Letter from the Director of LANSCE

Welcome. I am pleased you have chosen to carry out your research at Los Alamos Neutron Science Center (LANSCE). You are coming here at a very exciting time. We have recently completed much needed improvements to our facility that have increased its reliability greatly. We are also in the middle of several upgrades that will increase the proton beam power at the Manuel Lujan Jr. Neutron Scattering Center from 56 to 160 kw and add several new neutron scattering spectrometers.

Our vision at LANSCE is to play a key role in solving important national problems using high-intensity accelerators and spallation neutron sources. We are an internationally renowned center for the development and safe use of high-power accelerators and spallation neutron sources for defense and civilian research. We also operate a national user facility providing state-of-the-art neutron instrumentation; safe, reliable operations; and expert collaborators for the defense and civilian research communities. The scientific staff at LANSCE, together with their many collaborators from across the globe, conduct leading-edge research in neutron scattering, neutron nuclear physics, and advanced accelerators.

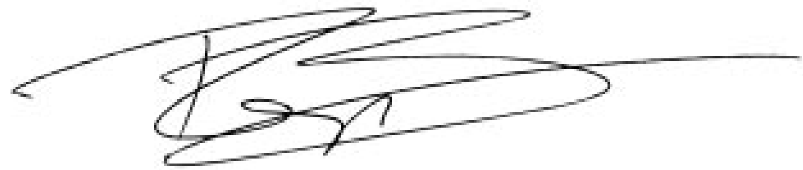
LANSCE uses its research capabilities to contribute to the Department of Energy (DOE) Science-Based Stockpile Stewardship program and to support a user program open to scientists worldwide. The DOE Office of Defense Programs and the DOE Office of Energy Research have synergistic long-term requirements for neutron and accelerator science.

Your suggestions and feedback are vital in helping us to provide a world-class facility for neutron science. The User Satisfaction Survey, provided to you during check-in, is the formal mechanism for providing input, and I ask that you take time to give us your feedback. We will look at all suggestions for improvement and decide how we can address them. We will let you know, by e-mail, what our response is so you can see the impact you have on our operations.

Your local technical contact or instrument scientist is the best source of technical support while you are performing your experiment. The User Office is your primary contact for any other needs you may have. LANSCE staff are here to assist you so please feel free to contact them with any requests that will make your visit more pleasant and productive. Any feedback you provide through any of these channels will be transmitted to me and other members of the LANSCE management team so that we may continue to improve our facilities and services to you and future users.

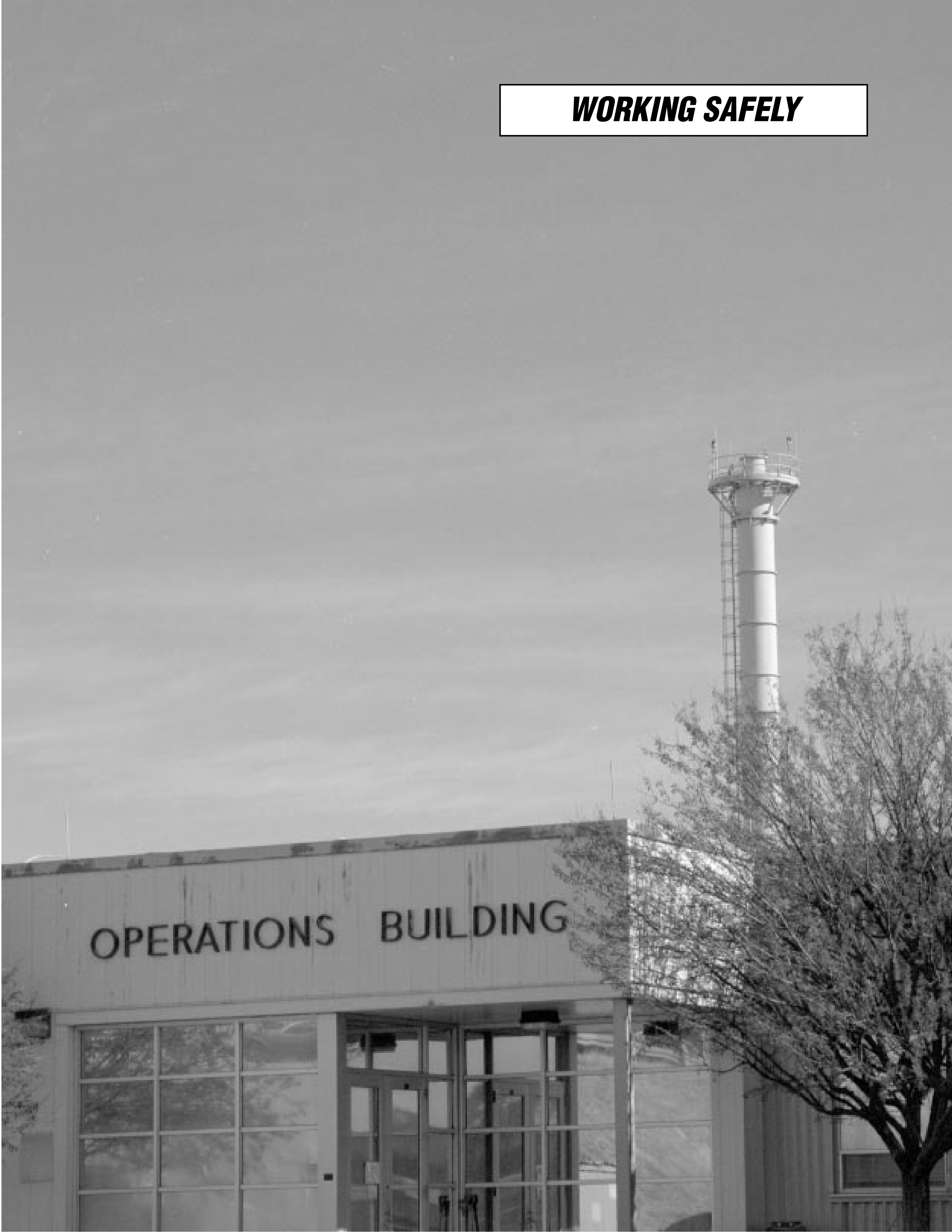
Your safety and the safety of other visitors and our workers is of utmost importance to us. It is crucial that all work be performed safely, and the training you are about to complete is an integral part in ensuring the safety of all who work here.

We hope your experience at LANSCE is a safe, pleasant, and rewarding one and that we will have the opportunity to continue to help you with your research in the future.



Roger Pynn

WORKING SAFELY



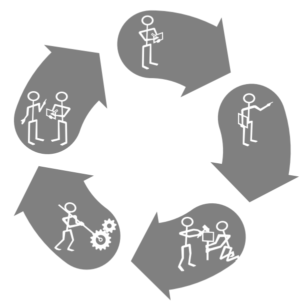
OPERATIONS BUILDING

WORKING SAFELY

To ensure a safe working environment, the first line of defense is individual awareness and commitment to safe work practices. All work performed at Los Alamos National Laboratory must be appropriately planned and hazards analyzed before the work begins. If there are established safety procedures already in place, they must be followed.

The following five-step process for performing work is used throughout the Department of Energy complex to review work practices and ensure work is being performed as safely as possible.

1) Define the scope of the work, set performance expectations, and prioritize tasks.
2) Analyze hazards.
3) Develop and implement controls to prevent or mitigate hazards. Establish a safety envelope for your work.
4) Perform the work safely.
5) Identify how you might improve your performance the next time around. Reinforce smart work practices and implement changes to improve your performance.



Five-step process.

As an experimenter at LANSCE, you should work through this five-step process in order to anticipate any potentially hazardous conditions. It is your responsibility to stop work if you see hazardous conditions or conditions that present a clear and imminent danger to you or your co-workers.

Please remember that if it comes to a choice between meeting programmatic commitments and doing work safely, safety always comes first!

SITE ACCESS

53-1145

SITE ACCESS

To enable you to work at LANSCE, you will be issued an identification badge or guest card. If you are a not a U.S. citizen, you will be issued a red badge with your photograph on it. Each time you enter the facility, stop at the gate and show the attendant your badge or guest card. The gate attendant will then wave you through.

The badges and guest cards are encoded for badge readers at LANSCE. A badge reader will automatically unlock a door or open a gate if it recognizes the code on your badge. If you need to enter the facility after work hours or on weekends, swipe your badge or guest card through the badge reader to open the facility gate. You will also need to use your badge to exit the facility after normal working hours. Please be careful going through the gate as it closes immediately after your car passes through.

In addition to access at the main gate, access to some buildings and experimental areas at LANSCE is controlled by badge readers. You will be allowed to enter office buildings and experimental areas to which you need access, provided you have completed the necessary training. Please have the Visitor Center personnel enter you into the badge reader system.

Any visitor without a badge who comes to the facility with you is your responsibility—you must ensure that the visitor does not wander on site unescorted. Even if escorted, visitors who are not U.S. citizens must be issued badges from Los Alamos National Laboratory's main badge office before entering the facility. Visitors must not perform work at LANSCE unless they have completed the necessary check-in procedures.

At the end of your visit, please return your identification badge or guest card and any keys to the LANSCE Visitor Center. If you are leaving the facility during nonbusiness hours, there is a drop box at the facility gate where you can deposit these items.

HAZARDOUS MATERIALS AND WASTE OPERATIONS

NO

HAZARDOUS MATERIALS AND WASTE OPERATIONS

To protect our environment and ourselves, proper management of hazardous materials and hazardous wastes is essential. Our goals are to ensure the safety of workers and visitors when they are working with or around hazardous materials, to minimize the amount of waste produced in our operations, and to properly dispose of the waste that is produced.

It is important that you inform your host before you bring any hazardous materials or chemicals on site. Besides affecting health and safety, such materials could require special handling, storage, or disposal. We must comply with a multitude of regulations here at Los Alamos National Laboratory, and as a user at LANSCE, you are required to meet strict requirements for handling, storing, and disposing of (1) radioactive or hazardous materials and waste and (2) all chemical products and chemical waste.

HANDLING HAZARDOUS WASTE

Hazardous materials may include chemicals, radioactive sources, metals, or other materials that could pose a hazard to workers or to the environment. Once a hazardous material is used in an operation, or a material is activated or exposed to radioactively contaminated material, the waste produced must be handled as hazardous, radioactive, chemical, or mixed waste (hazardous waste that contains radioactive material is classified as mixed waste). This means you cannot throw these types of wastes in the regular trash containers and you cannot dump chemicals down a drain. Doing so could result in consequences ranging from fines to criminal and civil penalties to facility or operational shutdowns.

The federal Resource Conservation and Recovery Act (RCRA) defines hazardous waste based on characteristics of toxicity, corrosivity, ignitability, or reactivity. Some materials are automatically listed as RCRA-regulated wastes, such as freon, acids, and acetone. All RCRA-regulated wastes must be handled, stored, and disposed of according to very strict guidelines.

If your experiment generates RCRA-regulated waste or any chemical or radioactive waste, you should consult with your host in order to ensure proper handling, storage, and disposal of the waste.

CHEMICAL SAFETY

Every chemical used at the Laboratory must be properly labeled and must have a Material Safety Data Sheet (MSDS) which describes the properties of the chemical and safety hazards associated with its use. Many of the experimental areas have hazard communication stations where MSDSs are kept. In addition, you may be able to find many of the more common MSDSs on the World Wide Web. Please ask your host for assistance if you cannot locate an MSDS for a material you will be working with.

You cannot throw outdated chemical products (items whose expiration dates have passed) into the regular trash. A chemical product, even if it has never been used, must be disposed of in the same manner as a waste product.

RADIOACTIVE MATERIAL AND WASTE

The handling of low-level radioactive material is fairly common for users performing experiments at LANSCE. Any potentially radioactive waste or radioactive material coming from a radiological area must be surveyed and tagged by a radiological control technician (RCT) before it is removed. If an item is found to be free of radioactivity, a health physics release tag will be issued that should remain on the material while it is on site.

In order to preserve knowledge of process of materials that are likely activated, special sticker-type labels are used. Do not remove these stickers unless an RCT has surveyed and released the material.

When you leave a radiologically controlled area, you must observe the posted exit requirements. Contact an RCT if you need clarification of the required procedures that you must follow in radiologically controlled areas.

Activated samples are generally stored by your host until radioactivity levels are low enough so that the items can be transported by regular carriers. If you have activated samples that you would like returned to you, please make arrangements with your host before you leave. Make sure all your samples are properly labeled with your name, home institution, and a description of the contents of the sample.

Experimental apparatus that is activated must be stored in a radioactive material control cabinet or storage area between uses or while awaiting shipment back to your home institution.

Because storage space is very limited and waste disposal is expensive, please arrange with your host to have all chemicals and equipment you use or purchase properly taken care of before you leave the facility.

RADIATION PROTECTION

CAUTION

RADIATION PROTECTION

TYPES OF RADIATION

The types of radiation that are produced by the proton beam's interaction with targets or as by-products of the beam activity include beta and gamma radiation, x-rays, and neutron radiation. In addition, some alpha radiation emitters are used in experiments or produced in targets.

Neutrons

Neutrons are produced when the proton beam interacts with targets and components in the beam line. Neutrons are produced only while the beam is on, but neutrons can cause nonradioactive material to become radioactive, or activated.

Neutron radiation is of concern primarily in the experimental areas; however, activation from neutrons should be expected any time the proton beam has a possibility of interacting with beam-line components. Concrete and polyethylene are the primary materials used for shielding; however, steel is also used for shielding of very high energy neutron radiation.

Beta and Gamma Radiation

Beta and gamma radiation are produced by

- the interaction of the accelerated beam with targets
- radioactive decay of material that has been in the beam line
- radioactive targets or sources used around LANSCE

Lead, steel, or concrete is used to shield against beta and gamma radiation.

When the beam is turned off, beta and gamma radiation remain in the form of activation or activated products. Even if the beam is shut down, do not assume that there are no radiation hazards. Beta and gamma radiation levels are highest right after the beam is turned off and decrease over time. To ensure that radiation levels are low enough so they do not pose a hazard, check with a radiological control technician (RCT) before entering certain beam areas after the beam has gone down. Observe the radiological postings in these areas: they should reflect current beam conditions.

DOSIMETRY

To accurately determine radiation doses, users are generally issued the following two types of dosimetry badges.

Thermoluminescent Dosimeter

The thermoluminescent dosimeter (TLD) is the primary dosimetry device used to keep track of your ionizing radiation exposure by measuring both low-energy neutrons and the gamma/beta dose. You will be issued a TLD when you have completed this safety training.

Once you have been issued a TLD, you must wear it at all times when on site at LANSCE. Do not leave the TLD on the dashboard of your car as this will affect the dose reading. Wear the TLD in the chest area, well above the waist, with the foil windows facing outward.

PN-3 Personal Neutron Dosimeter

The PN-3 personal neutron dosimeter measures neutron dose from high-energy neutrons not detected by the TLD. The PN-3, or "Lemon Badge," is required for work in all experimental areas when the beam is on and is worn in addition to a TLD. The badge must be worn above the waist, with the flat side to the chest. PN-3 personal neutron dosimeters are exchanged quarterly.

At the end of your visit, be sure to return any dosimeters you are issued to the LANSCE Visitor Center, or if you are leaving the facility after regular business hours or on a weekend, there is a drop box at the facility gate where you can deposit your dosimeters and badges. You will be notified by letter of your dose measurement results.

RADIATION DETECTION DEVICES

Several different types of radiation detection monitors are used at LANSCE. The following are monitors commonly found in the experimental areas.

Portal Monitors

As you walk through a portal monitor, it detects contamination on your person or clothing. If the alarm on a portal monitor should be set off, stay in the area and call an RCT (7-7069) immediately.

Neutron Detectors

Neutron detectors are used to detect elevated levels of neutron radiation. The Albatross is one type of neutron detector used at LANSCE and is found in almost all the experimental areas. If the alarm on a neutron detector is set off, immediately evacuate the area and call an RCT.

Continuous Air Monitors

Continuous air monitors (CAMs) are used in various areas to monitor the levels of airborne radioactivity. If the alarm on a CAM should be set off, immediately exit the area and call an RCT.

CAMs that detect alpha-emitting material are used in two locations at LANSCE: (1) MPF-29 (in the Weapons Neutron Research facility) to detect uranium and plutonium, and (2) ER-1 and ER-2 of the Manuel Lujan Jr. Neutron Scattering Center when plutonium and other actinides are being used in experiments. CAMs that detect beta-emitting material are used during certain experiments.

Gate Alarm

There is a radiation detection system located at the LANSCE main gate. If your vehicle sets off the alarm, a red light will flash and an alarm will sound. If this happens, stop, pull over, and call an RCT. The alarm is sensitive enough to detect medical isotopes you may have received. If you are receiving radiation treatments or are transporting radioactive materials, you may want to call the RCTs before you leave the facility to alert them that you might activate the alarm.

Please note that the gate alarm does not detect tritium or alpha-emitting material. If you are transporting these types of radioactive materials, you must ensure you have the proper release tags and shipping documents.

LINE D ROAD CROSSING

The Line D beam line passes under the roadway as it is transported from the switchyard to the Proton Storage Ring and the Weapons Neutron Research facility. At this location, a beam-spill accident could potentially cause dose rates in excess of 100 rem per hour. This is an extreme and unlikely scenario; however, do not loiter in the area of the Line D road crossing when the beam is on. You will notice that shielding blocks are used to line both sides of the road crossing and the area is posted, “No Stopping Next 50 Feet.”

COMPLYING WITH RADIOLOGICAL POSTINGS

It is each person’s responsibility to read and comply with radiological postings, signs, and labels. You should take every precaution to protect yourself, your co-workers, and the general public from unnecessary exposure to radiation.

Disregarding any postings or removing or relocating them without permission could lead to

- unnecessary or excessive radiation exposure
- personnel contamination or injury
- release of contaminated or radioactive materials into the environment
- loss of user privileges

EMERGENCIES

EMERGENCIES

In the event of an emergency, your own safety should always be your first priority. If you are the first person on the scene, call 911 and your host. If you call from a cellular phone, DO NOT dial 911 but rather call the Laboratory's Emergency Management and Response team at 667-6211. (If you call 911 from a cellular phone, your call will be automatically routed to Santa Fe.)

ALARMS

There are a number of alarms used at LANSCE. Alarms vary depending on the particular area in the facility. Except for a few radiation detectors, most alarms signal that the building should be evacuated. If you hear an alarm, immediately exit the building and do not re-enter until you have been authorized to do so by a Los Alamos National Laboratory supervisor or other manager.

EMERGENCY EVACUATION POSTERS

Emergency evacuation posters posted in the experimental areas show the evacuation routes from the buildings and where to assemble after an evacuation. Emergency phone numbers are also listed. You should carry your host's telephone number with you.

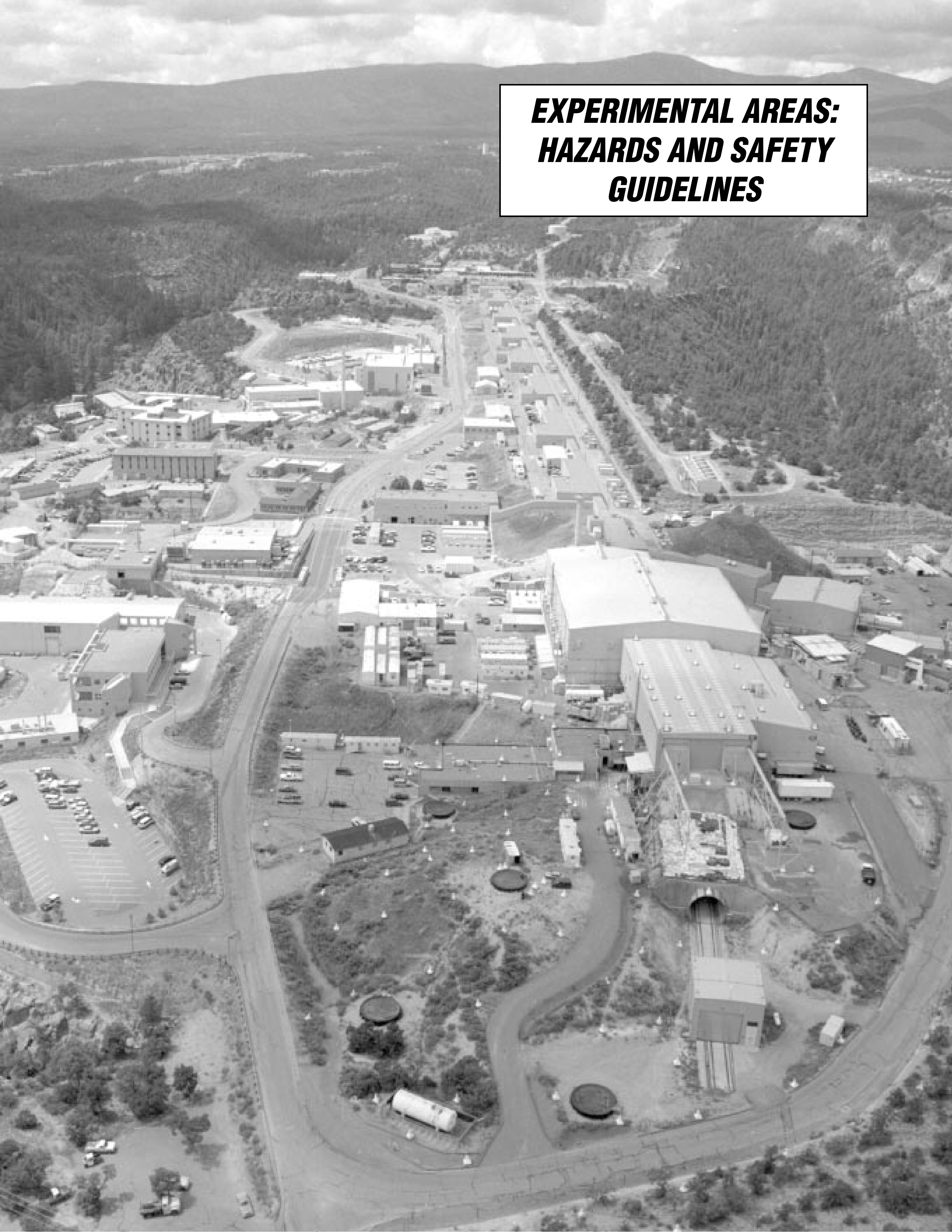
EMERGENCY MEDICAL CARE

Emergency medical care for the Laboratory is provided by the Los Alamos Medical Center. In the event of a major medical emergency, call 911 and ask for an ambulance. If you call from a cellular phone, call 667-7080 for an ambulance.

RESPONDING TO A SPILL

If there is a spill in your work area and the material spilled exceeds one gallon, is hazardous, or cannot be identified, immediately call the Laboratory's Emergency Management and Response team (7-6211) and then call your host. Spill containment and cleanup will be arranged. Please keep in mind the rules of waste management whenever cleaning up spills. In most cases, the cleanup materials used must be disposed of as regulated waste.

EXPERIMENTAL AREAS: HAZARDS AND SAFETY GUIDELINES



EXPERIMENTAL AREAS: HAZARDS AND SAFETY GUIDELINES

Line D of the LANSCE linear accelerator (linac) supplies beam to two separate experimental areas: the Manuel Lujan Jr. Neutron Scattering Center (Target 1) and the Weapons Neutron Research facility (Target 2 and Target 4).

WEAPONS NEUTRON RESEARCH FACILITY

At the Weapons Neutron Research (WNR) facility, high-energy neutrons and protons are used for basic and applied research in nuclear science and for weapons-related measurements. At Target 2 (the Blue Room), proton-induced reactions can be studied using the linac or the Proton Storage Ring proton beam. At Target 4, the 800-MeV proton beam from the linac is used to produce neutrons for study of neutron-induced reactions.

Radiological Postings

Since WNR is a multi-user facility, several experiments may be running simultaneously. Because of this, experiments and associated hazards on neighboring flight paths may change frequently. You must pay close attention to all radiological and other hazard postings. Don't assume that conditions will be the same from one day to the next.

At times, entry to some areas is controlled under a radiological work permit (RWP). You must review the posted RWP to learn about the most current radiological conditions, precautions, and dosimetry requirements. The RWP is generally posted at the access control point for the area.

The entire WNR south yard is designated as a radiologically controlled area. Any material or equipment that might have been activated or contaminated must be surveyed by a radiological control technician (RCT). Before any potentially radioactive material can be released to an uncontrolled area, it must have a health physics release tag attached to it.

Radiation Protection

During normal operations, the major radiation hazard at WNR exists only while the beam is running. This is when there is potential for exposure to ionizing radiation from the proton beam and the secondary neutron beams.


LANSCE

To guard against exposing anyone to excess radiation while the beam is on, a personnel safety system (PSS) is in place to control access to areas near the proton beam and near the neutron flight paths. The PSS keeps track of special keys that allow access to specific areas. These special keys are used for doors, cabinets, and flight-path resets. The keys are available to authorized personnel after completion of this training. Only when all the keys to an area are returned and a "sweep" has been performed will a shutter that allows the beam to come through the area be opened.

The administrative sweeps are conducted to ensure that people are not left in areas where they could possibly be exposed to unauthorized doses of radiation produced by the accelerator. Sweep procedures usually require searches of areas that would otherwise tend to be overlooked. Before securing an area for beam, an RCT and an accelerator operator perform a sweep of the beam-delivery area.

If you intend to enter an area protected by the PSS, you must first verify that the shutter on the flight path to that area is closed. You can verify shutter status by

- observing the lights on the PSS master box inside MPF-29,

- observing the shutter status reported on the shutter-control computer terminal inside MPF-29, or

- observing lights and signs at the PSS station for the flight path you wish to enter.

To open a shutter, the area must be clear of personnel and the PSS secured. There are specific WNR procedures that must be followed to secure the beam areas. Please ask your host for assistance.

Detector sheds on Target 4 flight paths may be entered only when the flight-path shutter is closed. The PSS will not release a key to you if the shutter is open. After gaining access to a detector shed, you must take the PSS key inside with you. The PSS will not allow the beam to be released into an area if even one key to the area is out.

Detector sheds on Target 2 flight paths and the Target 4 exclusion area may be entered only when plugs are inserted into the Line D beam path; the plugs prevent the beam from entering specific beam-delivery areas. A PSS key or door release cannot be obtained if the beam plugs are out. To request insertion of the beam plugs, you must call the central control room (7-5729). Because of the beam loss when someone must enter a beam-delivery area, you must coordinate with other users.

Other Hazards

At WNR, the electronic systems and the use of compressed gases and cryogenic fluids can potentially cause hazards. If you are not familiar with the use of these systems or substances, check with the WNR Safety Office (5-2029) or a knowledgeable staff member. Do not attempt to repair inoperable plumbing, compressed air lines, electrical breaker boxes, or any other equipment provided by Los Alamos National Laboratory.

Because of potential industrial hazards, hardhats are required in the following WNR areas:

- 1FP05 detector pit at all times
- MPF-29 when the crane is in use

Hardhats are available at the entrances to these areas and should be returned when you exit the area.

Machine Shop

There is a machine shop located in Building 18. Your host can assist you in contacting the shop supervisor should you need access to the shop equipment. You must have permission from the shop supervisor before you can use the shop.

MANUEL LUJAN JR. NEUTRON SCATTERING CENTER

The Manuel Lujan, Jr. Neutron Scattering Center includes two main experimental areas with 17 flight paths. Experimental Room 1 (ER-1) encircles the bulk shield surrounding the Lujan Center neutron production target. Experimental Room 2 (ER-2) is a large experimental hall that houses a range of instruments used for condensed-matter research and nuclear physics research.

Industrial Hazards

In ER-1, you must wear a hardhat (1) when you are working with or near the operating crane, (2) when you are working on the mezzanine, and (3) when you are working on the floor level but work is being performed above you, on the mezzanine or on the shielding that covers the flight paths. In ER-2, you must wear a hardhat when you are working with or near the operating crane. In both ER-1 and ER-2, you must wear a hardhat if the crane operator instructs you to do so.

Hardhats are located at each of the entrances to ER-1 and ER-2 and should be returned when you exit the area.

Falls and trips are potential hazards. In ER-1, be extremely careful whenever walking on the shielding areas at the mezzanine level. The shielding is uneven in spots and very slippery. A fall could cause injury.

Cryogens

Cryogens are used for certain experiments at the Lujan Center. If large amounts of cryogens are inadvertently released, oxygen can be displaced, creating a hazardous atmosphere. If you hear a low-oxygen alarm sound, immediately evacuate the area.

Experimental Room 1

The proton beam passes above the northwest corner of Experimental Room 1 (ER-1) and is bent downward to strike the target at the center of the bulk shield. Secondary beams emerge from the shield and enter ER-l, directed through flight paths.

About 8,000 pounds of mercury is used for flight-path shutters which block the neutron beam. The mercury is contained in tanks; however, if you should see a silvery metal fluid pooled on the floor or flowing out of the tanks, press an evacuation alarm button in order to alert others in the area of the spill, then evacuate the area immediately. Call the Laboratory's Emergency Management and Response team (7-6211) to notify them that a spill has occurred. In addition, call your host, and if possible, contact an instrument technician on the mechanical team to report the spill.


ANSCE

ER-1 is considered a Limited Access Area when the beam is on because of its close proximity to the accelerator beam line. The beam flows north-south to WNR. A spill of the WNR beam, though unlikely, could present increased radiological hazards to those working in ER-1. The probability of this condition occurring is extremely low. To prevent a beam spill, multilayered and redundant safety systems are in place that interlock with the beam-delivery system. Because radiation levels are normally low, workers are allowed to enter ER-1 during normal beam operations in order to work on equipment and conduct inspections.

During normal beam operations, you can gain access to ER-1 by swiping your badge through the badge reader at the door or access gate. The door or gate latch will then release and you may enter. To prevent unauthorized personnel from entering, make sure that the door or gate latches after you. If more than one trained person is entering the area at the same time, each individual must swipe his or her badge through the badge reader.

In addition to this training, those who need access to ER-1 must have current Radiological Worker I training, must wear both a thermoluminescent dosimeter (TLD) and a PN-3 personal neutron dosimeter, and must be enrolled in the badge reader for ER-1.

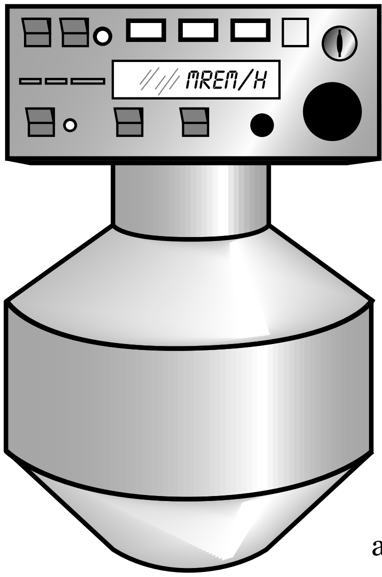
Visitors who violate the rules for entry may be subject to the following penalties:

- First violation: Warning

- Second violation: Access to ER-1 revoked for a specified period

- Third violation: Access to the experimental areas revoked for a period determined by management

As you exit the area, swipe your badge through the badge reader. In an emergency, don't worry about swiping your badge as you exit. The doors in all the Limited Access Areas are equipped with crash bars for easy egress.



Albatross neutron detector.

When you are in ER-1, you are protected from the high-energy ion beams by shielding and by several active protection systems which are engineered to shut off beam delivery in the event of a beam spill.

Certain area neutron radiation monitors are part of the secondary personnel protection system and are used to detect unwanted increases in radiation doses. The neutron detectors currently used for this purpose in ER-1 are Health Physics Instruments (Model 2080) known at LANSCE as Albatrosses.

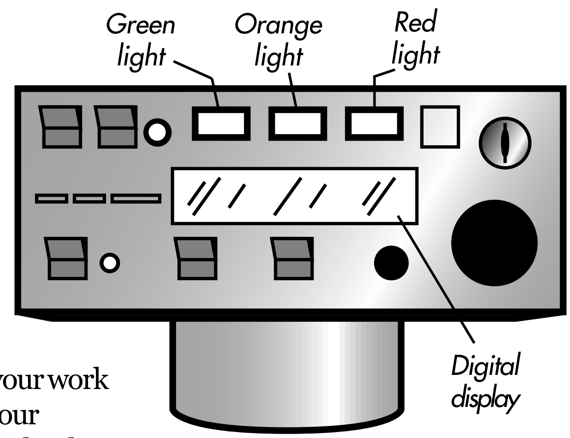
Before you enter ER-1, check the radiation dose rate displayed on the Albatross neutron detector located at the entrance. The Albatross at the entrance to ER-1 provides information only, but many of the Albatrosses located inside ER-1 are tied to the "run" permit. The run permit defines the safety requirements that must be met for the accelerator beam to operate. If the alarm goes off on one of the Albatrosses that is tied to the run permit, the accelerator beam will be shut off.

After you have checked the display at the entrance to ER-1, you should verify that the Albatross for the flight path you will be working at is operational. The Albatrosses are set up in strategic locations in ER-1. The Albatrosses are portable, but please do not move them from their set locations.

The Albatross is equipped with an LCD digital display and a variety of switches and lights. The digital display shows the detected neutron radiation dose rate in millirem per hour. As the level of radiation increases, the level indicated on the display will change accordingly. If the radiation dose rate hits the alarm trip point, the alarm on the Albatross will sound. The alarm trip point may vary depending on where the Albatross is located.

A small illuminated red light on the lower left of the instrument control panel indicates that the Albatross is powered. The Albatross should also be switched on. One of the three rectangular colored lights above the digital display should be flashing regularly if the Albatross is on. The color (green, orange, or red) depends on the dose rate the Albatross is measuring. It is important to remember that a single flashing light is an acceptable condition for normal operation, regardless of color.

Flashing Green. A flashing green light indicates a radiation level between 0 and 2 millirem per hour, which means little or no radiation is detected in the area. You can continue your work as usual.



Albatross control panel.

Flashing Orange. A flashing orange light indicates a radiation level between 3 and 19 millirem per hour. You should take a closer look at the Albatross control panel and read the dose rate on the digital display. If the radiation level is rising rapidly, you should exit the area and call the central control room (7-5729). If the radiation level is not changing much, complete your work in the area but exit the area as soon as possible in order to keep your exposure as low as reasonably achievable. Fluctuations in radiation level are to be expected.

Flashing Red. If the red light is flashing, the radiation level is 20 millirem per hour or above. You should take a close look at the radiation level shown on the digital display. If the level is rising rapidly, you should exit the area and call the central control room. If the audible alarm is not sounding, you may continue to work in the area, but you should exit as soon as possible.

Flashing Green/Orange/Red. If the radiation level has exceeded the alarm trip point, the audible alarm will sound and all three colored lights will flash together. If this happens, exit the area immediately. Once you are outside the area, call the central control room and an RCT (7-7069).

Static Green/Orange/Red. If the Albatross detects an extremely large rate of increase in the radiation level in an area, for example, in the event of a beam spill, you won't see a dose rate on the digital display. Instead, the digital display will read "FAST TRIP," the audible alarm will sound, and all three colored lights will be steadily illuminated. If this happens, immediately exit the area and call the central control room and an RCT.

Instrument Failure. If the digital display shows the word "FAIL," if the display is blank, if none of the colored lights are flashing, or if you see any other indication that something may be wrong with the Albatross, you should exit ER-1 immediately, then call the central control room.

Albatross Control Panel		
Illuminated Lights	**Radiation Dose Rate**	**What To Do**
Flashing green	0–2 mrem/hour	Little or no radiation in area—continue work
Flashing orange	3–19 mrem/hour	Generally safe but decrease time spent in area
Flashing red	20+ mrem/hour	Limit time in area
Flashing green/orange/red and alarm sounds	Radiation level is at or above the alarm trip point	Exit area immediately
Static green/orange/red, alarm sounds, and display reads "FAST TRIP"	Radiation level is rising precipitously	Exit area immediately

Summary

Before you enter ER-1, look at the control panel on the Albatross at the entrance.

- If the green light is flashing, it is safe to enter.
- If either the orange or red light is flashing, check the digital display. Is the radiation level rising quickly? If so, you probably should not enter the area. Call the central control room.
- If all the lights are flashing or static, do not enter the area whether or not the audible alarm is sounding. Call the central control room.

Once you are inside ER-1, locate the Albatross in the vicinity of the flight path you are working at and keep an eye on its control panel. Respond to any changes in the indicator lights.

If the alarm on an Albatross goes off while you are in ER-1, this indicates a higher than expected radiation field. You should exit the area immediately, then call the central control room and an RCT. Wait for assistance outside ER-1.

Never turn an Albatross off. Many of the Albatrosses in ER-1 are tied to the run permit and will stop the accelerator beam if turned off, if a system failure occurs in the Albatross, or if the radiation level detected triggers an alarm.

STUDY QUESTIONS ON ALBATROSS TRAINING

PLEASE NOTE: The test you must pass covers all the material in this booklet, not just the Albatross training.

1) On the control panel of an Albatross in ER-1, you see that the red light is flashing. Based on this information, what conclusions can you draw?

a. The dose rate is or has exceeded 20 mrem per hour.
b. The dose rate is dangerously high for this area.
c. The Albatross is not functioning properly.
d. The Albatross is running low on power.

2) You see that the orange light is flashing on the control panel of an Albatross. Based on this information, what conclusions can you draw?

a. It is not safe to approach the Albatross.
b. It is safe to approach the Albatross to get more information.
c. The Albatross is not functioning properly.
d. The Albatross is in FAST TRIP mode.

3) Upon closer inspection, the orange light is flashing and the display indicates that the dose rate is steady. Based on this information, what conclusions can you draw?

a. Work may continue, but I should limit my time in the area.
b. I should stop work immediately and call the central control room.
c. The Albatross is set to trigger an alarm at 30 mrem per hour.
d. There is a beam spill in the area.

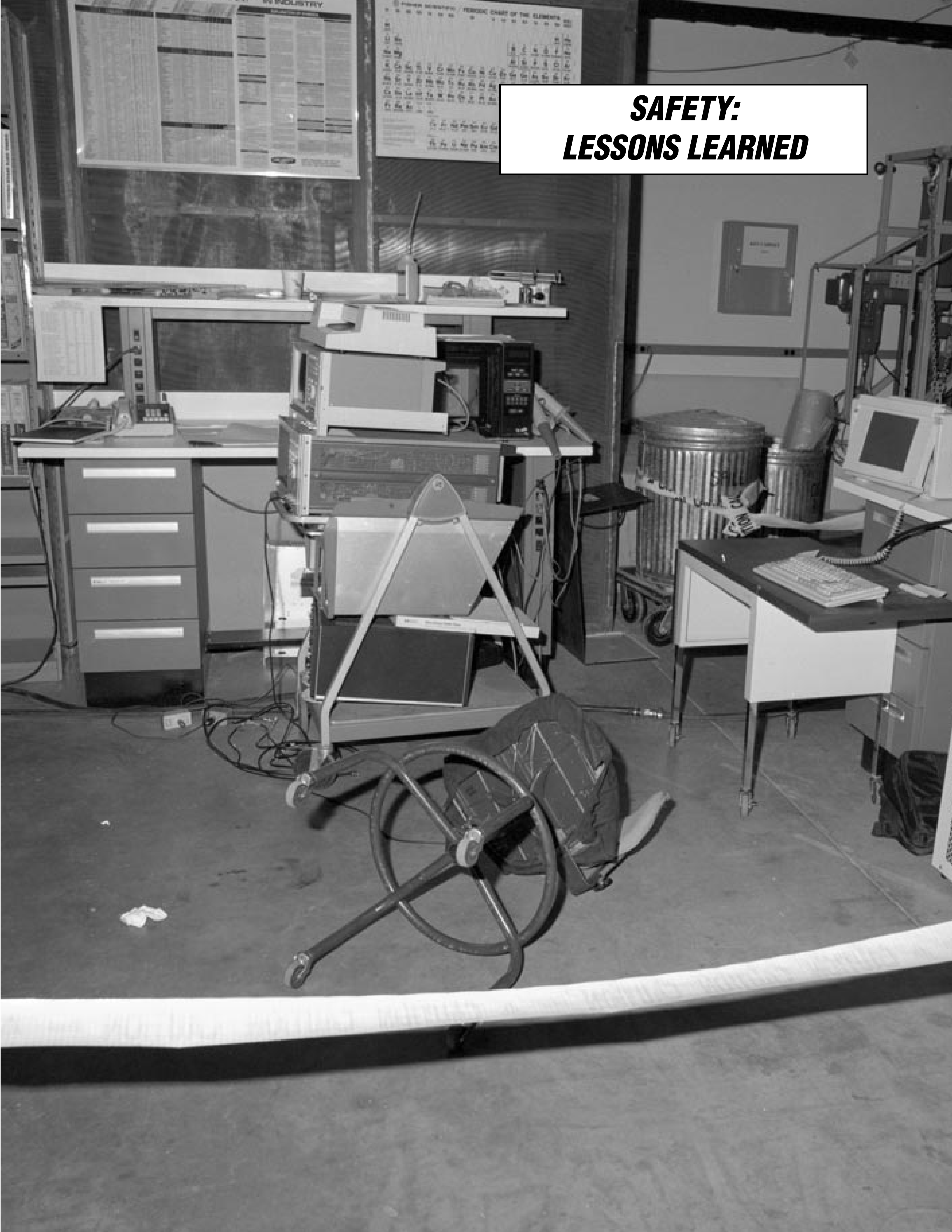
4) The orange light flashing and the dose rate is rising rapidly. Based on this information, what action should you take?

a. Continue work, but limit my time in the area.
b. Exit the area and call the central control room.
c. Press the reset button.
d. Check the alarm set point.

5) Working near an Albatross in ER-1, you hear the alarm sound and glance over at the Albatross. The green, orange, and red lights are all illuminated and static, and the digital display shows “FAST TRIP.” Based on this information, what conclusions can you draw?

a. There may be a beam spill. Exit immediately.
b. The Albatross must be malfunctioning. Turn it off and reset it.
c. The Albatross was left in test mode.
d. The red light should be flashing not static. The Albatross was not set properly.

ANSWERS
1. a
2. b
3. a
4. b
5. a



SAFETY: LESSONS LEARNED

MATERIAL SAFETY DATA SHEETS MAY CONTAIN INSUFFICIENT INFORMATION

In mid June, 1997, news surfaced about a professor's death at Dartmouth College as a result of dimethylmercury poisoning. This prompted the cleaning of a laboratory at Oak Ridge National Laboratory after a container of carbon-14 tagged methylmercury iodide was found.

Because of the tragic outcome of the Dartmouth incident, concern was raised about the handling and disposal of the particular alkyl mercury compound found in the lab at Oak Ridge National Laboratory. An effort was initiated to dispose of the methylmercury iodide. The Material Safety Data Sheet (MSDS) was referenced for personal protection and handling guidance, but key information was not included in the MSDS.

Although the MSDS correctly stated that methylmercury iodide is highly toxic if inhaled, if it contacts the skin, or if swallowed (and may cause cancer and extensive central nervous system and kidney damage), the MSDS offered only general information for personal protection and handling.

In the process of reviewing other sources, important characteristics with respect to the rate of decomposition of carbon-14 tagged methylmercury iodide were noted. The MSDS made no mention of the rate of decomposition, although it did include the statement, "The chemical and physical properties of this material have not been thoroughly investigated."

Dimethylmercury (the compound used by the professor at Dartmouth) has also been used at Los Alamos National Laboratory (LANL). Although the MSDS explicitly warns of the extreme hazards and severe consequences of exposure to this compound, it makes no recommendations on specific types of gloves or respirators to use for protection. The use of the wrong type of gloves is believed to have led to the death of the Dartmouth professor.

Lessons Learned

These incidents emphasize the limitations of depending solely on MSDSs for information on chemical characteristics and for recommendations on specific types of personal protective equipment. A study funded by the Occupational Safety and Health Administration found that only 11% of the MSDSs studied had presented completely accurate information and that the three categories with lowest accuracy were the categories critical in providing information necessary to protect the worker.

Although labeling and MSDSs are useful for assisting in the recognition of extremely hazardous chemicals, the properties of such chemicals should be evaluated thoroughly before they are used. When specific handling and storage instructions are not readily available on the MSDS, other sources should be checked. Health and safety professionals may need to be consulted for proper guidance on personal protective equipment.

RESEARCHER LOCKED IN EXPERIMENT ROOM DURING OPERATING CONDITIONS

On November 15, 1995, a LANL researcher was locked in an experiment room at the LANSCE Accelerator Complex during operating conditions when entry is prohibited. Another researcher performed a sweep-and-lock procedure of the room and notified control center operators that the room was clear of all personnel. However, he had overlooked someone. The locked-in researcher was able to exit the room by activating a safety override. To prevent exposure to radiation, personnel are not allowed in the room when the Weapons Neutron Research beam is in operation.

Two researchers and a student were authorized to enter Experimental Room 1 at the Manuel Lujan Jr. Neutron Scattering Center for 30 minutes to tend their experiments on the flight paths. One of the researchers was designated as the Experimental Room 1 Entry Responsible (EER) person and was assigned responsibility for entry, clearing the room within the specified time, securing the room, and notifying control center operators that the room was secure.

With six minutes remaining in the entry time, the researcher designated as the EER initiated the exit sweep-and-lock procedure. He discussed exiting the room with the other researcher and the student as they completed their work. Although the EER did not direct the second researcher to perform a sweep, the second researcher believed he should assist in the sweep. The EER also forgot to make the local safety sweep announcement required by the procedure. The EER continued his sweep to the west and north doors. In the meantime, the second researcher completed his work and instructed the student to exit and stand outside the south tunnel door. The second researcher then proceeded to the west door as part of his sweep. When he reached the master indicator panel, he noticed that the lock procedure was complete and the doors secured. He ran back to the south door and activated an override to exit.

The second researcher was locked in the room for five minutes at the most, during which time control center operators had been notified to resume beam operations. An operator noticed the south door override activation and performed the sweep-and-lock procedure again. He found the room empty. The EER, the second researcher, the student, and the operator immediately notified their respective supervisors, who notified facility managers.

The managers issued an order that only qualified accelerator operations and technical support operators would perform room sweeps before resuming Weapons Neutron Research beam operations. Managers reviewed the event and determined that the locked-in researcher would not have received a significant radiation dose.

Lessons Learned

This event underscores the importance of positive, formal verification that all personnel have left an area when failure to do so could result in radiation exposure or injury. Visual verification is the most certain method and should be used.

A single point of entry and exit and a designated central meeting point can also enhance control, as can alarms, horns, or public address system announcements.

DEWAR TOP RUPTURES AND INJURES TWO RESEARCHERS

In preparation for work at the National Synchrotron Light Source at Brookhaven National Laboratory, a researcher from Germany transported a "dewar" filled with shaved dry ice and vials containing small quantities of chemical and biological solutions to Brookhaven. He carried the dewar, actually a commercially available coffee thermos, with him on a commercial airline flight.

The coffee thermos was 10.5 inches high with a mouth 3.25 inches in diameter and a screw-in top. The screw-in top was kept loose to allow venting of the dry ice gases during transport. The researcher placed the thermos in a cold room upon arrival at the National Synchrotron Light Source, unscrewed the top, examined the contents to ensure sufficient dry ice remained to keep the contents cold, and screwed the thermos top back on.

The researcher returned the next day to open the thermos but could not unscrew the top. He did not observe the absence of frosting on top of the thermos, an indication that the thermos was not venting the dry ice gas. He obtained assistance from a colleague, who used both hands to try to remove the top of the thermos while the researcher held the body of the thermos. While attempting this, overpressurization blew the top of the thermos off. The top hit the research in the forehead, and the body of the thermos hit the researcher's left thigh and thumb. The colleague was sprayed with dry ice and suffered contusions on his left hand and knee. Both received medical attention (a splint was placed on the researcher's left thumb, and the colleague's left eye was irrigated), were released, and returned to work the next day.

Brookhaven National Laboratory immediately carried out an investigation. The causes of the incident were determined to be a combination of inattention to detail, deficient training, and an error in the selection of equipment or material. A dewar or container with a screw-in top is inappropriate for the storage and transport of dry ice or other cryogenic materials that can evolve gas. The container may eventually overpressurize and rupture, which can clearly cause injury.

The airline had examined, x-rayed, and approved transport of the thermos as part of the researcher's hand-carried luggage in the passenger compartment. It is possible that the thermos could have overpressurized and ruptured its top during the flight.

Lessons Learned

Management, staff, and researchers at Department of Energy user facilities need to ensure that adequate care and precautions are taken in the handling, storage, and transport of cryogenic materials, in the laboratory setting as well as during transport that may involve airlines and other public or private means of transportation.

UNPLANNED RADIATION EXPOSURE AT ARGONNE NATIONAL LABORATORY

On March 17, 1993, a resident graduate student at Argonne National Laboratory violated an Intense Pulsed Neutron Source beam-gate procedure, and after removing several personnel access restriction devices, placed herself in a radiation area.

The experimental research facility was in normal operation at the time of the event. The student had been trained in facility safety and qualified on the instruments, and she had been a resident of the facility for over a year. Despite this training, the student ignored the wall-mounted beam-gate open light and the ceiling-mounted accelerator-current display, violated the posted beam-gate operating procedure, accessed the beam area without closing the beam gate, and thus was exposed to a low-intensity neutron beam. Results of the investigation of the incident indicated that the student received a total effective dose equivalent of 1,900 mrem during the five-minute interval of the exposure.

The student had removed a chain gate labeled "Restricted Area: No Thoroughfare," used keys to unlock a padlock on the beam-access barricade, moved the barricade to the side, and removed a wheel-mounted radiation shield. Investigators concluded that the event occurred because of a lack of concentration by the student and the urgency to complete work.

Lessons Learned

Procedures and administrative controls should not be the only means of protecting personnel. Addition of active interlocks would prevent accidental personnel exposure to a direct beam, even when all procedures and administrative controls have been violated.

The event could have been more severe if the worker had spent an extended time interval in the area. However, if proper procedures had been followed, or if active interlocks had been in place, the unplanned exposure would not have occurred.