Course # 15414

TA-53 Facility Radiation Protection (FRPR)

Requirements Training

for

Residents and Visitors

LANSCE
Los Alamos Neutron Science Center

May 29, 2012

Trainee Study Guide

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1.0 INTRODUCTION

The LANSCE-ST-121-003.R3: *TA-53 Facility Radiation Protection Requirements (FRPR)* demands that a training component be made available to provide an overview of its technical requirements. **The intended audiences for this training are the residents and visitors who perform work at TA-53 and require unescorted access to RCAs**. This training specifies the radiation protection requirements that are necessary for ensuring radiation safety for residents and visitors at TA-53, LANSCE.

The *TA-53* FRPR defines how the Los Alamos National Laboratory (LANL) radiation protection requirements found in P121, *Occupational Radiation Protection Requirements*, are implemented at TA-53, LANSCE. It also incorporates lessons learned, operational experience, and best practices in the field of radiation protection.

1.1 Enabling Objectives

Upon completion of the TA-53 Facility Radiation Protection Requirements (FRPR) Training for Residents and Visitors, the trainee will:

- **E.O.1.** Identify the intended audience, the purpose and scope of the LANSCE-ST-121-003.R3: *TA-53 Facility Radiation Protection Requirements (FRPR)* document.
- **E.O.2.** Identify the worker(s) responsible for maintaining and ensuring the operability of safety equipment.
- **E.O.3.** Identify the correct response to an abnormal event, alarm or emergency.
- **E.O.4.** Describe the dosimetry requirements at TA-53.
- **E.O.5.** Identify the two main radiological areas at TA-53 where radiological posting will be seen.
- **E.O.6.** State the training requirements for unescorted entry into TA-53 radiological areas.
- **E.O.7.** Identify the three basic methods by which access to the TA-53 primary or secondary beam tunnels is controlled.
- **E.O.8.** State the PPE requirements for RCAs controlled for radiological and contamination hazards.
- **E.O.9.** Recognize when it is appropriate to use a Radiological Work Permit and when it is not.
- **E.O.10.** Recognize when it is necessary to use a Radiological Control Technician (RCT).Describe some of the radiation protection instrumentation in use at TA-53.
- **E.O.11.** Describe some of the radiation protection instrumentation in use at TA-53.
- **E.O.12.** Identify the general requirements to minimize the spread of contamination.
- **E.O.13.** Recognize when to use a Personal Contamination Monitor (PCM).
- **E.O.14.** Identify the general requirements for item and equipment removal from RCAs for volume contamination.
- **E.O.15.** Identify the requirements for shipping, transferring or receiving accountable sources at TA-53.

1.2 Purpose

Using LANSCE-ST-121-003.R3: *TA-53 Facility Radiation Protection Requirements (FRPR)* as the primary source document, this training:

- Defines the responsibilities, requirements, and processes to control radiological hazards and personnel exposure to radiological hazards at TA-53, LANSCE.

- It provides a direct correlation to P121, defining facility-specific applications where appropriate. It identifies basic requirements for most routine low-hazard radiological work and for some moderate- and high-hazard radiological work as defined by P121, including use of engineered controls, administrative controls, and personal protective equipment (PPE).

- This training specifies the minimum radiation protection requirements that must be met at TA-53, LANSCE. The TA-53 Facility Radiation Protection Requirements document (LANSCE-ST-121-003.R3) can be referenced in its entirety or in parts, as needed, to specify appropriate hazard controls in work control documents such as *Integrated Work Documents* (IWDs). **The requirements contained within the LANSCE-ST-121-003.R3 document are minimum requirements and are supplemented through the use of other formal work control documents when hazards dictate (for example, general or operation-specific procedures, IWDs, or radiological work permits (RWPs)**.

- Adherence to the requirements of P121 and the *TA-53 Facility Radiation Protection Requirements (FRPR)* document by residents and visitors ensures a formal and consistent approach to radiation protection at TA-53, LANSCE to help minimize personnel external exposure to ionizing radiation, the risk of internal exposure to radioactive material, and the spread of radioactive contamination.

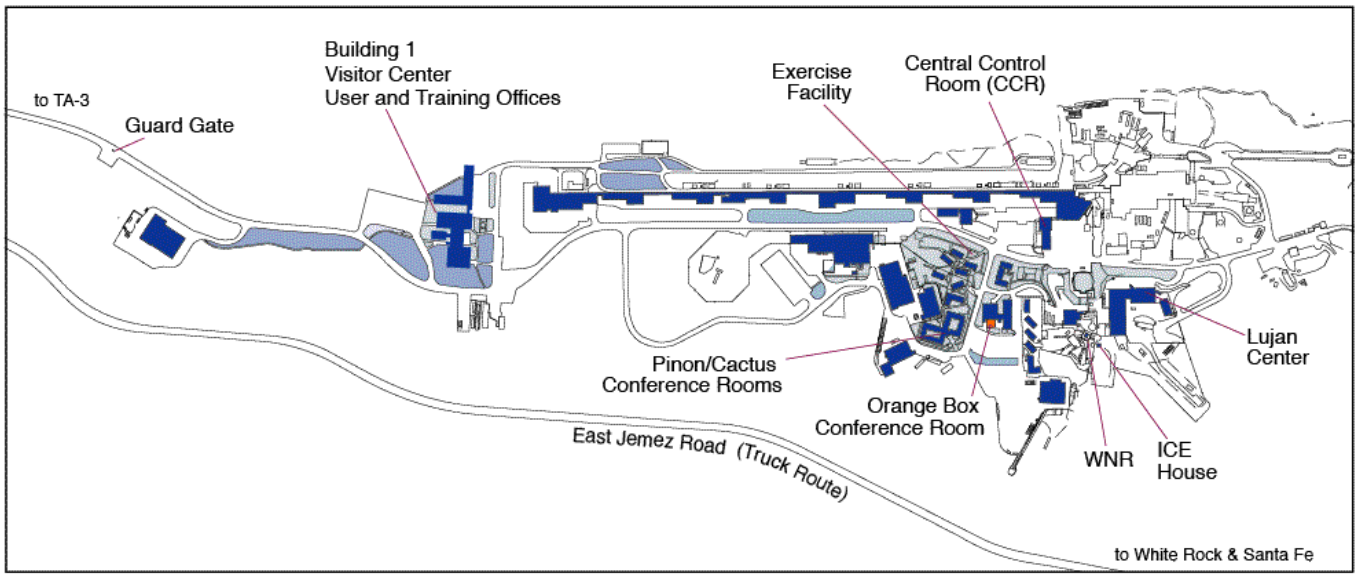
- This training also serves as facility-specific training for the *TA-53 Facility Radiation Protection Requirements (FRPR)* document required by P121. **It provides the requirements and authorization specified in LANSCE-ST-121-003.R3 to allow entry by residents or visitors into the following radiological areas at TA-53, LANSCE in accordance with P121**:

    - radiation areas,
    - high radiation areas below 1 rem/h, and
    - contamination areas.

1.3 Scope

The training module will provide an overview of the FRPR along with a 15 question open referenced quiz. **The trainee must obtain a minimum passing score of 80% to receive credit for the course**. This training shall serve to reinforce knowledge of safety practices for all radiological activities that are conducted by all personnel visiting or working within the boundaries of the TA-53, LANSCE site as put forth by the *TA-53 Facility Radiation Protection Requirements (FRPR)* document (LANSCE-ST-121-003.R3).

The boundaries of the TA-53, LANSCE are defined on the north, south, and east by the edges of the mesa encompassed by TA-53, and by a facility boundary fence immediately to the west of mpf-2 and the mpf-987 water storage tank. The entry security post and parking area just west of the boundary fence are also part of TA-53.



The *TA-53 Facility Radiation Protection Requirements (FRPR)* document is the source document exclusively used for this training. **It applies to all operations and entry into areas where a radiological hazard may exist, including operations involving radioactive material.** The FRPR document defers implementation of shielding and access control requirements specific to accelerators and *radiation-generating devices* (RGDs) to the *Prompt Radiation Protection and Shielding Policy (LANSCE-ps-121-002. R4).*

The *FRPR* document defines facility-specific application of the LANL radiation protection requirements found in P121 and is supplemental to that document. Where no facility-specific requirements exist, the P121 elements are referenced directly.

Note: The governing documents 10 CFR 835, *Occupational Radiation Protection*, and P121 must be implemented at TA-53, LANSCE unless formal variance is granted for specific requirements.

1.4 Precautions and Limitations

The TA-*53 Facility Radiation Protection Requirements (FRPR)* document does not address non-radiological hazards or controls. **Work that involves non-radiological hazards must be**:

- appropriately scoped,
- analyzed,

- controlled, and
- performed in accordance with established *Integrated Work Management* (IWM) principles and processes.

For work that includes radiological and non-radiological hazards, controls must be:

- coordinated,
- integrated, and
- optimized in accordance with IWM requirements to ensure overall worker safety.

The *TA-53 Facility Radiation Protection Requirements (FRPR)* document does not address all possible questions, issues, or situations that might arise pertaining to implementation of requirements. For situations or issues not specifically addressed in this document, decisions regarding interpretation or applicability of LANL or TA-53, LANSCE radiation protection requirements are made as needed when communicated in writing by the RP-1 team leader for TA-53, LANSCE or by an RP-1 group level manager.

Variances from the requirements in *TA-53 Facility Radiation Protection Requirements (FRPR)* document are allowed:

- only with formal approval of the responsible line manager,
- the RP-1 TA-53, LANSCE Team Leader (or group level manager), and
- the TA-53, LANSCE Facility Operations Director or their designees.

Note: Variances from P121 requirements also require approval of the RP Division Leader.

Variances are documented and must address the specific area of variance; any compensatory measures if applicable; the scope of work, areas, and individuals to which the variance applies; the duration of the variance; and any communication requirements, such as training and posting of operator aids, if indicated.

The *TA-53 Facility Radiation Protection Requirements (FRPR)* document **does not apply to criticality safety**.

1.5 Definitions

Definitions unique to radiological control can be found in P121, *Appendix A, Glossary*.

Definitions Unique to Radiological Control

Selected important definitions used at TA-53:

DEFINITIONS UNIQUE TO RADIOLOGICAL CONTROL	
Term	**Definition**
airborne radioactivity area	Any area accessible to personnel where the concentration of airborne radioactivity, above natural background, exceeds or is likely to exceed the derived air concentration (DAC) value; or a worker present in the area without respiratory protection could receive an intake exceeding 12 DAC-hours in a week.
Contamination area	Any area accessible to personnel where removable surface contamination levels exceed or are likely to exceed the removable surface contamination values that are specified in P121, Table 14-2, but do not exceed 100 times those values. Designation of contamination areas is performed in accordance with P121.
High contamination area	Any area accessible to personnel where removable surface contamination levels exceed or are likely to exceed 100 times the removable surface contamination values that are specified in P-121-1, Table 14-2. Designation of high contamination areas is performed in accordance with P121.
High radiation area	Any area accessible to personnel where radiation levels could result in a worker receiving a deep dose equivalent in excess of 0.1 rem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.
Hot job exclusion area	A temporary area established around an unknown condition in the event of a radiological incident or an operation that is expected to increase the potential for contamination and/or personnel exposure because of the nature of the operation (hot job).
Non-approved container	A container that is not an approved nuclear material container in accordance with P118

DEFINITIONS UNIQUE TO RADIOLOGICAL CONTROL	
Term	**Definition**
open-front hood	For the purposes of this document, a confinement device designed to confine through air movement and to exhaust radioactive materials in gaseous, vapor, or particulate (aerosol) form. The following are synonymous: • open-front hood, • introduction hood, • California hood, • open-front box, • entry box, • open-port glovebox, • slot box, slot hood, and • ventilated hood.
Radiation area	Any area accessible to personnel where radiation levels could result in a worker receiving a deep dose equivalent in excess of 0.005 rem in 1 hour at 30 cm from the source or from any surface that the radiation penetrates.
Radioactive material area (RMA)	Any area accessible to personnel where items or containers of radioactive material are present and the total activity of radioactive material exceeds the applicable values provided in P121, Table 1 6A.
radiological area	Any area within a controlled area defined as a: • radiation area, • high radiation area, • very high radiation area, • contamination area, • high contamination area, or • airborne radioactivity area. **Note:** A radiological controlled area is not a radiological area.
Radiological buffer area (RBA)	An area within a radiological controlled area and outside a radiological area that provides a second boundary to minimize personnel exposure and the spread of contamination. An RBA may surround or be contiguous with RCAs or radiological areas.

DEFINITIONS UNIQUE TO RADIOLOGICAL CONTROL	
Term	**Definition**
Radiological controlled area (RCA)	Any area to which access is managed by or for DOE to protect personnel from exposure to radiation and/or radioactive material. RCAs may be designated for the following: • Access to the area is managed to protect personnel from exposure to radiation. • Removable contamination may be present at the levels specified in 10 CFR 835, *Appendix D.* • Volume-contaminated materials that are not individually labeled may be present. **Note:** Radiological controlled areas may contain radiological areas. In such a case, the entire area may be referred to as the RCA.
Radiological control technician (RCT)	A person who has been trained and qualified through the RCT training program at LANL, whose qualifications are current, and who is assigned to or authorized by RP-1 to provide radiological safety support. **Note:** RP-1 technicians who have not completed qualifications may perform some RP-1 activities for which formal on-the-job training has been completed.
Very high radiation area	Any area accessible to personnel where radiation levels could result in a worker receiving an absorbed dose in excess of 500 rad in 1 hour at 1 meter from the radiation source or from any surface that the radiation penetrates.

Acronyms and Abbreviations

Acronyms and abbreviations commonly used at TA-53:

Acronym or Abbreviation	Definition
ALARA	as low as reasonably achievable
anti-C	anti-contamination
CAM	continuous air monitor
CFR	Code of Federal Regulations
DAC	derived air concentration
HEPA	high-efficiency particulate air
HFM	hand and foot monitor
HJEA	hot-job exclusion area
HPR	health physics release
IHS	Industrial Hygiene and Safety organization
IWD	Integrated Work Document

Acronym or Abbreviation	Definition
LAA	Limited Access Area
OM	Occupational Medicine
PCM	personnel contamination monitor
PN3	personal high energy neutron dosimeter
PPE	personal protective equipment
RBA	radiological buffer area
RCA	radiological controlled area
RCT	radiological control technician
RMA	radioactive material area
RP-1	Health Physics Operations Group
RP-2	Health Physics Measurements Group
RP-3	Radiation Protection Technical Support Group
RP-DO	Radiation Protection Division
RPP	Radiation Protection Program
RWP	radiological work permit
TLD	Thermoluminescent dosimeter

1.6 Prerequisites for Entry and Work

LINAC

Unescorted access to radiological controlled areas at TA-53, LANSCE is granted subject to a set of requirements, including the following:

- General Employee Radiological Training or Radiological Worker training or RCT qualification
- TA-53, LANSCE facility-specific training
- Training on the LANSCE-ST-121-003.R3 document **(this training)***

- Participation in the appropriate dosimetry program described in Section 2.4, Personnel Dosimetry

*See Section 2.6, Training, for specific training requirements.

Access to radiological controlled areas may be granted without training/qualification on the FRPR document is on a case-by-case basis when controlled through an approved Radiological Work Permit (RWP) or by following the procedure for LANSCE Tours and Visitors.

1.7 Tours and Visitors

Visitors may view facilities at TA-53 as members of either a working tour or a guided tour. The procedure for visitors and tours is TA53-ST-121-001. Requirements for Visitor Tours and Escort Responsibilities may be obtained from the LANSCE webpage: http://int.lansce.lanl.gov/source/orgs/lansce/mesalib/.

All radiological work must be authorized in accordance with Laboratory and TA-53, LANSCE facility-specific requirements for facility and programmatic work.

1.8 Responsibilities

All organizations working at TA-53, LANSCE are responsible for maintaining and ensuring the operability of safety equipment throughout the facility. These responsibilities are called out in the FRPR document and in other supplemental documents, including authorization/safety-basis documentation for the facility.

Overall responsibilities are addressed in the following table:

ORGANIZATIONAL RESPONSIBILITIES FOR MAINTAINING AND ENSURING THE OPERABILITY OF SAFETY EQUIPMENT AT TA-53	
Person/Group	**Responsibilities**
Facility residents, visitor escorts, and other occupants	• Demonstrate responsibility and accountability through an informed, disciplined, and cautious attitude toward radiation and radioactivity • Follow radiation protection rules and ensure these rules are followed by those they supervise and those they escort • Participate in applicable dosimetry programs, including wearing a dosimeter properly and submitting bioassay samples when required • Follow all radiological postings • Be aware of the radiological conditions in the work area • Maintain their exposure as low as reasonably achievable (ALARA) using the ALARA techniques of time, distance, and shielding • Use good contamination control practices and good housekeeping • Stop work and evacuate promptly when instructed to do so by coworkers, RP- 1, or facility operations personnel or when unsafe conditions exist • Obey RCT or RP-1 instructions during a response to a radiological incident or during radiological work • Participate in pre-job and post-job briefings when required • Know how to contact RP-1 personnel assigned to the area
TA-53, LANSCE Facility Operations Director or designee	• Reviews and approves the *TA-53 Facility Radiation Protection Requirements (FRPR)* document
Line management	• Inform an RP-1 manager before performing any activity that could cause a change in radiological conditions (e.g., when moving temporary shielding, moving radioactive material, or changing a process when the change could affect radiation protection hazards or controls) • Ensure employees are enrolled in the correct dosimetry • Ensure compliance with applicable requirements of this document
RP-1	• Provides support to the facility, including emergency response, facility support, programmatic operational health physics support, and oversight of institutional compliance • Uses available radiation protection resources as necessary to help ensure implementation of this document

2.0 REQUIREMENTS

Each requirements section that follows corresponds to a chapter of P121. Where appropriate, facility-specific application of LANL requirements is detailed. The applicable chapters of P121 are listed for reference in each area.

2.1 Emergency Response

Laboratory requirements for emergency response are described in P121, Chapter 2, *Response to Radiological Emergencies and Incidents*, which defines LANL requirements for response to abnormal situations, emergency exposures, personal injury, personnel contamination, and accidental exposures.

TA-53, LANSCE maintains an emergency management and response program; detailed in [TA-53, LANSCE Facility Emergency Preparedness Plan, TA53-PL-400-001, http://mesalib.lanl.gov/mesalib)]. Facility-specific emergency requirements supplement are consistent with P121-required actions.

For additional actions to take in radiological emergencies, refer to the *Prompt Radiation Protection and Shielding Policy*, LANSCE-PS-121-002 (http://mesalib.lanl.gov/mesalib).

General Emergency Actions

The following table describes the steps that should be taken in an emergency:

STEPS THAT SHOULD BE TAKEN IN AN EMERGENCY	
Step	**Action**
1	Immediately take actions to ensure the safety of yourself, your coworkers, and the facility.
2	Inform appropriate facility resources (see emergency notifications below) that the event has occurred, and then provide background information about the event.
3	Follow instructions of RCTs or other RP-1 personnel during a radiological incident response.
4	Assist facility personnel (as requested) in mitigating and recovering from the event.
5	Participate in any requested follow-up, including critiques and lessons learned.

Emergency Notification

In the event of an emergency incident, LANSCE personnel are responsible for making emergency notifications. Personnel must notify RP-1 (7-7069), LANSCE Central Control Room (CCR) (667-5729) and the LANSCE Duty Officer (664-7466), when any of the following events occur:

- Radiation safety equipment malfunction (particularly when ARMS, NDs, or CAMs are inoperable).

- Radiation safety equipment alarms including: area radiation monitors (ARMs) or neutron detectors (NDs) or continuous air monitors (CAMs).
- Radioactive material contamination, spill, or release.
- Wound sustained in a radiological controlled area.
- Reason to believe dosimetry readings could be inaccurate.

The TA-53, LANSCE *Central Control Room* (CCR) and RP-1 Field Office are staffed 24 / 7 during beam operations and can be reached for assistance in an emergency by calling [667-5729 or 667-7069] [if unanswered, a recorded message will provide after hours contact information]. The Central Control Room (CCR) can obtain an RP-1 response if an RCT is not immediately available in your location.

Response to Common Radiological Abnormal Situations

The following table describes abnormal events and what it is you should do in the event you should encounter an abnormal situation:

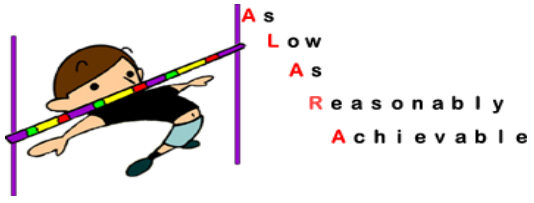
WHAT TO DO IN AN ABNORMAL EVENT	
Abnormal Situation	**Required Response**
Area Radiation Monitor (ARM) ALARM or Neutron Detector (ND) Alarm or Unexpected or unanticipated high-radiation fields (>100 mrem/h)	• Stop work activities • Alert others • Exit the area • Take measures to keep others from entering the area • Notify an RP-1 RCT and the Central Control Room. • Once outside the area, await the arrival for an RCT
Unexpected or unanticipated high-radiation fields (>100 mrem/h)	• Stop work activities • Alert others • Exit the area • Take measures to keep others from entering the area • Notify an RP-1 RCT and either the experimental area manager (EAM) or area manager (AM). • Once outside the area, await the arrival for an RCT and receive monitoring for contamination

WHAT TO DO IN AN ABNORMAL EVENT	
Abnormal Situation	**Required Response**
An indication of personal contamination (for example, elevated readings or an alarm of a contamination monitor (e.g. PCM))	• Remain in the immediate area if safe to do so. • Alert others to avoid cross-contamination, including stopping foot traffic through the area. • Minimize cross-contamination by avoiding movement or touching any surfaces unless necessary. • Notify an RP-1 RCT and either the experimental area manager (EAM) or area manager (AM).
Radioactive material spill	• If the material or its hazards are unknown or highly toxic, warn others and evacuate the area. • If the material and its hazards are known and not highly toxic, stop or secure the operation causing the spill only if you are appropriately trained, prepared, and protected with appropriate PPE. • Warn others in the area. • Isolate the spill if possible and safety to do so. • Minimize individual exposure and contamination. • Notify an RP-1 RCT and the Central Control Room and LFO Duty Officer.

WHAT TO DO IN AN ABNORMAL EVENT	
Abnormal Situation	**Required Response**
Continuous Air Monitor (CAM) alarm	If you <u>do not</u> have respiratory protection: • Leave the area immediately. • Remain outside the area until workers are monitored for contamination and are appropriately handled. • Notify an RP-1 RCT and the Central Control Room and LFO Duty Officer. If you <u>do</u> have respiratory protection: • Follow RCT instructions. • Place the work in a safe configuration, pause work, determine the cause of the CAM alarm, and implement additional controls to prevent the release of airborne radioactivity before work is resumed. • **Exception:** A CAM alarm inside containment devices with approved special settings documented in an RWP may not require pausing work. Other approved responses to CAM alarms during planned hot jobs will be discussed at pre-job briefings. Remove respiratory protection only after being surveyed for contamination by an RCT and when directed to do so.

As Low As Reasonably Achievable

The requirements for ALARA are described in P121, Chapter 3, *ALARA Program*.



ALARA is the principle of maintaining exposure to radiological hazards as low as reasonably achievable. This is accomplished by optimizing engineered and administrative controls through training, design review, job review, procedures, and performance assurance.

2.2 Dose Limits

Dose limits are described in P121, Chapter 4, *Dose Standards*, which defines LANL requirements for occupational and non-occupational dose limits, planned special exposures, and dose management.

Dose limits are set such that exposure at or below the limits does not produce a significant increase in harmful effects or unacceptable risk to personnel. The risk to workers who remain at or below dose limits is comparable to the risk to workers in other non-nuclear industries.

Total dose depends on quantity of exposure, type of radiation and radionuclide, and mode of exposure (internal, external, skin, extremity, etc.). Dose is measured using a full spectrum of dosimetry, described in Section 2.4, Personnel Dosimetry.

Declared Pregnant Workers

Declared pregnant workers have lower dose limits than other radiological workers. The Laboratory maintains a reproductive health assistance program to monitor and ensure the safety of the declared pregnant worker and the fetus. Workers who are pregnant or who may be pregnant are covered by this program only when they declare their pregnancy or potential pregnancy to the Occupational Medicine Group (OM). For more information, consult OM.

There are requirements that must be followed by line management when Laboratory dose action levels are exceeded. Laboratory action levels are established at 20% of regulatory dose limits (i.e., 1 rem whole-body dose, 10 rem to extremities, etc). A review of the worker's dose, activities, and work areas to identify areas of potential dose savings must be completed by the worker's line management. Compensatory measures may include restricting the worker from receiving any additional dose (e.g., through controlled area access restrictions).

2.3 Personnel Dosimetry

Dosimetry requirements are described in P121, Chapter 5, *Personnel Dosimetry*.

It is required that personnel wear appropriate external dosimeters, wear dosimeters properly, and participate in bioassay programs as needed. **External dosimetry is used to ensure that, if you are exposed to ionizing radiation, your dose is properly recorded.**

Line management must ensure that each worker is assigned to the appropriate dosimetry program. Dosimetry enrollment for employees must be reviewed upon initially hiring a person to work at TA-53, LANSCE when there is a change in job assignment, when radiological hazards of the job change, upon termination, and at least annually for every worker.

The TA-53, LANSCE dosimetry enrollment criteria are found on the Laboratory's Dosimetry Enrollment System (DES) [https://des.lanl.gov], with links also found on the RP Division web-site. The TA-53, LANSCE dosimetry matrix defines dosimetry requirements for workers and visitors at TA-53, LANSCE. The matrix further defines external and internal dosimetry requirements according to worker type. **Dosimetry may also be specified in RWPs or other work control documents.**

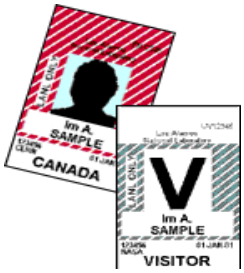
A Thermoluminescent Dosimeter (TLD) and a PN-3 Neutron (or Track-Etch) dosimeter may be required simultaneously depending on whether the TA-53 worker requires access, during beam operations, to the following areas: 201 BLZ, Isotope Production Facility (IPF), 1L Compressor Trailer Area, Mechanical Equipment building (MEB), Ring Equipment Building (REB) or Experimental Areas B, C, ER-1, ER-2, WNR.

- ***Thermoluminescent dosimeters*** **(TLDs)** and extremity dosimeters (wrist bands, finger rings) must not be left in radiological controlled areas when not in use. Instead, they must be kept in a designated area outside the RCA or under the control of the individual to whom they are assigned. A TLD is used to assess the legal dose-of-record because it is the most accurate indicator of dose equivalence. TLDs are used to assess beta, gamma, x-ray, and low-to-mid energy neutron radiation dose.
- ***High Energy Neutron dosimeter (PN-3 Track-Etch Dosimeter,*** **aka TED)** measures only high-energy neutrons to which the TLD is insensitive. PN-3 neutron sensitivity begins at 100-200 keV, which is the point at which the TLD neutron sensitivity decreases to zero. For this reason it is necessary to wear both the TLD and the TED dosimeters simultaneously when the potential for high-energy neutron exposure exists.
    - **NOTE:** If you choose this category in the DES, you must also choose either a monthly or quarterly TLD as appropriate for your work.

External Dosimetry

The dosimetry requirements given in the matrix are for normal operations; personnel involved in radiological incidents may be placed on special bioassay programs as indicated by RP-1 or RP-2 (the Health Physics Measurement Group). **External supplemental dosimetry may be prescribed for unique operations or for entry into certain areas; such requirements are stated in work control documents and RWPs.**

Additionally, organizations that host users, visiting scientists or other visitors requiring dosimeters must ensure that proper dosimetry is issued and used. **Users and visiting scientists must be checked in via the LANSCE visitor center.** For after hour arrivals the host organization must obtain dosimetry in advance or make prior arrangements (48 hours) for visiting scientists to pick up dosimetry at the RP-1 Health Physics Field Office.



Medical Diagnostic Procedures or therapy Involving Radioactive Materials
Personnel who receive medical diagnostic procedures or therapy involving radioactive material must notify RP-1 before they enter TA-53. RP-1 must be informed because such procedures may set off alarms at contamination monitors and give false readings on dosimeters. RP-1 will inform security personnel because these individuals may set off TA-53 front gate detector alarm as they are leaving the site.

Note: Personnel receiving medical administration of radionuclides may not wear TLDs until cleared to do so by RP-2.

2.4 Workplace Monitoring

Requirements for monitoring radiological conditions in the workplace are given in P121, Chapter 6, *Workplace Monitoring*.

Radiological monitoring of radiation exposure levels, contamination, and airborne radioactivity is conducted for the following purposes:

- Demonstrate compliance with regulations
- Document radiological conditions
- Characterize workplace conditions and detect changes in those conditions
- Detect the gradual buildup of radioactive material in the workplace
- Verify the effectiveness of engineered and administrative controls in containing radioactive material and reducing radiation exposure
- Identify and control potential sources of personnel exposure
- As necessary, determine exposure rates during each entry to a high or very high radiation area.

"*Monitoring*" is accomplished through a program of fixed instrumentation, routine radiological surveys, and ad hoc surveys. Routine radiological surveys are prescribed in RP-1 routine monitoring instructions. Ad hoc surveys are performed by RP-1, as needed, to characterize potentially changing radiological conditions (e.g., frequent surveys during radiological hot jobs).

Workplace monitoring for purposes of radiation protection is conducted by personnel who are trained and qualified by RP- 1, using instrumentation maintained and calibrated by RP-2. Records of workplace monitoring are managed by RP-1 and are available for review.

Survey results are communicated in a variety of ways, including survey maps that are posted and filed, completed survey tags on items, in work control documents, and by radiological postings. For radiation and high radiation areas, monitoring results are listed on area posting or on maps posted at the entrance to the room or area.

Changes in Radiological Conditions
It is critical that workers inform RP- 1 management of operations that change radiological conditions, have the potential to change radiological conditions, or may otherwise necessitate changes in radiological monitoring methods or instrumentation. For example:

- changes in radionuclides,
- quantities,
- physical or
- chemical form, process, or
- location must be communicated to RP-1 management.

Such changes could require corresponding changes in routine surveys or air monitoring to ensure proper characterization of the radiological hazards.

2.5 Area Designations and Posting

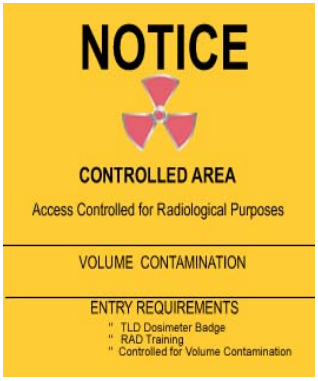
Requirements for designation of areas and posting are described in P121, Chapter 7, *Area Designations and Posting*. Additional radiological posting is described in RP-1 procedures.

TA-53, LANSCE is divided into two primary types of areas based on radiological risk:

1. uncontrolled areas and
2. *radiological controlled areas* (RCAs).

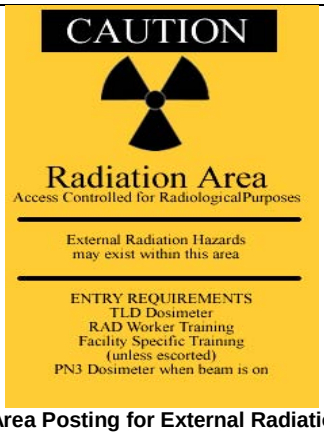
Read Postings!

Depending on the radiological hazards present, RCAs may contain radiological buffer areas and radiological areas.



Controlled Area Posting for Volume Contamination Hazards

Signs that indicate the type of area and the entry requirements are posted at the entrances to radiological controlled areas, radiological buffer areas, and radiological areas. Signs are also posted at some exits from RCAs and RBAs to communicate necessary exit requirements otherwise there will not be an exit sign posted.



Radiation Area Posting for External Radiation Hazards

The types of administrative and engineering controls used to minimize the risk of radiation exposure at TA-53, LANSCE depend on the area type.

- Only individuals authorized by RP-1 may place or remove radiological postings.

Area Designations for Radiological Hazards

The types of area designations for radiological hazards are defined in the table below:

RADIOLOGICAL AREA HAZARDS TABLE	
Area	**Description**
Uncontrolled areas	• The potential risk of radiation exposure and radioactive contamination is negligible. No controls on personnel or equipment exist, but radiological surveys may be performed to verify contamination control at boundaries of radiological controlled areas.

RADIOLOGICAL AREA HAZARDS TABLE	
Area	**Description**
Radiological controlled areas (RCAs)	• RCAs are established and posted to warn individuals they are entering areas that are managed to protect them from exposure to radiation or radioactive materials. In an RCA, radiation doses are not expected to exceed 100 mrem/year. Radiological buffer areas and radiological areas can exist within RCAs. • RCAs include the LANSCE accelerator and experimental areas. See *Appendix C* for all RCA locations. • These areas may be controlled for external radiation hazards, in combination with volume contamination (i.e. activation) hazards and contamination hazards. **Note:** All equipment left inside primary or secondary beam lines/caves during beam operations must be surveyed and tagged by an RCT. Items removed from the primary beam line areas must be surveyed before removal. At the RCTs direction, items may be tagged as '*Radioactive Material: pending RCT Survey*' to maintain *knowledge of process* (KOP).
Radiological buffer areas (RBAs)	• There is a greater potential for exposure to contamination, and/or radiation exposure may be greater than 100 millirem/year. For example, all the contamination areas at TA-53 are within RBAs and RCAs. • See *Appendix C* for RBA locations.
Radioactive material areas (RMAs)	• An RMA is an area accessible within a radiological controlled area in which items or containers of radioactive material are present with detectable radioactivity and the total activity of radioactive material exceeds the applicable values provided in P121, Table 1 6A. • RMAs include a number of different locations at TA-53. These RMAs include activated (i.e. volume contaminated) beam line components, activated shielding blocks, and radioactive source storage areas. See *Appendix C* for RMA locations.

RADIOLOGICAL AREA HAZARDS TABLE	
Area	**Description**
Radiological areas	• Radiological areas have known and quantified contamination and/or external radiation hazards. They include the following: o Radiation areas o High radiation areas o Very high radiation areas o Contamination areas o High contamination areas o Airborne radioactivity areas • Standard LANL radiological postings are used to identify radiological areas, with appropriate entry requirements posted for each area. The most recent survey results for each area are communicated through survey maps and radiological posting. • Entry and exit requirements are: o based on LANL RP requirements, o documented in applicable work control documents, and o posted at the entry to radiological areas. • Radiological areas may exist in many radiological buffer areas, resulting from radiological operations or after a spill or release of radioactive material. • It is essential that all radiological areas be identified to ensure appropriate posting, access control, PPE, work planning, monitoring, dosimetry, and hazard communication for the area. • Areas designated as radiological areas on a long-term basis are listed in *Appendix C*.

RADIOLOGICAL AREA HAZARDS TABLE	
Area	**Description**
Hot-job exclusion areas (HJEAs)	• The hot-job exclusion area (HJEA) sign may be used to restrict access to actual or potential radiological hazards. • Locked doors in combination with posted warnings and ribbon/rope barriers are used to restrict access during radiological incident response and to restrict access to areas where certain radiological work is performed. • During initial response to radiological incidents, the affected area is controlled with a locked door or ribbon/rope barrier in addition to HJEA designation until conditions in the area are determined and the area is re-posted based on radiological conditions. • When the HJEA designation is used in connection with planned radiological work, the work is performed under an RWP, and access to the area is limited to those qualified, authorized, and prepared to perform the particular work (including wearing proper PPE). • If conditions have been measured to meet or exceed levels requiring posting as other radiological areas, the area must be posted with the appropriate radiological area posting or the 8-hour rule for continuous attendance, in place of posting, must be used. The HJEA sign may be used concurrently with other radiological area postings
General radiological posting requirements	• Radiological posting is required at all access points to RCAs, RBAs, RMAs, and radiological areas. • This posting includes entry and exit requirements where applicable (there being situations where work control documentation or RCT instructions replace posted entry and exit requirements). • Radiological posting must be conspicuous and not obscured. • All posted radiological requirements must be understood and followed. • No radiological posting may be removed or altered without the permission of RP- 1.

RADIOLOGICAL AREA HAZARDS TABLE	
Area	**Description**
Continuous attendance instead of postings	Continuous attendance by individuals may be used in place of posting for up to 8 continuous hours when radiological posting is not practical, such as during radioactive material transfers, when the following conditions are met: • The areas is continuously observed and controlled by individuals who are knowledgeable of radiological conditions, levels, and entry/access requirements. • The individuals are empowered to implement required access and exposure control measures • Individuals are stationed where they can provide direct, line-of-sight surveillance and can give verbal warning.

Note: All materials and equipment (samples or beam components) that might have been exposed to prompt radiation hazards (e.g., neutrons or protons) during beam operations (e.g., inside of the beam tunnels and experimental caves) **shall be surveyed and tagged by an RCT before removal**. These items may be staged awaiting an RCT survey in a controlled storage area using a sticker/label that indicates the item as *'Potential Radioactive Material'*. The sticker/label helps preserve *knowledge of process* (KOP).

- See *General Requirements* Section 2.16.1 (p. 63) for Item and Equipment Removal from *Radiological Controlled Areas* (RCAs) for Volume Contamination.

Exit posting

2.6 Training

Radiological training requirements are described in P 12 1-1, Chapter 8, *Radiological Training and Qualification*. Section 1.6, Prerequisites for Entry and Work, also describes unescorted access training requirements.

The following training requirements are specified in the FRPR:

- TA-53, LANSCE workers are required to have a combination of Laboratory, TA-53/LANSCE facility-specific training, and activity-specific training, depending on the type of work, the location, and the hazards.
- General Employee Radiological Training (GERT) **is the minimum** training required for unescorted access to radiological controlled areas (RCAs) and radioactive material areas (RMAs).
- Radiological Worker II Training (or completion of RCT qualifications) **is required for unescorted access to TA-53 radiological areas.**
- Facility-specific training on the LANSCE-ST-121-003: *TA-53 Facility Radiation Protection Requirements* (this training) **is also required for unescorted access to RCAs at TA-53**.
    - The *Facility Radiation Protection Requirements* (FRPR) document training will be presented in a computer based training module at the LANSCE training office.
    - The training module will provide an overview of the FRPR along with a quiz with minimum passing score requirement.
- At a minimum, activity-based training must consist of briefings on IWDs (or other work-control documents) or other, more formal training, such as documented on-the-job training.

Line management for each organization working at TA-53, is responsible for monitoring worker training and for taking actions to restrict activities of workers whose assigned training plans (i.e. 'Curricula') are incomplete or expired.

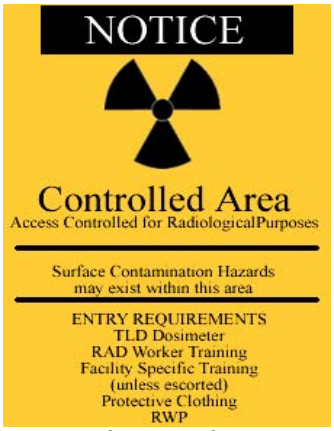
Documenting the completion of a facility orientation covering radiological hazards and controls is required for all visitors or escorted workers who have not completed formal training on the *TA-53 Facility Radiation Protection Requirements (FRPR)* document. Additional training requirements must be determined before escorting visitors or workers into RCAs. Refer to Table 8-3 of P121 to determine training requirements for escorted visitors or workers.

Under certain radiological conditions, escorting non-trained personnel is not permissible.

Contact TA-53, LANSCE Central Training Office (665-6256) deployed services personnel for additional information on training requirements.

2.7 Access Control

Access control is the use of physical and administrative controls to prevent unauthorized or unintended entry into areas with radiological hazards. Access control requirements are described in P121, Chapter 9, *Access Control*.



Controlled Area Posting: note the entry requirements

TA-53, LANSCE uses a combination of physical security systems and radiological controls to ensure only proper access to RCAs and radiological areas. Before any work is performed, operations must be assessed for potential hazards that would require designation of areas as radiological areas, particularly their designation as high and very high radiation areas.

Access Control Area Designations

The types of area designations for access control are defined in the table below:

ACCESS CONTROL DESIGNATION TABLE	
AREA	**DESCRIPTION**
Radiological controlled areas, radiological buffer areas, radiation areas, and contamination areas	• Administrative controls, primarily radiological posting, are used to restrict access to these areas • Radiological Controlled Areas may be a combination of 2 or more of the following RCAs: 1. Controlled for external radiation hazards. 2. Controlled for volume contamination (activation) hazards. 3. Controlled for contamination hazards. • An RCT must be present when entering/exiting contamination areas • Posting identifies the radiological hazard along with PPE and dosimetry requirements. Training allows access only to those qualified to enter these areas or to enter under escort by a qualified person. • Where the area is not bounded by walls and doors, the area must be enclosed with a visible barrier and the entry points posted. • Radiological posting is used to warn of actual or potential radiological hazards
High contamination areas and airborne radioactivity areas	• In addition to the administrative controls described for the areas above, high contamination areas and airborne radioactivity areas must have a visible barrier placed across access points at all times, except when an entry point is under control of an RCT.

ACCESS CONTROL DESIGNATION TABLE	
AREA	**DESCRIPTION**
High radiation areas less than 1000 mrem/hr at 30 cm	• Areas may exist in TA-53, LANSCE that exceed 100 mrem/h at 30 cm as a result of activation (i.e. volume contamination) due to prompt radiation exposure during beam operations. • These areas must be enclosed by physical barriers and posted; they also require use of an RWP for entry into the area (unless the radiological conditions are stable and well-characterized and the FRPR and an IWD are used for work control). The RWP must include the following, at a minimum: o Requirements for use of secondary (real-time) dosimetry o Requirements for dose tracking of secondary dosimeter results and identification of actions to be taken when action levels are approached or exceeded o Individual dose limits o Entry requirements for radiological monitoring to characterize the area and other RCT coverage requirements o The RWP will be briefed weekly.
High radiation areas that are greater than 1000 mrem/hour at 30 cm	• In addition to the requirements listed above for high radiation areas, areas exceeding 1000 mrem/h at 30 cm require additional specific regulatory-defined physical controls to prevent inadvertent or unauthorized access. • The *isotope production facility* (IPF) hot-cell and pump system, switchyard, *proton storage ring* (PSR), and 1L target cell including pump alcove may be high radiation areas immediately after beam operations. These areas are *Personnel Access Controlled System* (PACS) areas. • An RWP pre-job briefing will be given daily when work is performed.

ACCESS CONTROL DESIGNATION TABLE	
AREA	**DESCRIPTION**
Very high radiation areas	• Entry into very high radiation areas is not permitted except under emergency conditions requiring lifesaving. • For these areas, at least two independent physical controls must be present to prevent inadvertent or unauthorized access. • The accelerator beam tunnel is posted as a very high radiation area during beam operations. The beam tunnel areas are *Personnel Access Controlled System* (PACS) areas.

2.8 LANSCE Facility Specific Access Control

Entry into Primary Beam Tunnels following beam operations requires RCT coverage to conduct radiation surveys to monitor and characterize radiation levels. Unescorted beam tunnel entries by non-RP-1 personnel are restricted until the area is appropriately posted and controlled. See the *Accelerator Operations Manual* procedures for beam tunnel entries following beam operations.

At the LANSCE facility, **there are 3 basic methods by which access is controlled** to these areas.

These methods depend upon whether or not beam is in operation.

1. During beam operations High Radiation Areas not controlled by the interlocked *Personnel Access Control System* (PACS) **are typically controlled by RP-1 with the use of an AT-62 key**. The AT-62 key has been designated as the key core for controlling access to High Radiation Areas; examples include both the Area A and Lujan Center bone yards, and radioactive source storage locations; as well as any other area requiring temporary control of a High Radiation area(s).

2. PACS controlled areas are primary beam line areas and are posted as *"Very-High Radiation Areas"* during beam operations. These systems are controlled by CCR in conjunction with RP-1's AT-62 key core. PACS is secured when the accelerator is in run permit mode. In the event of an unauthorized attempt to enter one of these areas, the beam would shut down. PACS in the unsecured mode does not permit beam operations. During non-run cycle or maintenance periods; RP-1 typically maintains control of all PACS keys at the Health Physics Field Office for all primary beam lines.

The PACS System

3. EPACS are experimental area PACS Systems for secondary beam line flight paths in which the experimental scientists control entry and exit. Initial entry controls are not necessary because the activation of components and targets in the experimental flight paths is highly unlikely to generate High Radiation Areas when beam is turned off.

Experimental Area Personnel Access Control System (EPACS)

Warning: Entry into Very-High Radiation Areas **is not** permitted.

Restrictions on Items Brought into RCAs controlled for contamination

The following items are prohibited in RCAs controlled for contamination:

- Food and drink [(exception: drinking from water fountains)]
- Tobacco products—cigarettes, chewing tobacco, etc.
- Other consumable products—chewing gum, breath freshener, etc.
- Personal reading materials—books, magazines, newspapers, etc.
- Cosmetics not already applied—including lip balm
- Unnecessary personal attire—hats, bandannas, sunglasses, etc.

RCA Permissible Items

The following table describes the items that are permissible in RCAs controlled for contamination and how they should be stored:

RCA PERMISSIBLE ITEMS	
Step	**Action**
1	Take into RCAs only those items necessary to perform required tasks. Whenever possible, avoid taking into RCAs items such as car/house keys, coins, watches, rings, necklaces, and other jewelry.
2	Store valuables in your office or automobile. Visitors may arrange for storage of their valuables with their escorts.
3	Store items routinely used in TA-53, LANSCE within the RCA. Examples include calculators, pens and pencils, notebooks, etc. Leave laboratory notebooks dedicated to TA-53, LANSCE operations in RCAs.

Entry Requirements for Personnel with Wounds into a RCA controlled for contamination

Open wounds are injuries where the surface of the skin has been broken. Examples include lacerations (cuts), abrasions (scrapes), burns, blisters, and ulcerations.

The following RCA entry requirements apply:

- Personnel with open wounds must be evaluated by *Occupational Medicine* (OM) and obtain its approval before entering an RCA controlled for contamination.
- Personnel denied RCA entry by OM requires subsequent evaluation and approval from OM before entry into a RCA is permitted.
- Before entering an RCA, wounds must be covered as directed by OM (including wounds under protective clothing).

- OM restrictions must be followed. Personnel with occlusive bandages placed by OM may not enter high contamination areas, airborne radioactivity areas, hot-job exclusion areas, or perform work involving the breaching of internally contaminated systems or equipment.
- Personnel having wounds on the head or face that interfere (or potentially interfere) with respirator fit may not perform any work where authorization to use a respirator is required (including glove box work) until approved by OM to resume work.

2.9 Personal Protective Equipment (PPE)

Requirements for radiological PPE are described in P121, Chapter 10, *Personal Protective Equipment*.

This section describes PPE requirements for entering and working in RCAs, RBAs, and certain radiological areas. Specific operations may require additional PPE as defined in work control documents. Entry into RCAs, RBAs, and radiological areas requires the use of LANL issued anti-C clothing. The type of anti-C clothing used depends on the area posting and the type of work to be performed.

The PPE should be sized appropriately so that the worker is comfortable and the clothing is not binding. Care should be taken with the length of PPE coveralls. The pants leg should not drag on the ground. If the pants leg needs to be rolled to prevent dragging, then the roll should be on the inside, or the cuff should be taped to prevent catching contamination in the cuff.

There are differing levels of contamination protection based on type of PPE. **The correct type of PPE needs to be specified (based on the work description) and stated in the RWP by RP-1**.

Reuse of anti-C clothing:

- Anti-C clothing that has been monitored in accordance with the requirements of this document may be reused for up to one week. Do not re-use anti-C clothing for more than one week.
- Do not reuse anti-C clothing that is soiled or dirty.
- Do not reuse laboratory coats and coveralls that were worn during a PCM alarm, even if the alarm was proven to be false. Air purifying respirators may not be reused if there was a true CAM alarm while the respirator was worn or if contamination is detected on the coveralls, respirator, or hood while the respirator was worn.

PPE Requirements for Radiological Controlled Areas controlled for external radiological hazards:

The following table demonstrates the PPE Requirements for Radiological Controlled Areas controlled for external radiological hazards:

PPE REQUIREMENTS FOR RCAs CONTROLLED FOR EXTERNAL RADIOLOGICAL HAZARDS	
Requirement	**Comments**
Dosimetry **Note:** Dosimetry is not considered PPE but is included in this section.	All personnel must wear a Laboratory-issued TLD badge where posted as an entry requirement unless they are being escorted on a tour. Requirements for *Visitor Tours and Escort Responsibilities* may be obtained from the LANSCE webpage: http://int.lansce.lanl.gov/source/orgs/lansce/mesalib/. **Note:** During beam operations, access to the accelerator beam tunnel and experimental areas require a track etch PN-3 high-energy neutron dosimeter in addition to the TLD badge.

PPE Requirements for Radiological Controlled Areas controlled for contamination hazards:

The following tables list **minimum PPE requirements for entry into RCAs controlled for contamination**. This list is applicable to areas posted as RCAs controlled for contamination (See *Appendix C* for areas controlled for contamination at TA-53).

MINIMUM PPE REQUIREMENTS FOR ENTRY INTO RCAs CONTROLLED FOR CONTAMINATION	
Requirement	**Comments**
Full leg covering	• Shorts, skirts, and dresses are not permitted. Nylon stockings must be covered.
Low-heeled, closed-heel, closed-toe shoes	• High-heels, sandals or clogs are not permitted.
Anti-C shoe covers (booties)	• Booties must be inspected before use, and those that are defective or have holes must be discarded.
Dosimetry **Note:** Dosimetry is not considered PPE but is included in this section.	• All personnel must wear a Laboratory-issued TLD badge where posted as an entry requirement unless they are being escorted on a tour. Requirements for Visitor Tours and Escort Responsibilities may be obtained from the LANSCE webpage: http://int.lansce.lanl.gov/source/orgs/lansce/mesalib/. • **During beam operations, access to the accelerator beam tunnel and experimental areas require a track etch PN3 high-energy neutron dosimeter in addition to the TLD badge.**
Clean anti-C laboratory coat, fully buttoned, or coveralls, fully zipped	• Anti-C laboratory coats may be worn over non-anti-C clothing (e.g., blue coveralls, surgical scrubs, or personal clothing) for performing administrative work, visits, or tours.

OTHER PPE RCA REQUIREMENTS	
Requirement	**Comments**
Low-heeled, closed-heel, closed-toe shoes	Work shoes are considered anti-C clothing under the following condition: • They are not worn or removed beyond the TA-53, LANSCE [RCA boundary or commingling areas]. • They are clearly identified with bright paint markings provided by facility maintenance/support. **Note:** Work shoes that are not identified and controlled as anti-C shoes are considered personal clothing for the purposes of reporting contamination. **CAUTION:** Use of anti-C shoes is required for work in contamination areas, high contamination areas, and airborne radioactivity areas and during hot jobs controlled by an RWP indicating the need for anti-C shoes.
Anti-C shoe covers (booties)	• Booties must be inspected before use, and those with holes or are otherwise defective must be discarded.
Dosimetry	• During beam operations, access to the accelerator beam tunnel and experimental areas require a track etch PN3 high-energy neutron dosimeter in addition to the TLD badge. • Refer to the facility-specific dosimetry matrix in the on-line dosimetry enrollment system for detailed information on dosimetry requirements.
Anti-C lab coat	• Anti-C laboratory coats may be worn over non-anti-C clothing (e.g., blue coveralls, surgical scrubs, or personal clothing) for performing administrative work, visits, or tours.
Anti-C protective coveralls, fully zipped	• Personal clothing, other than undergarments, may not be worn with coveralls. (Exception: During some emergency response activities by authorized personnel, personal clothing may be worn under coveralls).
Anti-C gloves	• Anti-C gloves must be worn when touching items in RBAs. The only instances anti-C gloves are not required are the specific exceptions listed under Exceptions to PPE requirements for RBAs, below. • Before using telephones in RCAs/RBAs, remove your anti-C gloves and monitor your hands. Do not wear anti-C gloves when using telephones unless it is unavoidable when dealing with an emergency. • For repetitive tasks, personnel may exit an RBA to an RCA wearing

	the inner pair of anti-C gloves, provided that those gloves are thoroughly monitored at the RBA exit in the same manner as is required for hand monitoring and when no contamination on the gloves is detected or suspected. • When working with tools or abrasive surfaces that can damage anti-C gloves, ensure that there are controls (such as hazard elimination, supplemental gloves, or engineered holding fixtures) that will prevent damage or compromise the integrity of the gloves. • Protective gloves, such as leather work gloves, that provide physical protection from hazards such as cutting or abrasion may be considered the outer pair of anti-C gloves when approved by RP-1 SME and must be worn with impermeable anti-C gloves underneath. If worn as supplemental to anti-C and on the outside of anti-C gloves, there are no additional approvals required. • Cotton glove liners are not considered anti-C gloves and may not be worn if not wearing anti-C gloves. • If a worker performing an activity monitors anti-C gloves and finds them free of contamination, the gloves may be left on to perform other radiological work. • **During routine work in RCAs and RBAs, anti-C gloves may be removed and re-used as long as they are thoroughly monitored for contamination before removal, are visually inspected for integrity before re-use, and are kept in the custody of the person using them. Do not leave anti-C gloves unattended for later re-use**.
For glove box work: One pair of anti-C gloves taped to coverall sleeves	See *Section B* for contamination control requirements for glovebox work. Eliminate or reduce hazards (for example, guarding sharp objects) that could cut, tear, or damage glovebox gloves, or take compensatory measures (for example, protective over gloves) that will prevent a cut or puncture wound.
When handling material with loose or removable contamination: Two pair of gloves, with the inner pair taped over the sleeves of coveralls	Apply appropriate contamination control measures to prevent spread of contamination.
When splashes are likely to occur:	Workers and line management make this determination, considering the quantity and type of material as well as the operation.

Moisture-repellent aprons, hoods, or other suitable protection	
Anti-C head covering over long hair (shoulder-length or longer), or tie hair back	Secure your hair with a head covering or tie it back so it does not contact potentially contaminated surfaces. During work with contaminated items or radioactive material outside of gloveboxes, wear ponytails or long hair under lab coats or coveralls rather than on the outside of PPE.

2.10 PPE Requirements for Radiological Buffer Areas for Contamination Control

The following table lists minimum PPE requirements for all personnel entering RBAs. Additional PPE requirements may be specified in operation-specific procedures or permits. There are some specific exceptions listed below.

2.10.1 Exceptions to PPE Requirements for RBAs

Personnel may wear the PPE including lab coat, booties, no anti-C glove requirement in RBAs only for the following exceptions:

- Performing paperwork, computing, or using the telephone at desks located in RBAs.
- Touching items that are hand-carried into the RBA and that do not come into contact with surfaces or objects in the RBA.
- Using telephones and computer keyboards.
- Touching items that must be touched to exit the area, such as monitoring equipment, check sources, and doors.

It is permitted to sit in chairs in RBAs when wearing lab coats.

For performing work or touching any items in an RBA not in this list of specific exceptions, the PPE for RBAs is required (lab coat, booties, anti-C gloves).

Examples of work that may be performed in RBAs in lab coats without anti-C gloves are:

- hands-off tours or inspections and
- supervisory duties that do not require touching items in the RBA.

2.10.2 Variances to Anti-C Requirements

More restrictive anti-C use that allows for a greater level of protection than those specified is permissible when indicated by:

- work control documents (procedures, permits, etc),
- a work supervisor, or
- an RCT, providing that the PPE does not introduce new hazards or exacerbate existing hazards.

Project, task, or area-specific anti-C requirements that are less rigorous than those specified are allowed when the responsible line manager, RP-1 team leader, and the Facility Operations Director concur (variances from P121 require additional RP-DO approval) in accordance with Section 1.2, Scope.

2.10.3 PPE in Radiological Areas

Entry into contamination areas, high contamination areas, airborne radioactivity areas, or hot-job exclusion areas requires PPE. All entries into these areas require a work control document, approved by RP-1, which specifies PPE requirements. **Note that entry into high contamination areas and airborne radioactivity areas requires an RWP in all cases**. Respiratory protection must be considered for these areas depending on the work to be performed and the potential to create airborne radioactivity. Consult RP-1 for additional information.

Note: Unused PPE and other supplies that were staged to support hot jobs and present in the area during the job must be surveyed and found free from contamination before returning them to storage.

2.10.4 Use of Respiratory Protection

Personnel performing job tasks with an increased potential for airborne contamination are required to maintain authorization to wear full-face respirators. Tasks that require the use of full-face respirators include:

- Entry into an airborne radioactivity area
- Opening accelerator radioactive liquid water (RLW) systems, working in the IPF hot cell, and working in posted High Contamination Areas.
- When required by an RWP or other work document

Personnel may not grow facial hair that impedes the fit of the respirator when either of the following:

- Their job tasks require or may require the use of a respirator.
- They perform work where there may be an emergency need to don a respirator (for example, glove box work).

Occupational Medicine (OM) determines the medical fitness of personnel for respirator use. After clearance by OM, the *Industrial Hygiene and Safety organization* (IHS) authorizes and fits personnel for the use of respirators.

Note: During beam operations at LANSCE, there may be greater external hazard from airborne emissions due to the short-lived radioactive gas due to air activation. A respirator is not used under these conditions. **The use of respirators is decided on a case-by-case basis in accordance with regulatory requirements and the potential for airborne contamination.** For requirements on respiratory protection for different radiological hazards, consult RP-1.

Notes:

- For requirements on respiratory protection for non-radiological hazards, consult with Industrial Hygiene personnel.
- Required respiratory protection indicates a significant potential for airborne contamination.
- To protect the face, neck, and hair from that same hazard, anti-C hoods are required when respirators or other respiratory protection are prescribed.
- Personnel may not perform any work where authorization for respirator use is required if they have wounds on the head or face that could be adversely affected by the use of a respirator or interfere with respirator fit.
- Personnel may not wear anti-C clothing (with the exception of anti-C undergarments) in any laboratory, office, lunchroom, loading dock, restroom, or other area beyond RCAs and designated commingling areas.
- Laboratory-Provided Undergarments and Modesty Garments:
    - Laboratory-issued undergarments (for example, yellow T-shirts and socks) may be worn with blue coveralls or “surgical scrub” type modesty clothing. Laboratory issued undergarments or “surgical scrubs” may not be worn with personal clothing.
    - Laboratory issued undergarments and “surgical scrub” modesty garments may not be worn beyond the boundaries of the TA-53, LANSCE site (unless workers clothes are held for contamination control purposes and workers are issued modesty garments to wear home).
- Exceptions:
    - Personnel may wear anti-C clothing beyond posted RCAs only when escorted by an RCT;
    - when under emergency conditions such as a facility evacuation.

2.11 Work Planning

Requirements for the planning of radiological work are described in P121, Chapter 11, Radiological Work Control.

CAUTION:

Working with legacy or other unknown materials requires special care. Before personnel work with unknown materials, the materials must be fully assessed for radiological and other hazards, and controls must be established through an approved work control document. **If unknown materials are encountered during the course of work, workers must stop and recover, ensuring hazard assessment and implementation of appropriate controls before work proceeds**.

Laboratory requirements for work planning address the use of RWPs and other methods to plan and control radiological work. As stated in Section 1.2, *Scope*, the *TA-53 Facility Radiation Protection Requirements* document identifies the minimum radiation protection requirements at TA-53, LANSCE. These requirements may be supplemented through the use of other formal work control documents (for example, Integrated Work Documents or other hazard control documents permissible under Integrated Work Management).

Hazard Grading for Radiological Work activities

This section describes specific requirements for radiological work control, RWPs, and RCT job coverage requirements.

Table 11-4 of P121 provides hazard grading for radiological work activities. Specific examples of hazard grading pertinent to TA-53, LANSCE are listed below. The hazard gradings must be used when developing work documents. For hazards not specifically shown in the table below, refer to Table 11-4 of P121 or contact RP-1 management for assistance.

Note: Radiological hazard grading is not the same as *Integrated Work Management* (IWM) hazard grading. IWM has its own hazard grading criteria that will dictate the IWM document requirements.

WARNING!

Effective contamination control for work on physical systems requires two components:

- Sufficient knowledge of the system, and
- Establishing effective controls for the hazards that could be present.

It is essential that, before a facility system at TA-53, LANSCE is breached or penetrated, the system be evaluated for potential hazards. In general, most water systems should be considered contaminated and work planned on those systems should include appropriate control measures until and unless they are demonstrated to be not contaminated.

The following table demonstrates the type of radiological hazard, LANSCE radiological work examples, and the documents required to perform the work:

LANSCE RADIOLOGICAL WORK EXAMPLES TABLE		
Hazard Grading	**TA-53, LANSCE Examples**	**Document Required**

High-Hazard radiological work, and an IWD and RWP are required.	Does the work involve any of the following?
	• Work that could contaminate uncontrolled areas or the environment
	• Work in (or likely to create) a high contamination area
	• Work in (or likely to create) an airborne radioactivity area with levels >40 derived air concentration (DAC)
	• Dose Rate >1 rem/hr in the work area Extremity dose rate >10 rem/hr (considering all radiations, at contact with accessible material)
	• Work expected to create uncharacterized radiological conditions including:
	  • Working outside engineered controls
	  • Breaching engineered containment systems
	
	Examples:
	• Remediation of legacy contamination in proximity to uncontrolled areas
	• Decontamination of liquid waste containment systems
	• Opening a highly contaminated radioactive material (RAM) shipment
	• Retrieving, packaging, shipping, and receiving high activity activation products
	• Breach of internally contaminated systems where the breach could create an airborne radioactivity hazard, including maintenance or troubleshooting activities on hoods, glove boxes, and associated ventilation systems that are known to be contaminated
	• Decontamination and demolition of radiological facilities or contaminated systems
		RWP and IWD (or work document equivalent to IWD)

LANSCE RADIOLOGICAL WORK EXAMPLES TABLE		
Hazard Grading	**TA-53, LANSCE Examples**	**Document Required**
Moderate-Hazard radiological work, and an IWD (or "qualified worker") and either an RWP or FRPR (for routine, stable, well-characterized conditions) are required.	Does the work involve any of the following? • Dose Rate >5 mrem/hr and <1 rem/hr • Work in (or likely to create) a contamination area • Work in (or likely to create) airborne radioactivity with levels <40 DAC **Examples:** • Use of an accountable source to performance test health physics instruments • Routine handling of dispersible radioactive materials within intact engineered controls, where the activity and work area are stable, well characterized, controlled in accordance with FRPR, and where sustained performance demonstrates effective controls (such as routine glove box work).	An IWD (or equivalent work document) approved by RP-1 and either an RWP or the FRPR (for routine stable, well-characterized conditions) are required.

LANSCE RADIOLOGICAL WORK EXAMPLES TABLE		
Hazard Grading	**TA-53, LANSCE Examples**	**Document Required**
Low-Hazard radiological work, occupational exposure will likely be less than 100 mrem/yr, and neither an IWD nor RWP are required. Follow the IWM process to address non-radiological hazards.	Does the work involve routine activities in a facility covered by an FRPR and within the following limits? • Dose Rate <5 mrem/hr • No contamination exceeding Table 14-1 on readily accessible surfaces or penetration of internally contaminated systems • No measurable airborne radioactivity Examples: • Administrative work such as management walk-arounds or inspections • Handling robust containers of RAM such as closed, surveyed, Department of Transportation (DOT), or standardized special nuclear material (SNM) containers • Leak-testing of accountable sealed sources (<5 mrem/hr @ 30 cm) • Conducting routine radiological surveys • To be considered low-hazard radiological work, radiation levels must be less than 5 mrem/h (measured at one foot) and contamination levels must be no more than P121 Table 14-2 (e.g., no more than 1000 dpm/ 100 cm2 beta - gamma (removable) or 5000 dpm/100 cm2 total beta - gamma (removable plus fixed)	No additional once facility-specific entry requirements are met.

The hazard-grading table above addresses radiological work activities. In addition, **RWPs are required for entry into certain areas, irrespective of the work to be performed**. Additional requirements for RWPs are discussed in the next section.

P121 requires that for work to be considered moderate-hazard radiological work:

- it must have intact engineered controls;

- the activity and work area are stable, well-characterized, and controlled in accordance with this document; and
- sustained performance demonstrates effective controls.

When these conditions are not fully met, an RWP can be required by either the responsible line manager or RP-1. In addition, an RWP may be required by RP-1 for purposes such as tracking or monitoring performance.

When the *TA-53 Facility Radiation Protection Requirements* document or an RWP are used to establish radiological controls in a work document, the work document must incorporate the applicable controls specifically or by reference.

An RP-1 designated SME must approve documents that specify radiological controls. Radiological hazards and controls must be discussed by an individual knowledgeable of RP requirements as part of activity pre-job briefings. **For radiological work activities controlled by an RWP, an RP representative must provide a briefing on the RWP before the work activity begins.**

Escorted workers must follow established controls, including requirements for entry and access (with some exceptions possible for training; see Section 1.6, Training), PPE, and work control documents (IWDs and RWPs) required for the area entered and the work to be performed.

2.12 Radiological Work Permits

This section describes specific requirements for the use of RWPs. Radiological work permits are used to address only radiological hazards or to supplement procedures for unique tasks or unique radiological hazards.

An RWP must be used for entry into the following areas, irrespective of the work to be performed:

- High radiation areas (areas ≥ 1000 mrem/h, sum of all radiations)
- Extremity dose rate >10 rem/hr (considering all radiations, at contact with accessible material)
- High contamination areas
- Airborne radioactivity areas
- Hot-job exclusion areas (except when being used during the response to a radiological emergency)
- When indicated as a requirement on radiological entry posting

In addition, RP-1 may require the use of an RWP to enter high radiation areas (> 100 mrem/h at 30 cm) or to perform work activities whenever tracking of doses or performance improvement is indicated.

WARNING!

When conducting radiological work in High Radiation Areas in which the dose rates in the work area are between 100 and 1000 mrem/hr it is recommended that an RWP be used to facilitate the use of dose tracking and control doses, and thus maintain doses ALARA. Administrative work may be done in these areas without an RWP, provided the provisions of this procedure are followed.

Radiological hold points will be included in the work control documents to ensure that work activity agrees with the anticipated radiological conditions and controls that are in the RWP. Limiting levels of contamination outside of engineering controls will be included in RWP. If un-anticipated radiological conditions are found at any time, then work activity must be placed in a safe condition and paused. **Radiological safety concerns shall be addressed and documented by PIC and RP-1 SME before work is allowed to restart**.

For RCAs, RBAs, contamination areas, and radiation areas (less than 100 mrem/h), completion of formal training on this document satisfies the requirement for written authorization to enter these areas in accordance with P121, Section 1121.

Standing RWPs may be used for repetitive activities in areas with well-characterized and stable radiological conditions. **An RWP is no longer valid if any of the following take place**:

- The scope of work changes.
- Radiological conditions change in such a way that the protective requirements are no longer appropriate for the conditions.
- It is discovered that conditions were not properly characterized when the RWP was written.

Changes to the scope of work or radiological conditions covered by an RWP require either an RWP change or completion of a new permit. An RWP change requires the same approvals as the original. Workers must sign a new acknowledgement log and attend a pre-job briefing for each change form.

Note: An RWP may not be used to control non-radiological hazards.

2.13 RWP Pre-Job Briefings

All workers participating in work under an RWP or using an RWP to enter an area requiring an RWP must attend a pre-job briefing conducted by the RCT or RP-1 SME before the work is performed.

RWP briefings must take place as follows:

- For standing RWPs: when the RWP is revised or reissued (standing RWPs are reissued every 90 days)
- High Hazard classified RWPs shall have a pre-job briefing on a daily basis.

- Whenever an RWP is revised
- As otherwise indicated on the RWP

Any unresolved issues among those attending a pre-job meeting must be addressed and resolved through the supervisory/line management chain before the work may be performed.

The required reading of an RWP is not an acceptable substitute for a pre-job briefing. For RWPs with multiple stages/phases, it is permissible to brief only on the stages to be performed, with the RCT indicating on the acknowledgement log the specific stages/phases briefed. Additional briefings are then required before other stages or phases are performed. Some RWPs may require reading and signing of the acknowledgement log before use. These requirements are incorporated into the RWP.

2.13.1 RCT Coverage Requirements

Emergency and incident-related activities receive the highest priority in assigning RCT resources and may affect RCT availability for scheduled and unscheduled work. RP-1 activities required for compliance with 10 CFR 835 take precedence over operational support, however scheduled operational support is typically accommodated when compliance activities can be accomplished within their required time frame.

Work that requires RCT coverage should be scheduled and resource-loaded through the integrated plan-of-the-week and plan-of-the day. Work that requires RCT coverage that is not scheduled in advance will be supported as resources permit but may be postponed or cancelled if RCT support is unavailable.

RCT job coverage is required for the following types of operations:

- When moving radioactive material that could cause a new radiation area or high radiation area to be created
- Work with the potential to create high radiation areas or very high radiation areas (for example, handling or movement of high-activity sources or materials with potential for personnel exposure)
- Whenever the operation has not been characterized so that changes in external radiation levels are understood by workers and appropriate controls established
- When entering and exiting contamination areas, high contamination areas, airborne radioactivity areas, and high radiation areas
- When breaching contaminated systems such as gloveboxes, ventilation ducts, radioactive waste lines, and other internally contaminated systems
- When respiratory protection is required to control radiological hazards
- When opening radioactive material containers outside glove boxes or open-front hoods
- Maintenance/decontamination of contaminated open-front hoods

- To survey items and equipment and approve their removal from contamination areas, high contamination areas, or airborne radioactivity areas
- To survey items and equipment and approve their release from RCAs
- When receiving radioactive material shipments
- Initial opening of radioactive shipped containers
- To survey radioactive material shipments before shipment out of the facility
- To perform leak testing of accountable radioactive sealed sources
- To provide response to radiological instrument alarms and to release individuals who have alarmed contamination monitors or when contamination is indicated
- When indicated by a work control document (RWP, procedure, etc.) or by RP-1
- When indicated by survey results or incident history

An RCT radiological survey is required before personnel access areas in TA-53, LANSCE not normally accessed or lacking current surveys for example, accelerator beam tunnels and target areas that are PACS controlled after beam operations.

As part of the process for planning work and performing it safely, personnel performing work and their supervisory chain (for example, first level manager, group leader, etc.) are responsible for determining if their operations might result in changes in radiological conditions or that could require RCT coverage.

Some typical RCT tasks that have low or minimal risk may be performed by line personnel under special authorization. **"*Authorization*" includes:**

- Training and performance requirements, and
- It is typically documented through a radiological surveillance authorization agreement.

Allowable tasks that are subject to radiological surveillance authorization agreements are specified in RP-1-DP-10, *Radiological Surveillance Authorization Agreement*.

2.13.2 New Activity ALARA Reviews (NAARs)

New activity ALARA reviews (NAARs) provide the method to ensure that radiological hazards are analyzed and controls established for new or changed work activities. The NAARs are performed by an RP-designated SME in accordance with a documented RP-1 process.

A NAAR is required based on or more of the following triggers and the activity may not proceed until this review is completed:

- New, uncharacterized radiological operations
- Increase in source term (quantity of radioactive material) above what is currently performed
- Change in type of hazard, including a new radionuclide or physical/chemical form of material

- Change in process or tools that would increase hazards or result in an uncharacterized condition
- Change or new location in an activity different from where it is currently performed
- Reduction of or significant change in engineered controls
- Activities that have not been performed for a period of 24 months or more whether or not previously reviewed and approved

To initiate a NAAR, contact the RP-1 team leader.

2.14 Design and Control

Design and control requirements are described in P 121-2, Chapter 12, *Radiological Design and Control*.

Physical design features or engineered controls are the primary method for controlling radiation exposure and radioactive contamination. Administrative controls and procedural requirements are used to supplement physical design features.

New facility and facility modification design control are in accordance with DOE-HDBK-1132-99; DOE Handbook Design Considerations. However, **this handbook does not address design considerations specific to accelerators**. Thus, additional information specific to the design of accelerators must be used. This information is available primarily from NCRP 144: Radiation Protection for Particle Accelerator Facilities. The IAEA Report 188: Radiological Aspects of the Operation of Electron Linear Accelerators and IAEA Report 283: Radiological Aspects of the Operation of Proton Accelerators also provide additional information.

Shield design and control requirements for the LANSCE accelerator and other accelerator facilities located at TA-53 are listed in 53PS 402-700-02.0: Prompt Radiation Protection and Shielding. Neutron production and control are of particular concern at LANSCE. Unless the shield design problem is well understood, the results of the MCNPX code analysis should never be assumed better than a factor 3 to 4. New or modified shielding shall have a shielding integrity survey performed by RP-1 as part of commissioning. The *Radiation Safety Committee* (RSC) at LANSCE approves modification of shielding required for prompt radiation protection.

A radiological design review is required when modifications to existing process, systems, or facilities are planned that will significantly affect radiological conditions. Radiological design reviews are coordinated through the LANSCE RSC with concurrence by RP-1 LANSCE Team Leader and may include the assistance of RP-3 radiological engineering personnel or designees.

Design or modification features must:

- use ALARA optimization methods in developing and justifying design and physical controls;
- have as a design objective to maintain exposure levels below an average of 0.5 mrem/hr in areas of continuous occupation (based on 2000 hours per year);
- under normal conditions, use confinement and ventilation to avoid contamination release to the workplace and to control inhalation of radioactive material to levels that are ALARA; and
- include features that facilitate operations, maintenance, decontamination, and decommissioning.

Additional design objectives and requirements are found in P121.

Interlocks for radiation-producing machines/processes must not be bypassed or overridden, except with specific approval. If interlocks need to be bypassed, the activity must be coordinated through the work control system. In addition, the LANSCE RSC, the RP-1 management and the TA-53, LANSCE Accelerator Operations Manager must grant approval in advance.

2.15 Instrumentation

Requirements for radiological instrumentation are described in P 12 1-1, Chapter 13, *Radiation Protection Instrumentation*.

Rigorous quality and regulatory standards cover the calibration and use of radiological instruments. Instruments used for radiological protection purposes must be calibrated and maintained by RP-2 and used in accordance with RP-1 approved procedures.

Area Radiation Monitors **(ARMs)**

There are a variety of ARMs used at LANSCE to measure gamma and neutron dose rates. ***GA-6s*** measure gamma dose rates at the injectors, injector test stand, the equipment service aisle above the LINAC tunnel penetrations and the MEB. **RMS-3s** also measure gamma dose rates and are located in the IPF facility.

GA-6 Gamma Detector

Two RMS-3s are used in IPF facility.

- A high range RMS-3 is located inside the hot cell and is set to provide notification in the HEPA filter room when dose rates in the cell exceed 500 mrem/hr.

- A low range RMS-3 is located directly above the hot cell cask-access port. The RMS-3 will alarm when dose rates exceed 100 mrem/hr. This RMS-3 was placed above the cask access port to provide immediate indication of when the cask lid is not put in place, or misplaced on top of the cask. An R0-7 (high-dose-rate instrument) is placed inside the hot cell and is used to measure the dose rate from irradiated targets.

Albatrosses—commonly referred to as "*neutron detectors*" (NDs)—are used to measure area-neutron dose rates. The NDs are strategically located in areas where dose rates could exceed design basis accident dose rates. ND locations include ER-1, 1L Cryogenic Systems Area (CSA) limited access area, Mechanical Equipment Building (MEB) limited access area and the Line D exclusion area.

The alarm set points will vary depending upon ambient radiation levels in each area. Some of the NDs are connected to the accelerator's run permit system. See 53 FIR 402-701-01, *Limited Access Areas*, for requirements regarding NDs in Limited Access Areas.

Albatross

Operational Checks of Contamination Monitors

Ensure that monitors used for detecting radioactive contamination are functioning correctly. Escorts perform this function for their visitors.

Note: Automated *personnel contamination monitors* (PCMs) are checked daily by RCTs. The user need only verify that the instrument is functioning normally, with no warning indications, before use.

2.15.1 Beta/ Gamma portable contamination monitors

Small portable contamination monitors are used to frisk hands and feet when exiting the RLW facility. These may be used as necessary during other radiological evolutions at LANSCE. RP-1 will deploy as necessary, and post the area exit requirement.

The following table describes the actions to follow when checking the operability of portable beta/gamma contamination monitors:

ACTIONS TO FOLLOW WHEN CHECKING THE OPERABILITY OF PORTABLE BETA/GAMMMA CONTAMINATION MONITORS	
Step	**Action**
1	Source-check monitors that do not automatically verify operability at laboratory exits by using the provided check source. Source-check the monitor immediately before self-monitoring. Source-check monitors at glovebox or open–front-hood workstations before starting operations. **Exception:** You are not required to repeat the contamination monitor source check if you witness a person in front of you performing the source check successfully while you are waiting your turn to exit.
2	Contact an RCT or the RP- 1 office if a contamination monitor is not functioning properly.
3	If an RCT cannot respond immediately, place a note on the faulty contamination monitor or probe indicating out of service.

ACTIONS TO FOLLOW WHEN CHECKING THE OPERABILITY OF PORTABLE BETA/GAMMMA CONTAMINATION MONITORS	
Step	**Action**
	WARNING: Contamination may be present. Do not exit an RBA or RCA without self-monitoring or being monitored by an RCT, unless it is an emergency.
4	Locate a functioning contamination monitor and self-monitor as required or call for an RCT to assist and wait for the RCT to arrive before exiting the area.

Note: Instructions for using portable beta/gamma contamination monitors are given in *Attachment D*.

Continuous Air Monitors (CAMs)

RP-1 evaluates radiological hazards to determine the need for CAMs. These evaluations use RP-1 and LANL RP documents and are based on the type and quantities of radioactive material and other factors. Instrumentation settings, including alarm set points, may be changed only by RP-1 as required by operational needs, procedures, or RWPs. CAM settings are documented by RP-1 and maintained by the RP-1 Team Leader.

Inoperability of a continuous air monitor affects operations in the area. **If a CAM is inoperable or its performance is suspect, contact RP-1 and the TA-53, LANSCE CCR immediately**. RCTs verify the operability of CAMs daily and perform routine performance tests as specified in RP-1 Routine Monitoring Instructions.

Electronic Personnel Dosimeters (EPDs)

Electronic personnel dosimeters are issued to personnel whose dose due to work assignment could exceed an administrative limit or an ALARA goal in a relatively short time. It is also issued to personnel to track job specific doses.

2.15.2 Vehicle Radiation Monitor (Commonly Referred to as the "Gate Monitor")

The "*gate monitor*" is used to survey vehicles as they exit the facility. The system includes two detector columns that vehicles pass through, with visual and audible alarms (red stop light and horn) that are triggered in the event elevated radiation levels are detected.

Before leaving TA-53, RP-1 must be notified of any radioactive material shipments, recent nuclear medicine treatment or diagnostic treatments.

When exiting TA-53 by vehicle, you must slow down to at most 10 mph (miles per hour) when exiting, this will allow the radiation detector to scan your vehicle.

Posted Speed Limit

If you set off the gate alarm while exiting TA-53 with the gates open or closed:

- Pull into the parking lot across from the security post.
- Use the telephone near the gate to call the Health Physics Office (RP-1). The number is posted near the telephone.

A camera takes a photo of any vehicle that causes an alarm. Pull over and wait in the parking lot for Health Physics personnel. **Do not leave the area until you cleared to do so by RP-1.**

Gate Radiation Monitor

Note: Problems with the gate radiation monitor and/or alarm system shall be reported upon discovery to the RP-1 supervision who will inform the LANSCE on-call duty officer. For problems

after hours the notification shall be made as early as practical during working hours the next working day. The duty officer will consult with the FOD to implement compensatory measures that include either suspension of sanitary waste pick-ups or RP-1 monitoring arrangements and issuance of timely message/instructions regarding the reduced operability to the TA-53 residents.

Contamination Control

Requirements for contamination control are described in P121, Chapter 14, *Contamination Control*

2.15.3 General Requirements

WARNING
Contamination may be present. Always check anti-C gloves for contamination before removing them from your hands, regardless of the type of work performed.

Exception: Do not self-monitor anti-C gloves that you know or suspect are contaminated. Contact an RCT for assistance and follow the RCT's directions.

The following table puts forth the general requirements to minimize the spread of contamination:

GENERAL REQUIREMENTS TO MINIMIZE THE SPREAD OF CONTAMINATION	
	General Requirements
1	Eating, drinking, smoking, applying cosmetics or lip balm, chewing gum, and other consumer products are not allowed in RCAs, other posted radiological areas, or commingling areas.
2	Refrain from unnecessarily touching equipment in RCAs or RBAs. This includes bare-hand touching and casually leaning against containment systems and other potentially contaminated systems. Requirements for anti-C glove use are described in Section 3.4.
3	When withdrawing from glovebox gloves or from open-front hoods, exiting RBAs, and exiting RCAs, self-monitor for radioactive contamination as detailed in *Appendix D*.
4	Self-monitor in accordance with posted requirements, the instrument instructions in *Appendix D*, and your radiological worker training.
5	While working with radioactive material or on equipment likely to be contaminated, monitor frequently with the proper instrument to detect the presence of contamination as early as possible and to minimize the potential for the spread of contamination.
6	Minimize the amount of material and equipment brought into RCAs. Do not bring in any unnecessary material, including personal items not required for work. Packaging material must not be brought into RCAs unless absolutely necessary. Replace wooden pallets with metal pallets provided by Facility Waste Services outside of the RCA.
7	Before monitoring for alpha contamination, ensure that the surface being monitored is dry. If your hands are wet, or perspiration is present, wait for your skin to dry completely before self-monitoring.
8	Ensure that any vacuum cleaners used in RCAs are HEPA-filtered. Any exceptions to this requirement must be approved by the [TA-53 LFO-FOD] Manager/designee and RP-1 before work is begun.

GENERAL REQUIREMENTS TO MINIMIZE THE SPREAD OF CONTAMINATION	
	General Requirements
9	To prevent the spread of contamination, surveys must be performed by RCTs when the following activities are performed: • Entry into these TA-53 areas that include, but are not limited to, the 1L target cell, 1L pump alcove, Switchyard valve gallery, Area A valve galleries, Target 4 pump alcove, and A-East. • Before moving equipment that has been stationary for a long period of time • Before accessing areas that are not normally accessed • Before any facility modifications are made if contamination is present Examples where these requirements apply include the following: • Accessing or working on cable trays or conduit in radiological controlled areas for contamination • When moving or removing shielding located in RCAs controlled for contamination (dose rate surveys must be conducted in addition to contamination surveys) • When accessing cabinets or storage areas in radiological controlled areas for contamination that are not routinely used or opened **Note:** An RCT survey of a high contamination area requiring a special RCT survey before it is accessed or worked on is considered current for 2 days (unless otherwise posted), after which the survey must be repeated if the area is to be accessed again.

GENERAL REQUIREMENTS TO MINIMIZE THE SPREAD OF CONTAMINATION	
	General Requirements
10	Radioactive materials outside gloveboxes or open-front hoods must be handled in a manner that prevents spills or leaks. Handling or storing radioactive material (with surface contamination levels greater than P121, Table 14-2) in a non-approved container outside of gloveboxes or open front hoods requires an RWP (or other work document approved by RP-1) with specific hazard controls. The following requirements apply to handling or storage of radioactive materials or contaminated items outside of engineered controls (i.e., gloveboxes or open-front hoods or other designated areas): • External surfaces of radioactive materials and potentially contaminated items, or their packaging, must have surface contamination levels less than Table 14-2 limits when removed from areas controlled for contamination hazards • A glass container may not be considered a barrier to a spill or leak • Surface contaminated items with easily dispersible radioactive material must have, at a minimum, triple containment • Containments must be compatible with the physical and chemical form of the materials in such a way that, if the material spills or leaks, the material will be fully contained • For liquids, containment must be large enough to contain the volume of spilled material, and the primary containment should be kept upright
11	Unused PPE and other supplies that were staged to support hot jobs must be surveyed and found free from contamination before returning them to storage.
12	Before handling face shields, goggles, or safety glasses that are stored in RBAs, remove anti-C gloves if they are being worn and thoroughly monitor hands for contamination. Protective equipment stored in RBAs should be stored in a way that minimizes the likelihood of them becoming contaminated.

What to do if a contamination monitor alarms: The following actions must be taken if a contamination monitor alarms or if contamination is indicated on any instrument or in any area:

- Minimize your movements.
- Immediately call for assistance. If an RCT is unavailable in the immediate area, call RP-1, or ask someone to call for you.
- Do not leave the immediate area unless there is an emergency condition such as CAM, evacuation, ventilation, or fire alarm.

Contamination is of secondary concern under emergency conditions. Follow facility emergency procedures, including assembling at muster areas where RCTs will be available to monitor for contamination.

2.15.4 Personal Hygiene

When wearing anti-C gloves, do not touch exposed areas of your body (face, hair, etc.). As in any laboratory operation, it is a good practice to wash your hands after leaving RCAs.

Personnel are required to shower and wash their hair before dressing in personal clothing or leaving TA-53, LANSCE in the following cases:

- They sustain skin contamination.
- They otherwise need a shower for decontamination
- They are present without respiratory protection and a hood during a true CAM alarm.
  They sustain personal clothing contamination above the shoes (determined not to be radon-related).

Working in Gloveboxes

The following table describes the actions workers should take when working in gloveboxes:

ACTIONS WORKERS SHOULD TAKE WHEN WORKING IN GLOVEBOXES	
Step	**Action**
	WARNING: If systems do not indicate required negativity, evacuate the laboratory and contact RP-1 immediately.
1	Immediately before the start of each operation conducted in a glovebox, check the gloves to verify that they are being drawn into the glovebox and not being pushed out into the room.
2	Don gloves and tape them over the sleeves of your coveralls.
3	Before starting work, perform a source check of the contamination monitors (*Appendix D*) that will be used, and inspect the glovebox gloves for damage according to the steps in Appendix B.
4	After each withdrawal from glovebox gloves, immediately self-monitor your gloved hands, using the contamination monitor probe closest to the workstation.
5	When leaving a glovebox line, monitor your anti-C sleeves (up to the shoulders) and other areas of your protective clothing that you suspect could be contaminated (e.g., the front of your anti-Cs if you leaned against the glovebox). Use the nearest available monitor for this.
6	If contamination is indicated, notify RP- 1.

2.15.5 Exiting from RBAs

The following table describes what a worker should do when moving from an RBA used for contamination control:

STEPS FOR MOVING FROM AN RBA USED FOR CONTAMINATION CONTROL	
Step	**Action**
1	Before removing items and equipment from RBAs, have them swipe-monitored or direct-monitored, as appropriate. For requirements, see Section 3.8.1, Item and Equipment Removal.
2	Remove and discard anti-C gloves before exiting the RBA unless you need to continue to use them (radioactive or hazardous material is being moved, your next operation requires them, etc.). For repetitive tasks within an RCA, personnel may exit an RBA to an RCA wearing the inner pair of anti-C gloves, provided that those gloves are thoroughly monitored at the RBA exit in the same manner as is required for hand monitoring and when no contamination on the gloves is detected or suspected.
3	After performing work that requires RCT coverage, a full-body survey by an RCT is required before exiting the RBA where the work was performed.
4	For work that did not require RCT coverage, self-monitor by performing a full-body survey if any of the following activities were performed: • Work involving handling or opening of radioactive material, containers of radioactive material, or contaminated items or equipment • Work that required kneeling, leaning against, or sitting on any surfaces in the RBA; the full-body survey is not required if the only surface you sat on is a chair • Work involving hands in glovebox gloves • Hands-on work on the exterior of gloveboxes (for example, glovebox maintenance, repair, or troubleshooting) Perform the full-body survey using a hand-held beta/gamma contamination monitor. Ask a co-worker for assistance in monitoring areas of your protective clothing that you cannot reach.
5	In all cases, immediately before exiting the RBA or going to an adjacent room, monitor your hands (or gloves) and booties using a hand-held contamination monitor. **If an operational hand-held contamination monitor is not available at the exit, proceed directly to the nearest personnel contamination monitor (PCM)**.
6	If contamination is indicated on personnel, or if the equipment malfunctions, notify RP- 1.

Exiting from other RCAs

The following instructions address exiting from TA-53, LANSCE and exiting other RCAs:

STEPS FOR EXITING FROM AN RCA	
Step	**Action**
1	Items and equipment must have KOP or be monitored by RP-1 before their removal from any RCA. For requirements, see Section 3.8.1, Item and Equipment Removal.

STEPS FOR EXITING FROM AN RCA	
Step	**Action**
2	Self-monitor your hands and feet and other areas suspected for contamination with a hand-held contamination monitor.
3	Remove your booties while stepping over the bootie line (indicated with a painted line on the floor), and dispose of the used booties.
4	Perform whole-body self-monitoring on the personnel contamination monitor (PCM).
5	If contamination is detected: • Minimize your movements. • Have a fellow worker call RP-1.
6	In certain cases (such as automated instrumentation malfunction), RCTs may perform required contamination monitoring. In such cases, follow RCT directions.

These instructions apply to contamination areas, high contamination areas, and airborne radioactivity areas. **RCT coverage and full-body contamination monitoring is required for exit from these radiological areas.**

Exiting may involve:

- removing personal protective clothing and
- may include step-off areas and
- decontamination.

When exiting these areas, follow RCT instructions that will include a final whole body survey with a *personnel contamination monitor* (PCM). They are used to measure surface contamination on your shoes, clothes, and/or skin as you leave areas where there is a possibility for you to have been contaminated. PCMs are considered to be more accurate and thorough in detecting contamination than hand-held instruments.

Personnel Contamination Monitor (PCM)

2.16 Working with Volume Contaminated (Activated) Materials TA-53

Radioactive materials and Volume Contaminated (activated) materials are primarily dealt with at TA-53. It is important to maintain KOP.

These requirements apply to the handling, movement, and storage of all radioactive and contaminated items, and potentially radioactive and contaminated items, within the boundary of TA-53, so that KOP is maintained.

2.16.1 General Requirements for Item and Equipment Removal from Radiological Controlled Areas (RCAs) for Volume Contamination

2.16.1.1 Labeling Volume Contaminated Materials

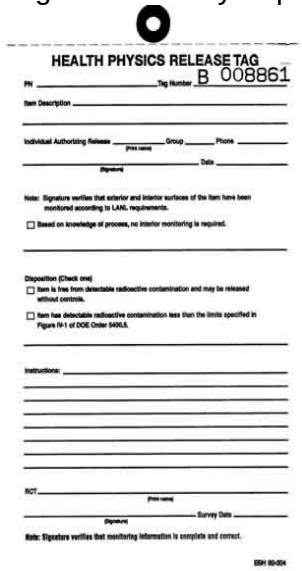
"Volume contamination" is radioactive contamination dispersed throughout a material and is caused by materials becoming activated through irradiation by a particle beam.

Administrative and physical controls shall be implemented for these radioactive materials commensurate with the physical and chemical characteristics of the contaminant, the radionuclides present, external dose rates, and their contamination levels.

Removing materials that are determined by an RCT survey to be radioactive (e.g., greater than no detectable activity criteria (>NDA); shall be tagged by the RCT with the "*Health Physics Radioactive Material Survey*" tag prior to removal from the area.

Materials that are determined by an RCT survey to be non-radioactive (<NDA) shall be tagged by the RCT with the "*Health Physics Release*" tag according to Laboratory requirements.

Front of HPR Tag



Back of HPR Tag

Materials that are potentially radioactive or are awaiting survey results shall be labeled or tagged to maintain KOP. These will be:

- Marked with the Radioactive Material label (**see Appendix F: Radioactive Material Tags That May Be Applied by Facility Personnel**), or
- Placed in a container bearing the Radioactive Material label, and
- Stored in a posted RMA or RCA.

Note: Dose rates on a particular item may exceed the requirements for RMA or RCA; these items may need to be stored in RA or HRA.

There is no current DOE or laboratory policy regarding the release of volume contaminated (activated) material. Therefore, items that are volumetrically contaminated (activated) above detectable levels may NOT be released to the public.

Volume activation with respect to the moratorium is a significant issue for accelerators; LANSCE intends to develop a methodology conforming to NNSA guidance on release of volume activated material. The methodology, based on modeling and survey protocol, was agreed to at a meeting between DOE and contractor reps at the Nevada Site Office in 2009.

2.16.1.2 Label Removal

Any trained worker can apply the Radioactive Material label. It may be removed from an item or container only by an RCT after completion of an appropriate survey and receipt of survey results. The label shall be replaced only by a *Health Physics Radioactive Material Survey* (HPRMS) tag or a *Health Physics Release* (HPR) tag.

- The HPR Tag must be removed before the item leaves laboratory property or if the conditions of the tag no longer apply (e.g., reinstalling an experiment or beam line component, reintroducing the item into an area controlled for contamination) and may be removed by anyone.

- The HPRMS tag may only be removed by an RCT following appropriate surveys.

2.16.1.3 Materials Removal

Beam line components, experimental samples, facility equipment, and other types of materials are often removed from the immediate area of potential activation or a RCA for volume contamination (for example: flight paths, beam lines, primary beam tunnels) without being removed from the surrounding RCA. In doing so, KOP for potentially radioactive items can be lost. To prevent loss of KOP, one of the following two options shall be used:

Option 1

Note: This option must be used if the item is also being removed from a primary beam line if the component/item dose rates could generate RA or HRA. These items will already be in a RA or HRA.

Immediate RCT survey and tagging with a HPRMS tag or a HPR tag, as appropriate, or

Option 2

Labeling the item with the radioactive materials label (see *Appendix F*)**,** or the equivalent (contact RP-1 if an equivalent is desired, a variance will be initiated), any trained worker can apply the Radioactive Material label. RP-1 will supply the electronic file to make these labels for use by material owners in ER-1/2, PSR, Blue Room, Areas A/B/C, beam tunnels, and other areas, as needed to control Volume Contaminated (activated) radiological materials.

When applying the label, either the "*pending RCT survey*" or "*awaiting survey results*" must be checked. The latter box should be checked only by an RCT after a survey and includes spaces for RCT initials and date, indicating when a sample was taken.

Option 3

The Lujan Center has flight path specific radioactive material boxes that are used for experimental samples. Samples are removed from flight paths, placed in zip locked bags (per Lujan procedure) with label marked as "*pending RCT survey*" and placed in a flight path specific box.

Each flight path radioactive material box has two shelves. The upper shelf is labeled for Radioactive or Potentially Radioactive samples. The bottom shelf is for "*Cold*" free release, non-radioactive samples. Samples found to be radioactive (above NDA) are tagged with a Radioactive Materials Tag and placed back in the radioactive material shelf. Samples found to be non-radioactive are placed on the lower "*Cold*" shelf with a Free Release Tag attached to the sample bag and may be handled with no controls at the experimenter's discretion.

Item and Equipment Removal

Equipment movement between areas inside RCAs and removal from RCAs are controlled to prevent spread of contamination.

- **Removing Items and Equipment from Radiological Areas**

REMOVING ITEMS AND EQUIPMENT FROM RADIOLOGICAL AREAS	
Step	**Action**
	Note: Radiological areas to which this section refers are contamination areas, high contamination areas, and airborne radioactivity areas.
1	An RCT survey is required for removal of items from radiological areas established for contamination (contamination areas, high contamination areas, or airborne radiological areas).

REMOVING ITEMS AND EQUIPMENT FROM RADIOLOGICAL AREAS	
Step	**Action**
2	Surface contamination limits for beta-gamma emitters per table 14-2 of P121 are 1000 dpm/100cm^2 and 5000 dpm/100 cm^2 total (fixed plus removable) for mixed activation products (MAPs).
3	When an item to be removed from a contamination area, high contamination area, or airborne radioactivity area has contamination levels greater than these limits, attempt to decontaminate the item and request another survey by the RCT.
4	If decontamination cannot reduce the contamination level below these limits, or if contamination levels are unknown on inaccessible surfaces that have not been monitored, specific requirements for packaging and labeling are applied. Contact an RP-1 manager for requirements and guidance.

- **Removing Items and Equipment from RBAs used for contamination control**

REMOVING ITEMS AND EQUIPMENT FROM RBAs USED FOR CONATAMINATION CONTROL	
Step	**Action**
1	Monitor any equipment for contamination that is being moved from an RBA to another RBA or RCA. This survey is not required for items that were hand-carried into the RBA and that did not come into contact with surfaces in the RBA. **Note:** The survey must be performed by taking a large area swipe of the item and monitoring the swipe on the appropriate contamination monitor, or by monitoring directly using a hand-held contamination monitor.
2	Before removing equipment that is used to transport radioactive material in TA-53, LANSCE (for example, carts, wagons, packaging/ containment devices), perform additional surveys. This requirement includes movement of equipment between rooms or RBAs. The survey must include monitoring of a representative sample of all surfaces that have the potential to be contaminated by radioactive materials, and must include the wheels. This requirement applies whether or not radioactive materials are being transported at the time the equipment is being moved.
3	If contamination is detected, do not move the item until approved by an RCT.

- **Removing Items and Equipment from RCAs used for contamination control**

Before items and equipment are removed from RCAs used for contamination control, they must be monitored. **Only RCTs may perform this survey**.

- No items above release limits can be unconditionally released.
- Items that are unconditionally released are tagged with an RP-1 Health Physics Radiation (HPR) tag or an HPR multiple release sticker, or documented on an RP-1 item removal log.

- The RP-1 Team Leader may approve items for release with detectable contamination below release limits on a case-by-case basis based on an ALARA evaluation. This approval must be in writing.

Exception: Hand-held items such as notebooks, clipboards, or personal items that remained in possession of an individual and did not come into contact with surfaces in the RCA or RBA do not need to be surveyed before removal from the area unless the person carrying these items is found to be contaminated. This exception does not apply to items removed from contamination or high contamination areas; all items, including hand-carried items, removed from contamination or high contamination areas must be monitored by an RCT.

If the item is to be unconditionally released, interior components must be monitored under any of the following conditions:

- The item is or was connected to a potentially contaminated system.
- Internal contamination is known or suspected.
- The item is tagged as potentially contaminated.
- Direct or smear surveys of the exterior show that surface contamination exists.
- The item was in a contamination area, high contamination area, airborne radioactivity area, or any area during a known airborne contamination release.
- The item pulled ambient air from a known or suspected contaminated environment.
- The complete history of the item during its time in the RCA is not known.

Contamination Control Requirements

Contamination control requirements for specific situations are listed in the table below:

CONTAMINATION CONTROL REQUIREMENTS FOR SPECIFIC SITUATIONS TABLE	
Item	**Process**
Contamination Containment Control	• Each glove bag or equivalent containment device shall be evaluated and meet the requirements in RP-1 procedure DP-65, ‘Radiological Containments’.
Removing radioactive materials or contaminated items from TA-53, LANSCE	• RP-1 management must approve the transfer of radioactive material or contaminated items from RCAs that are not shipped or moved directly to another RCA. • The storage location must be approved and the items must be labeled or tagged with an HPRMS tag.

CONTAMINATION CONTROL REQUIREMENTS FOR SPECIFIC SITUATIONS TABLE	
Item	**Process**
Removing compressed gas cylinders	• Maintain a slight positive pressure in compressed gas cylinders taken into RCAs to minimize the potential for internal contamination of the cylinder. • When moving a compressed gas cylinder out of an RCA for contamination, contact an RCT for assistance. The RCT smear-surveys the exterior surface of the cylinder and takes a swipe sample of the cylinder orifice for analysis. • Compressed gas cylinders that are external to RCAs, but connected to systems within RCAs, also must be surveyed by a RCT for potential contamination.
Removing chemicals	• Factory-sealed chemical containers may be removed from RCAs in accordance with release requirements in this section. • Opened chemical containers may be moved from RCAs to other RCAs in accordance with laboratory conditional release requirements. • In general, opened chemical containers (those in which the factory seal on the original container has been broken) may not be free-released from RCAs and are handled as suspect-radioactive or suspect-mixed waste. • Contact the Waste Management Group for assistance in disposing of chemicals from RCAs.

2.17 External Exposure Control

Requirements for external exposure control are described in P 12 1-1, Chapter 15, *External Exposure Control*.

WARNING
All individuals who handle radioactive materials or containers of radioactive material at TA-53, LANSCE must be aware of both contact and 30-cm dose readings regardless of where the items are handled. If these dose values are not known or there is uncertainty (e.g., if there was a change in configuration), pause work and obtain the RCT dose readings before proceeding.

2.17.1 General

External radiation exposures at TA-53, LANSCE are primarily due to prompt radiation created during accelerator operations and exposures to activated accelerator beam line and target components during accelerator maintenance periods.

Low-level, chronic exposures are highly dependent on work location during accelerator operations and on the amount of time workers and Users spend there over the course of a work year (e.g., many User workstations are located in Lujan experimental room ER-1 or ER-2). As a result, engineered controls including shielding at LANSCE are designed and implemented with this exposure mode in mind.

Higher-level dose rates do exist for some operations at LANSCE, and combinations of engineered and administrative controls are used to effectively minimize these types of exposure.

3.13.2 Shielding

Shielding is the primary engineering control used at LANSCE for minimizing external exposures ALARA. Shielding design, composition, and application are customized to the operation and the material that is handled. Shielding, whether temporary or permanent, cannot be moved without obtaining approval of LANSCE RSS engineer or experimental area manager, with communication with RP-1, since radiological conditions may change. In most cases, an RCT will need to be present to characterize radiological conditions when shielding is moved, especially during beam operations.

Temporary shielding will be posted 'Temporary Shielding: contact *experimental area manager* (EAM) and RP-1 prior to removal." Temporary shielding may not be installed, modified, moved, or removed without written approval.

Note: Shielding material may be added in accordance with the ALARA philosophy, and not as a matter of required controls, by operations or program personnel. In this case an RCT is not required to be called when the shielding is removed. However, do not remove unlabeled shielding without KOP unless RP-1 is notified.

The LANSCE Prompt Radiation Protection and Shielding Policy (LANSCE-PS-121-002.R4) describes the process for identifying engineering and/or administrative controls that will be utilized to assure radiation control guidelines are not exceeded. **The *LANSCE Prompt Radiation Protection and Shielding Policy* is applicable to all TA-53 accelerators and any *radiation-generating device* (RGD) located at TA-53.** The TA-53 *Radiation Safety Committee* (RSC) is the implementing authority for this policy and is charged with the responsibility of making compliance determinations.

Specific External Radiation Controls

The following required controls have been established at TA-53, LANSCE to assist in the control of external radiation:

- An RCT must be present to perform external radiation monitoring when work with radioactive materials could cause unknown or uncharacterized conditions.
- Pause or stop work when external radiation dose rates are higher than expected.
- For areas greater than 100 mrem/h (at 30 cm):

- The area is posted and enclosed in barriers (such as radiation ribbon or rope) and the posting indicates an RCT is required for entry.
- An RCT is required for either entry into the area or for performing work in the area.
- Daily tracking of doses (measured on secondary dosimetry or EPD) is required.
- When individuals reach 90% of the RWP individual dose limit, no further entries are permitted until the worker's manager is notified and modifies the dose limit with change tracked in 'notes section' of the RWP software application.
- If the dose rate exceeds 750 mrem/h during work and an RWP has not been approved for this activity and hazard, then:

    - Pause work.
    - Restrict access to the area to prevent others from being exposed.
    - Write an RWP for the activity and hazards.

To limit extremity doses, if the radioactive material (including both samples and activated items) involves hands-on (or contact) work with a dose rate greater than 100 mrem/h at 30 cm, than a contact survey is required with an ALARA strategy that includes necessary controls.

2.18 Source Control

Requirements for radioactive source control are described in P121, Chapter 16, *Radioactive Sealed Source Accountability and Control*.

Radioactive sealed sources are defined in P121 as follows:

> "*A radioactive source manufactured, obtained, or retained for the purpose of utilizing the emitted radiation. The sealed radioactive source consists of a known or estimated quantity of radioactive material contained within a sealed capsule, sealed between layer(s) of non-radioactive material, or firmly fixed to a non-radioactive surface by electroplating or other means intended to prevent leakage or escape of the radioactive material. RSSs do not include reactor fuel elements, nuclear explosive devices, and radioisotope thermoelectric generators*"

In accordance with that definition, any item that contains radioactive material or has radioactive material fixed to it is considered a sealed radioactive source if the item is used for its emitted radiation. For example, a radioactive or nuclear material container would be considered a "*sealed source*" if it is used for its emitted radiation. Since these items are used and handled, they are subject to sealed source requirements including periodic leak testing.

Consumer products are not considered RSSs; there is an additional list of excluded items in P121, *Attachment A, Glossary*.

Accountable radioactive sealed sources are sources with activities equal to or greater than the quantities listed in P121, *Appendix 16A*. Radioactive sealed sources with activities less than the quantities listed in *Appendix 16A* are non-accountable.

RP-1 must be notified immediately when a radioactive sealed source is misplaced or missing. **In addition, the Facility Operations Director (FOD) and RP-3 must be notified immediately when an accountable radioactive sealed source is misplaced or missing**.

Leak testing of accountable sealed sources is required at a frequency not to exceed six (6) months. When a leak test of a radioactive sealed source indicates that radioactive material is leaking (regardless of level) the required actions are to:

- immediately remove from service
- immediately containerize or package the source to prevent spread of contamination
- determine conclusively if the source is leaking if it is in question
- the source may be returned to service and normal use after it has been determined to not be leaking
- if it is confirmed to be leaking, then take actions to mitigate or dispose of the source and to prevent the spread of contamination

2.18.1 Source Control Requirements

Accountable Sources
The following table describes the actions necessary to control accountable sources:

ACTIONS NECESSARY TO CONTROL ACCOUNTABLE SOURCES	
Step	**Action**
1	Groups owning accountable sources must assign a source custodian who is responsible for the following in accordance with Laboratory requirements: • Source accountability • Inventory • Source receipt • Transfer • Storage • Leak-testing • Use • Record-keeping
2	The source custodian contacts RP-1 as necessary to ensure proper movement, use, storage, and leak-testing of sources.

ACTIONS NECESSARY TO CONTROL ACCOUNTABLE SOURCES	
Step	**Action**
3	ALARA principles must be applied to the storage and use, including leak-testing, of radioactive sources.
4	Operations with radioactive sources that create high radiation areas in occupied or potentially occupied areas require special controls as stated in Section 3.2, Access Control. Personnel require an RWP for entry into high radiation areas > 1,000 mrem/h or working with an accountable source with a dose rate of > 100 mrem/h.
5	When radioactive sources arrive at TA-53, LANSCE or are manufactured at the facility, notify RP- 1. When incoming shipments with accountable sources are received, they must be surveyed for contamination and external radiation, and assigned to a source custodian.
6	Store accountable sources in such a way that personnel are not exposed to radiation unnecessarily. Ensure that storage rooms, cabinets, or other containers of radioactive sources are secured and posted.

2.18.2 Storage and Labeling

Requirements for storage and labeling of radioactive material or containers of radioactive material are described in P121, Chapter 17, *Labeling, Storing, and Receiving Radioactive Material*.

2.18.3 General Requirements

Radioactive materials, items, or containers holding radioactive materials must be individually labeled or tagged to alert personnel to the radiological hazard. The label or tag must be durable, clearly visible, and bear the radiation symbol and the words:

- WARNING: RADIOACTIVE MATERIAL

The radiation symbol must be black or magenta with a yellow background. If a label is applied to packaged radioactive material, it must be applied to the outside of the package or be visible through the package.

Items with surface contamination in excess of P121, Table 14-2, values must be labeled and packaged to prevent spread of contamination when used, handled, or stored in areas other than contamination areas, high contamination areas, or airborne radioactivity areas.

Placement or storage of radioactive material (with surface contamination in excess of P121, Table 14-2, values) outside at TA-53, LANSCE must be approved in writing by an RP- 1 manager in advance to ensure radioactive material packaging, labeling, and other requirements (such as routine monitoring if needed) are implemented.

Labeling Exceptions: In accordance with P121, Table 17-3, the following items **do not** require labeling:

- Radioactive materials or containers holding radioactive materials in quantities less than one-tenth the values specified in P121, Table 16A.
- Materials that are packaged and labeled in accordance with Department of Transportation regulations.
- Materials in [gloveboxes, open-front hoods, hot cells], or samples under the control of a knowledgeable person.
- Radioactive materials located inside RMAs, RCAs, RBAs, or radiological areas when enough information is given to permit individuals to take precautions or control exposures.
- Materials that are inaccessible or accessible only to individuals authorized to handle, use it or work in its vicinity such as areas having access, engineered and administrative controls that preclude unauthorized entry.
- Items installed in manufacturing, process, or other equipment such as piping, tanks, ductwork, or valves, when other controls (such as facility work control processes) identify the radiological hazards of the systems.
- Nuclear weapons and their components.
- Consumer products.

Gloveboxes, radioactive liquid waste lines, vacuum systems in switchyard and PSR in TA-53, LANSCE <u>are all considered potentially internally contaminated</u>. Administrative controls described in the FRPR document and other radiation protection processes (including worker training, contamination control, and item removal) ensure that this equipment is treated as such. Radioactive material labeling of such equipment while in RCAs is not required.

Required Information on Radioactive Labels and Tags:
The label or tag must provide sufficient information (such as radionuclide present, estimated quantity of radioactivity, date for which the activity was estimated, and radiation levels) to enable personnel who are handling or using the material or containers, or working in the vicinity of the materials, to take precautions to avoid or minimize exposure.

Labeling of radioactive material with activity in excess of one-tenth of the values specified in P121, Table 16A, must include the following information:

- Radionuclide present, or some representative description
- Estimated quantity of radioactivity, contamination level, or dose rate (contamination and dose rate information must be provided by RP-1)
- Date when the quantity was estimated or measured

Supplemental information is required on labels for contaminated items, items with internal contamination, and items with fixed contamination. See P121, Table 17-2, for required supplemental information.

Health Physics Radioactive Material Survey Tag

An RP-1 *Health Physics Radioactive Material Survey* (HPRMS) Tag must be used to identify items and equipment intended for removal from the RCA when they have been monitored and determined to contain radioactive material, are internally contaminated, or are contaminated above release limits.

Limitations for use of a HPRMS Tag are as follows:

- Since the tag is not weather-durable, it may not be used for labeling items stored or kept in outside areas. In such a case, weather-resistant posting/labeling must be used.
- The tag must not be used if it cannot be secured to, or it is not practical to secure it to, an item (e.g., a small radioactive sample). In such a case, place the item in a container that can be tagged or use a label meeting the requirements of this section that can be secured to the item.
- See section 2.16.1.2 Label Removal Requirements.

2.18.4 Storing Radioactive Materials

To prevent release of contamination:

- Radioactive materials must be stored and packaged so that package integrity is maintained.
- Storage locations must be periodically inspected to ensure this integrity.

Placement or storage of radioactive material (with surface contamination in excess of P121, Table 14-2, values) outside TA-53, LANSCE must be approved in writing by an RP- 1 manager in advance to ensure radioactive material packaging, labeling, and other requirements (such as routine monitoring if needed) are implemented.

2.18.5 Receiving Radioactive Materials

An RCT must be contacted to perform a receipt survey when radioactive material is transported to the facility, and the survey must be completed before the transport vehicle leaves the facility. Both contamination surveys and dose rate surveys are required.

An RCT must be present to perform surveys when transportation containers are initially opened and radioactive material labeled containers are initially opened.

Receipt surveys are not required for:

- low-level instrument check sources,
- low-activity samples (e.g., radiological smears, environmental samples, air sample filters),

- items with low-level residual contamination (e.g., used respirators, instrumentation, laundry), or
- other items exempted by RP in accordance with P121.

2.19 Radiation Generating Devices

Requirements for operation and maintenance of x-ray-generating devices are described in P121, Chapter 18, *Radiation-Generating Devices Control*. Operating groups of RGDs are required to inform RP-3 (Radiation-Generating Device Control Office) and RP-1 of new RGDs used at TA-53.

The RP-3 RGD Team performs x-ray radiation generating device (RGD) surveys and radiation generating facility-shielding calculations. It is also responsible for the development of Lab-wide x-ray-radiation-generating-device policy documents.

2.20 Performance Assurance

Requirements for the performance assurance of radiation protection are described in P121, Chapter 19, *Performance Assurance*.

External performance assurance processes are based on these factors:

- External regulatory and oversight requirements
- Institutional requirements defined under the Contractor Assurance System
- Organization requirements focusing on business and ESH&Q performance by the RP Division
- Function requirements unique to radiation protection
- Institutional processes, including triennial 10CFR835 assessments, Radiation Protection Observations (RPOs), management assessments, and radiation protection metrics

The RP-1 LANSCE team performs other performance assessments of radiological protection activities, including the following examples:

- Behavior-based safety observations
- Management Observations and Verifications (e.g., management walk-arounds)
- RP-1 self-evaluations

The TA-53 Radiation Safety Committee is an internal review committee advisory to management regarding all issues related to occupational or environmental radiation safety at TA-53. This would include not only prompt radiation caused by site accelerator operations, but also other areas related to radiation safety such as control of activated materials, radioactive sealed sources and other areas relevant to occupational radiation safety as addressed in LANL P 121-1.0, Radiation Protection.

2.21 Records

Requirements for maintenance of radiological records are described in P121, Chapter 20, *Radiation Protection Records and Reports*. There are facility-specific applications of these requirements.

2.21.1 References

Document Number	Title
10 CFR 835	Occupational Radiation Protection
P121	Radiation Protection
TA-53-PL-400-001.3	TA-53 LANSCE Facility Emergency Preparedness Plan
LANSCE-PS-121-002.R4	LANSCE Prompt Radiation Protection and Shielding Policy
LANSCE-ST-121-003.R3	TA-53 Facility Radiation Protection Requirements (FRPR)

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3.0 APPENDICES

Appendix A: Self-Inspection of Safety Equipment and Engineering Controls

Self-Inspection of Safety Equipment and Engineering Controls

SELF-INSPECTION OF SAFETY EQUIPMENT AND ENGINEERING CONTROLS	
Step	**Action**
1	Ensure that safety equipment and engineering controls that are directly related to personal radiological safety are operating correctly before beginning work. Examples include the following: • Ensure operability of contamination monitoring equipment. • Check that glovebox or open-front hood pressure is negative relative to the laboratory before beginning work and periodically during your work. • Inspect glovebox gloves according to the steps in *Appendix B*, Inspecting Glovebox Gloves.
2	Visually verify that other safety equipment and engineering controls are functioning correctly daily before starting work. Examples include the following: • Verify that CAMs are energized. • Check that glovebox bubbler systems (where installed) are operating correctly. • Examine storage containers for radioactive and hazardous materials in open areas, open-front hoods, or gloveboxes for abnormal conditions (leakage, corrosion, bulging, or other damage). • Contact RP-1, if you question the integrity of a container.
3	An RWP (or other work document approved by RP- 1) with specific hazard controls is required for handling or storing radioactive material (with surface contamination levels greater than P121, Table 14-2) in a non-approved container outside of engineered controls (i.e., outside of gloveboxes or ventilated hoods). **WARNING** Workers may encounter unknown materials. If this occurs, stop and recover to assess hazards and implement controls. An RWP is required for handing or opening questionable or suspect containers. Open and inspect questionable or suspect containers only in a glovebox or other area where materials will be contained in the event of a spill or leak. Use of ventilated hoods is not allowed for containers that might be pressurized or contain material that could otherwise be ejected when the container is opened.

SELF-INSPECTION OF SAFETY EQUIPMENT AND ENGINEERING CONTROLS	
Step	**Action**
4	Do not continue work if malfunctioning safety equipment or engineering controls are discovered that can adversely affect the safety of personnel, facilities, or the environment. Immediately notify your supervisor of any malfunctioning safety equipment or engineering controls. **Note:** If you have any questions regarding the operability of facility equipment, contact the central control room or LANSCE RP-1 management.

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Appendix B: Inspecting Glovebox Gloves

Inspecting Glovebox Gloves

INSPECTING GLOVEBOX GLOVES	
Step	**Action**
	WARNING If at any time a glovebox glove breach (cut, tear, etc.) is noticed when hands are not in the gloves, the CAMs are not alarming, and there is no indication of area contamination, inform others in the area and do not touch the glove. All personnel not wearing respiratory protection must perform a safe exit of the room (i.e., perform self-monitoring). Red-light the room and contact an RCT. The room must remain red-lit until the glovebox glove is changed or the gloveport sealed.
1	Before beginning the operation or using the workstation, perform a thorough, daily visual inspection of each glovebox glove to be used. This inspection is repeated if an operator leaves the glovebox line and has lost process knowledge of what has occurred in the glovebox during his/her absence.
2	Before starting a process or operation, inspect the expiration date on all glovebox gloves that will be used. If a glovebox glove is past its expiration date, change the glove before proceeding. Glovebox gloves past their expiration date may only be used with an RWP, respiratory protection, and after passing a pre-use inspection.
3	Before inserting hands in glovebox gloves to perform an inspection, ensure that contamination monitors are operable by performing a source check in accordance with *Appendix D*.
4	Before inserting hand in glovebox gloves, perform a visual inspection of the glove looking for cuts, tears, anomalies, etc in the visible portion of the glove. If anything suspicious or questionable is noticed, contact an RCT immediately.
5	Perform a swipe of the glovebox glove using cheese cloth or other similar media and monitor on the adjacent glovebox-mounted contamination monitor. If contamination is detected, stop the glove inspection and contact an RCT immediately.

<table>
<tr><th colspan="2">INSPECTING GLOVEBOX GLOVES</th></tr>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>6</td><td>Place hand and arm into the glove and inspect the entire interior surface of the glove exposed to the glovebox atmosphere for any degradation that can impair the effectiveness of the glove as a barrier to radioactive contamination. Do not press the glove against the glovebox window to perform this inspection. Defective gloves include those displaying the following characteristics:

<table>
<tr><td>Punctures</td><td>• pinholes
• nicks
• other small openings</td></tr>
<tr><td>Tears</td><td>• rip or jagged-edge opening</td></tr>
<tr><td>Cuts</td><td>• slice or smooth-edge opening</td></tr>
<tr><td>Chemical attack</td><td>• blistering
• shredding
• shedding layers</td></tr>
<tr><td>Heat damage</td><td>• burned or melted areas</td></tr>
<tr><td>Wear</td><td>• cracks
• abrasion
• dry rot
• brittleness</td></tr>
<tr><td>Other symptoms</td><td>• such as color change</td></tr>
</table></td></tr>
<tr><td></td><td>WARNING:

A glove breach could result in the release of contamination and airborne radioactivity. If a glove breach is discovered while you are in the gloves, notify RP-1, or have someone else notify RP-1, without removing your arms.

The person who assists you must first don a respirator before helping you don your respirator</td></tr>
</table>

INSPECTING GLOVEBOX GLOVES	
Step	**Action**
7	If a defective glove is discovered, perform the following steps: • Have a second respirator-qualified person obtain a non-contaminated (i.e., in a plastic bag) respirator in your size, don his/her respirator, and then assist you with donning your respirator. • After the respirator is donned, and with the assistance of an RCT, slowly remove your arms to minimize contamination and the potential for an intake of radioactive material. **Notes:** If this requirement poses another threat (such as contamination into an open wound, prolonged exposure to other hazards, or indications of elevated airborne radioactivity in the room), or if help cannot be reached, slowly remove your arms, exit the laboratory, and immediately obtain assistance. If you are present in a room when someone discovers a glove breach while working in glovebox gloves and you are called on to assist, make sure you thoroughly monitor your hands and other parts of the body likely to have become contaminated before obtaining a respirator, and don a respirator yourself before assisting the person with donning his/her respirator. a. If there is evidence of glove penetration, or if exterior contamination is present, cover the gloveport with a gloveport cover or new glove or tape over glove port if these items are not readily available. b. Place two pieces of yellow tape over the glove port in the form of an X. c. Using a black permanent marker, write on the tape: DO NOT USE, the date, and your initials. d. Schedule the glove change. e. Change defective gloves as soon as practical in accordance with TA55-WI-039, Changing Glovebox Gloves, including recording the glove change information.

Open-Front Hood Survey and Decontamination

Best practices for effective management of contamination hazards in open-front hoods include knowledge of the radiological conditions in the hoods, periodic housekeeping, and decontamination.

The following requirements must be performed in operational open-front hoods in RCAs. The requirements must also be performed in non-operational hoods within RCAs before making them operational.

Hood survey and decontamination requirements:

- At least quarterly, operational open-front hoods must be surveyed to determine contamination levels.
- Hoods with removable contamination levels found to exceed 100k dpm/100 cm^2 (beta/gamma) or 2k dpm/100 cm^2 (alpha) must receive decontamination.
- Decontamination must consist of at least two consecutive wipe-downs.
- Detailed steps for these operations are provided in a supplemental RWP or procedure.
- Hood surveys are scheduled and performed by RP- 1 in coordination with hood/laboratory owners.
- Hood decontamination activities are scheduled and performed by hood/laboratory owners in coordination with RP-1.

For documentation on this process, contact RP- 1.

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Appendix C: Listing of Radiological Posted Areas at TA-53

Listing of Radiological Posted Areas at LANSCE/TA-53.

Number in table specifies the number of rad posted areas within a listed location.

AREA	CONTROLLED AREA			RMA	RBA	CA	HCA	RA	HRA	VHRA			
	External	Surface	Volume										
Sector J	X												
Sector A Service Aisle	X			3									
Sector B Service Aisle	X												
Sector C Service Aisle	X												
Sector D Service Aisle	X			1									
Sector E Service Aisle	X												
Sector F Service Aisle	X												
Sector G Service Aisle	X												
Sector H Service Aisle	X												
IPF Upper Level	X				1								
IPF Target Cell	X						X	X	X	X			
IPF Beam Channel	X		X		X			X	X	X	IPF target cooling system is CA,		
Sectors A-H Beam Channel	X		X					X	X	X	IPF stairwell outside is RBA		
Switch Yard	X	2	X			1		X	X	X			
Line D North	X		X					X	X	X			
Line D South	X	1	X	1		1		X	X	X			

AREA	CONTROLLED AREA			RMA	RBA	CA	HCA	RA	HRA	VHRA			
1LSA	X	1	X	1	1	1		X	X	X			
1l Compressor Area	X			1									
1L Pump Alcove	X					X		X	X	X			
1L Target Cell	X		X			X			X	X			
Blue Room	X	1	X	2				X	X	X			
South Yard	X		X	3				X					
MPF-1289 - Icehouse	X		X						X				
MPF-370	X		X						X				
MPF-371	X		X										
Target 4 Tunnel	X		X					X		X			
FP-15L Shack	X		X						X				
ER-2	X			14				Controlled for Volume Contamination inside flight paths					
ER- 2 FP-1	X		X					X	X				
ER-2 All Other Flight Paths	X		X						X				
Lujan Labs	4												
ER-1	X		X	7				X	X				
MPF-17	X			X									
MPF-29	X		X	2					X				
MPF-365 tunnel	X			X					X				
MPF-15	X			X									

AREA	CONTROLLED AREA			RMA	RBA	CA	HCA	RA	HRA	VHRA			
Lujan Bone Yard	X			X					X				
Lujan Bone Yard HRA	X								X				
MPF-14	X		3	2									
MPF-18	3												
MPF-19	?												
ETL	X			1	Brandon Roller's magnet shop, ion pumps, machine shops store volume activated items inside RMAs.								
MPF-28	X												
MEB	X												
MPF-1	2			2									
MPF-1 Basement	2												
PSR Exclusion Area	X												
PSR Zone 1	X		X	2				X	X	X			
PSR Zone 2	X		X						X	X			
PRAD Dome	X		X	4		1		1		X			
PRAD Count House	X												
PRAD service Aisle	X			3									
Area B	X		X	2				2	1				
MPF 315	X												
North Bone Yard	X			X				X					
NRAD	X	X	X						X				
Line B	X		X					X	X				

AREA		CONTROLLED AREA			RMA	RBA	CA	HCA	RA	HRA	VHRA			
Staging Area		X			1									
Old IPF		X			2		X		Requires pre-entry survey					
Area A East		X			3		1		1	1				
MPF-364		X												
Area A		X	1	1	2		1			3				
Area A Mezzanine		X			1									
Remote Handling		X												
Equipment Building B		X												
TOFI		X			4	1	3		4					
Vacuum and RF Shop		X		Potentially activated components.										

Appendix D: Instructions for using portable beta/gamma contamination monitors

Instructions for using portable beta/gamma contamination monitors

INSTRUCTIONS FOR USING PORTABLE BETA/GAMMA CONTAMINATION MONITORS	
Step	**Action**
1	Check that the instrument is on.
2	It is preferable to source check the detector and monitor the hand before picking up the detector. If possible, leave the detector in an upward facing direction so that this can be done. Hold the provided check source over each detector. A rapid increase in the audible count rate must occur for the instrument to pass the source check. If the instrument fails to respond, notify RP-1, then locate a functional instrument and self-monitor as required or call for an RCT and wait for the RCT to arrive before exiting the area
3	Hold the provided check source over each detector. A rapid increase in the audible count rate or meter deflection must occur for the instrument to pass the source check. If the instrument fails to respond, notify RP-1, then locate a functional instrument and self-monitor as required or call for an RCT and wait for the RCT to arrive before exiting the area
4	If the instrument alarms during the source check, push the RESET (or RES) button. Otherwise, ensure that the audible count rate or meter deflection return to background values before beginning monitoring.
4	Keep the distance between the detector surface and the surface of the item being monitored to within 1/4 in.
5	If an audible click is heard while monitoring, immediately hold the object or detector (whichever is being moved) still for several seconds and watch for an increased count rate.
6	When monitoring of more than the hands is required or indicated, monitor the hands first.
7	Slowly move your hands across the probe at no more than 2 inches per second. Monitor both sides of your hands with your fingers spread.
8	When required or indicated, monitor other parts of the body by moving the detector at no more than 2 in. per second.
9	If contamination is indicated, if the instrument alarms, or if the instrument malfunctions, notify RP-1 and the Operations Center immediately. Do not leave the area unless it is an emergency. **Note:** An RCT equipped with a hand-held contamination monitor who alarms one of these instruments when self-monitoring is permitted to assess the situation and determine if additional RCT support is needed.

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Appendix E: Instructions for using the Eberline PCM

Instructions for using the Eberline Personnel Contamination Monitor

INSTRUCTIONS FOR USING THE EBERLINE PERSONNEL CONTAMINATION MONITOR	
Step	**Action**
1	Observe the display and ensure that the instrument is operational. Report any warning messages to RP-1. **Note:** If the PCM is out of service, RCT supporting activity will identify alternate PCM or contact RP-1 for a whole-body frisk.
2	Step on the foot detectors.
	WARNING Carelessly placing your hand in the detector can cause a scrape from the detector screen. Place your hand carefully.
3	Facing the detectors, carefully place your hands and feet where indicated by the diagram and turn your head to the right. The instrument will not count if your body is not placed in the correct position.
4	Hold the position while the count is completed.
5	When the count is completed, turn around facing away from the detectors, carefully place your hands and feet where indicated by the diagram, and turn your head to the right.
6	Hold the position while the count is completed.
7	At the end of count, the instrument announces contamination status.
8	If no contamination is detected, exit the RCA.
9	If contamination is detected, all workers must: • Minimize their movements • Have another worker call RP-1 (7-7069) or have CCR send a page for an RCT Do not leave the RCA unless it is an emergency.

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Appendix F: Radioactive Material Tags and Labels

Radioactive Material Tags That May Be Applied by Facility Personnel

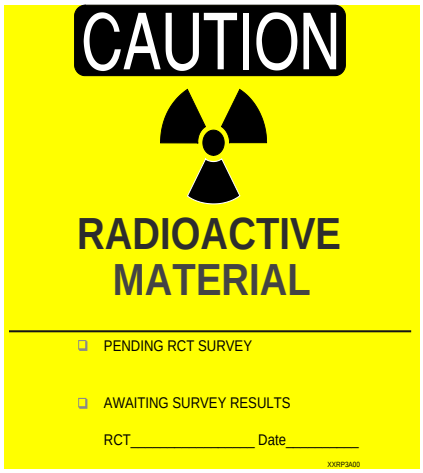

Figure 1: Radioactive Material Label that may be applied by facility personnel to identify potential RAM and that requires RCT survey.

Sample/Item to be Surveyed by RP-1

Name:_____
Flight Path:_____Date:_____
Phone:_____ Email:_____
Description of Sample/Item:

ER1 or ER2 Lujan Neutron Scattering Center

Figure 2: Label used at the Lujan Center to identify samples that require RCT survey.

Request Credit

After you receive credit for the course,
you will be directed to UTrain to take the #15414 on-line quiz.