergency number,

9-911, and report the fire (see Appendix A). Any minor fires that are extinguished by site personnel also must be reported immediately to the CAS (7-7080) so that possible secondary effects can be checked. If the Fire Department does not replace used fire extinguishers, please notify the HSO.

All fires and alarms, including false alarms, must be reported promptly to the CCR and the HSO (by the next workday, if it occurs after hours). Small fires that do not activate alarms also should be reported promptly, as above.

2. ***Reporting Industrial Accidents and Incidents.*** The Laboratory Health and Safety Program requires the prompt reporting of accidents involving injuries. If you have a job-related accident involving injuries, report it immediately to your supervisor and to the HSO. Incidents or near misses also should be reported to the HSO staff so that they can assist line management in preventing a similar accident or incident in the future.

3. ***Reporting Radiation Occurrences.*** Any radiation occurrence involving a spill of radioactive material, suspected exposures greater than normal, or an incident that might result in public inquiry must be reported promptly to the Accelerator Health-Protection Office (7-5890) or the Area A HP Office (7-7069) and to the CCR (7-5729); it must be reported by the next workday to the HSO (7-6176).

4. ***Reporting Vehicle Accidents.*** Any accident involving an official government vehicle (passenger vehicle, truck, fork lift, Truckster) must be promptly reported to your supervisor and to the HSO by the next workday. If the accident involves injuries, it must also be reported to the Safety Group, HSE-3.

All accidents involving road vehicles (passenger cars or trucks) must be reported to the HSO on GSA form 91, "Operator's Report of Motor Vehicle Accident" (a copy of the form must be kept in the glove compartment of each vehicle). Any off-site accident must also be reported to the local police.

The Los Alamos Police Department does not have jurisdiction in Laboratory technical areas but will investigate accidents in these areas, in response to requests, for insurance purposes. The police also investigate any accidents in these areas that involve injuries or an unknown vehicle.

5. ***Reporting Building Equipment Malfunctions.*** Any malfunction of building equipment, especially where it might involve personnel safety, should be reported promptly to the site Maintenance Inspector (ENG-5) at 7-5639. After hours, call on the paging system (dial 104-1154) and give the message. In particular, possible fire hazards and hazardous conditions in electrical or ventilation systems must be reported immediately. Malfunctions in an area where radioactive material or possible contamination exists must also be reported to the Accelerator Health-Protection Group at 7-5890 or 7-7069. All repair or modification of building equipment must be accomplished through ENG-5.

I. Safety Inspections and Appraisals

The effectiveness of a health and safety program can only be maintained by effective feedback from regular inspections and appraisals of all facilities and operations. With the data from these inspections, management can determine how effective the program is, how well the Safety Program Objectives are being met, and how reliably personnel are following the safety rules and procedures that govern their work.

The HSO shall organize a safety inspection each week to cover different areas of the MP-Division facility. The inspecting team attempts to identify safety problems and physical deficiencies and examines the procedures used by personnel in their work. Each inspecting team includes the HSO and HSE-Division site representatives and Group Safety Officers who are involved with the particular areas being inspected. Also, special reviews may be conducted periodically by HSE-Division personnel and Department of Energy Safety Representatives.

J. Fire-Protection Inspections

In coordination with HSE Division, the HSO shall conduct annual fire-protection inspections of all MP-Division facilities. The inspections cover fire-protection equipment in all areas to determine that it is adequate, that it is in working order, and that it has not been tampered with or compromised in any way, and to assure that changes in the MP-Division

Health and Safety Program and changes to Division buildings have been properly covered. The ultimate goal is to make sure that all facilities have adequate fire protection.

K. Correction of Deficiencies

According to the Safety Policy Statement in the front of this Handbook, the correction of physical safety deficiencies is to be given high priority. The identification of such deficiencies may come from safety inspections, from individuals, or from evaluations of accidents or incidents. The correction of identified deficiencies is to be given sufficient priority by responsible groups or building maintenance personnel to assure that they are corrected or are controlled in a timely manner. If you have questions or suggestions or need assistance about reporting and correcting such deficiencies, call the HSO at 7-6176.

L. Safety Training

Safety training is an essential part of the Laboratory and MP-Division safety programs. Many accidents and injuries can be avoided through adequate safety training of staff and users. The objectives of the Safety Training Program are

- to assure that all personnel know the health and safety rules and procedures required in their work,
- to increase awareness of safety in day-to-day work,
- to assure that personnel know how to perform their tasks in a safe manner, and
- to encourage safe attitudes and behavior in all personnel.

Safety training takes several different forms:

- Special safety training courses in various fields, such as electrical and radiation safety, are conducted by the Laboratory HSE Division and are sponsored by the HSO.
- Job-specific training is conducted by line supervisors for any employee assigned to a potentially hazardous job. The training covers the hazards in the job, the safety procedures that have been established to mitigate the hazards, the personal protective equipment the employee may be required to wear, and instruction in applicable standard operating procedures (SOPs) and special work permits (SWPs).
- Pertinent films and speakers are provided for group and division safety meetings; attendance is required.
- Courses in cardiopulmonary resuscitation (CPR) and first aid are given by the HSO.
- Special training is given to all persons who are working with liquid hydrogen or other cryogenic targets, with highly radioactive targets (for example, tritium targets), or with other hazardous systems.
- Courses for certifying fork lift and crane operators are given to the MP-Division staff.

For additional information on safety training refer to the Laboratory H&S manual, Sec. AR 1-4.

M. Working Alone

Working alone (out of sight or hearing of a second person who can aid in an emergency) is sometimes necessary at the Laboratory. However, such work is to be avoided in possibly hazardous situations and is absolutely prohibited in many common Laboratory situations. The main danger is that persons working alone could be injured in an accident and be unable to rescue themselves or notify emergency personnel.

Group leaders must evaluate working-alone situations on a case-by-case basis. Important considerations include

- the potential hazards of the work to be performed
- the employee's training and experience, and
- the existence of appropriate safeguards, together with the employee's knowledge of how to implement them.

Working alone is not permitted in particularly hazardous situations, including

- work with hazardous energized electrical equipment (see Electrical Safety section in this Handbook),

Fig. 2. LAMPF site entrance and exit gate system. The photograph shows the view when exiting the site with the gates open. Down the middle of the road are the exit badge reader, the center locking pole, the entrance badge reader, and the alarm and instrumentation shack. The radiation detector system is under the manhole cover in the center of the right exit lane.

- work in limited-access/confined spaces, and
- work on large power tools in a shop (for example, large mills and lathes).

For more details call the HSE-3 site representative at 7-1384 or refer to the Laboratory H&S manual, Sec. AR 1-8.

IV. Access Controls and Tour Procedures

A. *Badges*

LAMPF is an open facility of the Los Alamos National Laboratory. However, all personnel who work at the site, including users, are required to have Laboratory badges for identification; users must have and wear Visitors badges. Also, all personnel and users working at the site are required to have and wear a personnel dosimetry badge; any other visitor must be accompanied by a guide who is wearing one.

B. *Physical Security*

The LAMPF site (TA-53) is open to Laboratory staff, maintenance personnel, official visitors, and LAMPF and LANSCE/WNR users during normal working hours (Fig. 2). After hours and on weekends and

Fig. 3. Gate system with gates closed. The truck driver is inserting a badge into the badge reader to activate the exit gate-opening mechanism.

holidays, the entrance and exit gates to the site are controlled by a badge-reader system and are usually kept closed (see Fig. 3). To enter the site after hours the driver of a vehicle must stop at the badge reader and pass an official badge through the reader. If the badge is valid and this step is performed properly, the badge-reader system causes the gate to open and records the date, time, number of the badge, and the Z number of the badge holder. After the vehicle passes through the gate the system automatically closes the gate. Exiting the site after hours requires a similar procedure. Occasionally the system malfunctions, in which case it is switched over to key operation or the gates are locked open until repairs can be made.

The gates may be left open for construction contractors or special meetings, and sometimes they may be left open because of adverse weather conditions.

The outside doors to all buildings and trailers have security locks or padlocks and must be kept locked when unattended after hours. This is the responsibility of persons using any door during these times. Each person working at LAMPF is issued the necessary key or keys to permit free access to the site, buildings, and work areas as required.

C. Restricted-Access Areas

The LAMPF accelerator and experimental buildings, the Equipment Test Laboratory, and various other areas throughout the site, including some construction areas, have been designated Restricted-Access

areas because of the nature of the equipment in these areas and the possibility of exposure to radiation. The Nuclear Chemistry wing (D wing) and the basement of C wing of the Laboratory-Office Building (MPF-1) also are restricted areas. Only authorized persons, wearing personnel dosimetry badges, and properly escorted visitors are allowed access to these areas.

The following controls and procedures are mandatory for access to restricted areas in MP Division:

- Personnel dosimetry badges must be worn in a visible manner above the waist by all persons working at the site.
- All Laboratory employees, maintenance personnel, Department of Energy (DOE) employees, and guest scientists (users) who are wearing personnel dosimetry badges are considered knowledgeable of radiation in general and are authorized access to all available areas within the restricted zone, but they must always obey radiation barriers and signs.
- Family members may drive into the areas surrounding the accelerator and experimental buildings to discharge or pick up passengers. They are not required to have personnel dosimetry badges. However, they—and children in particular—must remain in the vehicle and are not permitted to wander around the area or enter any trailers or buildings, except for the lobby, auditorium, rest rooms, and lunch room in the Laboratory-Office Building.

  NOTE: Children are not allowed in laboratories, shops, or offices anywhere on the site.

D. Tour Approvals and Limitations

LAMPF is a popular tourist attraction for visitors to Los Alamos. Because of the nature of the program and the need to close areas at different times because of construction work or potentially hazardous operations, the HSO must coordinate and approve all tours of the facility.

- Anyone who plans to conduct a tour of LAMPF must be knowledgeable of the facility, must obtain prior approval from the HSO, and must wear a dosimetry badge.
- No one under 18 years of age may visit any LAMPF offices, shops, trailers, or operational facilities. However, persons 14 years of age or older are permitted on Laboratory-sanctioned tours.
- Arrangements for large group tours must be made through the Laboratory Public Affairs Office.
- Visitors on tour must be escorted by an authorized person wearing a dosimetry badge. Normally visitors are not issued dosimetry badges because the radiation levels in areas open to tours are so low that they would not receive a recordable exposure.
- Official visitors who have been authorized to enter the beam switchyard, Line D, and the PSR tunnel, or other restricted-access radiation areas, must be escorted by an MP-Division guide wearing a special dosimetry badge; special pocket dosimeters also may be required.
- Visitors normally are not permitted in construction areas or on the main floors of Areas A, B, or C. Area A may be viewed from the balcony if it has not been closed because of radiation from an experiment or target cell work. When Area C is open, the HRS may be viewed from the entrance tunnel, but visitors must stay off the main floor area. Visitors also are excluded from the Area A-East buildings and the Staging Area.
- Visitors normally are not permitted in the injector domes or on the elevated platforms in the injector areas, or in any high-voltage enclosures such as the rf system capacitor rooms or the beam-kicker power supply room.

V. Emergency-Preparedness Program

The MP-Division Emergency-Preparedness Program is designed to protect personnel, the general

public, and government property in the event of an emergency. The program includes plans and procedures specifying actions to be taken in case of industrial accident, fire, radiological incident, explosion, natural disaster, or civil disturbance. The program conforms to the laboratory Emergency Response Plan.

Basic actions to be taken in specific emergency situations are outlined in Appendix A and on MP-Division Emergency Procedures cards placed near telephones and at other strategic locations throughout the facility. During accelerator operations, the Chief Operator at the Central Control Room (CCR), 7-5729, is responsible for first-line operational safety and should be notified of any emergency. In such a situation the Chief Operator will provide assistance and other liaison functions as required, and the CCR can serve as a central point for communications.

To implement the Laboratory Emergency Response Plan, the Emergency-Preparedness Office (EPO) has been established at the Emergency Operations Center (7-6211). Any alarm received by the Central Alarm Station (7-7080) is also reported to the EPO for further investigation.

Principal Safety Rules and Procedures

I. Chemical Safety

A. Introduction

Although the work and research activities at LAMPF, except for those of the Nuclear Chemistry Group (INC-11), are primarily in the fields of engineering and physics, chemicals and toxic materials occasionally must be used in the preparation of targets and other pieces of equipment. The use of any chemicals, including solvents, requires various degrees of precautionary measures depending on the nature of the chemicals, how they are to be used, and the health hazards they present.

The purpose of this section of the Handbook is to provide some reminders of the basic safety precautions that should be used when working with chemicals (in accordance with the OSHA Hazard Communication Standard and the Laboratory H&S manual Adminstrative Requirements, Sec. AR 1-9). No attempt is made here to cover the field comprehensively. The important point is that workers limit or completely avoid contact with chemicals as much as possible. Every attempt should be made to prevent direct skin contact, to prevent inhalation of vapors, dusts, or mists, and to prevent ingestion. Also, protection of the eyes is vitally important.

B. Preliminary Safety Procedures

Before starting any work involving chemicals, be aware of some basic precautions:

- Know the physical characteristics of the chemicals to be used, their possible reactivity with other substances, and their flammability.
- Know the health hazards and toxic properties of the chemicals to be used and the symptoms and effects of overexposure. Refer to the Material Safety Data Sheets (MSDSs), if possible, for information about the chemicals you plan to use.
- Know the proper techniques for handling, mixing, storing, and disposing of hazardous chemicals.
- Determine what personal protective equipment is needed and know the reasons for its use, learn how to use it and care for it, and find out where it may be obtained.
- Determine the correct emergency procedures to use in case of a splash or spill.

C. General Procedures

The procedures governing a particular activity depend on the nature of the process and the chemicals to be used. However, the following activities can affect the safety of any chemical procedure:

- *Handling Incompatible Materials.* In use, storage, or in preparation for transport, incompatible chemicals (for example, acids, bases, other caustic or corrosive chemicals, and flammable solvents) require careful handling to keep them separated. Check with the HSO if there is any question about the chemicals you are using, particularly if they involve unconventional combinations of materials.
- *Labeling Materials and Containers.* Clear, accurate labeling of materials and containers is essential to the health and safety of workers handling chemicals. The use of a material that a worker mistakenly believes is something else can result in the loss of an experiment, or even in a disastrous accident.
- *Using Laboratory Glassware.* When inspecting laboratory glassware before its use, make sure

it is clean and in good condition; also, always check for cracks or indications of strain.

NOTE: Never use laboratory glassware for eating or drinking because of the possibility of previous contamination.

- *Opening Containers.* Most unopened bottles have an airtight seal. Because they are usually filled at a lower altitude than that at Los Alamos, the internal pressure may spray some of the material about when the bottle is opened. Therefore, when opening unused containers, be careful of possible spray. If the material in the container is potentially hazardous, wear face protection and appropriate protective clothing.

- *Storing Chemicals in Refrigerators.* Refrigerators directly from the factory have exposed electrical contacts inside and thus must not be used for storing flammable liquids. Some refrigerators in MP Division have been modified to move arcing contacts to the outside of the enclosure; these refrigerators must be so labeled. Do not store any flammable liquids in a refrigerator unless it has been modified and labeled. Also do not store food in a refrigerator that is used for chemical storage.

- *Using Safety Cans.* The primary use of a safety can is to store volatile flammable liquids in several-gallon quantities; glass bottles that hold more than 1 liter must not be used for storing flammable liquids. An approved safety can is an unbreakable metal can with a self-closing spout and a fine-mesh screen in the neck. The spout is designed to reduce spillage and to exclude air. The fine-mesh screen is a flame arrester to prevent flame from spreading from the spout into the main volume of fluid inside the can.

- *Handling Spray Cans.* The propellant in some spray cans may be toxic or flammable. Read the label when starting work with a new spray can. If the propellant is toxic or flammable, use the spray with adequate ventilation and away from heat and flame.

D. Personal Protective Equipment

To limit hazardous exposures, persons working with chemicals may be required to wear special personal protective equipment to supplement other controls. The degree of the health hazards that a chemical operation presents should determine the amount and type of personal protective equipment required for a particular operation.

- For protection from exposure primarily through the skin, wear impermeable gloves, an apron, and possibly sleeves.
- If there is a possibility of splashes into the eyes, wear goggles and a face shield.
- If the hazard is by exposure from inhalation, use a suitable respirator.

Contact the HSO or the HSE-11 Group Office for assistance with selecting and obtaining the proper personal protective equipment for a particular job.

E. Storage and Disposal of Chemicals

When a job is completed, chemicals preferably should be disposed of rather than stored. The general procedures to be followed in MP Division for storing chemicals include the following:

- Incompatible and reactive chemicals must be segregated.
- Chemical containers must be clearly labeled. The label also should show the date the chemical was received and the date the container was opened.
- Unopened chemicals should be disposed of within 6 months.
- Opened chemicals should be kept no longer than 3 months.
- Chemicals should not be left in hoods that are designated for general use.
- Flammable chemicals must not be stored in a laboratory or shop in containers that hold more than 1 liter; they must be stored in safety cans in storage cabinets especially designed for flammable chemicals.
- Chemicals should be disposed of through HSE-7 according to the H&S manual, Sec. AR 10-3.

F. Emergency Procedures

Everyone working in laboratories or shops at LAMPF should be aware of the procedures to be used in a chemical accident.

- *Chemicals splashed on the skin.* Promptly wash off with copious amounts of water. Removal of clothing also may be advisable.
- *Chemicals splashed into the eyes.* Immediately flush with water and continue flushing for at least 15 minutes. Use an eyewash fountain if available.
- *Clothes catch on fire.* Immediately place the person in a deluge safety shower or roll him or her in a blanket, rug, or any other material that will smother the flames.

To obtain assistance in emergencies, call the Fire Department at 9-911, the CCR at 7-5729, or the Area A HP Office at 7-7069.

II. Cryogenic Materials and Equipment

The principal hazards associated with most cryogenic systems are from the extremely low temperatures, from the high pressure associated with changing ratios of liquid-to-gas volumes (provision must be made to vent such gases safely), and from the possibility of large releases of gases in a closed area, which could cause asphyxiation should the sudden evolution of gas displace much-needed oxygen. The low temperatures also affect the strength of some common structural materials and make them brittle, and human tissue can be easily destroyed at cryogenic temperatures.

Unwanted gases, such as air entering through a leak, can be condensed at these ultralow temperatures and build up in unexpectedly large quantities. Many systems contain thin, highly stressed windows, and gas buildup can cause these windows to break without warning, releasing a high-velocity spray of debris and cryogenic liquid.

Personnel should always wear eye protection and gloves when working with cryogenic materials, and protective equipment is particularly necessary when working around systems with thin windows.

The design of cryogenic systems requires special precautions. Because many of the hazards are not obvious to designers and operators, designs for all new systems must be reviewed and approved. The LAMPF Cryogenic Section of MP-7 should be contacted for advice and assistance.

Liquid nitrogen is the most commonly used cryogenic material at LAMPF. Although its use requires no special approval, personnel should be careful in its handling and transfer, as with all cryogens.

Liquid helium is receiving greater use at LAMPF, but it is the handling of liquid hydrogen that is of the greatest concern because of the potential for explosions. Systems using this material require special handling, and personnel using it must have special training.

All systems using liquid hydrogen must be reviewed and approved by the HSO and the Laboratory Compressed and Liquefied Gas Committee.

Cryogenic systems in confined areas require additional precautions (for example, oxygen monitors). All such systems and operations must be reviewed and approved by the HSO.

III. Electrical Safety

A. Introduction

The ability of the human body to withstand electrical currents passing through it is so small that most electrical systems can be considered hazardous to health and life. Because of the variety of electrical systems used in MP Division, electrical safety is an important part of the health and safety program.

The hazards of conventional residential, commercial, and industrial electrical systems and equipment generally are well recognized and are well covered by the National Electric Code (NEC). The NEC has been adopted as a national consensus standard by OSHA to assure proper safeguarding of persons, buildings, and property from hazards arising from the use of

electricity. However, MP Division has unique electrical and electronic systems. Because special hazards can arise from the wide variety of operations and equipment used in these systems, existing codes and standards often must be supplemented to assure the safety of these special operational and research applications.

The full scope of the electrical safety rules and regulations is too broad to include in this safety handbook. The Laboratory H&S manual and the references at the end of this MP-Division Handbook are recommended for those desiring more details.

The discussion here covers selected electrical safety criteria that include

- electrical safety administration,
- design and construction of electrical equipment,
- installation of electrical equipment,
- maintenance of electrical equipment, and
- special safety procedures unique to MP Division.

B. Electrical Safety Administration

In electrical safety, as in all aspects of the MP-Division Safety Program, the line of responsibility passes directly from the Division Leader down through the Group Leaders and supervisors to each individual. Line managers must assume responsibility for the safety of the equipment and activities in their respective operations, and they must assure that all their personnel are thoroughly knowledgeable about the electrical hazards involved in their work and thoroughly trained in applying the rules that have been established for their safety.

Each new experiment, or major revision of an existing experiment, must be reviewed for electrical safety. Periodic reviews of existing programs involving electrical equipment also are conducted to ensure that cumulative additions and modifications have not introduced new unprotected hazards or compromised the protection previously provided.

C. Electrical Safety Criteria

Each person who is involved with design, construction, installation, or maintenance work on electrical equipment in MP Division must be familiar with, and apply, the requirements of the electrical safety sections of the Laboratory H&S manual (Sec. 7) and the DOE Electrical Safety Criteria for Research and Development Activities.

D. Design and Construction of Electrical Equipment

The following general safety criteria are to be used in the design and construction of electrical equipment. The details of the electrical safety design depend on the specific piece of equipment or system and its use.

- Provide physical barriers to prevent personnel from contacting energized parts. Enclose equipment that operates at potentials greater than 50 V and insulate connections. Digital equipment normally does not pose a serious hazard except for its power supply; however, it should be covered or enclosed to protect it from damage from external objects.
- Provide protective covers or barriers for high-voltage terminals and also for low-voltage terminals where high currents are accessible.
- Design protective devices, equipment, and systems to be fail-safe wherever practicable.
- Provide clearly visible power controls so that equipment can be turned off easily in an emergency.
- Provide warning or pilot lights to clearly indicate when equipment is energized.

E. Installation of Electrical Equipment

The proper installation of electrical equipment is vital to the safety of the operation, and is as important for experimental equipment as it is for operational equipment.

Following are some general guidelines for electrical installation work:

- Install signal cables only through cable trays. The draping of cables over equipment or across the floor is discouraged.

  NOTE: Under no circumstances shall MP-Division personnel, or users, install electrical power cables between their equipment and

a power-distribution panel; this work must be performed only by electricians. Personnel may connect cables only to existing power receptacles.

- Keep power-outlet strips and extension-cord connections off the floors in the beam channels and experimental caves.
- Provide sufficient access and work space around electrical equipment for personnel safety during operation and maintenance.
- Identify hazardous areas and the nature of each hazard by installing warning signs and lights. Do not use a light by itself without a sign.
- Ground metal cabinets, enclosures, and structural components with easily recognizable, permanent grounding conductors.
- Clearly label all power-panel disconnects and circuit breakers as to the loads they control. This requirement applies to building circuits as well as laboratory, shop, and operational equipment.
- Provide safety grounding hooks for hazardous electrical equipment; such hooks must consist of a bare or visible conductor of adequate size and must be clearly bolted to the equipment ground.

F. Operation of Electrical Equipment

Following are general safety criteria for use in the operation of electrical equipment. Safety criteria for work on such equipment is covered under Sec. III.G below.

- Operation of dead-front, grounded electrical equipment is relatively safe, but as soon as work must be done inside that equipment, other safety rules apply (see Sec. III.G below).
- When starting to work with a new experimental or operational setup, check to be sure that the equipment is properly grounded and that there are no exposed high-voltage terminals or components.
- Before starting to work on three-phase equipment, check the direction of rotation, particularly where injury to personnel or damage to equipment could result. Three-phase wiring apparently is different in the various buildings on site, and caution should be exercised.
- Up-to-date drawings and instructions must be maintained for all test and control equipment, power supplies, and experimental apparatus. All pertinent electrical drawings must be promptly corrected if a circuit is changed or wiring is altered.
- All portable electric-powered equipment either must be double-insulated and have a UL label or must have functioning three-wire cords and three-prong plugs; pigtail ground wires on two-wire plugs are not acceptable.
- Minimize the use of extension cords. Equipment should be connected directly to the power outlet if possible. Do not run extension cords across the floor where people might walk on them.
- Never handle electrical equipment when hands or feet are wet or when standing on a wet floor.
- Keep the work place as uncluttered as conditions permit.
- When it is necessary to touch electrical equipment (for example, when checking for an overheating motor), always use the back of the hand in case of accidental shock.
- Keep in mind that interlocks in some equipment may only disconnect the high voltage when a cabinet door is opened; power for control circuits may remain energized.
- Test safety interlocks regularly to ensure that equipment changes have not compromised their function.

G. Work on Electrical Equipment

Minimizing the risk of accidents is fundamental to safety during work on electrical equipment (Fig. 4). The discussion here contains the essential procedures to be followed when working on electrical equipment used in MP Division. Table I, taken from DOE Criteria (DOE/EV-0051/1), shows the classes of electrical hazards and the restrictions imposed for work on electrical equipment in these classes under specified conditions or modes.

TABLE 1 MINIMUM PERSONNEL AND ADMINISTRATIVE *REQUIREMENTS* FOR WORK ON ELECTRICAL EQUIPMENT*		WORKING MODES		
		MODE 1	MODE 2	MODE 3
		MINIMUM HAZARD SITUATION All operations performed with equipment in a "positively de-energized" state and locked out and tagged if possible.	MODERATE-TO-SEVERE HAZARD SITUATION Manipulative operations performed with equipment in a "positively deenergized" state, and locked out and tagged if possible. Equipment functions monitored from a safe distance with equipment energized and normal protective barriers removed.	SEVERE HAZARD SITUATION Manipulative and monitoring operations performed from a safe distance with equipment energized and normal protective barriers removed.
ELECTRICAL HAZARD CLASSES	CLASS A All four conditions are satisfied: 1) Primary ac voltage does not exceed 130 V (rms). 2) Primary ac current is limited to 30 A. 3) Stored energy does not exceed 10 J. 4) dc or internal secondary ac voltages either do not exceed 30 V between terminals or to-ground or have power limits of 150 VA.	A-1 •May work alone.	A-2 •May work alone. •Confined or massive ground spaces require two-man rule.	A-3 •Two-man rule at all times. *Low-voltage (<30 V) solid-state logic and analog systems are excluded from Class A if the ac power feeding the units is covered. Thus, work on these units does not involve the two-man rule.*
	CLASS B Any one, or more, of the following conditions are present: 1) Primary ac voltage exceeds 130 V (rms). 2) Primary ac current exceeds 30 A. 3) Stored energy exceeds 10 J. 4) dc or internal secondary ac voltages exceed 30 V between terminals or to-ground and have power limits exceeding 150 VA.	B-1 •Two-man rule until "positively deenergized." •Lock-and-tag procedure required. •May work alone.	B-2 •Two-man rule at all times. •High-hazard equipment may require a Special Work Permit (SWP).	B-3 •Two-man rule at all times. •Safety watch required. •Special Work Permit (SWP) required.

*Does not eliminate the need to follow other applicable SOPs.

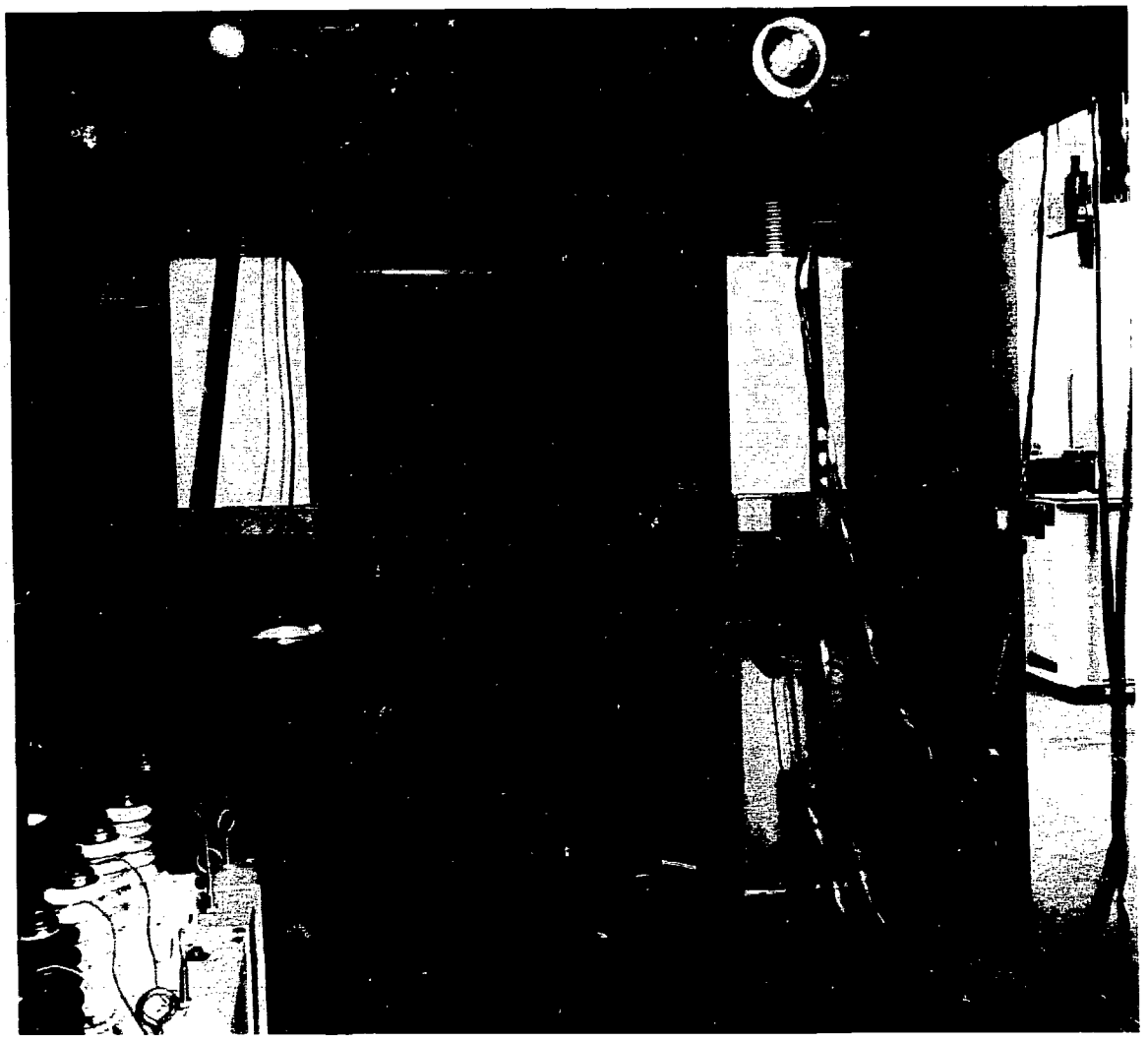


Fig. 4. An energy-storage capacitor bank enclosed in a metal room with a redundantly interlocked door and permanent grounding hooks. The grounding hooks hang inside across the entry door during operation.

- Work on potentially hazardous electrical equipment should only be done when the equipment is in a positively deenergized state.
- When it is necessary to work on energized equipment other than low-voltage, digital-logic (computer) equipment, a second person must be present and special precautions must be followed, depending on the hazard involved.
- When an individual is working with hazardous electrical equipment, a second person capable of helping in an emergency must be present. This requirement is known as "The Two-Man Rule." The second person should be knowledgeable of the work, be within sight or sound of the worker, and be able to help in case of an emergency. In an electrical emergency the second person should turn off the power, call for help if necessary, and then, being careful not to become part of the emergency, attempt to rescue the individual, applying CPR or first aid as required.
- Work on hazardous energized equipment that has interlocks disabled, enclosures open, or barriers removed should be permitted only as a last

resort. If such work is necessary, a Special Work Permit for Electrical Work (H&S Form 7-1A) is required and it must be signed by the immediate supervisor and the group leader.

- When an individual is working on an electronic chassis, turning off the power at the front switch is not sufficient. The power cord must be unplugged from the power outlet.
- Working alone on energized digital-logic circuits may be permitted if the low-voltage power source is external or is enclosed. Work on the low-voltage power source requires that it be completely deenergized.
- Capacitors and high-voltage power supplies must be visibly grounded before any work is performed on them. The grounding hook conductor must be rigidly fastened to a secure ground; clip-on attachment methods are not acceptable.
- Workers entering a high-voltage enclosure must wear eye protection, and a second person must stay by the entry door while the first person applies the grounding hook(s) to discharge all energy sources.
- Do not enter a high-voltage enclosure (such as a capacitor room) if there is any visible damage unless you have group leader or division level approval.
- High-voltage capacitors must be securely grounded when not in use. Dual grounding is recommended for these lethal hazards.

H. Lock and Tag Procedures

It is an absolute MP-Division requirement that before work is started on or in any exposed potentially hazardous electrical or mechanical equipment, the equipment must be isolated from the energy source or sources. It is also a requirement that the isolation device be secured with a padlock, if possible, and that it always be identified with a red danger hold-off tag (see Fig. 5). Each person responsible for a particular task must assure that his own lock and tag are installed for the work and must not depend on locks installed by others. Equipment with a plug-in cord should be unplugged, and a red hold-off tag must be attached to the plug.

For assistance with lockout procedures, contact appropriate MP-Division personnel as follows:

- Equipment in an experimental cave—the Channel Safety Representative.
- All other experimental area equipment—the MP-7 Area Manager's Office (7-7066).
- Equipment along the accelerator including the switchyard—Group MP-2 Operations Section (7-6929).
- Equipment along Line D and at the PSR—Group MP-5 (7-2778 or 7-6069).
- Equipment located in or around the LOB—the HSO (7-6176).

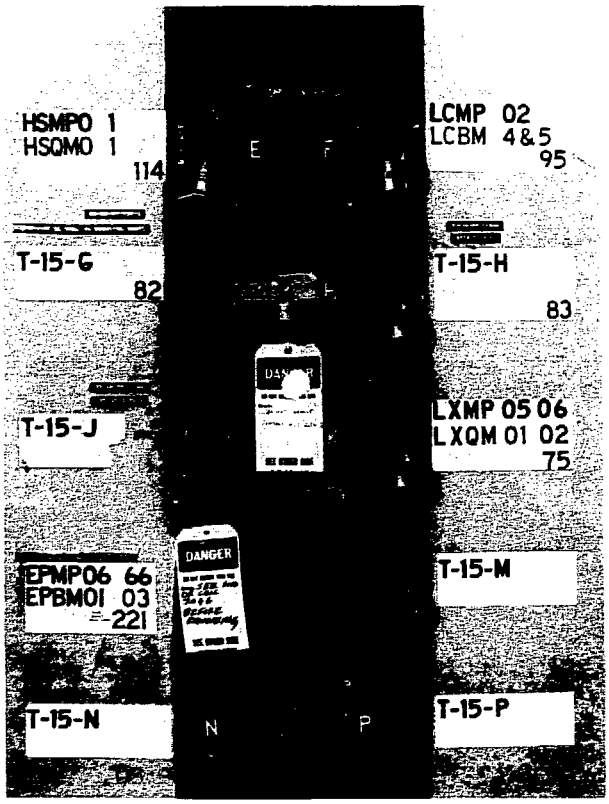


Fig. 5. A 480-V power distribution panel with the breakers locked out and tagged. The multiple lockout device is preferred. Each breaker is clearly labeled as to its designation and load.

Table II.[a] Effects of Electrical Shock on a 150-lb Man.

Current (60 Hz)	Physiological Phenomena	Feeling or Lethal Incidence
<1 mA	None	Imperceptible.
1 mA	Perception threshold	
1-3 mA		Mild sensation.
3-10 mA		Painful sensation.
10 mA	Paralysis threshold of arms	Cannot release hand grip. If no grip, victim may be thrown clear. (May progress to higher current and be fatal.)
30 mA	Respiratory paralysis	Breathing stops. (Frequently fatal if not treated promptly.)
75 mA	Fibrillation threshold 0.5%	Heart action is discoordinated (probably fatal).
250 mA	Fibrillation threshold 99.5% (>5-s exposure)	
4 A	Heart paralysis threshold (no fibrillation)	Heart stops during current passage, restarts normally on current interruption. (Usually not fatal from heart dysfunction.)
>5 A	Tissue-burning	Not fatal unless vital organs are burned.

[a]R. H. Lee, "Electrical Safety in Industrial Plants," *IEEE Transactions on Industry and General Applications* IGA-7, No. 1 (January/February 1971).

- Equipment located in or around the ETL—the MP-8 Group Office.

For more details, obtain copies of "General Lock and Tag Procedures at LAMPF" (MP-2 SOP #224) from the MP-2 Group Office. Also see the Laboratory H&S manual, Sec. AR 8-6.

I. Effects of Electrical Shock on Man

Accidental contact with electrical energy accounts for about one-tenth of the fatal injuries in the atomic-energy industry. Electrical accidents account for a significant number of all serious injuries. Table II summarizes the results of research on the possible quantitative effects of electric currents on man.

IV. Fire Protection

A. Policies

The Laboratory and MP-Division policies for fire protection are essentially to minimize fire risk to personnel and property through sound engineering design and safety procedures based on current national codes and standards. These are supplemented by special procedures based on the nature of specific programs, by special efforts to minimize combustible materials, and by a continuing educational effort. However, the basic responsibility for fire safety rests with each individual working at the Laboratory and using its facilities.

B. Fire-Protection Systems

Most buildings and many of the trailers on the LAMPF site are protected by fire-detection systems incorporating smoke or heat detectors. Many buildings are also protected by sprinkler systems, and some computer rooms and many of the experimental trailers are protected by automatic Halon systems.

When an alarm is triggered, the signal is sent directly over telephone lines to the Central Alarm Station. The alarm also is received simultaneously in the CCR, and local evacuation alarm systems are automatically set off. Portable fire extinguishers are placed at strategic points throughout the Laboratory-Office Building and in all shops and operational areas.

Most buildings on the site have fire doors, or fire-rated doors, to limit the spread of fires. A fire door must never be blocked open; however, doors that have fusable links in the hold-open device may be left open. The doors along the service corridor of the 805-MHz linac have closers that are tied into the local fire-alarm system; these doors close automatically in case of a fire. In accordance with the Life Safety Code, exits to buildings, trailers, or other work areas must never be blocked in such a way that they cannot be used for rapid egress.

C. Fire-Alarm Procedures

A primary concern in the event of a fire is the safe evacuation of people from the scene of the fire. Each building on the site has its own separate fire-alarm warning-horn system. The horns are located throughout each building and emit a loud, slow, whoop-like sound. The trailers that have fire-alarm systems each have a loud bell and a red strobe light mounted on the outside of the trailer or on the power pedestal.

If an alarm is sounded, everyone should prepare to evacuate the building or area immediately and then attempt to determine the cause of the alarm; if there is any doubt about the cause, proceed with evacuation.

If a Halon system is triggered, evacuate the room, area, or trailer immediately. Because of the possibility of toxic fumes, it is recommended that you do not reenter the area until the Fire Department has checked it. Note that automatic Halon systems do not displace enough oxygen to cause asphyxiation.

Fire alarms frequently are set off by welding operations or fork lift exhaust. These alarms are not considered false alarms and they provide tests of the systems. However, personnel should not become complacent about any alarms; *never* completely ignore a fire alarm.

The Fire Department should arrive about 6 to 8 minutes after it receives an alarm. In the meantime, if you find that it is a real fire, make sure that everyone gets out of the building safely. Do not return to the building until it has been determined that it is safe to do so. If on hearing an alarm horn you are in doubt as to which building or area the alarm applies to, evacuate your building and then determine the source of the alarm.

D. Basic Fire Procedures

Whenever a fire occurs, the first step is to send in an alarm to the Fire Department; pull a fire-alarm box and dial 9-911. Also call the CCR at 7-5729, even though the fire can be controlled with a hand extinguisher.

If a small fire cannot be extinguished completely within a few minutes, the next step is to evacuate the building in case the fire should get out of control. Then immediately notify the HSO (7-6176). The possibility of related problems occurring is real, and the expertise of trained fire fighters is required to extinguish a fire and to check that it is completely out.

Personnel also are cautioned never to risk their own safety by trying to put out a fire that has grown out of control; let the Fire Department take care of it.

Any use of a fire extinguisher must be reported promptly to the HSO so that the extinguisher can be refilled.

Fig. 6. Types of fire extinguishers found in MP-Division facilities. From left to right are a pressurized water extinguisher for use on paper or wood fires, a dry-chemical extinguisher for use on either Class A (paper) or Class B (flammable-liquid) fires, and CO_2 and Halon (Freon-type) extinguishers that are primarily for use on electrical fires but that also can be used on flammable-liquid fires.

E. Fire Extinguishers

Every person working in MP-Division facilities should understand the proper type of fire extinguisher to use on different kinds of fires (Fig. 6). It is vitally important that the correct extinguisher be used; using the wrong extinguisher can cause a fire to spread, cause an explosion, or cause an electrocution.

1. Classes of Fires. Fires generally fit into four categories:

Class A — involves paper, wood, cloth—the ordinary combustible materials found in offices, computer rooms, and storage areas.

Class B — involves grease, gasoline, oil, and other flammable liquids.

Class C — involves electrical equipment.

Class D — involves combustible metals.

2. Types of Fire Extinguishers. Fire extinguishers are clearly marked as to the type of fire for which they are designed. Some extinguishers may be used on more than one type of fire. However, a water extinguisher must never be used on an electrical or flammable-liquid fire.

3. Using Fire Extinguishers. Fire extinguishers are effective on small fires if they are used properly.

1. Select the correct extinguisher for the fire.
2. Pull the safety pin.
3. Test the extinguisher with a short shot before approaching the fire.
4. Aim the extinguisher nozzle at the base of the fire.
5. Squeeze the trigger to release the material.
6. Remember that the contents of extinguishers—water, chemicals, CO_2, or Halon—come out under pressure. Be careful not to blow the burning material around and cause the fire to spread.

4. Access to Fire Extinguishers. Fire extinguishers are located throughout MP Division. Obstructions

must not block access to these extinguishers or obscure them from view.

5. *Recharging Fire Extinguishers.* Fire extinguishers must be kept fully charged and in their designated places, and they must be checked periodically to ensure that they are charged and have not been used or tampered with.

If an extinguisher has been used or appears to be faulty, report it promptly to the HSO (7-6176) so that arrangements can be made to have the extinguisher serviced and recharged.

F. Basic Fire-Prevention Procedures

1. Housekeeping.

- The accumulation of combustible materials, such as cardboard boxes, paper of all kinds, packing material, and wood, must be minimized in all work areas, offices, computer rooms, and storage areas.
- Bags, boxes of parts or paper, and stacks of computer printouts and drawings must be stored in cabinets (preferably metal) to minimize possible sources of fuel for a fire. The storage of such materials and equipment on top of cabinets is strictly prohibited.
- Rags must be kept in closed metal containers and disposed of promptly after use.
- Flame-Tamer trash receptacles are to be used in all control rooms, counting houses, and trailers; open-type wastebaskets are not permitted. Approved receptacles and Flame-Tamer heads are available from Stock:
  - *Cease-Fire Receptacle:*
    12-gal drum, LG 1112;
    15-gal drum, LG 1113.
  - *Flame-Tamer Head:* LG 1683.
- Solvents in work areas must be stored only in small quantities (less than 1 liter); larger quantities may be stored in approved metal safety containers or in special cabinets designed for storing flammable liquids.
- At no time should a building exit be blocked by material, furniture, or equipment.
- Offices, laboratories, and electronics trailers must not be used for storing experimental equipment without prior HSO approval. Storage facilities for parts and equipment are available either through the MP-Division Property Office or the HSO.

2. Maintaining the Integrity of Fire-Protection Systems.

- Access to portable fire extinguishers must never be blocked; extinguishers must always be visible and accessible.
- Access to any fire-detection equipment, such as smoke and heat detectors, must never be blocked, and such equipment must not be covered, even temporarily, without first contacting the HSO.
- Access to automatic extinguishing equipment, such as sprinkler systems, must never be blocked, and workers must not hang equipment or cables on the piping or use the piping to support such equipment.

3. Avoiding the Use of Combustible Materials. The use of combustible materials (wood, plywood, plastics) in the construction of experimental apparatus or models should be avoided; use fire-retardant materials whenever possible. Fire-retardant plywood is available through Stock.

Styrofoam and similar plastics produce copious quantities of black smoke when burning and thus can cause extensive smoke damage, even in a small fire. Also, some burning plastics produce highly toxic fumes and vapors.

Plans to construct temporary structures or enclosures in a shop or laboratory should be cleared with the HSO.

4. Caring for Electrical Equipment. The quantity of electrical equipment used throughout the site warrants special attention to prevent electrical fires. In particular, fires are frequently caused by faulty electric cords and by dirt or grease in the equipment. Basic precautions include the following:

- Frayed or faulty cords must be replaced promptly.
- Proper maintenance must be given to all electrical equipment.

- Electric cords must not be run outside without proper water protection.
- Electric cords must not cross floors where they may be walked on.
- Electrical interlocks must not be by-passed or rendered inoperative unless a clear warning sign is posted and the Operations Group is notified.

G. Trailers and Modular Buildings

The HSO and the Laboratory Safety Office (HSE-3) review and approve plans for each trailer and modular-building installation at LAMPF to ensure that they meet accepted fire-protection standards. It is the responsibility of all persons using trailers to see that they do not create a fire hazard to their trailer or to adjacent trailers. The HSO will advise as to the need for fire-detection systems and will recommend the type of system best suited for your needs.

H. Welding, Cutting, and Flame-Producing Operations

Approval must be obtained from the appropriate Building/Area Coordinator or the ENG-5 representative before any welding, cutting, or other flame-producing operation can be performed outside previously designated welding shops. A Special Work Permit for Spark/Flame-Producing Operations (H&S form 8-4A) must be obtained, filled out, and signed by the supervisor in charge of the operation and by the Building/Area Coordinator for the area involved. (Reference: H&S manual, Sec. AR 8-4.)

I. Fire-Protection Questions

If you have a question about fire protection or related procedures, or are aware of some activity or condition that may compromise fire safety at an MP-Division facility, please call the HSO (7-6176).

V. Hazardous Waste Control

A. Policies

The control of waste that is hazardous to health is a vital and complex operation and is governed by special procedures. These procedures must be followed in the disposal of liquid and solid chemical wastes to ensure the protection of personnel, the public, and the environment, as well as to conform with federal and state regulations.

Hazardous waste consists of radioactive liquid and solid materials and nonradioactive chemical and solid wastes. Hazardous chemical waste includes any chemical or mixture of chemicals intended for disposal that is corrosive to living tissue, that is toxic or flammable, or that is in any way a hazard to human health or the environment. Chemical wastes commonly generated in the laboratories and shops include all types of research chemicals, oils, solvents, special compressed gases, and other solid or liquid wastes that are contaminated with hazardous chemicals.

The Laboratory requires groups to keep their waste generation to as low a volume as is reasonably achievable. The handling and disposal of radioactive wastes is coordinated by HSE-11; nonradioactive waste disposal is coordinated through the HSO. Group HSE-11 will assist in this operation by coordinating the disposal with other HSE-Division groups.

B. Waste-Disposal Procedures

The procedures to be used in disposing of waste products from LAMPF operations differ widely depending on the nature of the material.

- *Radioactive Waste.* Call the HSE-11 group office.
- *Nonradioactive Waste.* For nonhazardous materials call the MP-Division Property Office; for hazardous or toxic materials call the HSO.
- *PCBs.* The disposal of equipment contaminated with polychlorinated biphenyl (PCB) oils requires special procedures; call the HSO for assistance. (Reference: H&S manual, Sec. AR 10-4.)

Do not dispose of chemical wastes and oils by dumping them down a sink drain. All site drains are connected to the sewage lagoons through the sanitary sewer system, and chemical wastes may degrade the functioning of the lagoons.

For more detailed information refer to the Laboratory H&S manual, Sec. AR-10. Also see XIV below for more information on special procedures for the disposal of radioactive materials.

VI. Industrial Health

A. Hazardous Materials and Processes

Hazardous materials include acids and bases, adhesives and epoxy resins, asbestos, flammable and combustible liquids, mercury, solvents, polychlorinated biphenyl (PCB) insulating oils, and any other material that can be harmful or pose a threat to the safety of personnel. Hazardous processes include cleaning using acids, bases, and solvents, working with adhesives and epoxy resins, electroplating, sanding and spray painting, cutting and brazing, and welding.

The list of such materials and processes is long and complex, and details cannot be given here. However, manufacturers and suppliers must provide Material Safety Data Sheets that discuss the hazards associated with using a material and that recommend specific precautions to use when handling, using, or storing that material. The law now requires that these data sheets be available to all persons using these materials.

Toxic chemicals and materials are strictly controlled by the Laboratory. Use of carcinogenic items requires prior approval by HSE-5. They frequently suggest substitute materials and assist with special handling procedures.

To ensure that proper procedures are used by guest scientists in handling toxic materials, no such materials may be brought to LAMPF from outside the Laboratory without prior approval from the HSO.

Some basic precautions to take when working with hazardous materials follow:

- Practice good personal hygiene. This is essential for anyone working with hazardous materials. Always wash your hands after handling any such materials.
- Wear proper protective clothing and gloves to prevent contact with potential skin irritants.
- Use a face shield and goggles if there is the slightest possibility of the material splashing on you.
- Avoid breathing the vapors or dusts of hazardous materials. Breathing toxic vapors can cause chest pain, throat irritation, and chronic poisoning, and may affect the nervous system. Work with such materials must be performed under adequate local exhaust ventilation or with an approved respirator.
- Practice good housekeeping and proper waste disposal. These habits are vitally important to a safe operation.

Materials that are potentially hazardous to health include the following:

- *Acids and Bases.* Acids and bases can cause burns of the skin, eyes, and mucous membranes. Cleaning operations using such materials should only be performed under a properly ventilated hood with appropriate personal protective equipment.
- *Adhesives and Epoxy Resins.* The components in some adhesives, and in all epoxy resins, are sensitizers and potential skin irritants. They should be regarded as particularly hazardous materials, and persons using these substances must take special precautions. Work involving these materials should always be done in a well-ventilated area, preferably under a chemical fume hood.

  Avoid contact with these materials by practicing the highest degree of personal hygiene and by using appropriate protective equipment. The residues and contaminated papers and rags must be handled carefully and must be disposed of properly.
- *Asbestos.* Because of its potentially hazardous effects on the lungs, asbestos and materials made of or containing asbestos must *not* be used in any new construction, equipment, or applications in MP Division. Appropriate substitute materials are available through the HSO. Any asbestos that is not part of existing building construction or equipment should be disposed of through the HSO. Existing asbestos already built into certain facilities or pieces of equipment on site has been identified by HSE, has been rendered or is deemed safe, and is appropriately marked.
- *Flammable and Combustible Liquids.* These liquids are categorized by their ease of ignition.

A flammable liquid is one with a flash point at or below 100°F; a combustible liquid has a flash point in general in the 100 to 200°F range. Examples of flammable liquids include gasoline, acetone, and lacquer thinner; examples of combustibles are kerosene, fuel oil, and some solvents.

Extreme care and proper procedures are essential when working with flammable or combustible liquids.

- *Mercury.* The use of mercury in a laboratory or shop requires careful control to avoid spills. Should a spill occur, it must be promptly cleaned up and your supervisor and the Safety Office immediately notified. When large quantities of mercury are to be used, an SOP must be prepared and approved to cover the handling of the mercury and to determine cleanup procedures in case of a spill.
- *Polychlorinated Biphenyl (PCB) Insulating Oils.* Some high-voltage transformers, capacitors, and power supplies have PCBs instead of mineral or other insulating oils. PCBs also have been used in a wide variety of manfacturing processes.

  PCBs can be a hazard to health and to the environment. All containers and devices containing PCBs must be clearly labeled, and any leak or spill of such material must be properly contained and promptly cleaned up. Disposal of PCB oil and material contaminated with PCB oil requires special procedures conforming to federal regulations (see Sec. V above).
- *Solvents.* Solvents can be hazardous because of their narcotic properties, because of the danger of asphyxiation caused by the displacement of oxygen when solvents are used in confined spaces, and because of possible flammability. Exposure is usually by inhalation, but can also be by absorption through the skin.

  Their use in large quantities in poorly ventilated areas must be avoided. Where it is impractical to control solvent vapors with ventilation, an approved respirator must be used.

A complete list of potentially toxic materials is beyond the scope of this Handbook. Such materials range from benzene and carbon tetrachloride to oxalic acid and sulfuric acid, from beryllium and cadmium to lead and zinc. Whenever there is any question about the safety of a material you plan to use, check the Material Safety Data Sheets, contact the HSE-11 group office, or ask the MP-Division Safety Office.

B. Hoods and Local Ventilation

An important element in protecting the health of personnel is to keep the air they breathe free from concentrations of dusts, fumes, vapors, or gases. Some form of localized mechanical exhaust ventilation system is, in general, the first choice for the control of air contaminants that may be potential health hazards. Such systems include chemical fume hoods, slot exhaust hoods and local exhaust ducts for soldering areas and welding shops, and vacuum cleaner-type dust catchers for wood and machine shops.

- *Chemical Fume Hoods.* The chemical fume hood is the preferred type of local ventilation for controlling hazardous materials, chemical fumes, and flammable vapors in processes involving the use of lead, mercury, epoxy resins, beryllium, and similar materials.

  The important factor that makes the hood efficient is air velocity. The velocity at the face of the hood varies according to the amount the sash (sliding front window) is open. When the sash is completely open, the velocity of air flowing past a process in the hood is less than if the sash were partially closed. Up to a point, the more a process is enclosed by the ventilation system, the better the control of contaminants and the protection of personnel.
- *Local Exhaust Ventilation.* Local exhaust ventilation is designed to capture contaminants as close to the point of release as possible. The slot hood on a soldering bench is an example. With such a hood the fumes from a soldering operation are carried away as they are generated. However, this type of ventilation requires that work be done as close as possible to the hood and not, for example, on the floor some distance away.

- *Vacuum Cleaner-Type Exhaust Systems.* The dust collectors used with a belt sander or saw are examples of the vacuum cleaner type of local exhaust system. These are designed to capture the dust contaminants close to their source. Note that these systems are useful for relatively large particle contaminants (dust); a vacuum cleaner-type exhaust system is not effective for fine dust, fumes, or gases unless it has an appropriate filter or is equipped to discharge collected materials to a container outside the work space.

CAUTION: Do not use hoods for any process where perchloric acid fumes, corrosive vapors, or overspray from spray painting can contaminate the hood or the exhaust duct surfaces. Check your use of a hood with your supervisor or the MP-Division Safety Officer.

C. Limited-Access and Confined Spaces

Enclosures with limited openings for entry or exit may prevent a worker from being seen from the outside and hinder rescue should the worker be injured. Confined enclosures also may lack adequate ventilation or contain life-endangering conditions such as flammable, toxic, or asphyxiating atmospheres (Fig. 7). These conditions could arise from the previous use of the enclosure or from current operations, such as welding or cleaning. Spaces that have been closed for a long time also may be deficient in oxygen.

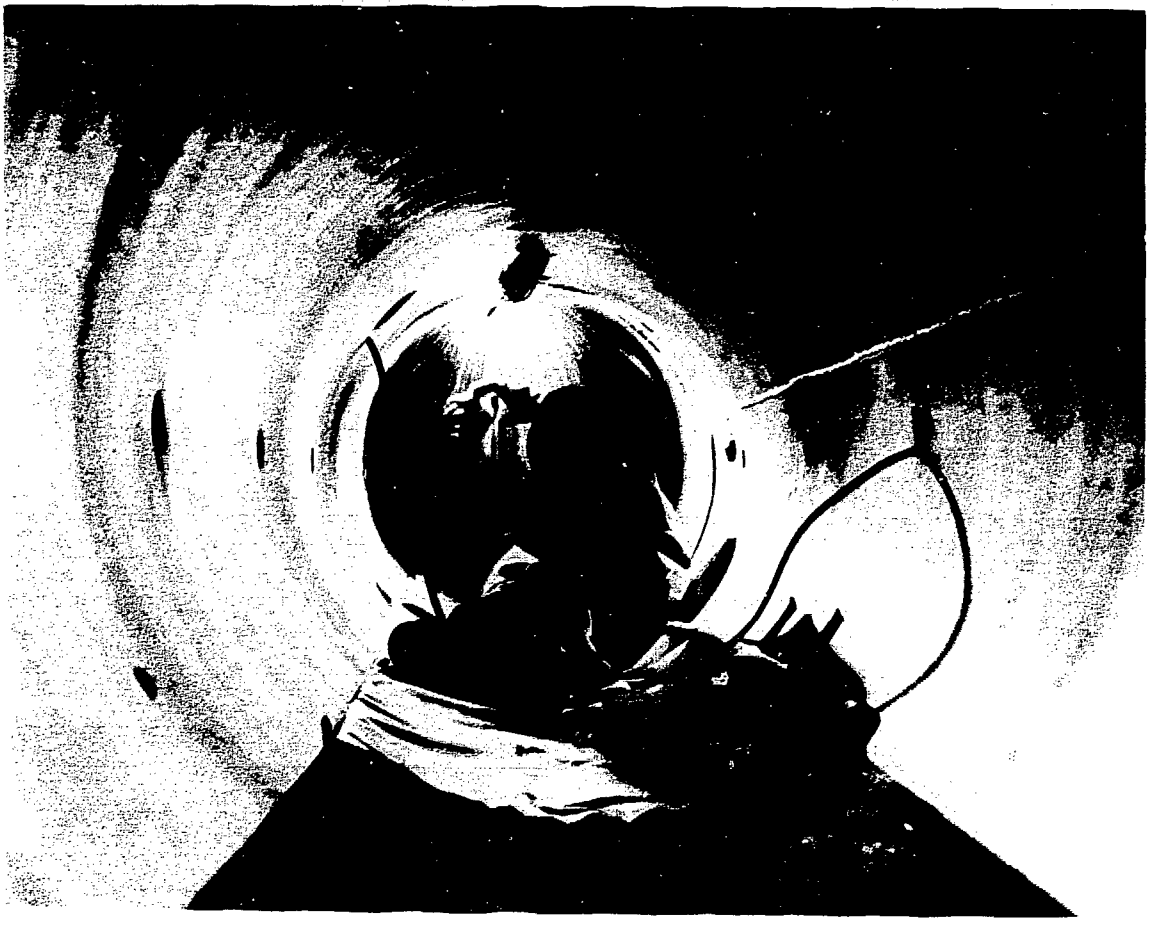


Fig. 7. Welding inside a confined space. Special problems frequently multiply on a job. Here, precautions are taken for a massive ground area and welding sparks, and eye protection and ventilation for a confined space are provided. The drop light is an electrically isolated low-voltage light.

- *Limited-Access Spaces.* A limited-access space is an enclosure that is so isolated or has such a limited entryway that an injured person may not be found immediately or rescue may be hampered. Examples include the spaces behind electrical control equipment and switch gear, ventilation equipment and exhaust ducts, and target cells and valve galleries. Sixteen such spaces have been identified in MP-Division areas (refer to Appendix E). These spaces have been posted and are covered by SOP #301.
- *Confined Spaces.* A confined space is a limited-access enclosure that may not have adequate ventilation. Examples of such spaces include storage tanks, pits, sewer manholes, boilers, and pump pits. Excluding electrical and sewer manholes, there are four such spaces at LAMPF. SOPs have been written for each, and each has been posted.

Physical hazards that may result from work being done in such enclosures include inadvertent activation of mechanical equipment, electrical shock from electrical equipment or lights, and injuries from thermal effects and noise.

1. Controlling Hazards in Limited-Access Spaces.

- Make sure that hazardous electrical and mechanical systems are locked off.
- Use the "Buddy System" so that someone knows where you are working.
- Use personal protective equipment where applicable.
- Follow radiological safety procedures where applicable.

2. Controlling Hazards in Confined Spaces.

- Purge and ventilate the space.
- Check the oxygen content of the air with an oxygen monitor.
- Use supplied-air respiratory equipment if the air is not satisfactory.
- Use personal protective equipment.

Confined spaces in MP Division should be posted. Special procedures for entry into these spaces include the following:

- Use a safety belt and life line.
- Before entering the space, have at least one person, and preferably two, stand outside the enclosure ready to assist in an emergency.
- Maintain visual contact with the worker outside the enclosure; audio or radio communication also is recommended.
- Use low-voltage illuminating and electrical equipment and make sure the equipment has a ground fault detector, or have the power supplied through an isolation transformer.
- Make sure oxygen monitoring is available in the confined spaces.
- Follow radiological safety procedures in all areas.

For further administrative details and procedures refer to the Laboratory H&S manual, Secs. AR 8-1 and TB 801.

D. Soldering, Brazing, and Metal Cleaning

1. Soldering and Brazing. Soldering and brazing operations must be performed only in a well-ventilated area, preferably with a slot exhaust hood or a portable exhaust hood. The concerns with these operations arise from the fumes from the solder and fluxes used. Most silver solders generally contain as much as 18 to 20% cadmium, which is released as a fume when the solder is melted; thus, use of this type of solder should be avoided. If it must be used, it must be approved by the Industrial Hygiene group (HSE-5); they will only approve its use in a well-ventilated area. Some silver solders do not contain cadmium, and these should be tried first.

Some soldering fluxes may generate toxic fluoride fumes. These fumes are actually particulate matter, so if it is impractical to perform a soldering operation in a well-ventilated area, workers should wear appropriate respirators.

2. Metal Cleaning. Metal-cleaning operations can take several forms:

- *Mechanical cleaning* includes such actions as wiping, sanding, grinding, rubbing with steel wool,

or machining. The health hazards involved are associated with vapors arising from any solvents used and with airborne particulates.

- *Solvent cleaning* presents two primary hazards depending on the type of solvent used: (1) the toxicity of the vapors and (2) the possible flammability of the solvent and its vapors. Of the more common solvents, carbon tetrachloride and benzene must not be used because of their toxicity and because of the extreme flammability of benzene.
- *Acid-dip cleaning* presents hazards that include burns of the skin, mucous membranes, and eyes. Also, irritating and possibly toxic fumes may be generated. Extreme care must be used when cleaning metals in an acid-dip tank. Workers must wear personal protective clothing and must use a properly designed local exhaust system.
- *Vapor degreasing* presents the same problems as solvent cleaning. However, because of the nature of this operation, vapor concentrations may be greater than those from ordinary solvent cleaning. Local exhaust ventilation is required for this operation.

3. Safety Rules for Soldering Operations.

- Wear safety glasses, goggles, or a face shield.
- Do not inhale fumes from soldering fluxes or metal conditioners.
- Use care in removing molten solder; do not flip it off.
- Clean up spilled flux immediately.
- Do not rub any part of your head, face, or clothing until your hands have been washed.
- Be aware of the rapid heat transfer that occurs through thin metal.
- Use pliers (not gloves) for picking up hot pieces of metal.
- Do not use electric soldering guns or irons while standing or working in wet areas.
- Be careful of steel wool; it is a fire hazard.
- Always turn off torches and irons when work is finished.
- Be sure that you clean up your work area when you are finished.

If you receive a minor burn in a soldering operation, the following procedures are recommended:

- For acid burns, flush the burn immediately with large quantities of water.
- For a minor heat burn of the skin, immediately immerse the burn in cold water for 5 to 10 minutes. Although the source of the burn (for example, a hot soldering iron) may have been removed, the effect of the heat continues under the skin. Soaking in cold water will greatly minimize the effects of the burn and relieve the pain.

4. Using an Oxyacetylene Torch.

- Wear approved welding goggles or face shield.
- Inspect the equipment before you start. Make certain cylinders are chained, or restrained by some other means, if they are not mounted in a cylinder cart. Inspect hoses, valves, and connections; do not use equipment if there are any defects. Report defects to your supervisor or to the HSO.
- Store and use acetylene cylinders in an upright position. If an acetylene cylinder should inadvertently be laid down, set it upright for at least 24 hours before using it.
- Always release regulator pressure screws before opening cylinder valves.
- Do not stand close to the front of a regulator when you open a cylinder valve in case the regulator should rupture.
- Turn the oxygen cylinder valve wide open. Adjust pressure to a reasonable value for your operation (30 to 45 psig).
- Open the acetylene cylinder valve one-quarter to one-half a turn. Leave the valve handle in place for quick closing. Adjust the acetylene pressure so that it is no greater than 15 psig.
- Always release regulator pressures and close cylinder valves when your work is completed.

E. Spray Painting

The spray application of paint and other coatings involves the use of many materials that may be health hazards or potential fire or explosion hazards. Most spray painting in MP Division is of a minor nature, such as an occasional touchup or small job for the protection of small pieces. Strict regulations are not imposed on such operations. However, when more extensive work is involved, special precautions must be taken to prevent the inhalation of fumes and vapors by the worker, the generation of excessive noxious fumes in occupied areas, possible fire or explosion conditions, or the contamination of hoods and duct work with overspray.

- *Safety Procedures.* All spray painting should be done where there is adequate ventilation (small- to medium-size jobs should be done under a hood; large jobs, outdoors). A suitable respirator may be advisable if a large job is anticipated. Parts should be arranged so that fumes and overspray are not drawn into the worker's breathing zone. For extensive work, protective clothing such as gloves, apron, face mask, and cloth cap should be worn. For large jobs where a respirator may be needed, contact the HSO or HSE-11.

VII. Industrial Safety

A. Compressed Gases

Compressed gases are useful in the operational areas and shops and, if handled properly, can be used safely. However, improper handling and use can result in serious accidents involving explosions and fire and can cause serious injury to personnel or extensive property damage.

The following guidelines have been established by industry to minimize the possibility of accidents with compressed gases.

- Know the characteristics of the gas you are using.
- Label compressed-gas cylinders legibly as to their content—the color of a cylinder cannot be relied upon to identify its contents. Always read the label of each cylinder.
- Treat gas cylinders with respect. Careless handling may result in valve or cylinder damage and could cause a severe accident.
- Store compressed-gas cylinders in a secure and upright position in an area designated for such storage.
- Secure individual cylinders with a lashing or chain at all times to prevent them from toppling over.
- Store oxygen cylinders at least 6 m (20 ft) away from flammable gases or behind an approved fire-retardant barrier. (Cylinders in an oxyacetylene cart are considered to be in use, so this restriction does not apply).
- All cylinders stored inside a building must be located in a well-ventilated area.
- Gas cylinders used in any area where there is a possibility of activation or contamination must be checked by HSE-11 before being returned to the Gas Plant. The plant will not accept contaminated cylinders for refilling.
- Place protective caps (when provided) over cylinder valves when cylinders are not in use or when they are being moved.
- Move cylinders only on a cart designed for that purpose.
- Clearly tag or mark empty cylinders and place them in designated racks for pickup.
- Use regulators and pressure gauges only for the gases for which they are intended.
- Never use oil or grease on an oxygen valve or regulator.
- Make sure that hoses, valves, and regulators are tightly secured and in good repair.
- Never use acetylene at pressures above 15 psig.
- Never store acetylene cylinders on their sides because the acetone in the bottom of each cylinder is a propellant that under certain conditions could cause an explosion.
- Close all cylinder valves when your work is completed.

B. Handling and Storage of Materials

The proper handling and storage of all materials used in MP Division is essential to the safety of personnel, to fire protection and control, and to the safe and smooth functioning of the program.

Accidents from the manual handling of materials, whether in a laboratory, shop, receiving area, office, or operational area, are primarily the result of unsafe working procedures—improper lifting, carrying too heavy or awkward a load, or incorrect gripping of a load.

Similarly, the improper storage of supplies and materials can increase the possibility of accidents. Examples include blocking aisles and doors, stacking materials too high, and permitting the accumulation of excessive scrap and combustibles.

- *General Storage Procedures.* The method of storing supplies and equipment is critically important for safe operation. In receiving and storage areas, material must be placed so that it is conveniently available but does not block aisles, doors, light switches, fire extinguishers, and safety equipment. In offices, books and materials must not be stacked high on top of bookcases or cabinets. The accumulation of combustibles (paper and packing materials) and scrap items must be kept to a minimum.

  All personnel must be ever mindful of these requirements and must promptly dispose of or store unneeded items.

- *Access to High Storage Places.* Use only appropriate ladders or other stable means to reach high storage places. Do not use chairs or rolling step stools.

C. Pneumatically Pressurized Equipment

This equipment may be defined as any equipment or apparatus that uses either compressed air or compressed gases at pressures above 15 pounds per square inch gauge (psig). Such equipment must be designed for safe operation in occupied areas; otherwise it must be barricaded to protect persons from flying objects should the equipment fail.

1. Compressed-Gas Systems. Compressed-gas systems include all systems that use compressed gases at pressures above 15 psig. Such gases may be supplied by the house compressed-air system or may come from commercial gas cylinders.

2. Applicable National Codes. Several national codes apply to compressed-gas systems:

- The Department of Transportation (DOT) Regulations, Tariff No. 10, cover the transportation of dangerous articles. These regulations specify gas-cylinder construction, pressures, contents, and identification so that cylinders can be accepted by common carriers; they also ensure a reasonable degree of safety in our use of these items. The regulations require that the markings on a cylinder include the cylinder type and pressure rating, the serial number, and the last test date.

  In spite of these regulations, the labeling of the contents of a cylinder is a problem. Although most cylinders are conspicuously painted, apparently no real consistency exists from one supplier to another, and the color of a cylinder cannot be relied upon for identification of the gas it contains. Thus, each gas cylinder must be clearly labeled with the name of its contents. Decals or adhesive labels should be used; chalk is unacceptable.

  NOTE: Many experiments use high-purity or specialty gases. The Gas Plant recommends that any gas, where the purity is critical to the operation, should be analyzed before use. Past experience indicates that this analysis should be requested automatically.

- The American Standard Code for Pressure Piping ASA B31 specifies the manner in which manifolds and pressure piping should be built. A manifold serves as a common outlet when two or more cylinders must be used for a particular operation. The design and construction in these operations require special expertise to ensure the reliability of the manifold under high pressures. Use commercial manifolds and associated parts rather than trying to construct a high-pressure manifold in-house.

- The National Fire Protection Association (NFPA) specifies requirements for piping systems for welding and cutting operations and for fuel-gas systems. Manifolds for fuel gas and acetylene must conform to these standards; they also must be electrically grounded.

3. ***Pressure Vessels.*** This category of equipment, also referred to as "Unfired Pressure Vessels," includes essentially all pressure vessels and associated piping where the internal pressure exceeds 15 psig. Compressed-air tanks are included, but devices such as hot-water heaters are not.

The design of such vessels is explicitly covered by national codes, including the American Standard Code for Pressure Piping ASA B31 (referred to above) and the ASME Boiler and Pressure Vessel Code.

Pressure vessels, including those to be used in experiments, must be designed, fabricated, tested, and certified in accordance with the codes. A safety factor of 4 is to be used in the design of such pressure systems. Designs should be checked by a licensed mechanical engineer.

The installation of such equipment also must be in accordance with the codes, and all new experimental installations must be reviewed by the MP-Division Safety Officer and the HSE-3 Safety Engineer. Review by the Laboratory Pressure Vessel Committee also may be required.

4. Testing of Pressurized Systems. Because testing of pressurized systems can be quite hazardous, special precautions are necessary. Hydrostatic methods are to be preferred over pneumatic testing, but this type of testing is not completely safe either and reasonable safety precautions must be used to protect personnel.

In hydrostatic testing, few precautions are necessary if all the gas or air is bled out of the system first. If this is not possible, however, the test must be treated as though it were a pneumatic test and the system must be barricaded, personnel must be removed from the test area, and no one may approach the test device until the pressure has been reduced well below the maximum pressure obtained during the test.

D. Shop Safety

- *General Safety Precautions.* All personnel must be checked out and must display competence before they may be authorized to use any large machine tools. No one is to work with large power tools unless a second person is nearby within sight or sound. Loose clothing, ties, rings, and gloves must not be worn when working with rotating machines, and long hair must be covered. Personnel must read, be familiar with, and follow the posted safety rules for each machine they wish to use (Fig. 8).

- *Machine Tool Lockoff.* Large machine tools must be locked off when they are not in use.

- *Safety Glasses.* Personnel must wear safety glasses, cover goggles, or face shields when they are in the machine and wood shops, whether or not they are working on a machine. Face shields also are required for grinding operations. (Reference: H&S manual, Sec. AR 12-1.)

- *Compressed Air.* The compressed-air pressure for general shop use must not exceed 30 psig unless an approved safety nozzle is used. Compressed air should not be used to clean chips or sawdust from machines; a brush is far safer. Likewise, the compressed-air hose should not be used to blow dirt or chips from clothing or skin.

For additional details see Sec. AR 8-5 in the Laboratory H&S manual.

E. Vehicles and Hoisting Equipment

- *Official Road Vehicles.* The use of official road vehicles is restricted to personnel holding a valid state driver's license. *LAMPF users normally are not permitted to use MP-Division vehicles.* Exceptions must be approved by the MP-Division Office or the HSO.

  Anyone operating or riding in a vehicle on official business must wear a seat belt (when provided) whenever the vehicle is in motion.

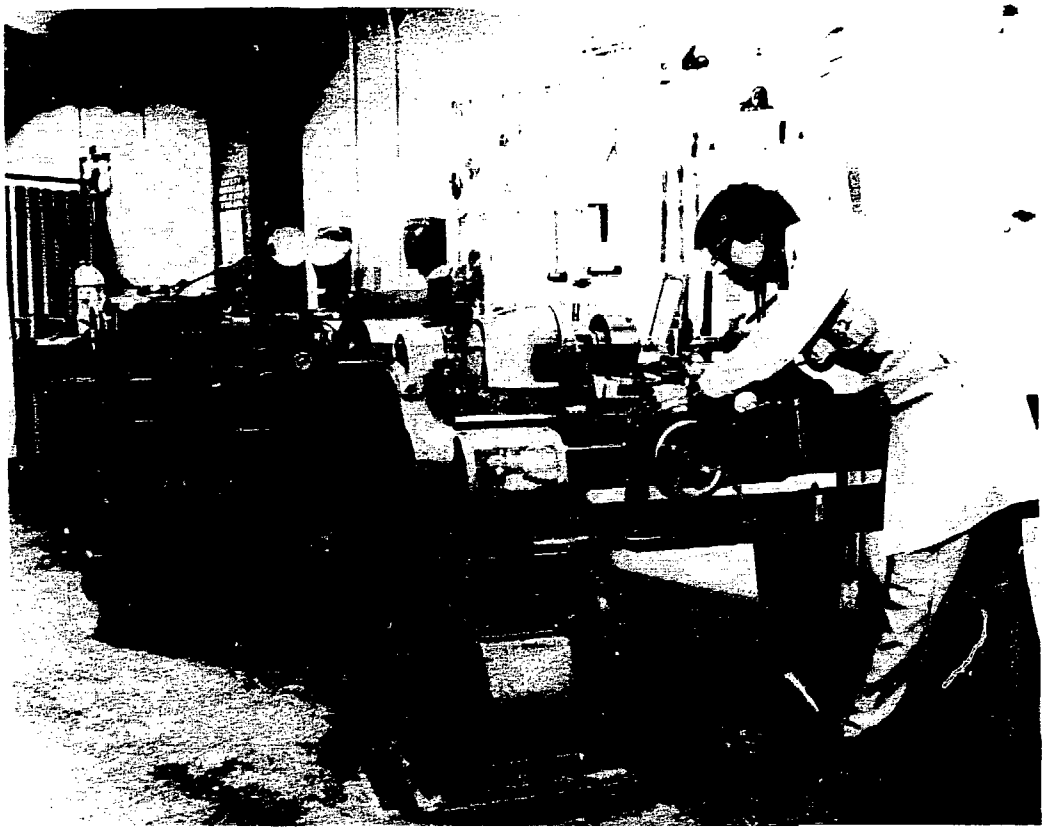


Fig. 8. A lathe operation in an MP-Division shop.

- *Fork Lifts.* Fork lifts (Fig. 9) may only be operated by certified licensed operators. If a fork lift is needed for a particular operation, call the MP-7 Area Manager's Office (AMO), 7-7066, or the HSO.

  Operator training and licensing courses are given periodically by HSE-3 and MP-Division instructors. To sign up for a course, call the HSO at 7-6176. (Users are not issued fork lift licenses.)

- *Gas Utility Carts.* Gas utility carts (Putzers) are assigned to specific groups and are to be operated on site only. Operators must comply with all speed and parking regulations covering government vehicles.

- *Vehicle Maintenance.* To ensure that all government vehicles are in safe operating condition and that maintenance is satisfactory, all maintenance work is coordinated through the HSO. Refer all unsafe operating conditions and service requests to that office, 7-6176. Arrangements will promptly be made to have problems corrected.

  Service and maintenance for fork lifts and Putzers are handled through a contract between the Laboratory and a private contractor. Only HSO personnel may request, authorize, or accept work orders for these vehicles for MP Division. For service, call the HSO at 7-6176.

  NOTE: Modifications or alterations may not be made to any vehicle without prior HSO approval; governors are not to be defeated at any time.

- *Cranes.* Cranes and hoists with capacities over 1 ton may be operated only by certified licensed

Fig. 9. Several sizes of fork lifts used at MP Division. The photograph shows the relative sizes of 30-, 10-, and 3-ton fork lifts.

crane operators. For assistance with crane operation in Areas A and B and the Staging Area, contact the AMO at 7-7066.

Crane operator training and licensing are given periodically; to be included, call the HSO at 7-6176.

NOTE: All persons in the vicinity of crane operations must wear hard hats.

- *Hoisting Equipment.* All installations and modifications of hoisting equipment must be approved by ENG-5, and damaged hoisting equipment must be inspected by ENG-5. Rated loads may only be exceeded with special written permission obtained through the HSO. (Reference: H&S manual, Sec. AR 13-2.)

F. Warning Systems

Table III shows the warning systems that are used at LAMPF to alert personnel to various hazards and situations.

G. Welding, Cutting, and Grinding

Welding, cutting, and grinding operations present some special hazards that require careful control. The primary hazards are from ultraviolet (UV) and intense visible light, fumes and gases, and heat and sparks. The intense light is hazardous to the eye, and the UV light can produce toxic gases as well as a "sunburn." The fumes contain a conglomeration of particles from the metals being welded together, the filler material, the flux and its by-products, and the coating on the welding rods.

Cutting and grinding operations also can produce hazardous fumes, and the possibility of igniting nearby combustible materials with sparks must be considered. Engineering controls such as local exhaust ventilation in a designated welding area should be provided, and personal protective equipment for the operator and any helpers is essential.

1. General Precautions. Specified areas for welding, cutting, and grinding must be established based on

Table III. Warning Systems at MP Division.

Lights

Color	*Type*	*Use*
Amber	Rotating	rf in Sector A Beam Channel Escort Vehicles Site Entrance Gate Closed
Magenta	Rotating	Radiation Areas
Red	Stationary	Magnet On
	Rotating	High Voltage On
	Strobe	Fire Alarm

Horns and Bells

Type	*Use*
Steady Klaxon	Beam-Line or Cave Sweep in Process
Rapid Intermittent Horn	Area A—Immediate Evacuation
Slow Whoop Horn	Fire Alarms in All Buildings
Steady Bell	Trailer Fire Alarms
Steady Doorbell	Gamma Radiation Monitors
Intermittent-Tone Sonalert	Portal Monitors
Steady-Tone Sonalert	Neutron Monitors Equipment Alarms in Counting Houses and Control Rooms
Two-Tone Horn	Area B—Neutron Monitors
High-Pitched Intermittent Horn or Bell	Heavy Vehicle Backing Up

fire potential, personnel distribution, and the scope of anticipated operations.

Welding areas should be free of combustibles. If combustibles are unavoidable in the immediate vicinity, screens must be erected to prevent sparks from igniting the materials, and an additional person must be designated to serve as a fire-watch. A suitable fire extinguisher must be kept near the welding area (Fig. 10).

2. ***General Safety Rules.***

- Goggles, helmets, aprons, and other protective equipment must be worn by welders and helpers during welding operations. (Refer to Appendix D for appropriate welding-shade lens numbers.)
- Welders and helpers must wear suitable protective clothing so that their skin is covered and not exposed to ultraviolet radiation.

Fig. 10. Technician cutting a steel plate. Safety equipment includes heavy gloves, welding hood, and apron. The enclosure is clear of flammables, but a fire extinguisher is nearby.

- The atmosphere in the vicinity of the operation must be free of flammable gases and vapors.
- Persons working near cutting or welding operations, or passing by, must be protected from ultraviolet rays and sparks by the appropriate placement of noncombustible or flameproof welding curtains or screens.
- No welding, cutting, or grinding may be performed on used drums, barrels, or tanks until they have been throughly cleaned (for example, with steam), so that there is no possibility of flammable liquids or any other materials remaining that, when heated, might produce flammable or toxic vapors.
- Welding that is not done in designated welding areas requires a Special Work Permit for Spark/Flame-Producing Operations (H&S form 8-4A), and a person must be designated to serve as a fire-watch.
- If welding is to be done under or near smoke detectors, the Fire Department should be notified so they can cover the detectors before the operation and then uncover them when the work is completed. Call the HSO for assistance with arrangements.
- If radioactive material is to be welded, a Radiation Work Permit may be required. Contact HP at 7-7069 (refer to Sec. XIV.G on p. 48).

3. *Special Precautions.* Special precautions are necessary for welding, cutting, or grinding work involving the following materials:

- stainless steel, lead, zinc, or cadmium;
- metals coated with any of these materials;
- metals coated with paint containing lead or mercury; and
- fluxes or other materials containing fluorides.

4. Electric Arc Welding Precautions. In addition to the general precautions outlined above, some specific procedures are required for the safety of personnel and equipment during electric arc welding operations:

- Spread out coiled welding cable so that its condition can be checked. The ground lead must be securely attached to the work.
- Inspect cables for damage and frayed insulation. All damage must be repaired before the equipment is used.
- Inspect the welding machine and carefully check all connections.
- Splice cables or join them to other cables only with connectors specifically designed for that purpose.
- Do not allow splices within 3 m (10 ft) of the welding operation.
- Wear an approved welding helmet or face shield of the proper shade (refer to Appendix D).
- Use darker lenses in the helmet when higher currents are used.
- Do not use a helmet that has a cracked or chipped filter lens.
- Wear safety glasses or goggles during all chipping operations.
- Do not wear synthetic clothing that is highly flammable, and do not wear trousers with the cuffs turned up.
- Do not breathe welding fumes. Make certain that the local exhaust fan is operating.
- Treat all metal, tools, tables, and equipment as if they were hot; pat before picking up.
- Clear the working area of any combustibles.
- Be careful of others when welding or chipping.
- Hang up the electrode holder. Do not lay it on a bench, the work piece, or the welding machine.
- Keep the work area clear. Do not allow rod ends to accumulate on the floor.
- Report promptly any malfunction of the welding machine or equipment to your supervisor or the HSO.

5. Inert-Gas Welding. The precautions for inert-gas welding operations are essentially the same as above except for the extra care needed to protect against the higher intensity of ultraviolet light and to protect against the displacement of a large proportion of the air by the inert gases themselves when welding is done in confined spaces. The UV light intensity in these operations is several times that from ordinary arc welding where the arc is somewhat shielded by the flux.

For these welding operations, use darker lenses in welding helmets, recognize that adequate ventilation is more important because the higher-intensity UV light produces more ozone, carbon dioxide, and other gases, and make sure that all skin surfaces are covered.

6. Metal Cutting. The precautions for metal cutting with an oxyacetylene cutting torch or for plasma cutting involve those outlined under Soldering and Brazing and include many of the same precautions required for welding. The operator must check the equipment and maintain it in proper condition, particular care must be exercised that sparks and molten metal do not reach any combustibles and start a fire, and appropriate personal protective equipment must be used by all persons involved in the operation.

VIII. Laser Safety

A. Introduction

A laser is a device that produces an intense, coherent, narrow beam of light. The term LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. The radiation emitted by a laser or laser system has the potential for causing irreparable damage to human skin and eyes, so all

work with lasers must be designed to minimize exposures of personnel to the beam. In addition, all persons working with lasers must be aware of the associated hazards and required safety precautions. (Reference: H&S manual, Secs. AR 5-2 and TB 501.)

B. Laser Safety Standard

The primary reference and standard for laser safety is "The American National Standard for the Safe Use of Lasers," ANSI Z136.1.

C. Classification of Lasers

Lasers are classified according to their capability of injuring personnel.

Class I—low-power lasers that are exempt from the requirement of an SOP. Under normal conditions, these lasers cannot produce a hazard to personnel.

Class II—low-power visible lasers that, because of human aversion responses, normally do not produce a hazard. They may be hazardous if viewed directly for extended periods of time.

Class IIIa—lasers that normally are not a hazard if viewed for a moment with the unaided eye. They may be hazardous if viewed with light-collecting optics.

Class IIIb—lasers that can be hazardous if viewed directly. At the higher-power levels this class of laser may produce hazardous diffuse reflections.

Class IV—lasers that can produce a hazard not only from direct or specular reflections but also from diffuse reflections.

D. Types of Lasers

The radiant output from lasers may be categorized as a function of time into one of the three following operational modes:

Continuous Wave (cw)—lasers that operate at a constant power level for periods of time greater than 0.25 s.

Pulsed—lasers that deliver radiant energy at a pulse-repetition rate of less than one pulse per second. The peak power of the pulse is often used in describing the ability of a pulsed laser to penetrate materials and cause damage.

Repetitively Pulsed—lasers that deliver multiple pulses of radiant energy at a fixed repetition rate of one pulse per second or greater.

E. Biological Effects

Laser radiation of sufficient intensity and exposure time can cause irreversible damage to human skin and eyes. The principal cause of tissue damage is thermal. Other damage mechanisms have been demonstrated for ultraviolet radiations. The tissue-damage mechanism for repetitively pulsed laser exposures is thought to be a thermal mechanism wherein the effects of individual pulses are additive.

F. Engineering Controls

The principal means of limiting hazardous exposures to personnel from laser radiation are the engineering controls that are an integral part of the laser or laser system. These controls include the use of an interlocked protective housing surrounding the laser system or, for the higher-class lasers, an interlocked room; beam path enclosures; an interlocked master key switch; a beam stop or attenuator; and visual or audible warning systems.

G. Administrative Controls

The basic administrative controls in MP Division to limit possible hazardous exposures to laser radiation include the following:

- Lasers may only be used in controlled-access areas, indicated by CAUTION LASER signs placed at all entrances.
- Lighted warning signs must be used to warn personnel of the operating status of a laser system.
- An SOP is required for all pulsed laser systems and for any cw laser operating at greater than 50 mW.
- Direct viewing of a laser beam is prohibited.
- All personnel working with lasers, including users, must register with HSE-2 and HSE-3 by submitting a completed H&S form 5-2A to

HSE-3 for evaluation. An eye examination and safety orientation may be required. (Reference: H&S manual, Sec. AR 5-2.)

H. Personal Protective Equipment

The personal protective equipment required in laser work includes correct eye protection in the form of goggles or prescription eyewear and, in some cases, protective clothing. Special eyewear using high optical-density filter materials is required to reduce potential optical exposures below the maximum-permissible-exposure (MPE) limits.

A wide variety of optical filter materials is available. Goggles must be selected for the particular laser system involved, depending on the wavelength of the laser radiation and the laser power.

NOTES:

1. ***Welding goggles should not be substituted for properly selected laser goggles.***
2. ***Laser protective goggles for one type (wavelength) of laser may be useless for another type.***

IX. Magnet Safety

A. General Hazards

Magnets present a variety of hazards including electrical, physical, and biological. The high currents in many magnets can cause arcing, resulting in molten metal if there is a short. Some magnets require high voltages under normal operating conditions and must be treated the same as any high-voltage system. Also, low-voltage magnets can generate high voltages by electromagnetic induction if the circuit is opened accidentally when the magnet is energized. Stray magnetic fields from large magnets can attract iron pieces, tools, and gas cylinders, causing equipment damage and possible injury to personnel. Finally, exposure to strong magnetic fields for even a moderate period of time can cause biological effects on human tissue and cells.

B. Safety Procedures for Work with Normal Magnets

- All magnets that are easily accessible and that may present severe hazards, including those being used with experiments, must be equipped with a red warning light to show when the power supply is on.
- All connections must be covered or insulated, both at the power supply and at the magnet.
- Where there are high fringe fields, barriers and signs must be provided to keep personnel at a safe distance.
- Personnel must make a reasonable attempt to avoid unnecessary exposure to high magnetic fields.
- The fringe fields of many magnets may affect cardiac pacemakers and metal prostheses, and personnel and visitors should be cautioned accordingly.

C. Guidelines for Occupational Exposures to dc Magnetic Fields

In 1979 the DOE established an *ad hoc* committee to develop exposure guidelines for persons working in and around dc magnetic fields. Even though adequate research data were not available, the committee was able to develop reasonable interim guidelines. These were published in October 1981 and are presented in Table IV.

Table IV. Constant Magnetic Fields.

	Exposure (T) [a]		
	8 h	**<1 h**	**<10 min**
Whole-body or head	0.01	0.1	0.5
Extremities	0.1	1	2

[a] 1 T = 10 000 G.

D. Safety Procedures for Work with Cryogenic Magnets

An increasing number of superconducting magnets (some quite large) are now in use at LAMPF (Fig. 11).

Fig. 11. One of the steel yokes for the superconducting MEGA magnet (MEGA is an acronym for Muon decays into an Electron and a GAmma ray). The yoke weighs about 20 tons.

Superconducting magnets can present some different and unique hazards. They may have high fringe fields, so adequate signs and barricades must be provided to warn personnel and identify the extent of the fields. They can generate extremely high voltages should the circuit be opened while the magnet is energized. Also, many superconducting magnets are capable of operation in a "persistent" mode in which the magnet is energized and then the power supply is disconnected and turned off. This situation can be particularly hazardous because the power supply meters cannot be used to determine if the magnet is energized.

Before work is done on any cryogenic magnet the current must be decreased to zero, sometimes at a specified rate, and sufficient time must be allowed for the current and the field to decay. Remember, many of these systems have a very long decay time. Never open the circuit until you are absolutely certain that the current is zero.

Various types of failures or improper operation can cause a superconducting magnet to "quench." When this occurs the conductor ceases to be superconducting and becomes resistive. Then the conductor is heated by the circulating current and the energy that is released heats the cryogenic liquids. This situation can result in damage to the conductor and cause the rapid venting of large quantities of gases that can be hazardous in confined spaces if improperly handled.

X. Miscellaneous Safety Requirements

A. Site Traffic Regulations

With the growth of AT Division, there are now more than 2000 vehicles entering and leaving TA-53 each workday. There are also many slow-moving fork lifts and Putzers traveling back and forth on the roads at all hours of the day and night. The situation has been aggravated by site construction because of the added traffic of construction vehicles, ditches across the roads, and rerouting of the roads.

It has therefore been necessary to establish traffic regulations, including speed limits and parking limitations, in order to ensure the safety of personnel and the smooth functioning of the AT-Division, LANSCE/WNR, and MP-Division programs. All personnel are expected to observe the posted speed limit and the stop signs and parking signs at TA-53. Many more areas on the site are congested now, and posted speed limits must be observed to avoid serious accidents. To enforce these speed limits, MP- and AT-Division management periodically conducts random speed checks using portable radar equipment. Parking is a continuing problem throughout the site and everyone is requested to park only in designated areas.

B. Motorcycle Restrictions

The use of any privately owned motorcycle, motor scooter, or motor-driven bicycle on official Laboratory business is prohibited by the University of California contract. Official Laboratory business means all reimbursable travel and official errands during times when an employee is on duty, including travel from one Laboratory building to another for obtaining materials, attending meetings, or performing work.

This policy does not in any way restrict the use of motorcycles and similar vehicles for personal business, such as transportation to and from work.

C. Salvage Disposal

All material and equipment in MP Division, except personal items, are government property and may be disposed of only through established channels. Items with property numbers must be disposed of through the MP-Division Property Office. Salvage carts are located throughout the site for small nonradioactive items; small radioactive items may be disposed of in the yellow, marked containers placed in pairs at various locations—one for *compactible* and the other for *noncompactible* items. To dispose of large radioactive items, including property-numbered items, contact the Accelerator Health-Protection Group (HSE-11) at 7-7069. To dispose of large nonradioactive items, contact the MP-Division Property Office at 7-4902 or the HSO at 7-6176.

NOTE: Items that are potentially hazardous, such as glassware, mercury batteries, asbestos, chemicals, and especially trash, must never be placed in salvage carts. For assistance with disposal problems call the HSO at 7-6176.

XI. Office Safety

A. Introduction

Safety in the office and its surroundings is an important element in the MP-Division Safety Program. Each year the National Safety Council reports numerous accidents in the office environment from slips and falls to cuts, bruises, and bumped heads. Most of these accidents can be avoided if personnel use common sense and follow some basic safety procedures.

B. Office Safety Procedures

The list of DOs and DON'Ts in basic office safety procedures can be quite long. A few of the essential points are given here:

- Personnel must be conscious at all times of their own safety and that of their co-workers.
- Good housekeeping is an essential element in personnel safety and fire protection in the office. Do not allow papers to accumulate unnecessarily; all materials should be stored inside cabinets, files, or bookcases. Also, do not store card files, books, or other heavy items on top of cabinets or bookcases.
- To gain access to high shelves, use a ladder or a stable step stool; do not use chairs or rolling step stools.
- Improper lifting and carrying cause many back injuries, as well as other types of injuries. If a load is too heavy or awkward, get someone to help you. Have maintenance personnel move desks, files, and other heavy furniture.
- File cabinets are another major source of office injuries. When working with filing cabinets, follow these precautions:
  - To prevent injury to your hand, always use the handle of the file drawer to close the drawer.
  - Open only one file drawer at a time to prevent the file cabinet from toppling over.
  - When you are working with a file, warn others nearby that you have a file drawer open so that they won't bump into or trip over the drawer.
  - If you must work in files continuously, it is recommended that you wear finger guards to avoid cuts from fasteners and sharp paper edges.
- Electrical safety in the office is equally important. The following items should be noted:
  - All electrical office equipment should be properly grounded with three-wire cords and connectors or be doubly insulated and have a UL label; two-wire cords should be replaced with three-wire cords.
  - Never yank a power cord to disconnect it; always grasp the plug.
  - Report frayed electric cords promptly to maintenance personnel.
- Keep electrical cords out of walkways. If a cord must be temporarily run across the floor, it should be taped down or, preferably, fastened to the floor with a rigid cover.
- If you have trouble with a piece of equipment or get even the slightest electrical shock from it, unplug it, put an OUT OF ORDER sign on it, and report it immediately to the appropriate person.

XII. Personal Protective Equipment

A. Introduction

Personal protective equipment may be required for work in laboratories and shops in MP Division for operations where hazards may not be controlled by other means.

Various types of personal protective equipment provide specialized protection of the eyes and face, feet, head, and respiratory system, as well as the entire body. However, personal protective equipment should never be considered the first line of defense, except for eye and face protection in the shops and rubber gloves in the laboratory when handling corrosive chemicals and epoxy resins.

If engineering control methods are not feasible and personnel are exposed to harmful levels of physical agents or toxic substances, then the use of personal protective equipment is required.

B. Protective Clothing

Protective clothing is designed to shield the body against potential mechanical, physical, or chemical hazards. Such clothing includes laboratory shop coats, shop aprons, coveralls, and gloves. Workers can be adequately protected only when their protective clothing is selected and cared for properly and when each person is trained in its use and uses it as it was intended. (Reference: H&S manual, Sec. TB 1202.)

C. Eye and Face Protection

Appropriate safety glasses, goggles, face shields, or welding helmets should be worn whenever there is

the possibility of flying particles, splashed liquids, or harmful rays that may be damaging to the eyes.

In most operations, industrial safety glasses provide adequate protection. These safety glasses are recommended for persons doing electronic assembly work because the trimming of leads on electronic components may be a greater hazard than the actual soldering.

In other hazardous operations, such as chipping, grinding, welding, chemical procedures where splashing may occur, work with cryogenic liquids, and operations where fine dust is produced, goggles, face shields, or welding helmets should be used as appropriate. A face shield by itself is not sufficient protection against splashes; goggles or safety glasses also must be worn. (Reference: H&S manual, Sec. TB 1201.)

NOTE: Although all eyeglasses produced since 1972 must have impact-resistant lenses, these lenses are not acceptable substitutes for industrial safety glasses that meet ANSI standards.

D. Protective Footwear

Safety shoes are recommended for persons working regularly in the shops or handling heavy material. The most common type of protective footwear is the safety shoe with a steel toe. Although safety shoes are not required for all persons working in MP Division, those people using the shops and working in the experimental areas should seriously consider the use of proper footwear to protect their feet. Safety shoes with nonconductive soles are highly recommended. Contact your group secretary about getting safety shoes through the group.

If you do not have safety shoes, sturdy shoes or boots (the heavier the better) should be worn whenever work is being done in the shops; tennis shoes and sandals *are not acceptable*. (Reference: H&S manual, Sec. AR 12-1.)

E. Head Protection

Hard hats are required in situations where persons may be struck by falling or flying objects. This requirement applies to persons in construction areas, or any area where overhead work is going on, and to persons working with, or in the vicinity of, crane operations. A nonmetallic type of hard hat also provides some protection against electrical shock. A "bump cap" may be used in less hazardous situations.

F. Respiratory Protective Equipment

Respiratory protective equipment may be defined as any device designed to protect the wearer from inhaling toxic or harmful atmospheres. These include dust masks, half-face and full-face air-purifying respirators, self-contained breathing apparatus, and supplied-air face pieces, suits, and hoods (Fig. 12).

Engineering controls should be provided where feasible to control toxic vapors, gases, or dusts, but where these controls are not feasible, special respiratory protection must be used. The potential hazards in some activities mandate the careful and informed selection of equipment specially designed for respiratory protection. Each type of respirator has its areas of application, its limitations, and its operational and maintenance requirements. Using the wrong respirator may be worse than using no respirator at all, analogous to depending on an empty fire extinguisher hanging on the wall.

If you think that you may need a respirator, contact HSE-11 for assistance. (Reference: H&S manual, Secs. AR 12-1 and TB 1203.)

G. Hearing Protection

Noise has been defined as "unwanted sound." High noise levels can cause temporary hearing loss; prolonged exposure can cause permanent hearing loss. In general, consider yourself as being exposed to hazardous noise levels if you must shout within about 1 m (3 ft) to be understood. This guideline applies not only to activities at work, but also to activities away from work such as motorcycling, shooting, car racing, and playing in a band.

High noise levels generally are controlled through the use of noise barriers, separation of personnel from noisy areas, or modification of noise-producing operations. If these methods are not effective or practical, personal protective equipment such as ear plugs or ear muffs may be required.

Fig. 12. Personnel wearing the three basic types of respiratory protection used at LAMPF. From left to right are a dust mask, a full-face respirator, and a self-contained breathing apparatus (SCBA).

Ear plugs are made of soft or hard plastic, rubber, or wax. Cotton or other makeshift ear plugs do not provide sufficient hearing protection and are not recommended. At the higher audio frequencies, ear muffs provide better protection than ear plugs. Ear plugs should only be used for short-term protection; they should not be considered a permanent solution to noise problems. (Reference: H&S manual Sec. AR 8-2.)

XIII. Radio-Frequency (rf) Safety

A. Introduction

Radio frequencies are the part of the electromagnetic spectrum from 10 kHz to 300 GHz. Radio-frequency power is used throughout the length of the accelerator, in the rf test area in the ETL, and in some experiments. Also, rf power may be radiated into the work area from a loose joint in a wave guide or coaxial line. Radio-frequency radiation is considered non-ionizing radiation.

B. Safety Standard

The maximum permissible exposure to rf radiation, according to the ANSI Standard C95.1, is 10 mW/cm^2. Personnel exposure should be kept well below that limit. Proper shielding and attention to wave guide and coaxial joints can reduce exposures to the range of microwatts per square centimeter.

C. Hazards

Contact with exposed rf circuitry may cause burns or electrical shock. In addition, rf radiation may affect heart pacemakers or cause thermal damage to the eyes (cataracts, for example). Because rf energy is

absorbed internally, thermal damage can occur even when there is no sensation of heat.

D. Permanent rf Systems

The existing 201- and 805-MHz rf systems are safe, provided established procedures are followed.

E. New or Modified rf Systems

Before power is applied to a new or modified rf system, inspect the system with appropriate HSE site representatives or other knowledgeable personnel who have not worked with the system and can impartially judge the safety of the system. Monitor rf power levels in the work area as power is applied to the system. Depending on the power levels and complexity of the system, written procedures or formal SOPs may be required.

XIV. Radiological Safety

A. Health Physics (HP) Office

The Laboratory Accelerator Health-Protection Group (HSE-11) provides HP personnel to advise and assist MP Division in radiological safety matters and personnel radiation protection. Members of this staff are located in the HSE-11 Office (Trailer 453, east of the Operations Building, 7-5890) and the Area A Health Physics Office (MPF-43, Room 106, 7-7069). HP personnel also may be reached through site paging (7-6913), two-way radio, the CCR (7-5729), or the HP channel on the interphone.

The primary responsibilities of the HP staff are

- to assist in radiation protection and control throughout the facility,
- to conduct radiation surveys and provide surveillance of all sources of radiation,
- to provide surveillance of the storage and movement of radioactive materials,
- to maintain records of personnel exposure and area survey data,
- to maintain inventory records of radioactive research sources and
- to serve as the single point of contact for coordinating all HSE-Division support to MP Division.

Members of the HP staff have the authority to stop any operation or exclude personnel from any area considered unsafe from a radiological standpoint. HP personnel are always available for consultation and assistance in radiological safety matters.

B. Radiological Safety Rules and Procedures

MP Division has prepared a set of Radiological Safety Rules and Procedures (SOP #104). Every person working with, or in the vicinity of, potential radiological hazards must read and be familiar with these procedures. Copies are available from the HSO and the HSE-11 Office.

C. Individual Responsibility

The responsibility for radiological safety rests with each individual associated with an operation involving radiation hazards. In particular, careful, prudent work procedures are essential, including a "no-touch" policy when working with radioactive materials and good personal hygiene (for example, washing hands after working with or around radioactive materials). In addition, personnel should not eat, drink, or smoke in radiation areas.

D. Minimizing Exposures

There are three basic methods of minimizing exposures:

- Maximize the distance from the source of radiation.
- Minimize the time of exposure to the radiation.
- Provide shielding (lead, steel, or concrete) between you and the source of radiation.

The radiation-protection standards set forth in DOE Order 5480.11 and in the Laboratory H&S manual, Sec. AR 3-6, Table 1, are considered maximum permissible exposures, not working limits. "As low as is reasonably achievable (ALARA)" is the operating guide for exposures to ionizing radiation (Fig. 13).

Under this guide, all personnel are to perform their work in such a manner as to keep exposures to radiation to the lowest practicable level and to avoid receiving any unnecessary radiation. They are to cooperate with HP personnel in observing all radiation barriers and signs and in conforming with established control procedures. (Reference: H&S manual, Sec. AR 3-1).

E. Personnel Dosimetry Badges

Personnel dosimetry badges are required for everyone working at TA-53. MP-Division staff receive their badges through their group offices; users routinely get their badges at the Visitors Center in the Laboratory-Office Building. Temporary badges or replacements for lost badges may be obtained at the Visitors Center or the Area A HP Office; after normal working hours, badges are issued by the Area A HP Office. For assistance call 7-7069.

Dosimetry badges normally are exchanged at the end of each month, and personnel are requested to exchange their badges promptly. Badges must not be left at TA-53 during nonworking hours and must never be left in a counting house or experimental cave. Users must turn in their badges to the Visitors Center or the HP Office before they leave Los Alamos.

F. Pocket Dosimeters

In addition to wearing personnel dosimetry badges, persons who expect to be working in an area where the radiation fields are greater than 10 mrem/h are issued pocket dosimeters to measure on-the-job exposures and to monitor exposures on a daily basis. Entry into some areas, such as the beam switchyard, automatically requires a pocket dosimeter. Pocket dosimeters are obtained from the Area A HP Office and are issued to anyone upon request.

Fig. 13. Remote-handling equipment at LAMPF used for maintenance and repair in radioactive areas. Technicians operate the equipment using only closed-circuit television for viewing.

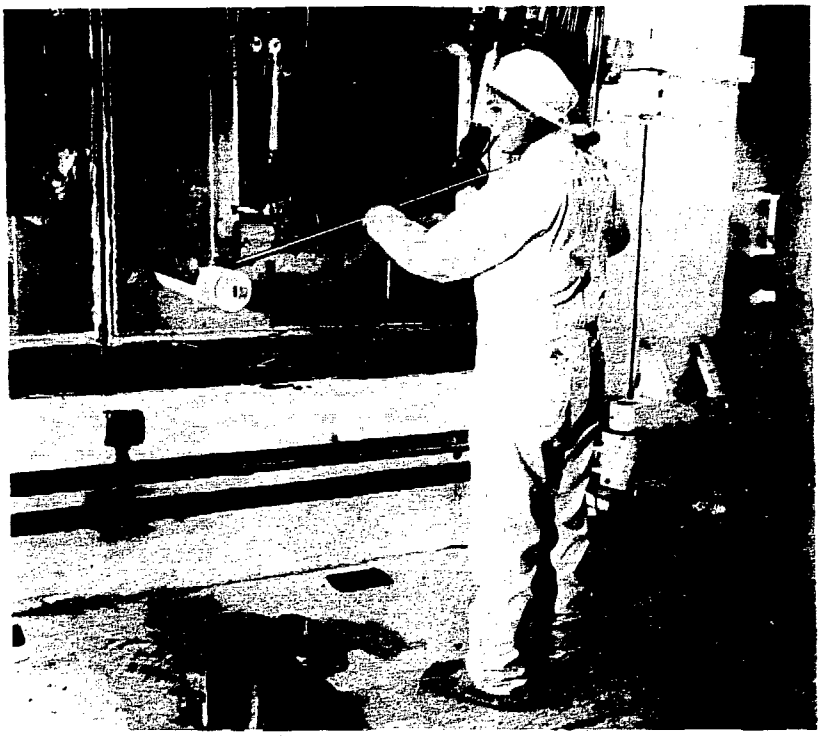


Fig. 14. Anticontamination clothing. The technician is wearing a cap, gloves, coveralls, and booties. Complete covering would require taping the sleeves, legs, and all seams, and wearing a full-face respirator.

G. Radiation Work Permits (RWPs)

To further the policy of keeping radiation exposures as low as reasonably achievable, RWPs (game plans) are required for the following types of work:

- any operation where the estimated total exposure to personnel may exceed 100 mrem;
- work ir a target cell, a beam stop area, the beam switchyard, the Proton Storage King (PSR), and many of the beam lines. (Persons entering these areas for short periods of time to check equipment or to make physical measurements do not require an RWP. However, these entries must be cleared each time with HP);
- operations requiring machining, grinding, burning, or welding on radioactive sources or radioactive materials where the contact radiation level is greater than 0.5 mR/h;
- any operation where anticontamination clothing or respiratory gear might be required (Fig. 14); and
- cleanup operations and janitorial work in the accelerator beam channel, main beam lines, the beam switchyard, the hot-cell area, or the PSR.

Whenever possible, RWPs should be prepared and submitted to HP at least 2 days before work is to begin, but in any case the RWP must be completed and approved before the work can be started. However, if an RWP has been prepared and approved on time but the work has been delayed for more than a week, the approvals can no longer be considered valid and the RWP must be updated and approved.

H. Radiation Levels in the Experimental Areas

In conformance with the policy of keeping personnel radiation exposures as low as reasonably achievable, guidelines have been established covering permissible operational radiation levels in the various LAMPF experimental areas.

- In Area A every attempt must be made to limit the background radiation to levels below 2.5 mrem/h from all sources. The background radiation in this area is predominantly due to neutrons with a very low energy distribution. The average neutron fluence that would yield 2.5 mrem/h is about 15 neutrons/cm^2/s. The shielding of the primary beam line and beam stop has been designed to keep exposures within this limit.
- No one is allowed in Areas B and C during operation. The combined leakage dose to occupied areas outside these areas must be held below 2.5 mrem/h.

I. Access to Accelerator Beam Channels and Experimental Caves

Access to all primary and secondary beam lines, beam areas, and experimental caves is strictly controlled. Each entry door or gate is locked with a Kirk key system, and different procedures are required for access to different areas. Personnel keys are provided at each key bank. Entry procedures require redundant steps to ensure that access cannot be obtained to any area where the beam might be directed.

The following safety rules and procedures for entry into these areas must be observed:

- At the beginning of every new operating cycle an HP technician must accompany the *first* person entering an area through which the beam has passed.
- Everyone entering an area in a Restricted-Access mode, such as the 805-MHz sectors, must take a key and retain it at all times while in the area.
- Everyone entering an experimental cave in Area A in the Radiation-Area mode must take and retain a key, and the gate must be closed within 1 min; otherwise, the system will drop to "Radiation Area, Contact HP for a Sweep," and an HP technician will have to reset the system and participate in the sweep of the cave (Fig. 15).

Detailed entry, sweep, and lockup procedures are posted at the entrance to each cave; copies are available from the MP-2 Group Office.

NOTE: Activities involving climbing on the cave walls in Areas A and B, or entering a cave while the beam is on, must be cleared and approved by both MP-Division management and HP.

J. Radiation Survey Instruments

Portable radiation survey instruments are provided by HSE-11 and have been placed on tables in convenient locations at the north and south sides of Area A, near the west door in Area BR, and by the entrance to Area C. When entry does not require HP assistance, you are encouraged to use these instruments to check for induced beta/gamma radiations from accelerator beam-line components, experimental target materials, or associated apparatus. Instruments also have been placed at the beam channel entrances for the use of HP staff and authorized maintenance personnel.

Please remember to turn an instrument off after using it. If you need an instrument for an activity other than entry into a radiation area, contact HP at 7-7069.

K. Handling and Control of Radioactive Materials

The proper handling and control of radioactive materials is essential in preventing possible contamination and minimizing personnel exposures. All activities concerned with the receipt, storage, movement, and disposal of radioactive materials, including research sources, induced sources, and irradiated materials, are under the direct surveillance and control of the Accelerator Health-Protection Group (HSE-11). (Reference: H&S manual, Sec. AR 3-4.)

All personnel must strictly adhere to the following guidelines:

- Anticipated or actual acquisition of radioactive materials, including research sources, must be registered with the HP Office (Fig. 16).
- Each experimental team or Laboratory group working at LAMPF that has, or anticipates the acquisition of, research sources must appoint an on-site representative to serve as Source Custodian. Most often each MP-Division Group

Fig. 15. Beam channel entrance, typical of the entryways to beam lines and experimental caves. Shown are status signs, a Kirk key release box and key bank, and an interphone.

Safety Officer is designated as Source Custodian for the group.

- Source Custodians are responsible for ensuring the proper use and storage of every source under their control. They are to maintain an accurate and up-to-date inventory record of all their sources and must present a semiannual update to HP when requested.

- Sources must be stored in locked cabinets or in locked, lead-lined source boxes when not in use. All unsealed alpha-active sources must be stored by HP, and it is preferred that all sources not in use also be stored by HP.

- The proposed movement of any radioactive material within or off the LAMPF site must be cleared with the HP Office before the transfer is made. All material leaving the site, not just

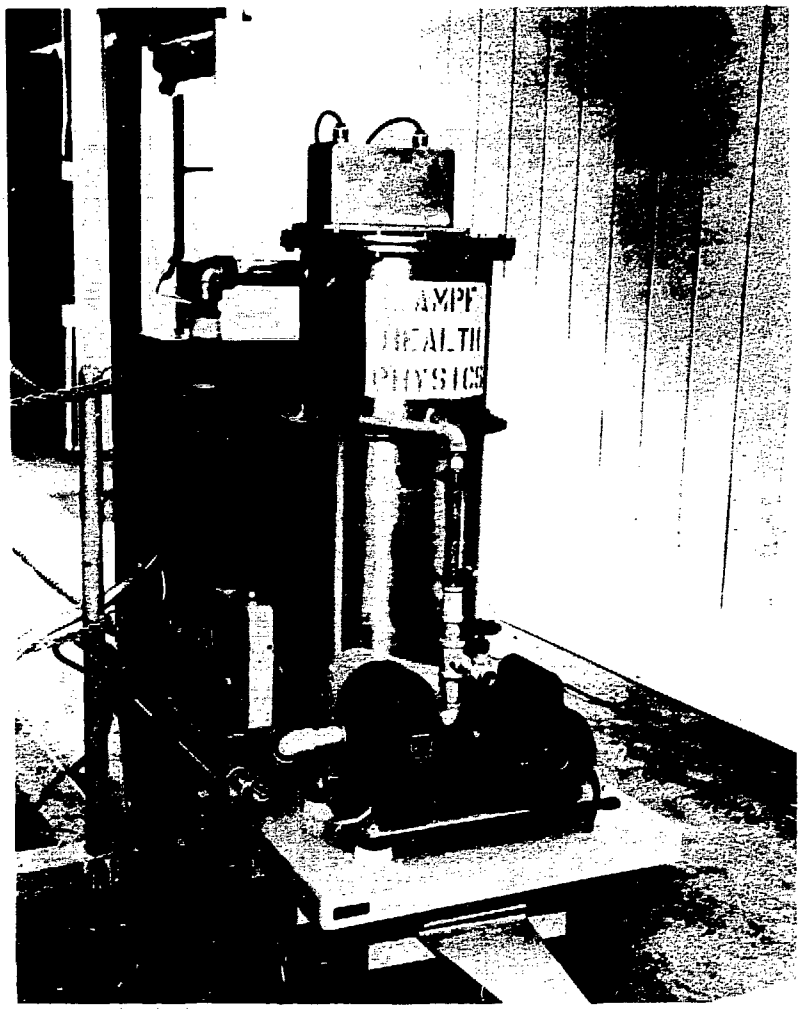


Fig. 16. Radioactive gas-monitoring system consisting of an air pump, a Kanne-type ionization chamber, and the necessary electronics to make the system completely self-contained so it can be used at different locations.

known radioactive material, must be monitored by HP.

- Radioactive material must not be shipped to LAMPF as part of another shipment without prior approval from the HSO.
- Radioactive material must not be transferred barehanded or transported in a private vehicle.
- In the Laboratory-Office Building, radioactive material is only permitted in the laboratory wing (C wing), the Nuclear Chemistry wing (D wing, north), and both basements.
- All items installed or left in primary or secondary beam areas while the beam is on are considered radioactive. They must be surveyed by HP personnel at the time of removal and tagged if found to be radioactive.
- All radioactive waste materials must be disposed of by contacting HP or by placing them in an identified yellow waste container. These containers are generally placed in pairs throughout the facility, one for *compactible* and the other for *noncompactible* radioactive waste.

NOTE: Contaminated or potentially radioactive materials must not be placed in salvage carts or trash receptacles that normally are not used for radioactive materials. Also, **salvage carts must not be used as garbage cans.**

L. Doorway and Gateway Monitors

Sensitive crystal radiation detectors have been installed at various doorways throughout the facility to assist in controlling the movement of radioactive materials. Any person carrying an item that activates a doorway monitor is required to contact HP immediately, unless the item has been tagged and its movement has been approved by HP. If an individual trips a doorway monitor for an unknown reason, that person also must call HP (7-7069).

LAMPF site, is designed to detect radioactive materials leaving the site. The system consists of a very sensitive crystal detector, associated electronics, alarm circuitry, and a camera system. The detector is located beneath the road in the exit lane just east of the gate. The alarm signal turns on a light and blows a horn at the gate; the signal also is transmitted to the Area A HP Office.

For optimum sensitivity, vehicle speeds should be limited to 10 mph. Unless prior HP approval has been received, the driver of a vehicle that triggers the alarm must pull over to the parking area and call the HP Office at 7-7069, using the telephone at the north end of the gateway trailer (MPF-430).

XV. Standard Operating Procedures and Special Work Permits

The requirements, responsibilities, and procedures for the preparation of SOPs and SWPs are identified in the Laboratory H&S manual, Sec. AR 1-3. These procedures and permits are required for specific operations that include, but are not limited to, the following:

- work on energized electrical equipment or work requiring personnel access into high-voltage areas;
- operations with a potential radiological hazard;
- work involving personnel exposure to toxic materials;
- work in confined spaces with limited egress or ventilation;
- work with lasers that have a power output greater than 50 mW (cw), and work with all pulsed lasers;
- operations with liquid hydrogen, cryogenic targets, and cryogenic magnets;
- operations involving a potential fire hazard; and
- any other operation judged sufficiently hazardous by MP-Division management or HSE Division.

If there are any questions concerning the need for or preparation of an SOP or SWP, call the HSO at 7-6176 or the HSE-11 Office at 7-5890.

Occupational-Medicine Program

I. Emergency Assistance

An ambulance may be requested by telephoning the Fire Department, 9-911. Help also can be quickly obtained by actuating a fire-alarm box, but the response will not include the dispatching of an ambulance. If the accelerator is in operation, assistance may be obtained by calling CCR at 7-5729 or the Area A HP Office at 7-7069.

II. First-Aid Supplies

First-aid cabinets are located throughout the laboratory, operational, and experimental areas. These contain Tylenol and dressings for minor cuts and bruises. Disaster kits (aluminum suitcases) also are provided at strategic locations. These kits contain general first-aid supplies, dressings and bandages for treating massive bleeding, and a small cylinder of oxygen (Fig. 17).

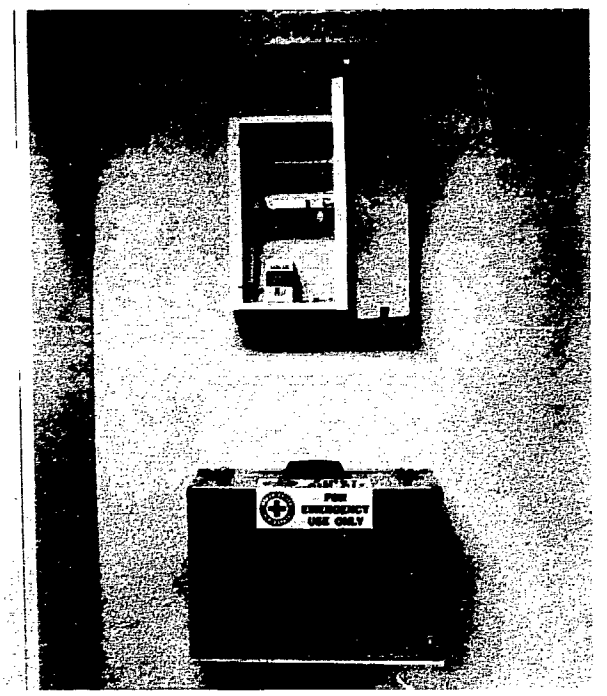


Fig. 17. First-aid supplies. First-aid cabinets and emergency cases are located thoughout LAMPF. The case contains an oxygen cylinder and supplies for treating major injuries.

III. Occupational-Medicine Services

The Los Alamos National Laboratory has a continuing concern for the health of its employees. The Occupational-Medicine Group (HSE-2) performs numerous services for Laboratory employees, including treatment of minor injuries, at the Occupational-Medicine Building (SM-409, TA-3, southwest of the Administration Building) and at various medical facilities throughout the Laboratory. One such facility (MPF-526) is located south of the Laboratory-Office Building and east of MPF-40. The hours are 8:00 to 12:00 a.m. and 1:00 to 5:00 p.m. during regular workdays. The TA-53 medical facility has a full-time physician, psychologist, and nurse in residence. The facility also has a well-equipped emergency treatment room (Fig. 18).

If you suffer a minor injury at work, go to the TA-53 medical facility. If it is closed for some reason, the injury can be treated at the Occupational-Health Building at TA-3. After normal working hours, or for major injuries, report to the Los Alamos Medical Center Emergency Room. Serious injuries are not treated by the Occupational-Medicine Group; such cases must be taken to the Medical Center.

LAMPF users are provided the same emergency medical care as Laboratory employees. When they register as guests of the Laboratory, users are asked to complete a short questionnaire outlining their medical history. This questionnaire is sent to the

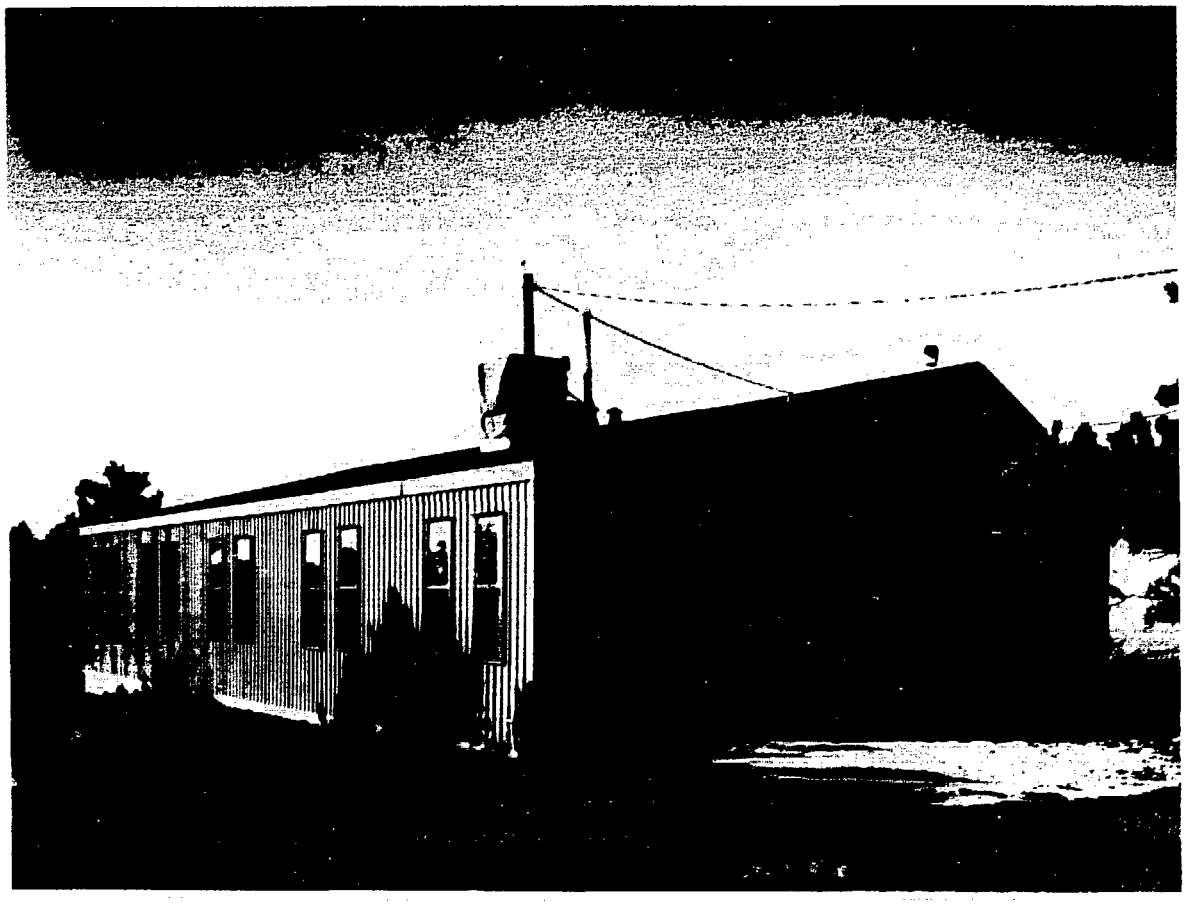


Fig. 18. Medical facility located at LAMPF.

Occupational-Medicine Group and becomes part of their confidential records to assist physicians treating users in recognizing chronic health conditions that might otherwise be misleading. The Laboratory requests this information solely in the interest of the user.

IV. Occupational Illnesses

If you become ill while at work and suspect that something in the work environment is the cause, report to an HSE-2 medical facility for evaluation. Occupational illnesses may occur from exposure to any number of chemical and physical agents. Also, if you become ill while working with chemicals or other hazardous agents, your supervisor should contact the appropriate HSE-Division group or HSE-11 so arrangements can be made to prevent further exposures. It is advisable to contact the HSE-11 Group Office before starting new procedures involving chemical or radioactive materials.

V. Occupational Illness/Injury Recovery Program

Employees who experience an occupational illness or injury can be considered for early return to work with possible job accommodation under the Laboratory's Recovery Program. Employees should recognize that return to work is expected as soon as it is medically feasible and that arrangements for an early return to work are an integral part of the Recovery Program.

VI. Workers' Compensation Insurance

In the event of a job-incurred injury to a user, the Laboratory presumes that workmen's compensation insurance is available from the home institution. Notwithstanding, the Laboratory carries a rider, as a part of its workmen's compensation policy, that provides insurance for visiting researchers and consultants whose work involves Laboratory operations, whether or not they are paid by the Laboratory. Specific questions should be directed to the Employee Benefits Group, PS-3, at 7-1806.

VII. Medical Insurance for Users

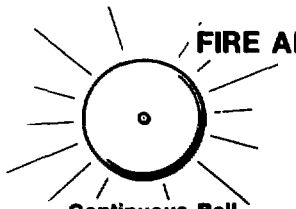
In general, illnesses and injuries that are not job-related are not covered by Workers' Compensation insurance. However, because health insurance usually is available to users through their home institutions, the Laboratory and Department of Energy have taken the position that acquiring this insurance is the responsibility of the individual. They strongly encourage principal investigators who perform research at LAMPF to require that their personnel be covered by institutional or other personal health insurance.

Appendix A

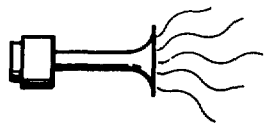
MP-DIVISION EMERGENCY PROCEDURES

AUDIBLE ALARMS

FIRE ALARMS



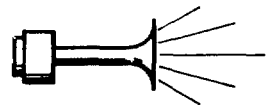
Continuous Bell



Slow Whoop Horn

Determine cause of alarm.
Prepare to evacuate.

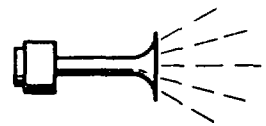
BEAM LINES AND CAVES PERSONNEL SAFETY SYSTEM READY



Klaxon Horn

Hit scram switch.
Evacuate beam channel or cave.

EXPERIMENTAL AREAS



Rapid Intermittent Horn

Evacuate immediately.

Fire Dept./Ambulance 9-911	Central Alarm Station 7-7080	Health Physics Office 7-7069	MP-Division Safety Office 7-6176
FIRES AND EXPLOSIONS	RADIOLOGICAL INCIDENTS	INDUSTRIAL ACCIDENTS	CIVIL DISTURBANCES
1) Call Fire Department. Pull box, or dial 9-911. 2) Attempt to rescue trapped persons and administer first aid where necessary. 3) Shut down endangered equipment. 4) Attempt to extinguish or evacuate area, depending on severity. 5) Notify Central Control Room 7-5729.	1) Evacuate immediate area, but remain nearby. 2) Call Health Physics Office 7-7069 and Central Control Room 7-5729. 3) Turn off fans or pumps, depending on nature of spill. 4) DO NOT SPREAD POSSIBLE CONTAMINATION!	1) Administer first aid. 2) For extensive injuries call ambulance (9-911). 3) In case of ruptured high-pressure systems evacuate the area and shut down the systems involved. 4) Notify Central Control Room 7-5729.	1) In case of a bomb-threat call, use check list on inside cover of LANL Telephone Directory and evacuate area involved. 2) If suspicious device is found, evacuate the area. 3) Call Central Alarm Station 7-7080. 4) Notify Central Control Room 7-5729.
Central Control Room 7-5729	ENG-4/TA-53 7-5639 or Phone Page 104-1154	Site Paging 7-6913	LA Medical Center 9-662-4201

Appendix B
Glossary of Acronyms and Terms

A-1	Target cell for EPICS and LEP secondary beam lines
A-2	Target cell for P^3 and SMC secondary beam lines
A-3	Low-intensity collimator/beam stop in Area A
A-4	Target stubout used for entry to the A-East beam line
A-5	MPF-3R target cell
A-6	Line A beam stop, Isotope Production and Radiation-Effects Facility, and neutrino target cell
AB/NucChem	Nuclear chemistry target cave in Area B
ADC	Accelerator Development Committee
A-East	Beam line and support facilities east of Area A
AMO	Experimental Area Manager's Office, MP-7 (MPF-43)
ANSI	American National Standards Institute
Anti-C	Anticontamination (clothing)
AR #-#	Administrative Requirement, reference to section in the Laboratory H&S manual
Area A	Main pion experimental area (MPF-3-M)
Area B	Nucleon Physics Laboratory, north of Area A (MPF-3-N)
Area C	HRS area, northwest of Area A (MPF-3-P)
ASME	American Society of Mechanical Engineers
MPF-3R	Former biomedical research facility, south of Area A-East
BR	West cave in Experimental Area B
BSY	Beam Switchyard
CAS	Central Alarm Station (fire and security)
CCH	Area C control room and counting house
CCR	Accelerator Central Control Room
CPR	Cardiopulmonary resuscitation

DAC	Data-Analysis Center (MPF-24)
DOE	U.S. Department of E gy
DTL	Drift-tube linac
EADC	Experimental Area Development Committee
ENG-4/TA-53	Facility Design and Maintenance Section for TA-53
EPICS	Energetic Pion Channel and Spectrometer, northwest cave in Area A
ESA	Experimental Staging Area (north of Area A-East)
ETL	Equipment Test Laboratory (MPF-2)
Fire-Watch	Special observer required for operations with a possibility of fire
Flame Tamer	Special cover for trash receptacles to limit fires
GSA	General Services Administration
GSO	Group Safety Officer
Guest Scientist	An experimenter registered with the Laboratory (User)
HIRAB	High-Resolution Atomic Beam Facility (Area B)
HP	Health Physics
HRS	High-Resolution Proton Spectrometer in Area C
H&S manual	The Los Alamos National Laboratory Manual—Chapter 1—Health and Safety
HSE-1	Radiation-Protection Group
HSE-2	Occupational-Medicine Group
HSE-3	Safety Group
HSE-5	Industrial Hygiene Group
HSE-7	Waste-Management Group
HSE-8	Environmental-Surveillance Group
HSE-11	Accelerator Health-Protection Group
HSO	MP-Division Health and Safety Office
ICR	Injector Control Room
ISORAD	Isotope Production and Radiation Effects Facility
Lagoons	Sanitary sewage lagoons southeast of experimental areas
LAMPF	The Los Alamos Clinton P. Anderson Meson Physics Facility

LANSCE	Los Alamos Neutron Scattering Center
LE/CS	Limited Egress/Confined Spaces (see H&S manual, Sec. AR 8-1)
LEEP	LAMPF Electronics Equipment Pool
LEP	Low-Energy Pion Channel, southwest cave in Area A
Linac	Linear accelerator
Line A	Main beam line, high-intensity H^+ beam, through Area A
Line B	Primary beam line, H^- beam, feeding Area B (NPL)
Line C	Branch beam line, feeding Area C (HRS)
Line D	South beam line under the road, feeding LANSCE/WNR
Line X	Branch beam line, H^- beam, feeding Lines B and C
LOB	The Laboratory-Office Building (MPF-1)
LSC	LAMPF Scheduling Committee
LUGI	LAMPF Users Group, Inc.
MP	Medium-Energy Physics
MP-Division	The LAMPF and LANSCE beam-lines management division
MPF-526	Medical Facility/First-Aid Station (southeast of the LOB)
MP-1	Electronic Instrumentation and Computer Systems Group
MP-2	Accelerator Operations Group
MP-3	Applications-Oriented Research Group
MP-4	Nuclear and Particle Physics Group
MP-5	LANSCE/WNR Beam-Delivery Group
MP-7	Experimental Areas Group
MP-8	Engineering Support Group
MP-10	Spectrometers Group
MP-11	Accelerator Support Group
MP-13	Beam-Line Development Group
MP-14	Accelerator and Nuclear Physics Research and Development Group
Module	Designation for a section of the accelerator
Monitors	The remote-handling servomanipulator systems

mR/h	Milliroentgen per hour (radiation exposure unit)
mrem/h	Millirem per hour (neutron radiation exposure unit)
MRS	Medium-Resolution Spectrometer (Area B)
MSDS	Material Safety Data Sheet
Neutrino Area	Neutrino Research Facility, south of Beam Stop A
NEC	National Electric Code
NFPA	National Fire Protection Association
NPL	Nucleon Physics Laboratory (Area B)
NTOF	Neutron Time-of-Flight line from Line B
Operations Building	Location of the Central Control Room (MPF-4)
OSHA	Occupational Safety and Health Administration
P^3	Pion and Particle Physics Channel, northeast cave in Area A
PAC	LAMPF Program Advisory Committee
PSR	Proton Storage Ring
Putzer	Gas-powered personnel carrier used by maintenance crews
rf	Radio frequency
RWP	Radiation Work Permit
Safety-Watch	Special safety observer required for hazardous work
Sector	A cluster or group of modules
SMC	Stopped Muon Channel, southeast cave in Area A
Sonalert	Miniaturized, high-pitched tone generator used for alarms
SOP	Standard (Safe) Operating Procedure
SWP	Special Work Permit
TAP	Technical Advisory Panel of the LAMPF Users Group
TB-###	Technical Bulletin, reference in the H&S manual by number (#)
Thin Target	Target area in Line A in the beam switchyard
TOFI	Time-of-Flight Isochronous beam line from the Thin Target Area in the beam switchyard

UL Label	A label placed on electrical equipment that has been tested and is acceptable to the Underwriters Laboratories
User	A person interested in the use and development of LAMPF
Vinnells	The ENG-3/5 metal buildings at TA-53 east of the LOB
Visitors Center	The registration center and central office for users, located in the lobby of the LOB
WNR	Weapons Neutron Research facility, located on the south side of the main site road and served by Beam Line D

Appendix C
Safety References

AEC TID 23992, "Safety Guidelines for High Energy Accelerator Facilities," 1967.

"A Guide to Good Practices for Accelerator Health Physics," expected 1987.

ANSI C2, *National Electrical Safety Code*, 1981.

ANSI C39.5, "Safety Requirements for Electrical and Electronic Measuring and Controlling Instrumentation," 1974.

ANSI N34, "Radiological Safety in the Design and Operation of Particle Accelerators," 1981.

ANSI Z136-1, "Safe Use of Lasers," 1980.

ANSI/NFPA 70 C1, *National Electrical Code*, 1981.

ASME, "Unfired Pressure Vessel Code," in *Boiler and Pressure Vessel Code*, Vol. VIII.

American Conference of Governmental Industrial Hygienists, *Threshold Limit Values for Chemical Substances and Physical Agents* (ACGIH, Cincinnati, Ohio, 1980).

DOE Order 5980.11, "Standards for Radiation Protection."

DOE Manual, "Operational Safety Standards," Chapter 0550.

DOE Manual, "Industrial Fire Protection," Chapter 0552.

DOE Manual, "Emergency Planning, Preparedness, & Response Program," Chapter 0601.

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C. F. Dalziel, "The Effects of Electrical Shock on Man," reprinted from *IRE Transactions on Medical Electronics* (PGME-5), May 1956.

F. J. Edeskuty, "Safety," in *Hydrogen: Its Technology and Implications, Volume IV, Utilization of Hydrogen*, K. E. Cox and K. D. Williamson, Jr., Eds. (CRC Press, Inc., Boca Raton, Florida, 1979), Chapter 5.

F. J. Edeskuty, R. Reider, and K. D. Williamson, Jr., "Safety," in *Cryogenic Fundamentals*, G. G. Haselden (Academic Press, Inc., London and New York, 1971), Chapter 11.

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"Los Alamos National Laboratory Manual—Chapter 15—Health and Safety."

W. Braker and A. L. Mossman, *Matheson Gas Data Book*, 5th Edition (Matheson Gas Products, East Rutherford, New Jersey, 1971).

NFPA, *National Fire Codes*.

NFPA 101, *Life Safety Code*.

National Safety Council, *Accident Prevention Manual for Industrial Operations*, 8th Edition, 1980.

National Safety Council, *Fundamentals of Industrial Hygiene*, 1975.

OSHA Regulations 29 CFR 1910, "Occupational Safety and Health Standards."

OSHA Regulations 29 CFR 1910.1200, "Hazard Communication Standard."

OSHA Regulations 29 CFR 1926, "Safety and Health Regulations for Construction."

H. W. Patterson and R. H. Thomas, *Accelerator Health Physics* (Academic Press, Inc., New York, 1973).

N. I. Saxe, *Dangerous Properties of Industrial Materials*, 5th Edition (Van Nostrand Reinhold, New York, 1979).

State of New Mexico, "Vehicle Code."

C. A. Willis and J. S. Handloser, *Health Physics Operational Monitoring* (Gordon Breach Co., New York, 1972).

Appendix D
Welding-Shade Lens Numbers

Operation	Recommended Shade Number[a]
Soldering	2
Torch brazing	3-4
Light cutting, up to 1 in.	3-4
Medium cutting, 1 to 6 in.	4-5
Heavy cutting, over 6 in.	5-6
Gas welding (light), up to 1/8 in.	4-5
Gas welding (medium), 1/8 to 1/2 in.	5-6
Gas welding (heavy), over 1/2 in.	6-8
Shielded-metal arc welding, 1/16-, 3/32-, 1/8-, and 5/32-in.-diam electrodes	10
Gas-shielded arc welding (nonferrous), 1/16-, 3/32-, 1/8-, and 5/32-in.-diam electrodes	11
Shielded-metal arc welding, 3/16-, 7/32-, and 1/4-in.-diam electrodes	12
5/16- and 3/8-in.-diam electrodes	14
Atomic hydrogen welding	10-14
Carbon arc welding	14

[a]Shades with more density than recommended may be selected.

Appendix E
Limited-Access and Confined Spaces in MP-Division Areas

Limited-Access Spaces (SOP #301)

1. A-1/LEP Valve Gallery
2. A-2 Valve Gallery
3. A-4 Beam Line
4. A-5 Valve Gallery and equipment spaces above MPF-3R
5. Deionization cylinder room and filter plenum in the Area A basement
6. Line B Tunnel
7. Nuclear Chemistry Cave and Line B beam dump
8. Line C beam dump
9. Line C in Area C to the wall
10. Line D Cave in the Beam Switchyard
11. Beam Switchyard
12. P^3 Beam Channel
13. SMC Beam Channel
14. PSR Cross Tunnel
15. WNR Target #4 Beam-Line Tunnel
16. Line D Beam Tunnel, behind shield wall
17. A-6 Gallery ("Dog House")

Confined Spaces

1. Area B Target Cell (LD_2 Pit)—*SOP #302*
2. ISORAD Pit at A-6—*SOP #303*
3. Subfloor Area in MPF-3R—*SOP #304*
4. The X0 Pump Pits—*SOP #305*

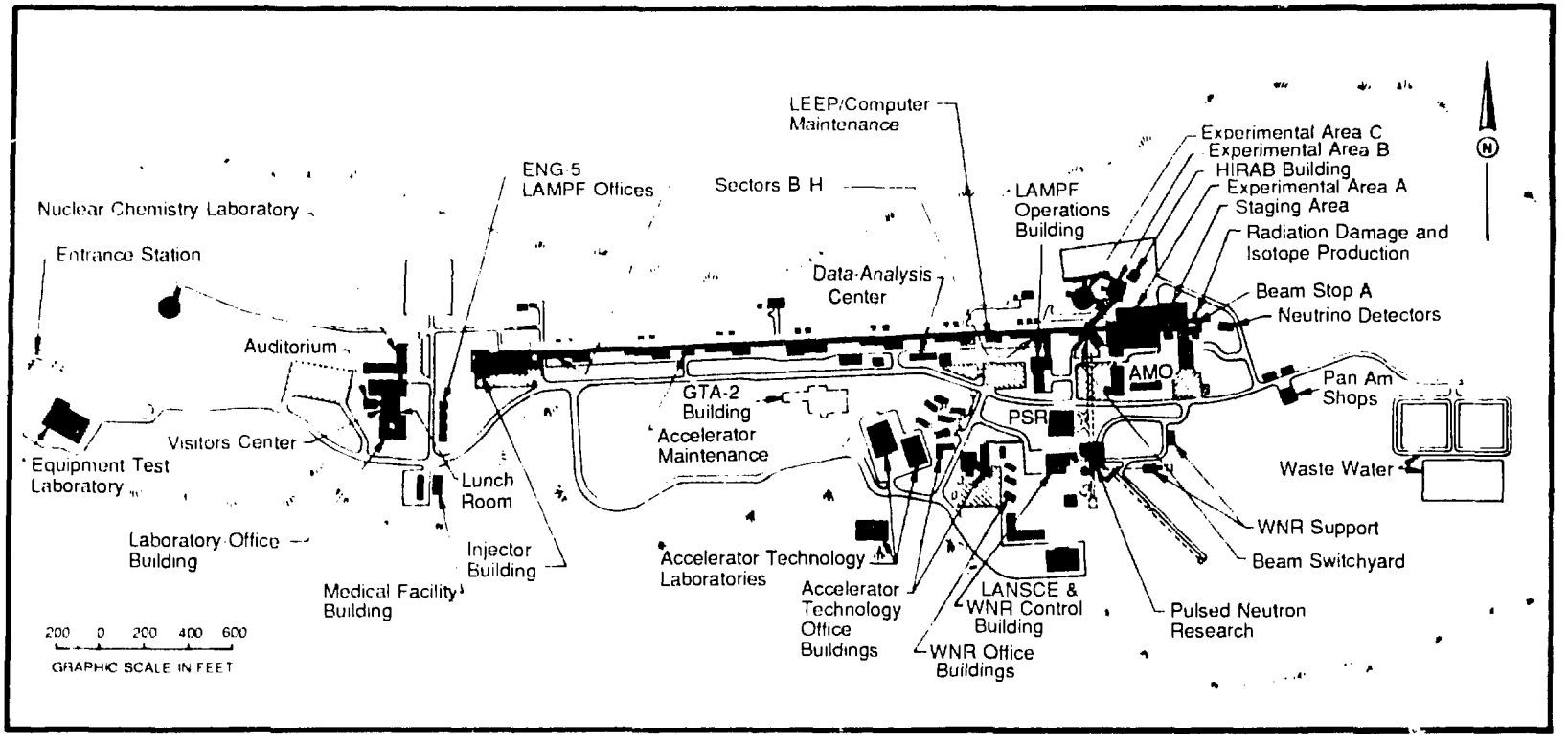
Index

Emergency Telephone Numbers

Area A Health Physics (HP) Office	7-7069
Central Alarm Station	7-7080
Central Control Room (CCR)	7-5729
Facility Inspectors, TA-53	7-5639
Telephone Page	104-1154
Fire, Ambulance, Police	9-911
Fire Department	7-7026
HSE-Division Emergency Number (work hours)	7-7878
Industrial Safety Office, TA-53	7-1384
Los Alamos Medical Center	9-662-4201
MP-Division Health and Safety Office	7-6176

Safety-Related Telephone Numbers

MP-Division Leader		
Donald Hagerman	7-5907	662-7389
Deputy MP-Division Leader		
Lewis Agnew	7-4359	662-7144
MP-Division/Users Safety Officer		
Donald Cochran	7-5763	672-3867
MP-Division Safety Assistant		
Milton Hollen	7-6176	662-3615
Experimental Area Operations		
Richard Werbeck	7-5680	662-4989
Accelerator Operations Group Leader		
Joe Bergstein	7-6929	662-3182
Occupational-Medicine Facility, TA-53		
Maggie Fisher	7-5781	
Industrial Safety Engineer		
Dug Pinyan	7-1384	662-5890
Telephone Page	118-195	
Industrial Hygiene Representative		
Fred Bolton	7-7819	672-1048
Telephone Page	118-311	
Accelerator Health-Protection Group		
Jerry Miller	7-5890	662-6692
Facility Engineering Section Leader		
Nikolajs Mezins	7-6481	672-1342



CLINTON P. ANDERSON MESON PHYSICS FACILITY