SECTION 025126 – RADIATION PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section components and instructions:

1. Drawings and general provisions of the contract, including general and supplemental conditions, and Division 01 sections apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

3. No portion, section, or part of these specifications may be modified or omitted from contracts without the advance approval from the University Radiation Protection Group Radiological Control Manager (RCM) at LBNL.

4. The regulation, 10 CFR 835, promulgated radiation protection standards, limits, and safety program requirements for protecting individuals from ionizing radiation at the University. 10 CFR 835 requires the University to document and submit a Radiation Protection Program (RPP) document detailing the University management approach and implementation methodologies for continued comprehensive compliance with the requirements of 10 CFR 835. The requirements of 10 CFR 835 and the RPP apply to all activities conducted at the University or properties managed by the University, including those performed by subcontractors.

a. The requirements of the DOE-approved RPP have been integrated into this document and associated implementation documents according to practices described in the DOE radiological control standards as “shall” or “must” statements. “Should” and “may” are used to convey best practices, not requirements. The meaning of these words will be used consistently throughout related Radiation Protection documents:

1) The word “Shall” identifies applicable regulation requirements, Department of Energy (DOE) orders, or University contractual requirements. When “shall” is used, the pertinent citation from the applicable requirement will follow in brackets. Exemption can only be granted by the DOE.

2) The word “Must” identifies University policy. Exemption could be granted by the Radiological Control Manager (RCM) or higher lab management (if no RCM is available).

3) The word “Should” identifies recommendations, best practices, or safest methods at the time the implementing document was developed. Exemption can be granted by line management.

4) The word “May” identifies additional options or allowable alternatives.

5. DOE Orders and other regulatory requirements for conducting radiological activities at the University include but are not limited to:

a. DOE Rule 10 CFR 830, Nuclear Safety Management, applies to University facilities, activities, and operations using radioactive materials.

b. DOE Order 458.1, Radiation Protection of the Public and the Environment, applies to the analysis of potentially contaminated materials and equipment for unrestricted release.

c. DOE Order 460.1D, Packaging and Transportation Safety, applies to the on-site transportation of radioactive materials.

d. DOE Order 460.2B, Departmental Materials Transportation Management, applies to the off-site shipment of radioactive materials.

e. DOE Order 420.2D, Safety of Accelerators, applies to the operation of accelerator facilities at the University.

f. DOE Order 231.1B, Environment, Safety and Health Reporting, applies to the receipt, creation, reporting, and off-site shipment of high-activity radioactive sealed sources at the University.

g. DOE Order 474.2A, Nuclear Material Control and Accountability, applies to the control and accountability of nuclear materials at the University.

h. The U.S. Department of Transportation (DOT) Rule, 49 CFR Subtitle B, Other Regulations Relating to Transportation, Chapter I; and the International Air Transportation Association (IATA) Dangerous Goods Regulations apply to the receipt and shipment of radioactive materials at the University.

i. DOE Rule 10 CFR 851, Worker Safety and Health Program.

j. California Executive Order D-62-02 [Prohibition on disposal of radiologically impacted decommissioning materials in Class III and unclassified landfills].

B. Excellence in Radiological Control

1. § 835.104 requires written procedures. Written procedures shall be developed and implemented as necessary to ensure compliance with this part, commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards. At the University, procedures include but are not limited to such documents as Technical Basis Documents (TBDs), Experiment Protocols, Work Packages, etc. – otherwise referred to as Technical Work Documents (TWDs).

2. The University has promulgated a Radiological Control Manual to assist and support line management in the execution of radiological work. The Manual is not an exhaustive explanation of how radiation protection is implemented at LBNL, as there are many means and methods to achieve the goal of ensuring personal exposures are as low as is reasonably achievable, but it does provide sufficient information for radiation workers to plan and perform their work safely and in compliance with the Rule. The Manual is made available on request to subcontractor personnel through their Laboratory host. Subcontractors are expected to adhere to the University Radiological Control Manual to ensure alignment with the University RPP.

3. The “As Low As Is Reasonably Achievable” Process

a. 10 CFR 835 requires DOE activities to develop and implement plans and measures to maintain occupational radiation exposures as low as reasonably achievable (ALARA) [see 10 CFR 835.101 and 835 Subpart K]. As applied to occupational radiation exposure, the ALARA process does not require that exposures to radiological hazards be minimized without further consideration, but that such exposures be optimized, taking into account both the benefits arising out of the activity and the detriments arising from the resultant radiation exposures and the controls to be implemented. In order for the University to meet its regulatory obligation for implementing ALARA, including radiological design review as specified in 10 CFR 835 Subpart K, planners, designers, project managers, and other personnel responsible for designing, constructing, or remodeling facilities must involve RPG personnel early in the design and planning stages.

b. ALARA is integrated into all radiological work at the University. An effective ALARA process includes effective consideration, planning, and implementation of both engineered controls and administrative controls to balance the risks of occupational radiation exposure against the benefits arising out of the authorized activity. Engineering controls shall be prioritized, with administrative controls used as a supplemental measure.

4. Integrated Safety Management

a. Radiation Protection policies and procedures provide a system of radiological controls that is implemented and tailored to meet facility- and hazard-specific needs, consistent with the University ISM Program. Implementing radiological control documentation should ensure the following are met:

1) Line Management Responsibility – indicates that line management is responsible for ensuring adequate implementation of the radiological control program.

2) Clear Roles and Responsibilities – clear roles and responsibilities for contractor line management, workers, and sub-tier contractors.

3) Competence Commensurate with Responsibilities – for providing classroom and on-the-job training so that individuals may gain and maintain the appropriate competence.

4) Identification of Safety Standards and Requirements – cross-references to other DOE, Federal Agency, scientific, and consensus standards that are important to developing and implementing an effective and comprehensive Radiation Protection Program.

5) Hazard Controls Tailored to Work Being Performed – for implementing a program that establishes radiological controls that are commensurate with the hazards and that provides flexibility for consideration of other hazards (e.g., industrial safety, industrial hygiene, chemical, environmental hazards).

C. Radiological Standards

1. The University's Radiation Protection Group will provide dosimetry and shall be consulted with any and all internal and/or external dose matters.

a. Unless otherwise indicated, administrative, lifetime, and special control levels and dose limits are stated in terms of the total effective dose, which is the sum of the doses received from internal and external sources. RPG will investigate any abnormal or unanticipated personnel exposure exceeding 100 mrem or any uptake resulting in greater than 100 mrem committed effective dose (CED). An investigation report, including the event circumstances and corrective actions, will be provided to the RCM and the Radiation Safety Committee.

b. No individual should be allowed to exceed the facility/project/experiment administrative control level without the prior written approval of the Radiation Protection Group, Radiation Safety Committee, and cognizant management as determined by the Radiation Protection Group.

2. Monitoring for contamination should be performed using frisking equipment that can detect total contamination at or below the values specified in Appendix D of 10 CFR 835.

a. Individuals found with detectable contamination on their skin or personal clothing, other than noble gases or natural background radioactivity, should be promptly decontaminated and reported to University RPG.

b. A surface is considered contaminated if either the removable or total surface contamination is detected above the levels in Appendix D of 10 CFR 835. Controls shall be implemented for these surfaces commensurate with the nature of the contaminant and level of contamination [see 10 CFR 835.1102(b)].

c. Surfaces exceeding the values in Appendix D of 10 CFR 835 for total contamination may be covered with a fixative coating to prevent the spread of contamination. However, reasonable efforts should be made to decontaminate an area before a coating is applied. A fixative coating should not be applied without the approval of the Radiological Control Manager or designee.

d. For areas with contaminated soil that are not releasable in accordance with DOE's environmental protection standards as implemented by the University, a soil contamination area should be established as follows:

1) The area should be posted according to the specifications in Article 238 of the DOE-STD-1098-2017, Radiological Control Standard.

2) Posting should include the words "Caution, Soil Contamination Area" and instructions or special warnings to workers, such as "Consult with Radiation Protection Group before Digging" or "Subsurface Contamination Exists."

3) Soil contamination areas may be located outside controlled areas if exposure to the material in the area is not likely to cause any individual to receive a total effective dose in excess of 100 millirem in a year.

4) If the contamination levels in the area exceed the values provided in Appendix D of 10 CFR 835 (as evidenced by the likelihood of tracking contamination out of the area at levels exceeding these values), then the area is a contamination area or high contamination area and shall be posted in accordance with contamination area and high contamination area and 835.603(d) and (e) requirements.

5) Soil contamination areas may be located outside a radiologically controlled area (including a buffer area)

e. Use of engineering and administrative controls to reduce the potential for internal exposure should be evaluated before allowing individuals, with or without respiratory protection, to enter airborne radioactivity areas. Posting requirements for airborne radioactivity areas are specified in Article 235 DOE-STD-1098-2017, Radiological Control Standard. Values of Derived Air Concentrations are provided in 10 CFR 835 Appendix A, and controls shall be designed to maintain exposures ALARA as described in 10 CFR 835 Subpart K.

f. Areas having only fixed contamination may not warrant the full range of entry controls established for areas having removable contamination levels exceeding 10 CFR 835 Appendix D values. Areas located outside of radiological areas having measured total contamination exceeding the total surface contamination values specified in Appendix D of 10 CFR 835 (removable contamination levels below Appendix D of 10 CFR 835 values) are subject to the following controls:

1) Periodic surveys shall be conducted to ensure the surface contamination remains fixed to the surface and removable surface contamination levels remain below 10 CFR 835 Appendix D values [see 10 CFR 835.1102(c)(1)].

2) Markings indicating the status of the area shall be applied [see 10 CFR 835.1102(c)(2)]. These markings should be applied directly to the surface (or at the access points) to provide appropriate warning. These markings may also provide appropriate instructions to individuals entering the area or contacting the surface (i.e., “Fixed Contamination, Notify Radiological Control Personnel Prior to Removing Paint, Welding, Grinding, or Drilling”). Signs, stencils, or other appropriate markings may be used.

a) Markings and postings should be maintained in a legible condition.

g. Radiological postings are intended to alert individuals to the presence of radiation and radioactive materials and to aid them in controlling exposures and preventing the spread of contamination. Specific posting requirements for the University can be found in the University Radiological Control Manual. In general, all of the following apply:

1) Signs shall contain the standard radiation symbol (radiation warning trefoil) colored magenta or black on a yellow background [see 10 CFR 835.601(a)]. Lettering should be either magenta or black. Magenta is the preferred color.

2) Signs shall be conspicuously posted at each access point [see 835.601, 603], clearly worded, and where appropriate, may include radiological control instructions [see 835.601(b)]. Radiological postings should be displayed only to signify actual or potential radiological conditions. Signs used for training should be clearly marked, such as “For Training Purposes Only.”

3) Posted areas should be as small as practicable for efficiency.

4) Postings should be maintained in a legible condition and updated based upon the results of the most recent surveys.

5) If more than one radiological condition (such as contamination and high radiation) exists in the same area, each condition shall be identified [see 835.603].

6) Postings at entrance points to areas of ongoing work activities controlled for radiological purposes may state basic entry requirements, such as dosimetry, radiological work authorization, and respiratory protection requirements.

7) Rope, tape, chain, tapes, and similar barriers used to designate the boundaries of posted areas should be distinctive (e.g., yellow and magenta or yellow and black in color).

8) Physical barriers should be placed so that they are clearly visible from all directions and at various elevations. They should not be easily walked over or under, except at identified access points. These barriers shall be set up such that they do not impede the intended use of emergency exits or evacuation routes [see 835.501(e), 502(d)].

9) Areas shall be clearly and conspicuously posted [see 835.601(b)]. Posting of doors should be such that the postings remain visible when doors are open or closed.

10) A radiological posting that signifies the presence of an intermittent radiological condition should include a statement specifying when the radiation is present, such as “CAUTION: RADIATION AREA WHEN RED LIGHT IS ON.”

h. Accessible areas may be excepted* from the radiological area posting requirements:

Implementation of the following exceptions must be approved by the University Radiological Control Manager.

1) During transient radiological conditions of less than 8 continuous hours duration when posting is not practical, such as radioactive material transfers. Under these conditions, the area shall be placed under the continuous observation and control of individuals who are knowledgeable of and empowered to implement required access and exposure control measures [see 835.604(a)]. These individuals should be stationed to provide line-of-sight surveillance and verbal warnings.

2) When the area contains only packages of radioactive material received from transportation while awaiting survey in accordance with Articles 552 and 554 of DOE-STD-1098-2017, Radiological Control Standard [see 835.604(c)].

3) * The exceptions discussed above apply only to radiological area and radioactive material area posting requirements and do not apply to the entry control requirements established in 10 CFR 835.501 and 835.502.

D. Conduct of Radiological Work

1. Written authorizations shall be required to control access to and work in radiological areas [10 CFR 835.501(d)]. “Radiological area” means 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” [10 CFR 835.2]. The level of detail included in such authorizations is dependent upon facility and work activity hazards and the nature of the work force.

2. Subcontractor Prerequisites for Commencement of Radiological Work:

a. Provide a detailed scope of all anticipated radiological work to their Laboratory host prior to work commencing.

b. Provide detailed information of all known or potential radiological hazards anticipated in the scope of radiological work. Potential radiological hazards shall be ascertained conservatively. Non-radiological hazards must also be identified when they are co-located with radiological hazards.

c. Provide the anticipated methodology to be used in the performance of the subject radiological scope work as defined, such as sampling, cutting, grinding, demolition, excavation, disassembly, etc.

d. Provide a Project Radiation Protection Plan (PRPP) that adheres to LBNL’s Project RPP template.

e. Provide all radiological procedure and technical basis documents necessary to perform the radiological scope of work.

f. Provide all known or potential radiological hazard data anticipated in the scope of radiological work. Potential radiological hazards shall be ascertained conservatively.

g. Through their Laboratory host, obtain an RPG-approved project Radiological Work Authorization (RWA) that will bound all subcontractor operations performed within the radiological scope of work. Any changes to the scope of work may require revision of the project RWA. The information provided in items “a” through “f” will be utilized by RPG health physicists to generate the subject project RWA. Highest risk radiological work will be reviewed and approved by the Laboratory Radiation Safety Committee.

h. Depending on the contract scope of work, Subcontractors may be required to develop their own sub-tier task specific radiological work control documents (e.g., Radiological Work Control Packages, Radiological Work Control Permits, Radiation Work Permits, etc.) and associated radiological hazard reviews in accordance with Chapter 3 of the Radiological Control Manual. These sub-tier radiological work documents may be reviewed, as applicable, by LBNL RPG.

LBNL's RPG will develop and implement a governing RWA for the Subcontractors' entire radiological work scope.

3. The governing RWA and any sub-tier radiological work packages include the following information, as applicable, unless the information is contained in other related work-control documents:
    a. Description of work
    b. Work area radiological conditions (or potential conditions)
    c. Dosimetry requirements, including any bioassay requirements
    d. Pre-job briefing requirements, as applicable
    e. Training requirements for entry
    f. Protective clothing and respiratory protection requirements
    g. Radiological control coverage requirements and stay time controls, as applicable
    h. Limiting radiological conditions that may void the RWA
    i. Special dose or contamination reduction considerations
    j. Special personnel frisking considerations
    k. Technical work document number, as applicable
    l. Unique identifying number
    m. Date of issue and expiration
    n. Authorizing signatures
4. RWA classes are assigned to indicate the level of hazards involved. This classification is based on the Hazard Guide Value (HGV) concept for the use of unsealed material or on the unmitigated exposure potential for the use of sealed sources or of radiation generating devices (see Radiological Control Manual, Article 322). Class 1 is the least hazardous and Class 3 is the most hazardous. The classification of the authorization also determines the needed level of review and approvals.
    a. RWAs must be updated if radiological conditions change to the extent that protective requirements need modification.
    b. RWAs should be posted at the access point to the applicable radiological work area or otherwise made available at the work location.
    c. Workers must acknowledge by signature or through electronic means where automated access systems are in place that they have read (English), understand, and will comply with the RWA prior to initial entry to the area and after revisions to the RWA that affect the radiological controls.
    d. If needed for dose accounting purposes, worker pocket or electronic dosimeter readings should be recorded in a format that identifies and provides linkage to the applicable RWA.
5. Pre-job briefings should be held prior to the conduct of work anticipated to exceed the trigger levels identified in the RWA.
    a. Pre-job briefings should be conducted by the cognizant work supervisor or other individuals most familiar with the work to be performed and the required controls.
    b. Workers and supervisors directly participating in the job, cognizant radiation protection personnel, and representatives from involved support organizations should attend the briefing.
    c. Attendance at the pre-job briefing should be documented. This documentation should be maintained with the technical work document(s) and RWA.
    d. At a minimum, the pre job briefing should include:
        1) Scope of work to be performed
        2) Radiological conditions (actual or anticipated) of the workplace
        3) Procedural and RWA requirements

4) Special radiological control requirements

5) Radiologically limiting conditions, such as contamination or radiation levels that may void the RWA

6) Radiological control hold points

7) Communications and coordination with other groups

8) Provisions for housekeeping and final cleanup

9) Emergency response provisions

6. Personal protective equipment (PPE) refers to equipment used to protect workers from hazards in the workplace. Selection of PPE is based on the need to protect employees from specifically identified hazards. PPE may be categorized by the type of protection provided, including eye and face, respiratory, head, foot, and hand protection.

   a. Protective clothing (PC), a PPE subset, is used to protect workers from contamination and generally includes gloves, aprons, lab coats, or full-body clothing. This clothing can be manufactured from a variety of materials. Supplement garments or supplement PCs may include sleeve covers, shoe covers, or hoods.

   b. Individuals shall wear PC during work in contamination and high contamination areas [see 835.1102(e)] and should wear protective clothing during the following activities:

      1) Handling of contaminated materials with removable contamination in excess of 10 CFR 835 Appendix D levels.

      2) Work in airborne radioactivity areas.

      3) As directed by LBNL RPG or as required by the RWA or other work authorization.

7. Entry and Exit Provisions

   a. DOE regulations for occupational radiation protection require that individuals complete radiation safety training commensurate with the hazards and required controls:

      1) Prior to unescorted access to controlled areas [see 835.901(a)]; and

      2) Prior to receiving occupational dose during access to controlled areas (whether escorted or not) [see 835.901(a)].

   b. LBNL General Employee Radiological Training (GERT) is required for unescorted entry into radiologically controlled areas, or radioactive material areas and underground radioactive material areas where an individual is not likely to receive 0.1 rem/year.

   c. Minimum requirements for unescorted entry into soil contamination areas, or radioactive material areas and underground radioactive material areas where an individual is likely to receive greater than 0.1 rem/year shall include:

      1) DOE Radiological Worker I training

      2) Worker’s signature on the RWA, as applicable

      3) Primary dosimeter as applicable

   d. Radiation, High Radiation, and Very High Radiation Areas:

      1) Requirements for unescorted entry into radiation areas shall include radiation safety training [see 835.901(b)] and shall include the following:

         a) DOE Radiological Worker I training

         b) Worker’s signature on the RWA, as applicable

         c) Primary dosimeter

      2) Requirements for unescorted entry into high radiation areas shall include radiation safety training [see 835.901(b)] and the following:

         a) DOE Radiological Worker II training

b) Worker's signature on the RWA, as applicable

c) A radiation survey

d) Supplemental dosimeter

e) Individuals shall be prevented from unauthorized or inadvertent entry to very high radiation areas [see 835.502(c)]

and should include:

f) A determination of the individual's current dose, based on primary and supplemental dosimeter readings

g) Pre-job briefing, as applicable

h) Review and determination by RPG regarding the required level of Radiological Control Technician coverage

e. Contamination, High Contamination, and Airborne Radioactivity Areas:

1) Minimum requirements for unescorted entry into contamination areas shall include radiation safety training [see 835.901(b)] and protective clothing [see 835.1102(e)] and shall include the following:

a) DOE Radiological Worker II training

b) Worker's signature on the RWA, as applicable

c) Personnel dosimetry, as appropriate

2) Minimum requirements for unescorted entry into high contamination or airborne radioactivity areas shall include radiation safety training [see 835.901(b)] and protective clothing [see 835.1102(e)] and the following:

a) DOE Radiological Worker II training

b) Worker's signature on the RWA

c) Respiratory protection when specified by the RWA or other written authorization

d) Pre-job briefing for high contamination or airborne radioactivity areas, as applicable

e) Personnel dosimetry, as appropriate

f) Review and determination by RPG regarding the required level of Radiological Control Technician coverage

f. Individuals exiting contamination, high contamination, or airborne radioactivity areas should remove protective clothing. When entering an uncontaminated area, these individuals shall be monitored, as appropriate, for the presence of contamination on their skin and clothing [see 835.1102(d)]. These individuals should perform whole-body frisking to detect personnel contamination.

g. Exit points from contamination, high contamination, or airborne radioactivity areas should include the following:

1) Step-off pad located outside the exit point, contiguous with the area boundary

2) Step-off pads maintained free of radioactive contamination

3) Designated containers inside the area boundary for the collection of protective clothing and equipment

4) Contamination monitoring equipment located as close to the step-off pad as background radiation levels permit

h. Controls shall be implemented as necessary to prevent the spread of removable contamination outside of radiological areas under normal operating conditions [see 835.1102(a)]. The extent of these controls is dependent upon the type and level of contamination present and the activities in and around the area, and should be designed to maintain exposure ALARA [see 835

Subpart K]. The following measures must be used to prevent the spread of contamination across the boundaries of contamination, high contamination, and airborne radioactivity areas:

1) Use solid barriers to enclose areas wherever practicable.

2) Mark and secure items such as hoses and cords that cross the boundary to prevent safety hazards and the spread of contamination. Markings may include radiological hazard warning labels, ribbon, or tape.

3) Control and direct airflow from areas of lesser to greater removable contamination or airborne radioactivity.

4) Use engineering controls and containment devices such as glove bags, glove boxes, and tents.

i. Individuals shall be monitored as appropriate for the presence of surface contamination when exiting contamination, high contamination, and airborne radioactivity areas [see 835.1102(d)]. Individuals shall perform a whole-body frisk immediately upon entry into an uncontaminated area after exiting contamination, high contamination, or airborne radioactivity areas. Individuals should also perform a whole-body frisk as directed by approved work control documents.

1) In addition to the above, individuals exiting a radiological buffer area containing contamination, high contamination, or airborne radioactivity areas shall, at a minimum, perform a hand and foot frisk. This frisk is optional if the radiological buffer area exit is immediately adjacent to the location where the exiting individual has already performed a whole-body frisk.

2) Where frisking cannot be performed at the exit from contamination, high contamination, or airborne radioactivity areas due to high background radiation levels, individuals should:

a) Remove all protective equipment and clothing at the exit

b) Proceed directly to the nearest designated monitoring station

c) Conduct a whole-body frisk or approved alternative

3) Personnel frisking should be performed after removal of protective clothing and prior to washing or showering.

4) Guidelines for personnel frisking are provided in Appendix 3E of DOE-STD-1098-2017, Radiological Control Standard.

5) Personal items, such as notebooks, papers, and flashlights, which have not been laid down in the posted area, may be frisked by the individual carrying them, provided the individual has been trained to perform this function.

6) Instructions for personnel frisking should be posted adjacent to personnel frisking instruments or monitors.

8. Work Conduct and Practices

a. The following work practices have been shown to be effective; line management and RPG will implement these practices, as appropriate, into ongoing operations and maintenance work.

1) Monitor contamination levels caused by ongoing work and maintain them ALARA. Curtail work and perform decontamination at pre-established levels, taking into account worker exposure.

2) Inspect tools and equipment to verify operability before being brought into contamination, high contamination, or airborne radioactivity areas.

3) Minimize the use of radiologically clean tools or equipment in contamination, high contamination, or airborne radioactivity areas by implementation of a contaminated tool crib in accordance with Article 442 of DOE-STD-1098-2017, Radiological Control Standard. When such use is necessary, consider wrapping or sleeving tools or equipment in complex or inaccessible areas to minimize contamination.

4) Install engineering controls, such as containment devices, portable or auxiliary ventilation, and temporary shielding, in accordance with the technical work documents and inspect them prior to use.

5) Verify the identity of components and systems prior to work.

6) Schedule work activities and shift changes to prevent idle time in radiological areas.

7) Where practicable, remove parts and components to areas with lower radiological hazards to perform work.

8) Upon identification of radiological concerns, such as inappropriate work controls or procedural deficiencies, workers should immediately report the concern to line management. If appropriate to control individual exposure to radiological hazards, the affected individuals should exit the radiological area until these issues are resolved and appropriate controls have been instituted. Line management must report the radiological concern to LBNL RPG.

9) Include requirements for area cleanup in technical work documents.

10) To minimize intakes of radioactive material, smoking, eating, or chewing in contamination, high contamination, or airborne radioactivity areas is not permitted. When the potential for personnel heat stress exists, drinking may be permitted within a contamination area under the following conditions and controls:

a) The potential for heat stress cannot be reduced by the use of administrative or engineering controls.

b) All drinking is from approved containers or sources.

c) The applicable requirements and controls are described in approved procedures.

11) Check communication systems required by the radiological work authorization or technical work document for operability before being brought into the work area and periodically during work. Workers should keep RPG personnel informed of the status of work activities that affect radiological conditions.

12) Radiological Control Technicians and their supervisors, line supervision, and any worker through their supervisor shall have the authority and responsibility to stop radiological work activities for any of the following reasons [see 10 CFR 851]:

a) Inadequate radiological controls

b) Radiological controls not being implemented

c) Radiological control hold point not being satisfied

b. Stop radiological work authority should be exercised in a justifiable and responsible manner.

1) Once radiological work has been stopped, it should not be resumed until proper radiological control has been reestablished.

2) Resumption of work involving radiological hazards should require the approval of the line manager responsible for the work and the Radiological Control Manager or designee.

c. Response to and reporting of abnormal situations or radiological concerns

1) The first priority in an emergency is lifesaving, the second priority is the protection of the environment, and the third priority is the protection of property.

a) Identify personnel requiring medical attention and immediately dial x911.

b) Notify RPG at 510-486-7277, or from a Lab telephone x7277.

c) Apply first aid only if qualified to do so, only at the level trained, and only if it will not endanger you or the victim.

d) If applicable, isolate contaminated areas, equipment, and personnel who do not require medical treatment.

e) Stop the spill and prevent the spread of contamination, but only if wearing the appropriate PCs and if properly trained and equipped to do so.

2) Response to a spill of radioactive material includes the following actions:

a) Stop or secure the operation causing the spill, but only if wearing the appropriate PCs and if properly equipped to do so.

b) Warn others in the area.

c) Isolate the spill area if possible.

d) Minimize individual exposure and contamination.

e) Secure unfiltered ventilation.

f) Notify RPG personnel at 510-486-7277, or from a Lab telephone x7277.

3) Radiological incidents (e.g., personnel contamination, contamination outside areas posted to control contamination, posting violations, access violations), accidents, and near misses shall be immediately reported to the University RPG. Emphasis must be placed on timely review and RPG notification for potential Occurrence Reporting and Processing System (ORPS) categorization and reporting.

d. Accelerator operations

1) Special considerations associated with accelerator facilities include the presence of extremely high dose rates, the generation of activation products, and detection and monitoring difficulties associated with pulsed or high energy radiation.

2) In addition to the requirements in 10 CFR 835, DOE O 420.2D, *Safety of Accelerators*, contains requirements specific to accelerators. University programs for complying with DOE O 420.2D is documented in Chapter 9, Article 914 of the Radiological Control Manual.

3) Safety devices and interlocks that are necessary to meet the high radiation area control requirements of 10 CFR 835 Subpart F shall be operational prior to and during operation of a beam. Operational status should be verified by testing. Safety devices and interlocks must satisfy the requirements described in the LBNL EHS RGD Interlock Program.

e. Radiation Generating Devices (RGDs)

1) RGDs include devices that produce radiation intentionally (e.g., X-ray diffraction and fluorescence analysis systems, particle accelerators), those that produce radiation incidentally (e.g., electron microscopes, high-voltage electron guns, electron arc-welding machines), and ultra-intense lasers capable of producing ionizing radiation on interaction with materials.

2) The University classifies RGDs according to their unmitigated dose potential if operated without any dose-mitigating controls (e.g., shielding, interlocks, training). The classification of the RGD will determine the controls required for the device.

3) The University Radiation Generating Device Program is documented in Chapter 9 of the Radiological Control Manual.

4) If the RGD has radiation safety interlocks, RGDs must meet LBNL's interlock requirements and test procedures specified in the LBNL EHS RGD Interlock Program.

E. Radioactive Material

1. Radioactive Material Identification, Storage, and Control

a. The control, accountability, storing, handling, processing, shipping, receiving, and transferring of reportable quantities of nuclear materials listed in the current DOE O 474.2 are subject to the controls in the LBNL EHS Material and Control Accountability Plan.

b. Materials and equipment in contamination, high contamination, or airborne radioactivity areas shall be considered contaminated until surveyed and released [see 835.1101(a)].

c. Radioactive material located within radiological areas does not require specific labeling or packaging if sufficient information is provided to allow individuals to take appropriate protective actions [see 835.606(a)].

d. RPG must be notified immediately in the event of a loss of radioactive material. Depending on the type and quantity, such a loss may need to be reported to the DOE.

e. 10 CFR 835 requires labeling of individual containers of radioactive material and radioactive items except under certain specified conditions in which existing postings and control measures provide adequate warning, as described above [see 835.605 and 835.606(a)]. Implementation of labeling exceptions must be approved by the University Radiological Control Manager.

f. Material and items having removable contamination in excess of the 10 CFR 835 Appendix D values shall be contained and labeled when used, handled, or stored in areas other than radiological areas.

g. When labels are required, labels shall include the standard radiological warning trefoil and the words “Caution” or “Danger” and “Radioactive Material” [see 835.605]. The radiation warning trefoil shall be black or magenta and imposed upon a yellow background [see 835.601(a)]. Magenta is the preferred color for the trefoil and the lettering.

h. Required labels shall also provide sufficient information to permit individuals handling, using, or working in the vicinity of the labeled material to take appropriate actions to control exposures [see 835.605].

i. If a material or item is too small to be labeled with all of the desired information, the label may be applied to the device containing the material, the item’s container (package), or the storage location with sufficient information available to trace the item to the appropriate label. In these cases, a small yellow sticker with magenta or black trefoil shall be affixed to the item.

j. Radioactive material that is outside a radiological area and is confirmed or suspected of having removable radioactive contamination levels greater than 10 CFR 835 Appendix D values should be securely wrapped in plastic or placed in a closed container.

k. Radioactive material with removable or potentially removable contamination levels in excess of 100 times 10 CFR 835 Appendix D values should have additional packaging controls such as double-wrapping or the use of plastic bags inside containers.

l. Radioactive material in quantities exceeding 10% of 10 CFR 835 Appendix E limits shall be used, handled, and stored in a posted radioactive material area (RMA) or a radiological area.

m. A custodian (e.g., Principal Investigator) must be assigned responsibility for each radioactive material storage area; this is accomplished by the Radiological Authorization Program.

n. Storage of non-radioactive material in a radioactive material storage area is discouraged.

o. Outdoor storage of radioactive material is discouraged. In cases where outdoor storage is necessary, the integrity of containers or wrapping materials used should be ensured to prevent degradation from weathering and subsequent release of radioactive material.

p. Radioactive material should be stored in a manner that reduces combustible loading. The use of cardboard containers for storage is discouraged. Flammable or combustible materials should not be stored adjacent to radioactive material storage areas.

2. Release to Controlled Areas

a. Once material and equipment have entered radiological areas controlled for surface contamination or airborne radioactivity, comprehensive and time-consuming evaluations (survey and release) of the potential for contamination are required prior to releasing the material or equipment to controlled areas.

b. Reasonable efforts must be made to limit the amount of material and equipment that enters radiological areas and to prevent contamination or activation of material and equipment that do enter these areas.

c. Accessible surfaces of material or equipment that has entered contamination, high contamination, or airborne radioactivity areas shall be surveyed prior to release from these areas to controlled areas [see 835.1101(a)].

d. If an assessment of the prior use of the material or equipment indicates that inaccessible surfaces are not likely to be contaminated in excess of applicable limits, a complete survey of accessible surfaces and documentation of the assessment may be an appropriate basis to release material to the controlled area [see 835.1101(a)(2)].

e. If an assessment of the prior use of the material or equipment indicates that inaccessible surfaces are likely to be contaminated to levels in excess of the 10 CFR 835 Appendix D values, then the material shall not be released from the radiological area, except as permitted under Article 421 of DOE-STD-1098-2017, Radiological Control Standard [see 835.1101(a)(2)]. If it is necessary to release the material or equipment from the radiological area, the material or equipment should be disassembled to the extent necessary to perform adequate surveys.

f. Material and equipment with fixed contamination levels that exceed the total contamination values specified in 10 CFR 835 Appendix D values, and removable contamination levels less than 10 CFR 835 Appendix D values, may be released for restricted use in controlled areas outside of radiological areas [see 835.1101(c) & (c)(1)]. The material or equipment shall be routinely monitored and clearly marked or labeled to alert individuals to the contaminated status [see 835.1101(c)(2)]. RPG maintains procedures that establish requirements for monitoring of the material or equipment and surrounding areas.

g. Material and equipment with total or removable contamination levels exceeding 10 CFR 835 Appendix D values may be conditionally released for movement on-site from one radiological area to another if appropriate monitoring is performed and appropriate controls are established and implemented [see 835.1101(b)].

h. 10 CFR 835 requirements do not apply to radioactive material on or within material, equipment, and real property, which is approved for release when the radiological conditions of the material, equipment, and real property have been documented to comply with the criteria for release set forth in a DOE authorized limit and which has been approved by a Secretarial Officer in consultation with the Chief Health, Safety and Security Officer [see DOE O 458.1].

3. Release to Uncontrolled Areas

a. DOE O 458.1 and associated guidance documents describe the process for release of surface or volumetrically contaminated material, equipment, or real property based on authorized limits. The University implements a three-tiered clearance process, described in the DOE-approved LBNL Release and Clearance Plan.

1) Material, equipment, or real property has been demonstrated through process knowledge or radiological survey or both to not contain residual radioactive material that is distinguishable from background in accordance with MARSAME methodology. This is Tier 1.

2) Material, equipment, or real property has been demonstrated through process knowledge or radiological survey to contain residual radioactive material that is distinguishable from background but less than pre-approved authorized limits in DOE O 458.1 and implementing guidance in DOE STD-1241-2023, *Implementing Release and Clearance of Property Requirements*. This is Tier 2.

3) Material, equipment, or real property has been demonstrated through process knowledge or radiological survey to contain residual radioactive material exceeding pre-approved authorized limits. This is Tier 3.

b. Material, equipment, or real property meeting Tier 1 may be released without any restrictions on future use. Tier 2 materials may be approved for conditional clearance with approval from the University Radiological Control Manager. Tier 2 items may not be disposed of in a California landfill. Tier 3 materials require site-specific authorized limits approved by DOE and are not eligible for clearance until such limits are approved.

c. DOE O 458.1 criteria for unrestricted release of surface contaminated material, equipment, or real property may be more stringent than those established in 10 CFR 835 for release of surface contaminated material, equipment, and real property to controlled areas.

d. DOE O 458.1 and associated guidance documents describe the process for obtaining approved authorized limits for releasing material, equipment, or real property that has been contaminated in depth or volume, such as activated materials or smelted material. Material, equipment, or real

property with radioactive material on its surface or within its volume is exempt from the provisions of 10 CFR 835 if it may be released in accordance with an authorized limit approved by a Secretarial Officer in consultation with the Chief Health, Safety and Security Officer [10 CFR 835.1(b)(6)].

4. Transportation of Radioactive Material

   a. All radioactive material transportation/transfers shall be coordinated and approved by RPG prior to arrival on the University's site. Proscribed information will be provided to RPG, prior to any approval. Approval is contingent upon specification within an approved RWA.

   b. 49 CFR 170 through 180 establish requirements for inspecting and surveying packages, containers, and transport conveyances prior to transport via the public transportation system. These regulations apply to radioactive material transportation in commerce.

   c. DOE Orders 460.1D, Hazardous Materials Packaging and Transportation Safety, and 460.2A, Departmental Materials Transportation and Packaging Management, provide requirements that are in conformance with 49 CFR requirements for transportation of radioactive material using any conveyance. 10 CFR 835.1(b)(7) excludes radioactive material transportation not performed by DOE or DOE contractors from compliance with 10 CFR 835 regulations. However, radioactive material transportation (as defined in 10 CFR 835) does not include preparation of materials for shipment, packaging and labeling, or storage of material awaiting transportation for shipment. These activities shall be conducted in accordance with 10 CFR 835 [see 835.2(a) and 835.1(b)] and therefore in accordance with these manuals.

   d. 10 CFR 835 Appendix D removable contamination values are more limiting than 49 CFR requirements and shall be used as controlling limits for on-site and off-site transportation when using a conveyance that is owned by DOE or a DOE contractor [835.1(d)]. However, when a shipment is received from an off-site destination, by a non-DOE conveyance, the 49 CFR 173 transportation contamination values should be applied to all subsequent on-site transfers to the ultimate on-site destination.

   e. On-site transfers (within the LBNL fence line) over nonpublic thoroughfares or between facilities on the same site will be performed in accordance with approved radiological work control documents and any applicable RWAs, written procedures, or other measures. These documents typically include requirements to ensure appropriate monitoring and control of the radioactive material and will be approved by RPG.

   f. On-site transfers over public thoroughfares by non-DOE conveyance shall be performed in accordance with Department of Transportation, state, and local shipping requirements and pre-approved agreements. On-site transfers over public thoroughfares by DOE conveyance shall be performed in accordance with applicable DOE Orders and should conform with state and local shipping requirements and pre-approved agreements [see DOE 460.1D].

   g. Before shipment and upon receipt of a radioactive material shipment, a visual inspection of packages should be performed to ensure that packages are not damaged. The inspection should identify dents, flaking paint, debris, package orientation, and any indication of leakage.

   h. Specific arrangements shall be made for receiving packages containing radioactive material, regardless of the means of conveyance, in excess of Type A quantities (as defined in 10 CFR 71.4). These arrangements shall include arranging to receive packages upon delivery or to receive notification of delivery that leads to expeditious receipt of the package [see 835.405(a)].

5. Sealed Radioactive Source Controls

   a. Sealed radioactive sources as defined in 10 CFR 835.2 having activities equal to or exceeding the values specified in 10 CFR 835 Appendix E are considered accountable sealed radioactive sources.

      1) Written procedures are established and implemented to control accountable sealed radioactive sources. These procedures establish requirements for source acquisition, receipt, storage, transfer, inventory, leak testing, and usage. RPG will assist and coordinate activities through the approved RWA.

2) Accountable sealed sources and all other sealed radioactive sources having activities exceeding one-tenth of the values in Appendix E, 10 CFR 835, or their storage containers, shall be labeled with the radiation symbol, “CAUTION” or “DANGER,” and “RADIOACTIVE MATERIAL” [see 835.605]. The label shall also provide sufficient information to control exposures [see 835.605]. Many labels are affixed to sealed radioactive sources by their manufacturers. These labels are excepted from the normal color scheme of magenta or black on yellow [see 835.606(b)], but not from the required wording. If the size or configuration of the source precludes application of a suitable label, the label should be attached to the source container or mechanism. When this happens, an attempt shall be made to place a yellow sticker with magenta or black trefoil symbol on the source to ensure proper identification.

3) Each accountable sealed radioactive source shall be inventoried at intervals not to exceed six months [see 835.1202(a)]. This inventory shall [see 835.1202(a)]:

   a) Establish the physical location of each accountable sealed radioactive source.

   b) Verify that the associated posting and labeling are adequate.

   c) Establish that storage locations, containers, and devices are adequate.

4) Each accountable sealed radioactive source shall be subject to a source leak test upon receipt, when damage is suspected, and at least every six months [see 835.1202(b)]. Source leak tests shall be capable of detecting radioactive material leakage of 0.005 µCi or more [see 835.1202(b)].

5) Periodic leak tests need not be performed if the source has been removed from service. Such sources shall be stored in a controlled location and subject to periodic inventory in accordance with Article 431.3 of DOE-STD-1098-2017, Radiological Control Standard, and subject to leak testing prior to being returned to service [see 835.1202(c)].

6) If a source is located in an area that is unsafe for human entry or otherwise inaccessible (such as due to operational or environmental constraints), then periodic inventories and leak tests need not be performed [see 835.1202(d)]. When the conditions that restrict access to the area have been terminated, the inventory and integrity test should be performed before allowing uncontrolled access to the area.

b. If an accountable sealed radioactive source is found to be leaking radioactive material, then controls shall be established to prevent the escape of radioactive material to the workplace [see 835.1202(e)]. These controls should include wrapping or containing the source, applying appropriate labels, and removing the source from service.
Note: Any sealed radioactive source with removable contamination greater than 10 CFR 835 Appendix D values shall be controlled unless in an area posted for contamination (i.e., contamination area, high contamination area, airborne radioactivity area).

c. Both accountable and non-accountable sealed radioactive sources shall be used, handled, and stored in a manner commensurate with the hazards associated with the operations involving the sources [see 835.1201].

d. RPG’s sealed source program specifies controls for sealed radioactive sources having activities below one-tenth of the accountability values in 10 CFR 835 Appendix E to ensure their retention and proper use and storage.

e. Procurement of radioactive sources must be coordinated with RPG. This is normally specified in the Radiological Authorization and/or other TWD and between the Procurement department and RPG via the Restricted Articles program.

f. Receipt surveys of radioactive material shipments are performed or coordinated by RPG in accordance with Articles 552 and 554 in the University Radiological Control Manual.

g. Sealed radioactive sources, including handheld XRF units, radiography sources, soil density/compaction test gauges, etc., should not be brought on site by external organizations without the prior knowledge and approval of RPG. When such services are needed, the Radiological Authorization and/or TWD are utilized for approval and assignment of appropriate radiological safety controls.

h. A University custodian (e.g., Principal Investigator) will be appointed to coordinate sealed radioactive source procurement, issue, inventory, leak testing, and other aspects of the sealed radioactive source control program.

6. Decontamination

a. Radiological Authorizations or TWDs should include provisions to control contamination at the source to minimize the amount of decontamination needed.

b. Work preplanning should include consideration of the handling, temporary storage, and decontamination of materials, tools, and equipment.

c. Decontamination activities should be controlled to prevent the spread of contamination.

d. Water and steam are the preferred decontamination agents. Other cleaning agents should be selected based upon their effectiveness, hazardous properties, amount of waste generated, and ease of disposal.

e. RPG should be consulted prior to directing decontamination efforts.

7. Vacuum Cleaners and Portable Air-Handling Equipment

a. Vacuum cleaners and portable air-handling equipment used in areas established to control removable surface contamination or airborne radioactivity (except areas where only tritium is present) should be equipped with High Efficiency Particulate Air (HEPA) filters. If the material to be vacuumed is wet enough to preclude resuspension, then HEPA filters are not necessary.

b. HEPA filters used in vacuum cleaners and portable air-handling equipment should meet the applicable efficiency and construction requirements for the devices in which they are installed. The maximum flow rate of the device should not exceed the flow rate at which the HEPA filter was efficiency tested. In addition, the device should be leak tested prior to initial use, when units have undergone any type of service that may compromise the integrity of the HEPA filter or its sealing surfaces, and annually.

c. Vacuum cleaners used for radiological work should be:

1) Marked and labeled in accordance with Articles 412 and 464 of the University's Radiological Control Manual.

2) Controlled by written work authorizations.

3) Controlled to prevent unauthorized use.

4) Designed to ensure HEPA filter integrity under conditions of use.

5) Constructed and controlled to prevent unauthorized or accidental access to the inner surfaces of the vacuum.

d. Radiation and contamination surveys should be performed periodically for vacuum cleaners in use and labels on these units should be updated. The frequency of radiation surveys should depend on the specific use of the vacuum cleaner.

e. Airborne radioactivity levels should be monitored when a vacuum cleaner is used in a high contamination area.

F. Radiological Heath Support Operations

1. 10 CFR 835.402 requires that personnel dosimetry be provided to and used by individuals as follows:

a. Radiological workers who are expected to receive from external sources an effective dose of 100 millirem or more in a year or an equivalent dose to the extremities, lens of the eye, or skin of 5,000 millirem, 1,500 millirem or 5,000 millirem, respectively [see 835.402(a)(1)].

b. Declared pregnant workers who are expected to receive from external sources an equivalent dose of 50 millirem or more to the embryo/fetus during the gestation period [see 835.402(a)(2)].

c. Occupationally exposed minors likely to receive from external sources an effective dose in excess of 50 millirem [see 835.402(a)(3)].

d. Members of the public who enter a controlled area and are likely to receive from external sources an effective dose of 50 millirem or more in a year [see 835.402(a)(4)].

e. Individuals entering a high or very high radiation area [see 835.402(a)(5)].

2. The University elects to require dosimetry for individuals whose potential dose is greater than 50% of the 10 CFR 835 thresholds for required monitoring above. The calculated potential whole-body dose includes both photon and neutron doses. During the development of Radiological Work Authorizations, proposed radiological work is reviewed and appropriate monitoring requirements are evaluated. Articles 552 and 553 of the Radiological Control Manual further describe this process. RPG will manage the issuance and collection of dosimetry as prescribed by the governing Radiological Work Authorization.

   a. Dosimeters shall be issued only to individuals knowledgeable of their proper use and worn only by those to whom the dosimeters were issued. Individuals shall return dosimeters for processing as scheduled or upon request, and should be restricted by line management from continued radiological work until dosimeters are returned.

   b. Individuals shall wear their primary dosimeters on the chest area, on or between the waist and the neck, or in the manner prescribed by radiological control procedures or Work Authorizations.

   c. The University discourages the practice of taking dosimeters off-site.

   d. Individuals should not wear dosimeters issued by the University while being monitored by a dosimeter at another facility unless authorized by the Radiological Control Manager or designee. Individuals should not expose their dosimeters to security X-ray devices, excessive heat, moisture, or medical sources of radiation.

   e. Upon discovery, an individual whose dosimeter is lost, damaged, or contaminated should place work in a safe condition, immediately exit the area, and report the occurrence to RPG. The individual should be restricted from entry into radiological areas until a review has been conducted to verify that dose limits have not been exceeded.

   f. Pocket and electronic dosimeters are supplemental dosimeters that provide real-time indication of exposure to radiation and assist in maintaining personnel doses less than administrative control levels.

3. Individuals entering a high radiation or very high radiation area shall be monitored by a supplemental dosimeter or other means of determining the individual's effective dose during the entry [see 835.502(a)(2)]. Supplemental whole-body dosimetry is also required to be worn by an individual if it has been determined that the person has a routinely expected potential of receiving 100 mrem or greater external equivalent dose in a quarter or when required by a Radiological Work Authorization.

   a. Supplemental dosimeters should be worn simultaneously with the primary dosimeter and located in accordance with the Radiological Work Authorization.

   b. Supplemental dosimeters should be read periodically while in use and should not be allowed to exceed 75 percent of full scale.

   c. Work authorized by a written authorization should be stopped when supplemental dosimeter readings indicate total dose or rate of exposure substantially greater than planned. RPG should be consulted prior to continuation of work.

   d. The energy dependence and radiation sensitivity of supplemental dosimeters, particularly to low-energy beta and neutron radiation, should be considered in determining their applicability.

4. The University maintains an internal dosimetry program to provide monitoring of internal radiation exposure for individuals performing radiological work at LBNL. This program includes bioassay sampling and analysis, and internal dose calculations. The bioassay sampling and analysis function is accredited by the Department of Energy Laboratory Accreditation Program (DOELAP). The accreditation includes on-site in vivo analysis of radioiodine in the thyroid and off-site analysis of in vitro bioassay samples by a DOELAP-accredited laboratory.

   a. The criteria used to place workers in routine bioassay sampling programs are based on projections of potential intake. Calculations of potential intake, following the method described by HPS N13.39-2000 Appendix A, Guidance for Bioassay Implementation Levels Based on Material in Process (based on NUREG 1400, Air Sampling in the Workplace), are performed for

radiological operations to determine whether employees are likely to receive an intake that would result in a committed effective dose of 100 mrem or more. These calculations are performed as part of the overall Radiological Work Authorization program at the University by RPG and will be prescribed within the Radiological Work Authorization.

b. For some authorizations, baseline bioassay samples may be collected before any work is performed with radioactive materials. Since University research typically uses many different radionuclides, rather than monitor for all radionuclides on the authorization, it is more practical to perform baseline sample analysis for radionuclides previously used by an individual. In some cases, there may be no previous use and the baseline bioassay requirement may be waived.

c. Some authorizations may also require termination bioassays. RPG retains authority to place any individual in the internal dosimetry program at the discretion of the responsible Health Physicist.

5. Use of respiratory protection at the University is reduced to the minimum practicable by implementing engineering controls and work practices to contain radioactivity at the source. Occasions when the use of respirators is warranted (e.g., access and work in an Airborne Radioactivity Area). When used, the requirements of the University Respiratory Protection Program as outlined in Chapter 44 of the *Environment, Safety & Health Manual* (PUB-3000) shall be followed.

6. Heat stress may result from working in areas of high heat, humidity, and radiant heat; working in protective clothing; and using respirators, particularly where other protective equipment is required. Heat stress can occur at ambient temperatures (i.e., less than 70°F) when multiple sets of anti-contamination clothing or plastic suits are in use or strenuous work is required.

   a. The planning stages for work in hot environments should address heat stress controls, as applicable.

   b. Job supervisors should inform their personnel of heat stress precautions prior to work on job assignments in hot environments. Precautions that should be considered during work that includes a high probability of heat stress include:

      1) Engineering controls to moderate the work area environment

      2) Appropriate work time limits

      3) Use of protective clothing made of materials that wick perspiration away from the body

      4) Use of body cooling devices

      5) Provision of beverages at or near the work site, using appropriate contamination controls

      6) Relaxation of protective clothing requirements

      If an individual begins to feel symptoms of heat illness, the individual should immediately notify the nearest co-worker, exit the area, remove personal protective equipment, notify the supervisor, and rest in a cool area. In such cases, medical assistance should be provided.

7. Skin and Hair Contamination: When personnel detect skin contamination, they shall notify RPG immediately.

   a. Attempts should be made to determine the extent of skin contamination prior to initiating decontamination procedures. However, when a highly energetic beta or gamma emitter is involved, unnecessary delay to decontaminate should be avoided.

   b. Skin and hair decontamination efforts should include but are not limited to the following:

      1) Use an appropriate radiation detection instrument.

      2) Do not abrade or redden the skin.

      3) Avoid ingestion/inhalation of radionuclides.

      4) Do not attempt to decontaminate any wounds.

      5) Resurvey and repeat decontamination efforts up to three times if contamination levels drop by at least 20% during each effort.

      6) Use dose estimates made by RPG.

c. Levels of skin contamination that trigger the need for dose assessments should not exceed 100 millirem.

d. Individuals with skin contamination that triggers the need for dose assessment should be informed of the initial dose estimate to their skin as soon as practicable, preferably prior to the end of their work day.

e. Individuals with skin contamination for which dose assessment was not performed should be informed of the nature of the contamination and an upper estimate on the potential dose (such as less than 10 millirem) as soon as practicable, preferably prior to the end of their work day.

f. An assessment of skin exposure requires time to conduct a detailed evaluation. Requirements for assessments are provided in DOE-STD-1098-2017 Appendix 2D. Promptly after completion, the results should be explained to the persons affected.

8. Emergency medical care should be administered immediately for injuries involving radioactive materials. National Council on Radiation Protection and Measurements Report Number 65, Management of Persons Accidentally Contaminated with Radionuclides, contains applicable information. Medical treatment of injuries takes precedence over radiological control considerations.

   a. The treatment of contaminated injuries should include the following:

      1) Treatment of contaminated wounds by medically qualified personnel

      2) Identification of the radionuclides involved

      3) Medical determination of the need for therapeutic intervention such as blocking or chelating agents

   b. An injured individual should be counseled promptly on the medical and radiological implications resulting from contaminated wounds that are likely to result in internal doses greater than 2 percent of the Occupational Dose Limits. The counseling should be performed by senior radiological control and medical professionals.

9. Potential intakes of radioactive material are indicated when individuals without respiratory protection are exposed to airborne radioactivity or when respiratory protection has been compromised during use. If intakes of radioactive material are indicated that could result in an individual receiving a committed effective dose greater than 100 millirem, the following actions should be taken:

   a. Identify individuals potentially exposed to airborne radioactivity.

   b. Obtain nasal smears for qualitative indication of intakes where appropriate.

   c. Analyze air samples to determine airborne concentrations where appropriate.

   d. Determine duration of potential exposure to airborne radioactivity.

   e. Perform bioassay appropriate for the type and quantity of radionuclides involved.

   f. Evaluate dose prior to permitting the worker to return to radiological work.

10. Workplace monitoring provides a basis for posting and labeling, development of work authorizations, implementation of ALARA measures, issuance of individual monitoring devices, and verification of the efficacy of design measures and engineering controls.

    a. Radiological monitoring of radiation exposure levels, contamination, and airborne radioactivity shall be conducted to:

       1) Characterize workplace conditions and detect changes in those conditions [see 835.401(a)(2) & (3)]

       2) Verify the effectiveness of engineered and administrative controls [see 835.401(a)(5)]

       3) Demonstrate regulatory compliance [see 835.401(a)(1)]

       4) Detect the gradual buildup of radioactive material in the workplace [see 835.401(a)(4)]

       5) Identify and control potential sources of personnel exposure [see 835.401(a)(6)]

       6) Determine exposure rates during each entry to a high or very high radiation area [see 835.502(a)(1)]

b. Monitoring for radiation, contamination, and airborne radioactive materials is performed as specified in technical work documents, Radiological Work Authorizations, and survey plans.

c. Survey plans are drafted for use with approved work activities within the Radiological Work Authorizations. Survey plans may include but are not limited to survey maps, description of work area, a list of the primary radionuclides of interest and/or their associated radiations and energies, minimum number of survey points, and a list of instruments to accurately detect and quantify radiation present. The survey plans should include minimum expectations to satisfy each phase of work discussed in the authorization and enough detail to provide direction to perform the survey adequately to satisfy the objective and extent of the requirements prescribed in the authorization. The instruments used shall be [see 835.401(b)]:

   1) Periodically maintained and calibrated

   2) Appropriate for the types, levels, and energies of radiation to be detected

   3) Appropriate for existing environmental conditions

   4) Routinely tested for operability

d. Only instruments that have been inspected, been calibrated, and passed checks are used. Instrument checks include but are not limited to the following:

   1) Inspection of the instrument to ensure there is no physical damage.

   2) Verification of instrument calibration status.

   3) Battery, source/response (as applicable), and audio checks.

   4) Verification that the instrument is set to the proper scale.

   5) Portable instrument background checks for a minimum counting time of one minute in a low background area that is representative of the area or items to be surveyed. Background is established periodically based on location changes, operations changes, etc.

e. Monitoring is performed by qualified Radiological Control Technicians or specifically trained radiological workers, as approved by RPG and as authorized to perform such surveys as documented in the RWA [see 835.103].

f. Documented results of monitoring performed shall be reviewed to ensure that all required surveys have been performed and that the documentation is accurate and complete.

g. Survey results are available to line management and used in support of pre- and post-job evaluations, preparation or selection of appropriate Radiological Work Authorizations, ALARA preplanning, contamination control, and management of radiological control operations.

h. Unusual/unexpected monitoring data are tracked by RPG and reported to the Radiation Safety Committee at its regularly scheduled meetings.

i. General area radiation levels are measured at waist level (~1 meter) and taken at least 30 cm from the radiation source.

j. Radiation surveys are performed as specified by a radiological authorization, survey plan, or other written procedure:

   1) Upon initial entry into a radiation area or high radiation area.

   2) For installation or removal of temporary or permanent shielding, in accordance with appropriate authorization.

   3) Upon initial entry into an area where a radiography source or other source of penetrating radiation was exposed where unshielded exposure rates could exceed 5 mrem/h at 30 cm in order to verify that the source of radiation has been shielded or removed.

   4) During transfer of radioactive material that is expected to change existing radiological conditions or that may generate dose rates greater than or equal to 5 mrem/h at 30 cm.

   5) Upon receipt of radioactive material shipment.

6) Periodically before, during, and upon completion of work involving radioactive material that has the potential for causing changes in radiation exposure rates.

7) As necessary to detect buildup of and/or changing conditions caused by radioactive material transfer that increases/decreases inventory.

8) As necessary to document changing radiological conditions in occupied radiation areas and high radiation areas.

k. The survey frequencies are based on the level of radiological hazard as outlined in Radiological Work Authorizations. Where circumstances dictate, the Health Physicist may prescribe a different survey frequency. Such changes will be specifically spelled out within the approved RWA.

l. Radiation monitoring should include dose rate measurements of the general area, dose rates at a distance of 30 cm from a source or surface of interest to evaluate potential whole-body exposures, and dose rates on contact with potential sources of radiation where there is a potential for hands-on work or other direct contact.

m. Contamination surveys should incorporate techniques to detect both removable and fixed contamination.

n. Swipe surveys for removable contamination should be recorded in units of disintegrations per minute per 100 cm^2 (dpm/100 cm^2). For swipe surveys of small items covering less than 100 cm^2, the results should be recorded in units of dpm per area swiped. If contamination levels exceed the range of the available count rate meters, the swipes should be analyzed by holding an appropriate exposure rate meter within 0.5 inches and the results should be recorded in units of millirad or rad per hour.

o. Large area wipes are encouraged and should be used to supplement standard swipe techniques in areas generally assumed not to be contaminated, such as entrances to radiological areas. If an evaluation indicates that an area wiped is contaminated, a thorough contamination swipe survey should be performed.

p. Areas identified as either contaminated with, or having the potential for being contaminated with, highly radioactive particles (“hot particles”) should be surveyed using special swipe techniques to collect hot particles, such as tape and large area wipes.

q. Air sampling is designed to (i) ensure compliance with the requirements of 10 CFR 835.403 and (ii) help ensure potential internal exposures are adequately monitored so that they are maintained ALARA. Laboratory air sampling is designed to detect containment system failure. Air sampling equipment is placed in a location that ensures timely discovery of airborne releases.

1) There are two regulatory requirements for performing air sampling for radiological workers. The first is given in 10 CFR 835.403(a)(1), as to when an individual is likely to receive an annual exposure >40 derived air concentration (DAC)-hours per year. The second regulatory requirement for performing air sampling is given in 10 CFR 835.403(a)(2) and requires that air sampling be performed as necessary to characterize the airborne radioactivity hazard when respiratory protection devices for protection against airborne radionuclides have been prescribed.

2) Specific requirements for air sampling for a given activity or operation will be specified in the Radiological Work Authorization or other approved TWD.

3) Air samples will be evaluated using DAC values given in 10 CFR 835 Appendix A.

r. Air Sampling Requirements and Recommendations:

1) Air sampling shall be performed for all individuals likely to receive an exposure of 40 or more DAC-hours in a year. This determination shall be made based on the calculation of the intake potential as required by Article 555 of the Radiological Control Manual.

2) Air sampling shall be performed as necessary to characterize the airborne radioactivity hazard where respiratory protection equipment is required.

3) Air sampling shall be performed when personnel are performing work in a posted high contamination area.

4) When performing demolition or remodeling work on equipment or facilities where known or suspected radioactive material may be uncovered, air sampling should be considered and shall be performed within and at the worksite boundary when there is a potential for fugitive emissions.

5) Air sampling requirements, including frequency and sampler location, shall be specified on the RWA. Air sampling shall be performed using air sampling equipment that has a flow gauge and/or flow totalizer that has been calibrated using the approved applicable procedure.

s. Preliminary assessments of air samples utilizing field survey techniques should be performed promptly upon removal. In situations where background levels of radon and thoron daughters interfere with evaluation of alpha air samples, prompt field assessments may not be possible.

t. Air sample results should be evaluated as quickly as practicable for evaluation of the need for respiratory protection, area evacuation (if necessary), worker intake, and worker relief from respirator use.

u. Any of the various available air sampling methods (high or low flow rate grab samples, CAMs, lapel samples, etc.) may be used to demonstrate compliance with 10 CFR 835.403(a)(1).

v. Air monitoring results may be used for determination of internal doses but only under the conditions specified in 10 CFR 835.209(c). Efforts should be made to acquire and analyze air samples using the most representative and accurate techniques that are available, considering site-specific factors such as available resources and potential for missed dose.

w. When performing air monitoring to demonstrate compliance with either 10 CFR 835.403(a)(1) or (2), the method used shall be appropriate for the existing environmental conditions, consistent with 10 CFR 835.401(c)(3).

11. Radiological instruments shall be used to measure only the radiation for which their calibrations are valid [see 835.401(b)(2)]. ANSI N323A, Radiation Protection Instrumentation Tests and Calibration (as revised and current), provides appropriate comprehensive guidance for establishing and operating a radiological instrumentation calibration program. Calibrations shall use National Institute of Standards and Technology (NIST) traceable sources.

a. The frequency of calibration is defined for each type of operating equipment and standard. The frequency is annually for instruments and every three years for sources.

b. Calibration reference sources are either NIST traceable or are provided with NIST traceability by comparison to traceable standards.

c. A calibration sticker is affixed to all calibrated equipment, referencing the equipment identifier, the last calibration date, and the due date for the next calibration.

12. In the event that a source or piece of equipment is found to be out of calibration, defective, or otherwise suspect, it is taken out of service, isolated, and clearly labeled as out of service until the issue can be resolved.

a. Instruments whose “as found” readings indicate that the instrument may have been used while out of calibration must be reported to RPG. RPG must review surveys performed with the instrument while it was out of calibration and consider the need for additional surveys.

b. Only detectors that can be used under the typical environmental conditions existing at the University are procured [see 835.401(b)(3)]. Five years of site environmental meteorological data were evaluated to define these “typical” conditions, which are as follows:

1) Temperature: 40–75°F

2) Atmospheric pressure: 975–990 mbars

3) Relative humidity: <95%

c. Operational tests are performed before instruments are used to verify that the instruments are operating properly.

G. Training and Qualification

1. 10 CFR 835.901 establishes requirements for radiation safety training programs for two classes of individuals:

   a. Individuals who are permitted unescorted access to controlled areas or are occupationally exposed to radiation.

   b. Individuals who are permitted unescorted access to radiological areas or perform unescorted assignments as a radiological worker.

2. These training programs are referred to as General Employee Radiological Training and Radiological Worker Training (I and II), respectively.

3. In addition, 10 CFR 835.103 establishes requirements for the education, training, and skills of individuals who are responsible for developing and implementing measures necessary for ensuring compliance with 10 CFR 835.

4. Successful completion of the entire core academic component of a DOE core course at one DOE site within the past two years may be recognized by the University, when approved by the LBNL Radiological Control Manager. Allowances may also be made for individuals who have successfully completed other types of radiological control training. Documentation of previous training must include the individual's name, date of training, topics covered, and name of the certifying official. However, under these circumstances, any additional radiological control training necessary for the individuals to perform radiological work or to enter specific areas, including site-specific aspects of the radiation safety training, shall be completed [see 835.901(c)]. Site-specific training for General Employee Radiological Training and Radiological Worker I and II training may be included with other site orientation training, as approved by RPG.

   Note: The individual may be required to complete a Statement of Training and Experience Form. The RPG Health Physicist will evaluate the form and notify the individual whether course credit is given or additional course attendance is required.

5. Individuals shall complete radiation safety training prior to unescorted access to controlled areas and prior to receiving occupational radiation exposure during access to controlled areas [see 835.901(a)]. This training shall address the radiation safety training topics in Article 613 of the Radiological Control Manual to the extent appropriate for the degree of exposure to radiological hazards that may be encountered and the required controls [see 835.901(a)].

6. GERT includes DOE's core course training materials, as applicable, and is expanded to include site-specific information, such as site-specific radiation types, alarm responses, and policies. This site-specific information is included in GERT, and/or in site orientations, as applicable and approved by RPG.

   a. LBNL GERT, EHS0470, is an online training that provides general information about radiation, the controls the University implements to ensure the safety of workers and the environment, and each individual's rights and responsibilities, and that meets the requirements of 10 CFR 835.901.

   b. Additional training beyond GERT may be required for unescorted entry into areas posted for radiological control other than controlled areas, such as Radioactive Material Areas.

   c. If an escort is used in lieu of training, then the escort shall have completed the level of training required for the areas to be entered and the work to be performed and shall ensure that the escorted individual complies with the Radiation Protection Program [see 835.901(e)].

7. Each individual shall demonstrate knowledge of the radiation safety training topics established in Article 613 of DOE-STD-1098-2017, Radiological Control Standard, commensurate with the hazards in the area and required controls, by successful completion of an examination and appropriate performance demonstrations prior to being permitted unescorted access to radiological areas and prior to performing unescorted assignments as a radiological worker [see 835.901(b)].

   a. Workers may challenge DOE's Radiological Worker I or II core knowledge requirements by passing a comprehensive examination.

   b. DOE Radiological Worker II Training includes all of the requirements of DOE Radiological Worker I Training and expands on the topic of hands-on work with radioactive materials. DOE

Radiological Worker II Training prepares the worker to deal with higher levels of radiation and radioactive contamination.

c. Individuals with current DOE Radiological Worker I Training may be upgraded to allow unescorted access to other areas by completing only the additional training provided in DOE Radiological Worker II Training.

d. If an escort is used in lieu of training, then the escort shall have completed the level of training required for the areas to be entered and the work to be performed and shall ensure that the escorted individual complies with the Radiation Protection Program [see 835.901(d)].

e. In addition to the above, radiological workers are required to receive on-the-job training (OJT) from their authorization Principal Investigator (PI), or designee, on the specific radiation-related operations they are required to perform. Special attention is applied to radiation safety control measures and procedures. Such training should meet the requirements and guidance of the *Environment, Safety & Health Manual* (PUB-3000), Chapter 24, Job Specific Training. OJT training documentation must be maintained at the job site, typically filed in the appropriate authorization journal.

f. Subcontractors are expected to develop their own training programs to qualify their personnel to meet DOE requirements. The subcontractor training program documentation must be available for review upon request. The University may review subcontractor training program documentation to ensure alignment.

8. Specialized Radiological Worker Training may be required for non-routine operations or work in areas with changing radiological conditions. This training supplements Radiological Worker I or II Training for personnel assigned to work that has the potential for significant radiological consequences. Such jobs may involve special containment devices, the use of mockups, and ALARA considerations. In some cases, dependent upon a given situation and work scope criteria and pre-job briefings, radiological authorization OJT training provides an acceptable alternative to Specialized Radiological Worker Training. RPG will help establish the appropriate criteria when Specialized Radiological Worker Training is necessary.

9. Training and qualification of Radiological Control Technicians (RCTs) and their immediate supervisors address routine operations and also focus on recognizing and handling situations in both normal and changing radiological conditions. Newly qualified technicians and those still in training are given the opportunity to work with qualified, experienced technicians to foster development. The University does not train subcontract RCTs performing work for subcontractors.

   a. Because of the nature of their duties (e.g., monitoring the workplace, implementing administrative controls and entry controls), RCTs would generally be expected to have responsibility for implementing measures necessary for ensuring compliance with 10 CFR 835. Therefore, the RCTs are subject to the education, training, and skills requirements of 10 CFR 835.103. RCT training includes the standardized DOE Core “Fundamental Academic” course training materials, as applicable, and is expanded to include site-specific information.

   b. RCT qualification consists of three steps, the first of which is an initial evaluation of the individual’s past experience and qualifications. The University Radiological Control Manager may review and approve RCT candidates. Entry-level prerequisites include the following:

      1) High school education or equivalency.

      2) Basic understanding of the fundamentals of mathematics, physics, and chemistry.

      3) Basic understanding of mechanical processes, operations, and maintenance.

      4) Adequate reading and comprehension skills necessary to follow procedures, write permits and reports, prepare survey maps, and prepare shipping and transfer permits.

      5) Ability to work in a supporting role, including communicating verbal instructions to others.

      6) Physical requirements to handle personal protective equipment and radiological control equipment, and assist others in their work location commensurate with assignment.

   c. The second step to qualify as an RCT is completion of Core and University-specific training. This encompasses the specific learning objectives identified as necessary to function as an RCT in a

competent and safe manner at the University. The minimum required topics are outlined in Article 643 of the Radiological Control Manual.

1) Written examinations shall be used to demonstrate satisfactory completion of academic material and require a minimum passing score of 80%. A candidate may challenge the academic core training by taking the challenge examination.

2) RCT candidates may be required to take additional safety training according to expected work assignments.

d. The third step is completion of the practical training, which includes Job Performance Measures (JPMs) and facility training.

1) JPMs: The base tasks common to RCTs are covered in practical sessions referred to as JPMs. JPM training and evaluation must be approved by the University Radiological Control Manager, the RCT Supervisor, or an RPG Health Physicist. JPMs are based on the expected task and should include but are not be limited to posting, instrument operation, survey techniques, radiation/contamination surveys, air samplings, etc. Additional JPMs, directed by RPG management, may be required.

2) Facility Training: Facility training includes a general walk-through and familiarization for RCT candidates.

3) The candidate must complete the required JPMs and facility briefing prior to being allowed to perform base tasks without supervision. Training on JPMs may occur in any order, provided the prerequisite training pertaining to the task has been successfully completed and documented. Successful completion of JPM training is verified by signature for each JPM. JPM and facility testing should be completed as soon as practicable following the completion of academic core training.

e. The University Radiological Control Manager reviews and approves RCT candidates for final qualification.

f. Because of the nature of their duties, RCT supervisors are subject to the education, training, and skills requirements of 10 CFR 835.103. Training and education standards for RCT supervisors should be consistent with DOE-STD-1107-97, Knowledge, Skills, and Abilities for Key Radiation Protection Positions at DOE Facilities.

1) The RCT Supervisor must be able to respond and direct others in emergency and abnormal situations.

2) The RCT Supervisor’s depth of knowledge should exceed that expected of an RCT.

g. Training and education standards for line managers of radiological control programs (or elements of those programs) should be consistent with DOE-STD-1107-97, Knowledge, Skills, and Abilities for Key Radiation Protection Positions at DOE Facilities.

h. Line managers who manage, supervise, or provide oversight of radiological control programs are subject to the education, training, and skills requirements of 10 CFR 835.103 and should be trained in the principles of this document.

i. Appropriate technical support personnel (engineers/health physicists, schedulers, procedure writers, dosimetrists, analytical lab personnel, etc.) may be considered to be subject to the education, training, and skills requirements of 10 CFR 835.103 and should be trained in the ALARA fundamentals and dose reduction techniques.

j. Planners who develop detailed work plans involving or associated with radioactivity or radioactive materials should have Radiological Worker Training to the level required by the workers using the work plans.

k. Radiographers are subject to the education, training, and skills requirements of 10 CFR 835.103 and should have training in accordance with 10 CFR 34.31.

l. Radiation generating device operators are subject to the education, training, and skills requirements of 10 CFR 835.103 and should have training appropriate for the radiation source involved and commensurate with the level described in 10 CFR 34.31.

m. Any training subject to 10 CFR 835.103 must be approved by the University Radiological Control Manager prior to implementation.

H. Environmental Restoration and Deactivation and Decommissioning Activities

1. All real property determined to be radiologically impacted and subsequently remediated may require Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)-based final status surveys to demonstrate and document the remediation end state and achievement of remediation goals. End state remediation goals, final status survey plans, survey instruction packages, and final status survey reports are subject to DOE approval. All such activities are subject to independent verification by DOE.

2. All soil excavation and disposition are subject to the requirements in the University Environmental Services Group's (ESG) *Soil Management Plan – Radiological Assessment*. All activities that have the potential for environmental impacts are subject to the DOE-approved *Environmental Radiological Protection Program (ERadPP) Plan for Compliance with DOE Order 458.1*.

3. An air monitoring and dust control plan (AMDCP) must be developed for all activities with the potential to create dust. This document may cover more than radiological concerns (e.g., silica, lead) and should address implementation of dust mitigation and prevention measures. This document must identify potential dust sources, migration pathways, mitigation methods (e.g., water misting), and assessment of effectiveness. This procedure must describe the radionuclides of concern and worker protection limits (DAC values). It must include instructions for monitoring, controlling, and mitigating airborne radioactive contaminants that could contribute to personnel internal exposures and environmental releases [see 835 Subpart K].

4. Wastes generated must be managed in accordance with Chapter 4, Parts 4 and 5 of the Radiological Control Manual and the LBNL Waste Management Program Manual.

I. Radiological Control Records

1. Radiological control records shall be accurate and legible. The records should include the following, as applicable:

a. Identification of the facility, specific location, function, and process

b. Signature or other identifying code of the preparer and date

c. Legible entries in ink

d. Corrections identified by a single line-out, initialed and dated

e. Supervisory signature to ensure review and proper completion of forms

2. Radiological control records should not include opaque substances for corrections or shorthand or other non-standardized terms.

3. Unless otherwise specified, radiological control records shall use the special units of curie, roentgen, rad, and rem, including multiples of these units, or other conventional units such as dpm and dpm/100 cm^2 [see 835.4]. Use of the international system of units (becquerel, gray, and sievert) may be used but is limited to calculation, scientific, or reference purposes. The SI units – becquerel (Bq), gray (Gy), and sievert (Sv) – may be provided parenthetically for reference with scientific standards.

4. Radiological control programs require the performance of radiation, airborne radioactivity, and contamination monitoring to determine existing conditions in a given location. Databases, forms, or maps with sufficient detail to permit identification of original survey and sampling locations should be maintained. Radiological monitoring results should be recorded on appropriate standard forms and include the following common elements:

a. Date, time, and purpose of the survey

b. General and specific location of the survey

c. Name and signature of the surveyor and analyst

d. Pertinent information needed to interpret the survey results

e. Reference to a specific Radiological Work Authorization if the survey is performed to support it

5. In addition to the elements provided above, records of radiation monitoring should include at a minimum the following information:
    a. Instrument model and serial number
    b. Results of the measurements of area dose rates
    c. Locations of hot spots and other radiological hazards
    d. Facility conditions existing during the survey that may have affected radiological conditions, as applicable.
6. In addition to the elements provided in “4” above, records of airborne radioactivity monitoring should include at a minimum the following information:
    a. Model and serial number of the sampler or unique identifier of each sampler and laboratory counting instrument and appropriate supporting parameters including counting efficiency, counting time, and correction factors
    b. Locations of fixed air samplers
    c. Locations of portable air samplers used for a survey
    d. Measured air concentrations
    e. Supporting parameters, including collection efficiency, flow rate, duration of sampling, correction factors, and filter medium
    f. Identification (e.g., names and/or employee numbers) of individuals in the area for whom DAC-hour exposure should be calculated
7. In addition to the elements provided in “4” above, records of contamination monitoring should include at a minimum the following information:
    a. Model and serial number of counting equipment, when direct-reading surveys are conducted
    b. Contamination levels (using appropriate units) and whether the contamination was fixed or removable
    c. Appropriate supporting parameters such as counting efficiency, counting time, correction factors, and type of radiation
    d. Location of areas found to contain hot particles or high concentrations of localized contamination
    e. Follow-up survey results for decontamination processes, preferably cross-referenced to the original survey
8. In addition to the elements provided in “4” above, records of sealed radioactive source leak tests should include at a minimum the following information:
    a. Model and serial number of counting equipment
    b. Contamination levels (using appropriate units) and type of radiation with appropriate supporting parameters such as counting efficiency and counting time correction factors
    c. Corrective actions for leaking sources

    Records of accountable sealed radioactive source inventories shall include, at a minimum, the following information [see 835.704(f) and 835.1202(a)]:

    1) The physical location of each accountable sealed radioactive source
    2) Verification of the presence and adequacy of associated postings and labels
    3) Verification of the adequacy of storage locations, containers, and devices
9. Calibration records for fixed, portable, and laboratory radiation measuring instruments and equipment and individual monitoring devices shall be maintained [see 835.703(d)]. These calibration records should include frequencies, method, dates, personnel, training, and traceability of calibration sources to National Institute of Standards and Technology or other acceptable standards.

10. Calibration and maintenance records shall be maintained for instruments and equipment used for monitoring [see 835.703d]. Calibration and maintenance records should be maintained for the following equipment:
    a. Portable survey instruments
    b. Bioassay measurement equipment
    c. Laboratory, counting room, and fixed radiation measuring equipment
    d. Process and effluent monitors and sampling equipment
    e. Radiation area monitors
    f. Portal monitors and other personnel contamination monitors
    g. Pocket and electronic dosimeters
    h. Air sampling equipment
    i. Tool and waste monitoring equipment
    j. Protective clothing and equipment monitors
11. Documentation of instrument operational checks for documented surveys shall be maintained [see 835.701(a) & 835.401(b)(4)].
12. All records should be stored in a manner that ensures their integrity, retrievability, and security and, unless otherwise specified, shall be retained until final disposition is authorized by DOE [see 835.701(b)].
13. Methods for protecting documents should include vaults, file rooms with fixed fire suppression, fire rated cabinets, duplicate storage, or combinations of these.
14. Storage arrangements should address physical damage that could be caused by temperature extremes, moisture, infestation, electromagnetic fields, excessive light, stacking, theft, and vandalism.
15. All records, applicable to this document, must be turned over to RPG, as agreed upon or at the end of the project, prior to leaving the University site.

1.2 MATERIALS OWNERSHIP

A. Historic Items

1. Archeological relics, antiques, and similar objects remain the property of the University. Notify the University prior to relocation on the site and obtain acceptance regarding method of relocation.

B. Radiological Clearance

1. Item/equipment that is determined to maintain residual radioactive material above the University's clearance levels, as determined per DOE O458.1, may become the property of DOE/University. If it is determined that such an item/equipment requires disposal, subcontractor will be liable for disposal costs.
2. For an item/equipment that is determined to be potentially at risk, it is incumbent on the subcontractor to negotiate terms and conditions prior to placing item/equipment at risk of becoming contaminated with residual radioactive material.
3. An item/equipment that cannot be completely surveyed for residual radioactive material (un-monitor able surfaces) may also be at risk.
4. It is incumbent upon the contractor to employ actions necessary to prevent the item/equipment from becoming contaminated with residual radioactive material.
5. All items/equipment scheduled to be released from radiological control may be subject to independent verification by the University Radiation Protection Group and/or DOE. Independent verification may impact schedules and it is incumbent on the subcontractor to communicate plans, schedule, and intentions well in advance of actions.
6. An item/equipment that is determined to be sacrificed by the subcontractor, due to residual radioactive material, must be approved by both RPG and the Waste Management Group prior to use.

7. Volumetric material clearances are not approved at the University. Therefore, any materials (lubricants, solvents, etc.) that are determined by the University to be at risk of containing residual radioactive material will be required to be characterized and disposed of at the subcontractor's costs.

C. Equipment Verification

1. The Primary contractor of this project is responsible for ensuring all material and equipment coming on to University property, by sub-tier contractors and vendors that are employed by the Primary contractor in support of the project, are below the University's clearance levels, in accordance with Article 422 of the Radiological Control Manual:

a. Materials and equipment above the University's Tier 1 action levels may be subject to radiological controls and/or required to be removed from the University's property at no cost to the University.

b. Materials and equipment include but are not limited to tools, air handlers, waste transport vehicles, light duty vehicles, heavy equipment, instrumentations, pumps, motors, electrical cords, scaffold, ladders, and vacuums.

c. New-in-the-package consumable materials, anti-c clothing, plastic sheeting, decontamination supplies, etc. are not subject to pre-use radiological surveys.

1.3 SUBMITTALS

A. License:

1. If licensed by the Nuclear Regulatory Commission or an Agreement State, submit licenses, and reciprocity agreement as applicable, 5 business days prior to arriving at the University site.

B. Qualification Data:

1. Verifiable training certification/evidence for applicable DOE Radiological Worker, or RCT Core Academic training, for which the subcontractor is seeking reciprocity.

a. Include contact information for the organization that provided training for verification by the University's training authority.

2. Non-DOE certification for which training equivalence is being requested.

3. Training materials utilized to provide training and/or qualification as specified in 10 CFR 835, Subpart J, and Training and Qualification section above must be submitted to RPG 5 business days in advance of execution.

C. Sealed Source, Radioactive Material, and Radiation Generating Device:

1. Sealed Source manufacture certificates for any and all sealed sources being brought on site to the University.

2. Current leak test for sealed sources. Leak tests must have been completed less than 6 months prior to anticipated arrival of the source at the University.

3. Manufacture specification for interlocked devices.

4. All radioactive material, sealed sources, and/or radiation generating device must be approved prior to arriving at the University.

5. All radioactive material documentation must be received, to the satisfaction of the University's RPG, 5 business days prior to site mobilization.

6. All radioactive material and sealed sources must be surrendered to the University's RPG upon arrival at the University for inclusion within the University's inventory system.

D. Work Plans, Procedures, and Protocols (Technical Work Documents [TWDs])

1. All radiological work plans, procedures, and protocols implementing any portions of 10 CFR 835, or other applicable rules and DOE orders (see Section 1.1, B, 2 above), related to radiation protection of the employee, workplace, or environment must be submitted 10 business days in advance of execution of the activity. Failure to submit complete and/or accurate documents will cause delays. TWDs include but are not limited to:

a. Radiation Protection Plan demonstrating how the project will maintain compliance with the University DOE-approved *Radiation Protection Program* (RPP). A template Project Radiation Protection Plan is available from RPG and may be modified to apply to the specific scope of work of the project; however, all changes must be tracked using the MS Word track changes feature. If a section is not applicable, the text of the section may be replaced with the word "Reserved." For example, if sealed sources will not be used in support of the project, the sealed source section may be noted as "Reserved." All procedures required to implement the Project Radiation Protection Plan must be developed. Because this is dependent on the scope of work, a list of typical procedures/documents is provided below. This list should not be considered all-inclusive or the minimum required documents. Some topics may be combined into one document depending on the complexity and magnitude of the project scope of work.

b. Radiological Hazard Reviews (see section 1.1, E above).

c. Hazard evaluation procedures, including radiological hazards reviews. These documents must describe the radiological hazards reviews performed by a Health Physicist in accordance with Chapter 3, Parts 1 and 2 of the Radiological Control Manual, as applicable, for project radiological scope of work. This process must implement in part the As Low As Reasonably Achievable (ALARA) Program described in Chapters 1 and 3 of the Radiological Control Manual.

d. Instrument; calibration, operations checks, and operating instructions.

e. Radiological survey – plans, surveillances, forms or reports, and techniques. This document should describe the methods used to conduct radiation and contamination surveys applicable to the project scope of work, using standard techniques and survey protocols. The procedure should describe the development of survey plans, required radiological instruments, calibration requirements, instrument preoperational inspection and performance verification, proper instrument operation/use, conduct of applicable survey (radiation survey, contamination survey, etc.), documentation of survey results, reviews, and action items.

f. Air sampling – plans, specification, sample media, implementing actions, and alarm response. This document should describe how to determine the type and number of radiological air samples, the setup and operation of the air sampling equipment to be used (e.g., lapel, low volume, and high volume samplers), when and how to change out filters, how to perform analysis of the filters, documenting and tracking results, notifications, and follow-up.

g. Decontamination – protocols, techniques, and equipment. This procedure should document protocols, techniques, and equipment to be used in equipment and personnel decontamination.

h. Administrative controls, including posting, labeling, and access control procedures.

i. Engineering controls, including HEPA vacuum and air filter unit certifications.

j. Respiratory protection program. The purpose of this document should be to establish the procedures and requirements necessary to ensure that all affected individuals are protected from exposure to respiratory hazards (generically, any radionuclides, particulates, chemicals, vapors, aerosols, or fumes, regardless of whether a posted Airborne Radioactivity Area is established) that may be present in the workplace. The program should describe equipment to be used, procedures for respirator issuance, medical evaluations and fit testing, procedures for selection and use, training requirements, methods to evaluate program effectiveness, etc.

k. Measurement methods for radiological clearance surveys. This procedure must provide measurement methods that satisfy the sensitivity requirements of radiological clearance surveys. These survey methods are developed as extensions of the University Release and Clearance Program described in Chapter 4, Article 422 of the Radiological Control Manual and must include methods for determining whether residual radioactivity is indistinguishable from background (IFB) utilizing measurement methods with minimum detectable concentrations below the preapproved DOE O 458.1 limits. The methods in this procedure must provide instructions for performing the surveys applicable to release and clearance within the bounds of the scope of work and should include details on scan, static, and/or swipe surveys for gross alpha and gross beta at a minimum and may need to include tritium, carbon-14, or other contaminates of concern. This procedure may need to describe methods for determination of volumetric contamination.

l. Release and clearance procedures demonstrating compliance with the University DOE-approved Release and Clearance Program and associated technical basis documents. This procedure should define the processes by which materials and equipment or personal property that are encumbered by radiological regulatory controls are cleared from such controls (e.g., categorize and classify the materials and equipment, review documented process knowledge, determine release limits, determine survey method, generate survey plan, execute survey, evaluate results, make release determination). This procedure must implement the measurement methods documented in Chapter 4, Article 422 of the Radiological Control Manual. The radiological worker training procedure must include direction to complete University General Employee Radiological Training (GERT). The RCT training procedure shall include the three phases of RCT qualification, which include the 13 DOE Core fundamentals, applicable University project/site specifics (procedure exams), and applicable University project/site job performance measures (practical factors).

m. Incident reporting and investigation.

n. *Quality Assurance Plan*.

o. Air Monitoring and Dust Control Plan (AMDCP) (see Section 1.1, I for details).

p. Sample collection procedure. The procedure should describe the collection of any solid or liquid volumetric media sample, filters, and removable activity wipes collected for the purpose of on-site or off-site analysis. This includes, but is not limited to, soils, concrete, liquids, paint chips, swipes, and filter media (water treatment systems). The procedure should describe the intent of the sample collection (waste characterization, release and clearance of material, etc.), proper sample containers to be utilized, minimum mass/volume of sample required to support the analytical method required, and any follow-up analyses/recounts, and ensure data quality objectives are achieved, chain-of-custody use, approved analytical labs, analytical request codes, etc.

E. Equipment Verification

1. All materials and equipment that are expected to be used within areas controlled for radiological purposes and materials and equipment that may be in contact with radiologically impacted surfaces, air, etc. (i.e., may become contaminated), are subject to radiological survey by the University Radiation Protection Group prior to use.

a. Provide detailed lists of materials and equipment and scheduled arrival dates at least 3 business days prior to the items' arrival for review. The University Radiation Protection Group will review and identify any item(s) that will require radiological survey prior to use.

b. Detailed lists should include, as appropriate, make, model, quantity, used/new status, and potential hazards (e.g., chemical, electrical).

c. Materials and equipment include but are not limited to tools, air handlers, light duty vehicles, heavy equipment, instrumentations, pumps, motors, electrical cords, scaffold, ladders, vacuums, etc.

d. New-in-the-package consumable materials, anti-c clothing, plastic sheeting, decontamination supplies, etc. are not subject to pre-use radiological surveys.

e. Materials and equipment above the University's action levels may be subject to radiological controls and/or required to be removed from the University's property at no cost to the University.

F. Radiological Instrumentation

1. A list of all radiological instruments to be utilized and associated instrument calibration records. Records shall clearly establish that calibrations are NIST traceable and were performed in accordance with ANSI N323A. Establishing NIST traceability may require submittal of calibration certificates for calibration equipment and sealed sources used in the calibration process. All instrument calibration documentation must be received, to the satisfaction of the University's Radiation Protection Group, 5 business days prior to site mobilization.

G. Project Records

1. All project records required to demonstrate compliance with the rules and orders specified Section 1.1 shall be provided to the University upon project completion. All records must be organized and cataloged, in archival-ready condition in accordance with LBNL archive requirements.

2. All records must be maintained in electronic format as PDF files and organized in a manner that facilitates easy retrieval. For example, all training records must be organized in a folder identified as training, with multiple subfolders indicating the course number. Survey records must be sorted by the purpose/type of the survey (e.g., job coverage, release and clearance, shipment, perimeter air sampling). Electronic files must be provided to RPG on electronic media, such as an external hard drive, and an electronic catalog of all records contained on the media must be included.

1.4 QUALITY ASSURANCE

A. Organizational Structure:

1. Establish an organizational structure that defines and describes functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing the work with radiological controls or components, This structure is expected to establish management processes, including planning, scheduling, and providing resources, for the work (as described in DOE O 414.1D).

a. Organization structures shall include, when radiological activities are involved:

1) Radiation Safety Officer (RSO).

2) Health Physicist or other person knowledgeable of health physics practices, protocols, and requirements.

3) Radiological Control Technician Supervisor or other person knowledgeable of radiation implementation practices, protocols, and requirements, when Radiation Protection Technicians are active within a project.

2. Establish a process to identify potential quality-adverse conditions. This includes assessing program requirements, reporting potential conditions adverse to quality (CAQ), establishing a system to manage issues, and creating a method for developing and tracking corrective actions and effectiveness.

1.5 PROJECT EXECUTION

A. Hazardous Materials:

1. Notify the University promptly of contaminated, vermin-infested, or dangerous materials encountered.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 RADIOLOGICAL CONTROL ACTIVITIES

A. General:

1. Proceed with radiological activities only after the aforementioned conditions have been satisfied and the University Radiological Control Manager or designee has provided approval to proceed.

END OF SECTION 025126

NTS: Add a change log to the end of each section. This is for internal use only and the A/E will delete this from the project set of specifications.

Date	Reviewer	Paragraph	Summary of update
07/03/2022	*EBS*		*Master Specifications Update*
05/31/2024	*MPG*		*Updated for Subpart K compliance, current references, recordkeeping.*

08/06/2025	*JPA*		*Removed all references to specific EHS procedures. EHS procedural references were replaced with the applicable sections of the Radiological Control Manual. Revised Section B, Excellence in Radiological Control Item 2. Revised Section D, Conduct of Radiological Work, Items 2-7. Revised Section G, Training and Qualifications, Items 7 and 9.*